Alternative Reflections on Gravitation: An Update

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ABSTRACT

Several years ago three contributions in relation with astrophysics were published by the author of this paper. The first one explained the basic ideas of the alternative reflections on gravitation and several related consequences. The second one was concerned with the mass-diameter relation of spherical objects in the universe. In the third paper the obviously existing anomalous gravitational effects in the universe were the objects of interest. The statements in all three papers seem to be valid even today. In the meantime, however, a huge amount of new astrophysical observations is available. Several of them are discussed within this paper. And it seems that also these new observations, especially those which hardly can be explained by classical theories, are well compatible with the alternative reflections on gravitation.

Keywords: alternative theory; Mach's principle; axions; gravitational constant; flyby anomaly

1. INTRODUCTION

The "Alternative Reflections on Gravitation" (ARG) were formulated in detail earlier (Albers 1997a) by the author of the present paper. In order to enable the understanding of all the phenomena and their explanations on the basis of the ARG in this paper, it is necessary to recapitulate here briefly the basic principles and the affiliated mathematical formula of the ARG:

Every mass emits and absorbs gravitational radiation which is treated in complete analogy to the laws of optics and electromagnetic radiation. If the effect of all masses m_j of the universe is summed up for a reference point Q, one obtains a certain intensity I_0 of the gravitational radiation

$$I_0 = \Sigma_j (E * m_j / R_j^2). \quad (1)$$

Here, R_j is the distance between the location of m_j and the reference point Q, and E is a constant that describes the efficiency to emit gravitational radiation per unit mass. Two masses m_1 and m_2 near Q are considered which both partially absorb I_0. The absorption leads to a momentum transfer and thus to forces, directed towards the centers of both masses. By its own absorption, every mass shields the other one partially against the radiation I_0, leading to an attractive force between both masses, which follows exactly Newton's law of gravitation

$$F = - G_f * m_1 * m_2 / r^2. \quad (2)$$

However, G_f is not the "universal constant of gravitation", G, but a factor of proportionality, denoted as gravitational factor in the following, which is linearly dependent on I_0

$$G_f \sim I_0. \qquad (3)$$

From equations (1) and (3), the following relation can be deducted

$$G_f \sim \Sigma_j (m_j / r_j^2). \qquad (4)$$

Thus, the attractive force in equation (2) is a secondary effect which is based on the existence of all masses m_j in the universe.

The primary interaction between m_1 and m_2, however, is a force of repulsive nature. It is due to the momentum transfer produced by the absorption of gravitational radiation emitted by each of the two masses and absorbed by the other one. A suitable system to explain this effect is a system with spherical mass distribution, a mass M and radius R. According to equation (1), its masses produce gravitational radiation with a directional component I_d at its periphery

$$I_d \sim M/R^2. \qquad (5)$$

It has previously been shown (Albers 1997b) that the balance between primary, repulsive forces due to I_d and secondary, attractive forces due to I_0 can stabilize highly concentrated spherical mass accumulations. It has been indicated that such objects can be observed in the universe in the form of globular star clusters, elliptical galaxies and spherical clusters of galaxies. For these objects, the expected linear dependence of their mass M on the square of their diameter R could be revealed

$$M/R^2 = \text{constant}, \qquad (6)$$

and the value of the constant was determined to be about 160 M_{Sun}/pc^2. The above derivation is a short summary of the points in (Albers 1997a, 1997b), relevant also to the conclusions in the present paper.

Besides the mass-diameter relation according to eq. (6) (Albers 1997b), the anomalous gravitational effects according to eq. (4) are direct consequences of the ARG, as described in a further publication (Albers 1998). All the objects discussed in these three articles are of interest in the present paper and will be looked upon on the basis of recent astrophysical observations.

The first two chapters will deal with two types of mass and energy, which according to classical theories govern the gravitational effects in the universe to an amount of about 95 %: Dark Energy and *Dark Matter* (WIKI). Due to their outstanding magnitude, compared to the remaining 5 % linked to the luminous and other ordinary matter, its discussion at the beginning seems to be appropriate.

2. DARK ENERGY

The ARG were formulated around 1990, several years before they could be made open to the public in 1997 (Albers 1997a). Already in the early phase of their formulation, it had to be realized, that the ARG were hampered with an enormous problem, the controversial expectations concerning the expansion of the universe, between classical theories and the ARG.

Classically, the Big Bang produced the exploding nature of the universe. Because later only the gravitational attraction of all its masses could influence this behavior, a deceleration of the speed of expansion of the universe could be expected, and this was therefore generally accepted as a proven fact.

According to the ARG the emission and absorption, however, produce repulsive forces as primary gravitational effects. And from these effects an accelerated, but not a decelarated expansion of the universe had to be expected.

In 1998 the situation changed dramatically, because the results from new observations revealed an unexpected accelerating expansion of the universe. These new results obviously shifted the above mentioned problem away from the ARG, just towards the classical theories. There the new problem was solved by the revival of a suitable parameter, the *cosmological constant* (WIKI), usually denoted as Dark Energy. This parameter was once added by Einstein to his "General Theory of Relativity" (GTR). Later it was declared by himself as "the biggest blunder of his life". Until now no physical basis of this parameter could be found. These remarks should be sufficient to explain how little compelling the introduction of this parameter into classical theories is, in order to explain effects which are direct consequences in the frame of the ARG.

3. DARK MATTER

The explanations of anomalous gravitational effects by assuming the existence of *dark matter* (WIKI) already exist since more than 80 years. And up to now almost every publication concerned with this topic proclaims that the existence of dark matter is the only, and necessary explanation of especially increased gravitational effects. That this solution is based on unproven assumptions is usually never mentioned. Therefore, such explanations should perhaps not be considered to be in accordance with sound physical methods, as will be discussed in the following.

Every gravitational effect, usually represented by Newton's law of gravitation, which describes the force acting on a sensing mass m towards an attracting mass M, is governed by the Gaussian gravitational constant $G*M$, the product of M and Newton's gravitational constant G. If observed forces somewhere in the universe are larger than can be expected on the basis of $G*M$ and the luminous and other ordinary masses M, this effect may be attributed as a first reasonable solution to inappropriate values of G or of M. More than 80 years ago the decision was made towards M and the dark matter, although at that time and even until now not a single definite proof exists which validates that the value of G, measured by experiments on Earth, is valid everywhere in the universe. Already earlier (Albers 1997a) critical remarks from M. Berry (1990) were cited concerning the universality of G. And they seem to be valid until today. This is the reason which leads to the above statement that the concept of dark matter is not based on a sound physical foundation.

On the basis of the ARG the increased gravitational effects, which are predicted at the centers of highly concentrated luminous matter, are nothing but increased values of ordinary gravitation, expressed e.g. by the gravitational factor G_f, with values above that of G. No exotic new particles - only the often cited WIMPs may be mentioned here as examples - are the source of the dark matter and the increased gravitational effects. Thus, the ongoing search for such particles will be unsuccessful for ever and should be regarded as pure dissipation of huge financial resources in astrophysics. Here a very recent review paper may be cited, which gives an actual summary of the results of the searches for such particles (Davis 2015).

Due to the long time of unsuccessful search of suitable particles which produce the effects of dark matter, doubts of their existence are expressed often in recent publications. But because currently no other explanations besides the existence of dark matter (and black holes) are assumed as source of the anomalous gravitational effects, the concept of dark matter will probably not lose its astrophysical relevance in the next future.

While the first two chapters, until here, deal with the predominant part (95 %) of the mass-energy content of the universe, all the following chapters are concerned mainly with the remaining small amount (5 %) of luminous and other ordinary matter.

4. BULLET CLUSTER

Gravitational lensing studies of the *Bullet Cluster* (WIKI) are claimed to provide the best evidence to date for the existence of dark matter. The whole system consists of two galaxy-clusters, separated by about 1Gpc, and a huge cloud of gas just between them. The gravitational lensing measurements reveal two regions with increased gravitational potentials, both rather well centered at the two galaxy clusters. These findings are explained by the existence of an appropriate amount of dark matter. Though the baryonic mass of the gas cloud is even higher than that of the galaxy clusters, no significant amount of dark matter was found in this region.

What is expected on the basis of the Alternative Reflections? Already in the first paper (Albers 1997a) it was supposed that “the creation of gravitational radiation” occurs “especially in the interior of hot stars”. Therefore an increased gravitational potential according to eqs. (1) to (4) - conventionally explained by the existence of dark matter - is only expected in the region where the galaxies with their hot stars reside. The huge masses of gas don't create gravitational radiation and therefore also no increased gravitational potential which would need an explanation by the existence of dark matter. Thus it seems that the Bullet Cluster may be considered as an excellent validation of the ideas proposed by the Alternative Reflections on Gravitation, instead as an evidence for the existence of the hypothetical particles of dark matter.

The results of the weak lensing observations are of high importance for further conclusions on the basis of the ARG. Already very early (Albers 1997a) it was assumed that "comparisons between the amount of gravitational radiation produced in different regions as universe, galaxies, and globular clusters can be drawn reasonably only if these regions are comparable concerning the relevant parameters". The mass-diameter relation of spherical systems in the universe (Albers 1997b) could be expected only because these systems contain similar elements: old stars like our Sun with similar masses and mass to luminosity ratios near that of the Sun. Therefore in Fig. 4 in (Albers 1997b) the ordinate-units are shown with equal values for masses at the left and for luminosities at the right side.

The Bullet Cluster-observations, as well as later observations at similar systems, lead to the assumption that the production of gravitational radiation may be more likely proportional to luminosities L_j than to masses m_j. The production of gravitational radiation, the optical luminosity, the production of neutrinos and of the hypothetical Axions, they all are connected with the hot interior of stars. Therefore it seems to be appropriate for considerations including especially heavy stars to assume a relation

$$I_0 = \Sigma_j (E_L * L_j / R_j^2). \quad (7)$$

instead of eq. (1) for the production of the gravitational radiation. This results to enormous differences in the case of heavy stars or systems which mainly contain such stars. If e. g. stars belong to the main sequence, their luminosity increases according to *the mass-luminosity relation* (WIKI)

$$L_H/L_{Sun} \approx 1.5 * (M_H / M_{Sun})^{3.5}, \quad (2M_{Sun} < M_H < 20M_{sun}) \quad (8)$$

with the power 3.5 of the mass M_H of the heavy star. That means that a star with a mass two times that of our Sun shows a luminosity L_H which is already 17 times as high as that of the Sun. A star with a mass four times that of the Sun radiates with a luminosity which is 192 times as strong as that of the Sun. The consequences of these considerations will be discussed in several of the following chapters.

5. MACH'S PRINCIPLE NOT APPLICABLE?

According to eq. (3) the gravitational factor G_f is proportional to the intensity I_0 of the gravitational radiation produced by all the masses of the universe. Together with the dependence of the contribution of distant masses, inversely proportional to the square of their distance according to eqs. (1) and (4), this behavior corresponds well to Mach's principle, especially in the version which is assumed as a very general statement of *Mach's principle* (WIKI), "Local physical laws are determined by the large-scale structure of the universe."

The early speculation in (Albers 1997a), that the gravitational radiation may be especially produced in "the interior of hot stars" was discussed in the foregoing chapter and lead to the conclusion that the term "mass" can be restricted to "luminous mass" and effects proportional to the luminosity of this luminous mass. In connection with new interpretation of "mass", another statement in (Albers 1997a) is of interest here. The strength of the gravitational radiation I_0, e.g. from a star, can not increase according to eq. (1) to any high value, especially not by approaching to sufficiently small distances from the star. The statement "This follows already from the fact that the Sun is able to bind its planets" discussed there in connection with mass and density of a star, however, it is also valid for the case of a more and more decreased distance R in eq. (1). The question here is: How can this missing increase of gravitational radiation near a star be explained?

An interesting paper concerning this last statement was published by Unzicker and Fabian (2006). They show on the basis of precise gravity measurements that there is no dependence of G and of Earth's gravity g due to the distance changes along the elliptical orbit of the Earth around the Sun. This result is mentioned here to show that, contrary to Mach's principle, one Sun at 1 AU doesn't contribute a measurable amount to G and g at the position of Earth. On the basis of the ARG, however, the contribution of only one Sun at this short distance of 1AU would deliver an effect that, according to eqs. (1) to (4), supersedes by far that of all masses of the universe, which determine G_f.

Thus there remains the question: Why can the most distant stars in the universe deliver their contribution to the value of the gravitational factor G_f proportional to the factor $1/R^2$ at the position of our Earth, but not the most nearby star, our Sun? This question represented a second severe problem, when the ARG were developed, besides the above mentioned accelerated expansion of the universe. A possible solution also of this problem, however, will be discussed in chapter 7 and later ones of this paper.

6. FOUCAULT PENDULUM

Since 1851 the *Foucault pendulum* (WIKI) “is a simple device conceived as an experiment to demonstrate the rotation of the earth”. At the north pole the plane of swing of such a pendulum rotates by a full rotation in a sidereal day against an Earth-fixed coordinate system, because it is fixed against the positions of the most distant masses of the universe. In physics a coupling like this, between the pendulum and the distant masses, is only possible if there is some interaction between these two systems. For an electrically uncharged pendulum the only possible interaction must be of gravitational type. Standard theories of gravitation tell us that the interaction of a mass M to another system at a distance R is proportional to M/R^2. In order to elucidate the order of magnitude of possible interactions with the pendulum, some examples may be calculated:

An observer of the Foucault pendulum with a mass of 100 kg at a distance of 5 m produces a directional force according to an M/R^2-value of 4 kg/m^2, which obviously creates no significant disturbance to the pendulum. The corresponding value for the Earth itself, which produces Earth's gravity of 9.81 m/s^2 and determines the swing period of the pendulum, is about $1.5{*}10^{11}$ kg/m^2. This interaction is more than 10 orders of magnitude larger than that of the above mentioned observer. Corresponding values for our Moon, our Sun, and a star like our Sun at a distance of the next star (Proxima Centauri at a distance of 1.3 pc) are: $5{*}10^5$ kg/m^2, $9{*}10^7$ kg/m^2, and .0012 kg/m^2. And what a value is produced by all the masses in the universe? If all the homogeneously distributed masses contribute according to M/R^2 at the center of the universe one gets a value of $3{*}M/R^2$, where M is the total mass (10^{11} galaxies with 10^{11} stars each with a weight of $2{*}10^{30}$ kg) and R the radius of the universe (about $14{*}10^9$ pc). The relevant value in comparison with the former examples is .32 kg/m^2, which is even an order of magnitude lower than that of the above mentioned observer. However, the contribution of all the masses of the universe were added here according to their amount. If they were added correctly with their vectorial character, according to the spherical symmetry of the universe, the corresponding value of their gravitational influence on the pendulum comes out classically to be zero. In spite of this: not the Earth, not the moon, nor the sun determine the plane of oscillation of the Foucault pendulum, but just the distant masses of the universe.

So the question remains: How do the distant masses of the universe tell the Foucault pendulum how to swing? Even Wikipedia doesn't present an answer to this simple question. Therefore, more than 160 years after the Foucault pendulum began to swing in the Pantheon, the astonishing remarks of an expert in astrophysics, J. LaBelle, may be cited here. At the end of his informative video-lecture about the Foucault pendulum he states: “How can this pendulum here somehow know something about the entire universe? So it remains as an unproven conjecture, more in the room of philosophy than physics, at this point” (LaBelle 2010).

What now is expected on the basis of the alternative reflections on gravitation? All the masses of the universe contribute according to the laws of optics to a gravitational field at the place of interest as it is expressed by eqs. (1) or (7). The shielding of this field by the Earth leads to a force by which the pendulum is attracted towards the center of the Earth. Whether the Earth rotates or whether it doesn't rotate, there is no further interaction which can force the pendulum to leave its plane of oscillation. It must continue to swing within that plane, fixed to the distant masses of the universe, which it adopted by the pendulum immediately after its release.

Some remarks may be appropriate concerning the terms like “distant masses” or “distant stars” when used in connection with Mach’s principle or the Foucault pendulum. One may assume as a first approximation that all the relevant masses of the universe are distributed homogeneously within a sphere with a radius of 14 Gpc around the Earth. Then one can split up this system into 14 thousand spherical shells, each with a radial thickness of 1 Mpc. According to eqs. (1) and (7), every shell contributes the same amount to the gravitational field. Our galaxy and even the whole local group of galaxies are inside the most inner 7 shells. Thus, the more distant shells define the inertial coordinate system 2000 times more strongly than the whole local group of galaxies. Furthermore, from the conclusions in chapter 4 it should be taken into account that the relevant gravitational radiation is produced by the luminous matter, especially in the hot interior of stars, and not by cold matter of huge molecular clouds. Thus the most appropriate formulation of Mach's principle seems to be: The gravitational effects on Earth as well as the inertial coordinate system are determined by the most distant stars in the universe.

In reality, however the masses are not very homogeneously distributed in the universe. Especially the old and stable spherical mass accumulations, as globular clusters, elliptical galaxies etc., produce according to the ARG a gravitational potential which near to the centre of these systems exceeds the contribution of all the masses of the universe, as shown in Fig. (4) in (Albers 1998). If such a system rotates against an inertial system, it should be expected a frame dragging effect, increasing when approaching the center. There are strong parallels between these ideas and the Lense-Thirring effect: Classically the observed increase of the gravitational potential is often interpreted by the existence of a black hole. If this black hole rotates, it produces the Lense-Thirring effect with increasing strength towards the center of the black hole.

7. AXIONS AND ALPS

Axions are hypothetical elementary particles which are created especially in the hot interior of stars. "Because of their properties, axions interact only minimally with ordinary matter. Axions are predicted to change to and from photons in the presence of strong magnetic fields, and this property is used for creating experiments to detect *Axions*" (WIKI).

Based on the strong arguments for the existence of Axions, several experiments are running to proof their existence, especially ADMX and CAST. The *CERN Axion Solar Telescope* (*CAST*) (WIKI) is an experiment in astroparticle physics to search for axions originating from the Sun. The experiment, sited at CERN in Switzerland, came online in 2002 with the first data-taking run starting in May 2003. Until now, however, no successful detection of solar axions could be reported.

The properties of axions, or similar particles, seem to be very suited to explain the properties of the gravitational radiation postulated by the ARG. These particles are produced in the hot interior of stars, in full agreement with such an assumption for the source of the gravitational radiation mentioned already a long time ago in Albers (1997a). They penetrate the sun with negligible interaction and experience their transformation to other states on their further way. In the following not the axion itself with its theoretically well-founded exact properties will be of interest, but some kind of axion-like particle (ALP). The designation ALP is not created here but is already widespread in literature and is used for particles which possibly exist with similar properties as axions.

The properties of the furthermore favored type of ALPs is not based on theoretical considerations but on the own conclusions from a huge amout of astronomical observations. The process by which these ALPs are produced inside the hot interior of stars is of no principal interest here. Of interest, however, is that the ALPs can penetrate the outer regions of stars and can transform to other types of particles or radiation on their further way. One significant difference between these ALPs and the axions seems to be appropriate: The transformation may occur along the way of flight, even without a special influence, or by the influence of a transversal magnetic field, as in the case of axions by the Primakoff effect, or also by the influence of longitudinal magnetic fields, where flights of the ALPs parallel or anti-parallel to the magnetic field both may induce the transformation. The main difference between the axions and the ARG-relevant ALPs, however, is concerned with the type of particles to which the ALPs are transformed. Classically these are photons of the electromagnetic spectrum, especially X-rays. The ARG-compatible ALPs, however, are expected to be converted to gravitons, which produce gravitational forces and not e.g. X-rays. From that it follows that the useful detectors for ALPs should be sensitive not to radiation belonging to the electromagnetic spectrum, but to gravitational forces. Of course these considerations are highly speculative and still need a thorough examination.

Very interesting in connection with the basic ideas of the ARG are two statements in a recent paper by Ringwald (2015): "Axions or ALPs could be produced in hot stellar plasmas and could thus transport energy out of stars, thereby possibly influencing stellar lifetimes and energy-loss rates". And the second statement: "Recently, several authors have confronted new data with improved theoretical predictions and found hints for anomalous excessive energy losses".

8. ACCRETION DISKS AND JETS

With regard to the term *accretion disk* (WIKI) some statements in Wikipedia may be cited here: "An accretion disc is a structure (often a circumstellar disk) formed by diffuse material in orbital motion around a massive central body. The central body is typically a star. Gravity causes material in the disc to spiral inward towards the central body". Furthermore, one can find there the important statement: "Gravitational and frictional forces compress and raise the temperature of the material causing the emission of electromagnetic radiation". Besides stars, other central objects can posses accretion disks, Neutron stars and black holes. But "The most spectacular accretion discs found in nature are those of active galactic nuclei and of quasars, which are believed to be massive black holes at the center of galaxies."

Black holes are very often mentioned in literature as driving actors in accretion-disk-jet systems. They are assumed to possess the somehow mysterious ability to incorporate masses from the accretion disk and to catapult a part of these masses away from the center of the disk. The eruption occurs in the form of two jets which transport the material to opposite directions, perpendicular to the plane of the disk, in agreement with the observations. Because on the basis of the ARG black holes are not seen as the driving actors of the jet-production, the following considerations are concerned with a system which surely doesn't contain a black hole as the central mass. Such a system is, without doubt, a single star, together with its protoplanetary disk.

"A protoplanetary disk is a rotating circumstellar disk of dense gas surrounding a young newly formed star. The protoplanetary disk may also be considered an accretion disc for the star itself, because gasses or other material may be falling from the inner edge of the disk onto the surface of the star". "The disks are very often accompanied by jets", (*protoplanetary disk*, WIKI).

These statements are well compatible with the ARG and can be used as basis for further conclusions. But behind this point of agreement the opinions of classical theories and the ARG diverge. While in classical considerations masses must be absorbed by the central object, on the basis of the ARG it is only necessary that the disk masses rotate around the center, as will be explained in the following. However, not special articles belonging to the immense amount of literature concerned with the complex system of accretion disk and jets, based on complicated magneto-hydrodynamic theories will be cited here. Instead, simple physical laws may lead to the following conclusions.

A part of the masses rotating in every accreting disk may be regarded as charged particles, e.g. light electrons and heavy ions. Both groups of these particles produce electric currents due to their circular motion around the central object, in this case the protoplanetary star. It's not unreasonable to assume that the electrons with their small mass, three orders below those of the ions, under the influence of gravitational pull and the friction by collisions, don't produce exactly the same amount of current as the heavy ions. Then from the contra-rotating currents of these two groups of charged particles there results a non-zero effective current which produces a solenoid-like magnetic field with the highest intensity along its axis which runs through the star, perpendicular to the accretion disk. Along this axis the ALPs are converted at an increased rate to gravitons which accelerate all particles, whether charged or uncharged, away from the star, and thus produce the two observed opposite jets.

With regard to the magnetic field a rather recent paper by Carrasco-Gonzalez et.al. (2010) may be cited here. The authors report the detection of magnetic fields parallel to the jet of a young stellar object. This star with a luminosity of 1700 L_{Sun} and a mass of probably 10 M_{Sun} obviously contains no black hole as possible source of the jet. Furthermore, the authors assume that there is a "common origin of all astrophysical jets". These findings and assumptions are well in line with the ideas of the ARG.

In short one can express the basis for the occurrence of jets according to the ARG as follows: The first requirement is the existence of an object like a heavy star with a high production of ALPs. The second one is the existence of a strongly aligned magnetic field as it is produced especially by an accretion disk. And the third condition is the existence of material - atoms, molecules, ions or dust etc.- that can be accelerated by the gravitons which result from the transformed ALPs. However, in chapter 11 a possible scenario will be discussed that produces jets although not all three above mentioned conditions are fulfilled in the usual manner.

9. SOLAR FLARES, CMES, AND MAGNETIC RECONNECTIONS

The discussion in chapter 8 about jets emitted from protostars was chosen as a suitable example to explain mass ejections on the basis of the ARG. There, however, exist several other forms of mass ejections, from solar wind, coronal heating and coronal mass ejections (CMEs) up to the huge systems of active galactic nuclei (AGNs). In all these systems, it seems to be probably on the basis of the ARG, that they are powered by the same processes as discussed in connection with the above mentioned jets: Inside the hot interior of stars ALPs are created which are transformed to gravitons during their flight, especially with an increased transformation rate in the presence of magnetic fields. The gravitons couple to every particle with mass and therefore accelerate neutral atoms, molecules, ions and electrons, independent of the sign of their electric charge, away from the source of the ALPs. The magnetic field acts only like a catalyst, the energy connected with the mass ejection, however, is produced near the hot center of the stars and transported outwards by the ALPs.

Classical explanations of the particle acceleration usually assume the process of magnetic reconnection in the case of *solar flare*s and *CME*s (WIKI), and the action of super-massive black holes in the case of AGNs. Just in the case of AGNs and Quasars the title of a recent paper by Antonucci (2015) may be cited as a judgment about classical theories: "Active Galactic Nuclei and Quasars: Why Still a Puzzle after 50 years?"

There exist, however, also descriptions which strongly deviate from the classical explanations, especially in concern with the magnetic reconnection. Already in 2007 K. Zioutas et al. wrote "We stress here that within the axion scenario the local surface magnetic field is “only” the required catalyst for the axion–photon reactions to take place, and not the otherwise suspected / unspecified energy source of solar X-rays. In this framework, the inner Sun is the actual energy source that creates the outstreaming axions."

Of course the authors expect photons, especially X-rays from the conversion of axions and not gravitationally active gravitons, but otherwise their statement is very well compatible with the ARG - considerations.

10. TRANSVERSAL OR LONGITUDINAL MAGNETIC FIELDS?

The transformation of Axions, e.g. described theoretically by the Primakoff-effect, is possible with the support of transversal magnetic fields. In connection with the ARG and the considerations in chapter 8, it seems to be probable that longitudinal magnetic fields are perhaps even more effective than transversal ones. This assumption is not based on theories, but derived from astrophysical observations, as will be explained in the following.

There may be assumed a typical scenario with two components. The first one is a source from which ALPs are emitted radially. The second one is a solenoid-like magnetic field, as it may be produced by rotating stars or galaxies or by accretion disks. If such a system produces a bipolar jet, it is obvious that the direction of the jet coincides with the direction of the longitudinal magnetic field, and not with a transversal component of this field.

In 2010 the mysterious Fermi Bubbles were detected, outflows with huge clouds of gas above and below the plane of our Milky Way Galaxy (Sci-News 2010). The graphic in this article shows the strongest expansion of these clouds along the galactic rotational axis and thus parallel to the magnetic field lines.

As a third example, the *solar wind* (WIKI) of our Sun may be mentioned. There are observed two different members of this wind, a slow one with velocities of about 400 km/s and a fast one with velocities of about 700 km/s. The fast one, which is obviously powered more effectively than the slow one, is ejected from the solar poles and thus along a direction which is parallel to that of the magnetic field.

From all these three examples it may also be concluded that longitudinal magnetic fields probably support the transformation of Axions or ALPs to gravitons with equal efficiency during their motion parallel or anti-parallel to the magnetic field. These considerations will be of interest for the conclusions in the last chapter of this paper.

Although this chapter was already completed, a new observation should be added: Marti-Vidal et al. (1515) report the detection of "an extremely powerful magnetic field, beyond anything previously detected in the core of a galaxy". And they state: "This magnetic field is located precisely at the place where matter is suddenly boosted away from the black hole in the form of a jet." These findings and their presentation in the enclosed figure (eso 1515a.jpg) are well in line with the ARG-considerations within this chapter. This statement, however, does not include the existence of the assumed black hole.

Most recent techniques today allow to observe the correlation between mass ejections and magnetic fields in systems with much smaller dimensions, the spicules in the chromosphere of the Sun (Suarez et al.2015). Future investigations of this type will probably deliver extremely valuable contributions to the understanding of mass ejections.

11. JETS NEAR THE GALACTIC CENTER

In chapter 8 a protostar is discussed as a potential source for the production of jets, because it can produce as well ALPs as also an aligned magnetic field, resulting from an accretion disk. It is, however, not necessary that the ALPs and the magnetic field are produced by the same source. If there exists an aligned magnetic field from a first source, then a second source, away from the first one, but located on the axis of the magnetic field and producing ALPs can also produce jets. Such a situation may already have been observed, as will be discussed in the following.

Because the spiral system of the Milky Way rotates around its center, one may expect a magnetic field as in the case of accretion disks, with the axis of the solenoid-type field perpendicular to the plane of the spiral system. This may explain the expectations and disappointments described in the abstract of Li et al. (2013): "Despite strong physical reasons that they should exist and decades of search, jets from the Galactic Center Black Hole, Sgr A*, have not yet been convincingly detected".

The reason for the lack of jets from Sgr A* can easily be found e.g. in a picture focused on this place. At the position, where according to the orbits of two stars, S0-2 and S0-102, the supermassive black hole resides, there is no luminous object. And thus the necessary source for the production of ALPs, which is required for the feeding of jets, is obviously missing (arstechnica 2012).

On the other hand there was observed a feature like a jet (G359.944-0.052), about 13 arcs away from Sgr A*, which is located, at least in the two-dimensional projection, on the galactic rotational axis, and aligned exactly towards the galactic center (Li et al. 2013). The jet does not show the same intensity along its length. Especially close to the upper right end there exist two brighter, directly neighboring spots, as can be seen in another publication (Sci-News 2013).

If one looks to a picture of the same region (astronews 2013), taken at other wavelengths, one can recognize that near the positions of these spots there resides a luminous object, probably a star, and thus a likely source for the production of the necessary ALPs. Due to the modest resolution of the utilized pictures, it is not possible to decide definitely whether the star is exactly located at the position of one of the spots or just midway between them. The latter case seems to be the most probable one. This would point to a rather symmetric emission of jets in both directions away from just this center, a behavior which is well known from jets and outflows. It is of course not shure that this scenario is really correct. But there exist some hints which support its validity.

A jet from the black hole at the center of the milky way, as expected by Li et al. (2013), was already excluded above on the basis of the ARD. But even if such a jet really existed somewhere between the black hole and the observed jet, it would have been destroyed by jets and outflows from local sources in this crowded region on its way towards the observed jet. And such a jet could never regenerate and occur undisturbed at the mentioned more distant position.

A galactic magnetic field with the correct orientation along the galactic rotation axis, however, can very well exist at larger distances, even if it is heavily disturbed by small local sources near the galactic center. Everybody knows that the reading of a compass close to a strong electromagnet is not very helpful for orientation. But if sufficiently far away, at every place around the magnet, the compass can well fulfill its purpose, although the strength of the field from the Earth is more than four orders of magnitude below that of the electromagnet. These considerations are mentioned here in order to elucidate that a galactic magnetic field can very well exist with the above discussed position and direction, even if it may be disturbed by much stronger local fields near the galactic center. Thus, it seems to be very reasonable, that the catalysing magnetic field is of galactic type. An accretion disk at the position of the star would deliver controversial arguments. But such a disc was obviously not observed until now.

The second point of question, besides the magnetic field, is the energetic source of the ALPs which creates the jet. In concern with this question especially the length of the lower left arm of the jet is of interest. This length is about 4 arcs, which corresponds to about .17pc. If the jet was ejected from the galactic center, there can not be seen a reason why it ceased after a so small length. If, however, one assumes that the star is the relevant source, such a length appears reasonable.

In chapter 23 of this paper it will be explained that the typical distance, during which all ALPs are conversed to gravitons, is about .13 pc. Behind this distance thus no further gravitons are produced. From there the rejecting forces produced by the proposed star reduce more and more, probably proportional to the inverse of the square of the distance from the star. Thus, an end of the jet-arm of .17 arcs is well compatible with the basic principles of this paper.

12. FLYBY ANOMALY

According to the ARG the attraction between two masses, M and m, is produced by the mutual shielding of these two masses against the gravitational radiation, emitted from all the luminous masses of the universe. As a special constellation, here it is assumed that M represents the Earth and m a free flying space satellite. A radially symmetrical distribution of the masses in the universe produces a radially symmetrical attraction of m towards the Earth which is characterized by Newtons gravitational constant G. In Fig. 2 (Albers 1998) G corresponds to a value $G_u = 1875\ M_{Sun}/pc^2$.

What gravitational effects may be expected if the radiation towards the Earth has no radial symmetry? Especially one may think about the masses in the bulge of our galaxy. With a mass of $7.85 * 10^7\ M_{Sun}$ (as already used in Albers (1998)) at a distance of 8.5 kpc these masses emit a radiation corresponding to $1\ M_{Sun}/pc^2$. And this radiation is not radially symmetrical but directed , from the galactic center towards the Earth. Its value is about three to four orders of magnitude below G_u. Classically the masses of the galactic bulge have no measurable influence on the Earth-satellite-system. The corresponding tidal effect is far below any measurable limit.

What lets the ARD expect in this case?. If one looks from the galactic center towards the

Earth there results the following situation: If the satellite is before or aside the Earth both objects are subject to the same amount of repulsive radiation from the galactic bulge. Therefore they experience the same repulsive acceleration. Thus the satellite doesn't notice any deviation from the orbit around the Earth determined by Newtons law. If, however, the satellite is behind the Earth, seen from the galactic center, the partial absorption by the Earth of the gravitational radiation emitted from the galactic bulge must lead to an increased attraction towards the Earth with an amount of about three to four orders of magnitude below G.

The ARG do not contain until now any quantitative considerations about non-radial-symmetrically radiating systems. But what must be expected and can not be overlooked: There should be an additional attractive force of the satellite towards the Earth along that part of the orbit which is partially shadowed by the Earth. The maximum of this additional attractive force should occur for the line directed from the galactic bulge towards the center of the Earth. A radial-symmetric parameter model around this direction may serve as a first rough approximation for the fitting of this force.

Does there exist any hint to such an anomalous gravitational behavior? The so called *Flyby-Anomaly* (WIKI) might be just such an effect. At this place there exist several papers about *Possible Explanations* of this unexpected anomalous deviation from a Newtonian behavior. But here especially a paper is of interest which is not cited there, but is of high interest for the above considerations: H. J. Busack (2007) fits the values of the best proved flyby anomalies by a set of parameters which show some agreement with the foregoing considerations from the ARG. The best fit needs an extra-acceleration towards the Earth with a maximum value of $2.45 * 10^{-4} * G$ along a line towards a point defined by the following equatorial coordinates: Right ascension: 17.78 h, Declination: -37.5 deg. These values may be compared to the positional data of the galactic center and the bulge: Rec 17.76 h, Dec -29.0 deg. Moreover the fit uses the expected radial symmetry around the direction of the maximal additional attraction.

Though the parameters and the symmetry of the model don't correspond perfectly to the ARG, the amount of the effect and the rather good coincidence of the directional parameters are surprising. The evaluation of further flyby data must be awaited to judge about these explanations. Especially the huge number of orbits of the space satellite Messenger around Mercury, without the disturbing effects of an atmosphere, may perhaps be very useful for this purpose.

13. GRAVITATIONAL WAVES

In chapter 12, "Flyby Anomaly", a scenario is described on the basis of the ARG, which is concerned with a deviation from the ideally spherical symmetry of the gravitational field, and the output of suitable sensors which move inside this field and are able to detect such deviations. Another possibility to produce changing gravitational effects on a suitable sensor are sudden temporal increases of the gravitational field. Classically, on the basis of the GTR, such effects are known as "Gravitational Waves" (GW), which are expected from movements of mass-arrangements with a quadrupole moment. A typical example of this type is a rotating pair of neutron stars. But in spite of the use of a large number of new detectors, even with highly increased sensitivity: S. Weber's early report in 1969 about the successful detection of these classically predicted gravitational waves could not be confirmed until now.

On the basis of the ARG the ongoing rotation around their barycenter of two neutron stars, with masses of e.g. three times that of the sun, at a distance e.g. of 50 kpc, hardly produces a measurable periodic gravitational signal on Earth. The change in the strength of the attracting gravitational forces of these two objects, consisting of "dead matter", are as negligible as it may be estimated from Newton's law of gravitation. A quite different situation, however, appears if there exists a source which suddenly increases its luminosity and simultaneously its production of ALPs. In this case the gravitational effect does not result from the attractive forces of "dead matter", but from the repulsive forces, created by the luminous source.

Such a source is seen in the supernova *SN 1987A* (WIKI). From a star with a mass of about 17 M_{Sun} there resulted an exploding source of luminosity up to 100 Million times that of the Sun (cfa 2007), at a distance of about 51 kpc. One may compare these values with the luminosity and the distance of the bulge of the Milky Way in chapter 12 ($7.85 * 10^7$ M_{Sun} and 8.5 kpc), which probably produce the measurable effect of the flyby anomaly. Therefore, it seems reasonable to expect also a measurable gravitational signal on Earth from the supernova SN1987A. Such gravitational signals really seem to be observed by two gravitational-wave detectors (GWD) as reported by Kuchik and Rudenko (1991). The signals at the GWDs appeared almost at the same times as those of several neutrino detectors, but about two to three hours before the optical radiation arrived at the telescopes on Earth (*SN 1987A* (WIKI)). According to Kuchik and Rudenko (1991), however, "The GW energy release from SN 1987A ... theoretically should have been four to six orders of magnitude lower than the intensity ...", that was really detected by the two involved GWD detectors. The observed strong gravitational signals, however, comply well with the high values of the outburst of the luminosity and the consequences expected from the ARG.

The solar wind and the coronal mass ejections of our Sun are created by a single star. The gravitational effects from SN 1987A result from an object whose luminosity reaches values which are up to eight orders of magnitude higher than that of a single star. In spite of this, due to the ARG, all three effects are produced by the same procedure: Near the center of their luminous sources, ALPs are produced, probably proportional to the luminosity. The ALPs escape from their source without any delay, like neutrinos, which also scarcely interact with matter. During their flight, the ALPs convert to gravitons which somewhere interact with matter and produce repulsive gravitational forces.

14. TIDAL DISRUPTION NEAR THE GALACTIC CENTER

Due to its proximity and its enormous gravitational potential the Galactic Center is an extremely suitable region to study the effect of tidal disruption. To explain the differences between the conventional description and the ARG concerning this effect, the simplified rigid satellite calculation of the *Roche Limit* (WIKI) may be utilized.

A spherical satellite with a mass m attracts a test mass at its surface with a force proportional to $G * m$. On a Keplerian orbit around a large mass M there exists a second force which is of importance for the stability of the satellite: The tidal force which is proportional to $G * M$. The larger $G * M$ is, the stronger is the tendency for tidal disruption. A large value of $G * m$, on the other hand, provides more stability against this effect. For simplicity a system may be considered in which both forces are equal in value in the classical approach.

What differences between the classical approach and the ARG may be expected? From the observation of nearby stars on Keplerian orbits around the galactic center a central object with a mass M of about 4.6 Million M_{Sun} is calculated. The calculation, however, is based on the same assumption which already led to the more than 80 years old mystery of the dark matter: The universality of Newton's Gravitational Constant G. The really determinable quantity which governs the Keplerian orbit, however, is not G but $G*M$.

According to the ARD the same value of this quantity is true, but in the form of G_f*M_f with $G_f*M_f = G*M$. Here G_f is the gravitational factor, according to the ARG, and M_f is the true mass of the central object. G_f is no constant, but a factor which increases towards the center of our galaxy, mainly due to the highly concentrated masses of the bulge. In Fig. 2 a large cross is plotted at the left upper edge, which corresponds to an already earlier adopted bulge mass of $7.85*10^7$ M_{Sun} and a distance of 80 AU. This distance corresponds to the pericenter distance of the *gas cloud G2* (WIKI). This distance is even smaller than the pericenter distance of the well observed star S2 (pericenter at 120 AU). The value of G_f is several times higher than the value of G_u, which is created by all the masses of the world. G_u may be seen as roughly representative for the Newtonian gravitational constant G in the solar system, far away from the galactic center.

Due to these considerations the above mentioned tidal forces, based on the value of $G*M$, are exactly the same, whether determined classically or from the ARG. In the case of the stabilizing force, characterized by the value of $G*m$, however, there can occur important differences between classical approaches and the ARG. These especially occur when the mass of the satellite is not determined from the gravitational pull, as e.g. in the case of the mass of the galactic black hole, but by a method which can determine the real mass of the satellite. In the case of a star this may be a star-model, in the case of a gas cloud it may be the use of spectroscopic methods, analysing emission and absorption spectra. If the satellite mass is correctly determined in this way as m, the stabilizing force, according to the ARG is not $G*m$, but G_f*m which is several times higher than the classical value $G*m$.

15. MISSING TIDAL DISRUPTIONS

The spotting of bright stars orbiting the black hole at the center of our galaxy inside .1 parsec stimulates a lot of questions how these young stars could form in a region which is very hostile for star formation due to tidal disruption (Hansen et al. 2003). The strong stabilizing force G_f*m on the basis of the ARG may provide an explanation.

During the last years an object attracted high interest due to its ability to test theories and simulations concerning tidal disruption near the galactic center: The gas cloud G2. The G2 Summary Page (G2-Cloud) contains several papers and impressive videos till June 2013 about the expected tidal disruption and the accompanying optical effects. But until August 2015 no report can be found there which certifies these expectations. In July 2014 Ron Cowen, however, explains in NATURE/ NEWS "Why galactic black hole fireworks were a flop" (Cowen 2014).

On the basis of the ARG this result is not unexpected. Simulations with the same strength of the tidal force according to $G*M = G_f*M_f$, but an increased value of the stabilizing attractive force G_f*m of the cloud, probably will achieve a more realistic description of the disruption effects. An increase of the responsible parameter G_f*m, more than three times higher than the classically applied value $G*m$ near the pericenter, lets expect dramatic differences.

The increase of G_f with decreasing distances may normally be expected to stop near R_1 (about .08 pc, represented by a second cross in Fig. 2, and discussed in Chapter 23). But if the center is crowded by additional stars on Keplerian orbits, even higher values of G_f than that due to the upper cross in Fig.2 may be possible. But such a case is not treated until now by the ARG.

At the latest since Witzel et al. (2014) report their observations of G2 in back of the periapse, all the nice simulations mentioned above may be forgotten. G2 followed the expected orbit but survived the closest approach to the black hole almost undisturbed, results which are well compatible with the above ARG-expectations. As an explanation of the unexpected results the authors (Witzel et al. 2014) assume the existence of a central star inside the cloud. Such a star as a possible solution, instead of a purely gaseous model of G2, however, seems to be unlikely on the basis of other observations (Pfuhl et al. 2014).

16. TIDAL DISRUPTION IN ANDROMEDA

The problem of the missing tidal disruption is not exclusive to the center of our galaxy. It was also concluded from observations by the Hubble Space Telescope near the center of the nearby Andromeda Galaxy (heic0512 2005). Some statements from this news release may be cited here:

"Astronomers are perplexed about how the pancake-shaped disk of stars could form so close to a giant black hole. In such a hostile environment, the black hole’s tidal forces should tear matter apart, making it difficult for gas and dust to collapse and form stars."

"Now that we have proven that the black hole is at the center of the disk of blue stars, the formation of these stars becomes hard to understand," Bender added. "Gas that might form stars must spin around the black hole so quickly - and so much more quickly near the black hole than farther out - that star formation looks almost impossible. But the stars are there."

"The dynamics within the core of this neighboring galaxy may be more common than we think," Lauer explained. "Our own Milky Way apparently has even younger stars close to its own black hole. It seems unlikely that only the closest two big galaxies should have this odd activity. So this behavior may not be the exception but the rule."

The content of these statements is in full agreement with conclusions from the ARG which expects tidal disruption effects that are far below the expectations on the basis of classical theories. Especially the assumption that this behavior may be the rule, is fully supported by the ARG. Every type of spherical objects produces an increase of the gravitational factor G_f towards its center as shown in Fig. 2, and therefore all these objects guarantee stability against tidal disruption in regions where classically the stability is already lost.

17. GRAVITATIONAL CONSTANT G: NEITHER UNIVERSAL NOR CONSTANT

Since Cavendish measured the gravitational constant G in 1798, there were reported about 300 further experiments to get a more and more precise value of this "natural constant" (Rosi et al. 2014). The accuracy by which the value of G (about $6{,}673*10^{-11}\ m^3kg^{-1}s^{-2}$) is known according to the latest CODATA release in 2010 is about 120 ppm. This accuracy is so far away from the standard deviations of other well established natural constants, that everyone should ask: Is "Big G" really a natural constant, and are the typically used designation "universal" and the attribute "constant" are appropriate? What may be expected concerning this problem from the ARG?

According to the ARG the constant G in Newton's law of gravitation is not a constant but a factor G_f which is determined, as described in chapter 1 and earlier (Albers 1997a) (in accordance with Mach's principle) mainly by the distant luminous masses of the universe. But not only the contribution of these masses determine the exact value of G_f. As explained in chapters 7 to 10 the increased conversion of solar axions by heliomagnetic or geomagnetic fields to gravitons can contribute to G_f. Furthermore, the anisotropic distribution of the distant masses in the universe can produce classically unexpected contribution to the gravitational potential as discussed in connection with the flyby-anomaly in chapter 12. It should not be expected that these contributions, as well as further possible contributing sources, produce the same alteration of G_f, if the location and the type of experiment are not completely identical.

In order to get smaller standard deviations it is quite usual to average over a large number of measurements and measurement conditions. The equipment of Gundlach et al. (2000) measured the gravitational effects, produced not by the usual two, but by eight attracting masses, along directions which are rather equally distributed in space. The achieved standard deviation was 14 ppm, a value almost 10 times smaller than the 2010-CODATA value and more than 100 times smaller than the official value published by CODATA in 1998. There exist measurements with similar standard deviations. The problem, however is, that not all these precise measurements provide values of G which coincide within the range of their joint uncertainties, as can be seen in a figure in a lecture by Sorrentino (2014). Although there exist a lot new measurements with standard deviations much lower than those of the CODATA values (also shown in a figure of Sarrantino's lecture) there seems to be no demand to reduce markedly the CODATA-value of the uncertainty of G.

On the basis of the ARG not the Gundlach experiment, which expands the influence of two attracting masses of the Cavendish-pendulum to eight masses will solve the problem, whether G is a natural constant. Instead, experiments with a reduction towards only one attracting mass may help to elucidate which sources contribute to the gravitational effects on Earth. From an experiment with only one attracting mass Gershteyn et al. (2002) concluded, that the gravitational constant shows an anomalous component of 540 ppm with a sidereal period. Similar experiments, with only one attracting mass, would be of high interest to verify their results.

With respect to the above mentioned influence of magnetic fields on the gravitational constant according to the ARD only a single paper, published by Mbelek et al. (2002) may be mentioned here. They report a "Possible evidence from laboratory measurements for a latitude and longitude dependence of G". And they assume that the geomagnetic field is one of the sources of the huge differences between the values of G from different highly precise measurements. These considerations are well coincident with the expectations of the ARD. And also in this case experiments with only one attracting mass and thus a well defined direction of attraction may contribute to the solution of this open question. The use of similar equipment at different places would be desirable. The equipment needs no high precision of all parts because it is not built to provide highly precise values of G. It needs, however, a high degree of stability to detect the variations of G. Such experiments are of course much simpler and cheaper than those with the currently used equipment.

It is really a fortunate of high value, that a very recent publication can be added to this chapter. Anderson et al. (2015) assume that G may be no constant, but may contain small variable contributions which perhaps might be correlated with the solar cycle or the terrestrial magnetic field.

Very soon a critical assessment of these findings was published by Iorio (2015). The author disbelieves the sinusoidal variations, reported by Anderson et al. (2015), because the enormous effects, which should result from such variations of G on the orbit of Saturn, can't be observed.

What an estimation concerning these two really controversial papers can be expected from the ARG? The simple answer is: The statements about their experimental results can be accepted for both papers.

According to the ARG, gravitational forces may show a spatial asymmetry, as it is discussed in connection with the flyby anomaly. But the forces, which determine the value of the gravitational constant, may also show temporal variations. While the spatial asymmetries probably result from the hardly altering contributions of the distant masses in the universe, the temporal changes more probably are contributed by the nearest source, which can effect the measurements of gravitational forces on Earth: The Sun.

Such changes can result from variations of magnetic fields which drive the conversion of ALPs from the Sun into gravitons. Magnetic fields near the Sun play a role in connection with coronal mass ejections (CMEs) and the solar activity cycle. If, however changes of the geomagnetic field play the major role, then changes of the gravitational forces near Earth are expected, but no influences on the orbit of Saturn. In this case the statements in the papers of Anderson et al. (2015) and Iorio (2015) are not incompatible.

18. MASS-DIAMETER RELATION

On the basis of the ARG it was concluded that stable mass-accumulations with spherical symmetry can exist for long times. These systems are stabilized due to equal values of attracting and repulsive forces, acting on every mass at the surface of the spherical system. The attracting forces result from shielding effects of the gravitational radiation, produced by all luminous masses of the universe. The repulsive forces are generated in the same way from the luminous masses of the spherical object.

This conclusion could be shown to really be valid by a compilation of data from three different spherical systems: Globular clusters, elliptical galaxies, and clusters of galaxies, as shown in Fig. 4 in (Albers 1997b). The mass range of these systems span a region of 11.2 powers of ten. The data allow to determine a mass-diameter relation with a proportionality of the total mass to the square of the diameter. Later, in Fig. 1 in Albers (1998), the bulge of the Milky-Way was added, to show that old spherical systems , embedded at the center in spiral galaxies, also follow these principles. Furthermore, in the same figure data representing mass and diameter of the whole universe were added.

All these earlier mentioned systems can be found in Fig. 1 of this paper. But this new figure contains three additional entries. An open circle represents a system consisting of only one old star. The other two systems will be discussed in chapter 26.

19. UNIVERSALITY OF GALACTIC SURFACE DENSITIES

In 2009 Gentile et al. published a paper (Gentile et al. 2009a) which was observed with high interest, even outside the professional astrophysical community, most probably because these interesting findings were accepted for publication by the refereed journal Nature (Gentile 2009b).

The paper reports a scaling relation according to which the luminous matter mean surface density is constant within a certain scale length r_0 for galaxies spanning a luminosity range of 14 optical magnitudes (corresponding to 5.6 powers of ten). Because such a relation was observed already earlier also for the mean dark matter surface density, the authors interpret this finding as a close correlation between the enclosed surface densities of luminous and dark matter in galaxies. The results also mean that the gravitational acceleration generated by the luminous component in galaxies, as well as that of the dark matter, are always the same at this radius. The two different values of these attractive forces can be described by the quotient of the luminous matter M_L or the dark matter M_D inside the area $A = Pi_* r_0^2$: $M_D/A = 72\ M_{Sun/}pc^2$ and $M_L/A = 13\ M_{Sun/}\ pc^2$, with estimated uncertainties as high as 1 dex. A theoretical explanation of these interesting findings on the basis of classical considerations, however, is not presented in the paper. If the sum of both masses is related not to the area, but divided by r_0^2, one gets $(M_D+M_L)/r_0^2 = 266\ M_{Sun}/pc^2$.

How do the ARG compare with these findings? More than 12 years before the above mentioned paper (Gentile et al. 2009a) appeared, a publication with the title "Mass-Diameter Relation of Globular Star Clusters, Elliptical Galaxies and Spherical Clusters of Galaxies" was available on the same arXiv-database (Albers 1997b). As mentioned in the foregoing chapter, Fig. 4 in that paper contains different spherical objects. From the smallest globular cluster towards the largest cluster of galaxies, these objects span a mass-range of 11.2 powers of ten, just two times that described 12 years later in the above mentioned paper by Gentile.

After adding the group of mini clusters in Fig. 1 of the present paper, as explained in chapter 26, the region of spherical objects is extended down to masses of only 2 M_{Sun}. This rises the range of masses to about 13 powers of ten.

For a comparison of the details of the mass-diameter relation (Albers 1997b) and the surface density in the paper by Gentile et al. (2009a) some comments may be appropriate. Considering the rather strong scattering of the data in both publications, the quotient M/R^2 (with a value of 160 M_{Sun}/pc^2 in (Albers 1997b)) corresponds rather well to the value of the surface density of 266 M_{Sun}/pc^2 in (Gentile et al.2009a).

The mass-diameter relation is based on published data which are extracted by simple procedures from optical observations. The typical quantities are therefore luminosity, half-light radius, and mass-to-light ratio.

The determination of the surface density, however, is based on a concept which assumes the existence of dark matter. From the fitting of luminosity data to a special dark matter density model the necessary radius r_0 is obtained. Thus, it is not easy to compare the absolute values of these two relations. But the exact value of r_0 is not so critical, if the corresponding luminosity results only from those stars which lie inside the sphere with the radius r_0. This is expected from the ARG, which under these conditions, ideally predicts the same value of the mass-diameter relation. On the other hand, it must be considered that the ideal 1/r dependence of the volume density is often severely disturbed near the center of the spherical objects, as will be discussed later in chapter 22.

Although the above data (266 and 160, respectively) differ by less than a factor 2, one should not look too much to the absolute values of the surface-density and the mass-diameter relations. Of more interest is the fact, that in both cases the luminosity or mass are proportional to the square of the radius or diameter. Therefore, the results of Gentile et al. (2009a) may be seen as a confirmation of the earlier speculations in the mass-diameter paper (Albers 1997b) and thus as a strong indication for the real existence of this universal behavior.

20. FROM DISTANT MASSES TO MASS SEGREGATION

Two phenomena which are coupled to the distant masses of the universe were are already discussed in foregoing chapters: The Foucault-pendulum and Mach`s principle. For both of them classically there exist no convincing explanations. The observation of the Foucault-pendulum in the Pantheon in Paris is a fascinating and at the same time frustrating event. Fascinating is the fact, that a sphere of dead metal obviously can receive information from the most distant masses of the universe. Frustrating, however is the insight, that a human, a member of a species which is widely assumed to be the most intelligent one on earth, neither can feel such an influence nor can explain plausibly how on the other hand the metal ball can do it.

With respect to Mach's principle there exists a lot of contradictory opinions whether it can be explained classically. Therefore, only a clear assessment of the renowned Oxford Dictionary of Astrophysics may be cited here: "Einstein was influenced by Mach's principle, but his theory of general relativity failed to incorporate it. Many theorists have sought to remedy this failing, but with only limited success." (Oxford 1997).

From the ARG it follows directly, that the distant stars determine the inertial system on Earth and anywhere else. And because they determine the value of the gravitational factor G_f, they are also involved in every effect which depends on G_f. Many of these effects are discussed in the foregoing chapters and will not be mentioned here again.

But neither the Foucault pendulum nor Mach's principle and even the inertial system can be regarded as universal. This is because near the center of spherical mass accumulations, G_f is considerably influenced by nearby masses of these systems. Though it's not possible to place a Foucault pendulum at such a position and observe its movement, there seem to exist hints to the influence of these nearby masses on the gravitational potential near the center of these systems. This may be elucidated by the following considerations.

As discussed in chapter 18, the balance between the attractive forces, proportional to G_f*M, and the repulsive forces, proportional to the luminosity L, brings about a special type of star which is stable for long times. Such old stars are typical members of old systems like globular clusters or elliptical Galaxies. They belong to the so called population II, posses mass to light values close to one in solar units and represent the majority of the stars e.g. in globular clusters. No wonder, according to the ARD, that this same type of stars appear in all old spherical systems everywhere in the universe.

Because the type of star which must be expected at a certain place inside a globular cluster is dependent on the value of G_f, the ARG lets expect a special effect: One may assume that at the boundary of a globular cluster, a star with a mass M equal to M_{Sun} and $M/L = 1 *M_{Sun}/L_{Sun}$ is the appropriate one to correspond to $G_f = G_u$, according to Fig. 4 in (Albers 1998) and Fig. 2 of this paper, with a value G_u of G_f which is produced only by the distant masses of the universe. At some distance near the center of the cluster, closer than 1% of the clusters radius, however, the contribution of the clusters stars lift G_f to $2*G_u$, according to the above mentioned figures. Here a heavier star fulfills the stability criteria. If one assumes the power 3.5 in the luminosity-mass relation as already discussed in chapter 4, stable stars should posses a mass which is 32 % higher than M_{Sun}, with a luminosity L = 2.6 * LSun. Do there exist any hints that just near the centers of spherical systems the heaviest particles subsist?

Looking for *Mass Segregation* in (WIKI) one gets the following statement: "In astronomy, dynamical mass segregation is the process by which heavier members of a gravitationally bound system, such as a star cluster or cluster of galaxies, tend to move toward the center, while lighter members tend to move farther away from the center. Primordial mass segregation is non-uniform distribution of masses present at the formation of a cluster. After relaxation, all trace of primordial mass segregation is lost".

This formulation, which represents the results of astronomical observations, seems to be in good agreement with the results deduced above from the ARG principles, which however are not based on the process of mass segregation. Instead, from ARG it may be assumed that the heavy members near the cores of spherical systems have formed near the same region where they exist today. Thus, there also don't arise problems due to the huge relaxation times of mass segregations in clusters of galaxies.

21. BLUE STRAGGLERS IN GLOBULAR CLUSTERS

The findings published in a very recent paper (Ferraro 2015) strongly support the considerations on the basis of the ARG in the foregoing chapter. Ferraro presents, especially in his figures 3 and 4, a lot of data which show a strong increase of the specific frequency of blue stragglers, just towards the center of many globular clusters. For a possible classical explanation of this behavior, the author may be cited himself: "In stellar systems with no evidence of recent star formation, their origin cannot be explained in the framework of normal single-star evolution."

On the basis of the ARG, as explained in the foregoing chapter, the observed findings are not unexpected. The blue stragglers live at their home, that means at the place where they are borne and where they can live for long times as stable objects, as stable as stars of population II, which away from the center, are the dominant components of globular clusters. The blue stragglers can develop and live due to the same principles as stars of population II. But the region near the core of the globular clusters which is preferred by the blue stragglers, is governed by an increased value of the gravitational factor G_f, as described by the curves in Fig. 2 of this paper. And an increased G_f means, that here stars are stable which are heavier and more luminous than those of population II. Although the radius in the figures of Ferraro (2015) is linearly scaled, whereas the diameter in Fig. 2 in this paper and in (Albers 1998) has a logarithmic scale, the similarity of their massages is evident.

22. GLOBULAR CLUSTERS: FROM KING-MODEL TO CORE-COLLAPSE

Globular Clusters (WIKI) are spherical collections of stars with an increasing density of stars towards the cores of these systems. In 2007 Heggie and Giersz state that astronomers have constructed models of globular clusters for over 100 years (Heggie and Giersz 2007). This statement is cited here in order to point to the difficulties of classical theories to account for the existence and the properties of these widespread spherical systems.

Because within most of the clusters the star density stops to increase when approaching the core, a description like the King-model seems to be a very appropriate one for the density-problem. About 20% of the clusters, however, exhibit a density increase towards much smaller distances to the core. This behavior is usually explained by a "core collapse" process (*Globular Cluster* WIKI). The slightly pejorative designation "core collapse" favors the assumption, that the 20% clusters of this type should be considered as atypical, compared with the majority of the globular clusters which are better described by the King-model and are usually considered to be the more typical ones of these spherical systems.

On the basis of the ARG, however, the situation is just opposite: The core collapse clusters represent the systems with long term stability, intrinsically connected to such spherical systems, whereas the clusters described by the King-model and similar formula describe systems during a state of disturbance. This will be discussed in the following.

The ARG don't fit empirical formula to luminosity data like the King-model, but generate a description of the density in such spherical systems on the basis of physical principles. And as it was described earlier, the density profile in such systems should increase towards the center proportional to 1/r of the distance r (Albers 1997b). However, there exist effects which can produce deviations from a perfect 1/r-dependence towards the observed King-model-behaviour. As derived earlier (Albers 1997b) the 1/r-dependence results from the balance between the attractive and the repulsive forces of al the involved stars. Even if all the stars are of the same type, usually denoted as stars of population II, it must be considered that the ARG describe a uniform mass distribution, which however lets expect deviations from the 1/r-dependence if one explores this behavior close to the core of the clusters, where the behavior is determined by a small number of stars.

In these regions with high star densities, encounters are quite common which can lead to stars like the blue stragglers or even heavier stars. The disturbing effects of such stars with e.g. masses of two or four times that of the main members must not be seen primarily in their attractive effect, which is proportional to their mass. Their stronger effect results from the repulsive forces of their gravitational radiation which is assumed to be proportional to their luminosity.

Assuming, as explained in chapter 4, the power 3.5 in the luminosity-mass relation (eq. 8), a star with double mass produces a repulsive radiation which is 17 times as high as that of a typical star in that region. According to the mass-diameter relation corresponding to a value of $M/R^2 = 160\ M_{Sun}/pc^2$ this single star produces a repulsive radiation equal to that of all stars inside a radius of .27 pc around the core of the cluster. For a star with four times the typical mass it follows that its repulsive radiation amounts to that of all typical stars inside a radius of .9 pc, whereas its attractive force is only four times as high as that of a typical star. So it seems reasonable that such stars blow away many of their next neighbors and thus decrease the density near the core of the globular clusters and produce a density function which may be well described e.g. by the King-model. Therefore, one may state that though the 1/r-dependence of the star density function is the ideal description for the state in equilibrium, the King-model seems to be appropriate to describe the situation during disturbed periods. These periods may last for longer times than the periods without disturbances. And this can lead to the result that 80% of these systems are well described by the King-model and only 20 % are considered as "core collapsed".

23. BINARY STARS

At the left side in Fig. 1 a short vertical line is added. Its crossing point with the data line represents a hypothetical spherical object with a mass of only one Sun-like star and a radius R_1 with $R_1 = 7.9*10^{-2}$ pc. The radius of course can not be measured around a lonely, single star. The diameter $D_1 = 2*R_1$, $D_1 = .158$ pc, can be assumed as the smallest distance between stars at the center of the spherical mass accumulations. But may D_1 have some physical meaning?

It is assumed here that this diameter D_1 is the typical length along which the axions (or ALPs) during their flight are completely transformed to gravitons, whether with or without the influence of magnetic fields. At this distance D_1 away from the star the repulsive forces attain the value of the attracting forces and so deliver the basis for the stability of the spherical objects. It may be further assumed, that the amount of gravitons, produced by the transformation of ALPs, increases uniformly along the way from the star towards the distance D_1. Of course, the real transformation rate is not known. Instead of the linear dependence on D_1, also higher powers of D_1, up to D_1^3 appear reasonable, e.g. if the volume which is transversed by the APLs is the crucial factor.

What happens if two stars slowly come closer to one another than D_1? At this shorter distance the repulsive forces are smaller than the attractive forces, because not all ALPs are already transformed to gravitons. A stable state, however, is possible, if both stars rotate around one another on Kepler orbits with an appropriate speed, so that the centrifugal forces deliver the missing part of the repulsive forces. From these considerations it follows, that the maximal separation of two Sun-like stars in a binary system should be equal to D_1, that means .158 pc or $10^{4.51}$ AU. The semi-major-axis a, which is half as long as the separation D_1, should attain values with log a[AU] <= 4.21. Do there exist any hints which support this statement?

Hubber and Whitworth (2005) present two histograms with the observed distribution of semi-major axes a of binary star systems. In Fig. 4(a) the distribution ends abruptly at values of a, with log(a) about 2.7, quite well below the above mentioned value of 4.2. In Fig. 4(b), however, the log(a) values extend up to about 4, thus very compatible with the expected upper limit from ARG. May there exist plausible explanations for this different behavior in the two figures?

Fig.4(b) in (Hubber et al. 2005) contains binary systems with G-dwarf stars, that means stars which possess masses and luminosities like our Sun and like the stars in the old spherical systems that served to derive the mass-diameter relation and the determination of D_1. Therefore in this case the good coincidence of expectation and observation can well be expected.

The data in Fig. 4(a), however, result from binary systems with pre-Main Sequence stars with masses up to 5 times that of the Sun and highly increased luminosities. Such systems cannot exist with a separation as high as D_1, as will be explained in the next chapter.

Thus, the short line in Fig. 1 is a dividing line between two regions with systems showing different behaviors. At the right side there are spherical systems containing old stars which move on irregular orbits that are mainly determined by the interaction with their respective nearest neighbors. The left side, however, is populated by old binary stars which rotate around one another on well defined Kepler orbits. Their separation can span the region between a maximum as D_1 and a minimum at which tidal disruption allows only short survival times. Of course also multiple star-systems or even planetary systems on well defined Kepler orbits are reasonable in this region. But that will not be discussed here in detail.

24. BINARY SYSTEMS WITH HIGH MASS STARS

In chapter 23 binary star-systems with Sun-like stars were discussed. What, however, may be expected for binaries consisting of heavier stars. At first glance one may expect that binary systems with more heavy stars can exist at larger separations, because they are more stable against disturbing external influences. The ARG, however, lets expect a totally other result:

For example here may be regarded binary star systems where the larger star has a mass up to 4 times the mass of the Sun and belongs to the main sequence. The luminosity L_H of such a heavy star increases according to eq. (8) in chapter 4 very strongly with its mass M_H. The attractive force of the larger component with its mass M_H acting against its partner is proportional to M_H. The repulsive force, however, is proportional to the product of luminosity and distance R_H along which the ALPs are converted to gravitons. The value of R_H at which the repulsive force reaches the value of the attracting force defines the maximum separation S_H for a binary system containing a heavy star with mass M_H. From these considerations it follows:

$$M_H = const. * (S_H * M_H^{3.5}) \text{ and thus } S_H = const. * M_H^{-2.5}. \quad (9)$$

This dramatic decrease of the maximum separation SH with increasing mass M_H is in total dissent to the above mentioned expectation of an increase. May there exist any hints which support such a result? On the basis of their numerical simulations Bonnell and Bate (2005) report a relation $S_H \sim M_H^{-2}$. The difference between this power -2 and the above value -2.5 should not be taken to seriously, because the authors also present powers of -1 and -3 for different conditions. Their figures 1 to 3 as well show the drastic decrease of the separation with increasing mass, rather well in accordance with the own considerations.

25. OORT CLOUD

The above considerations on the basis of the ARG can lead to another interesting scenario. As an example an old star may be regarded, which has no close neighbor, e.g. our Sun with its next neighbor about 1.3 pc away, and thus with only small gravitational influence at a distance D_1 from the Sun. The old star should fulfill the condition that at the distance D_1 the repulsive forces are equal in amount to the attracting ones. On the whole spherical shell with this radius around the star, masses can reside, without feeling forces towards or away from the star. Outside this shell also no effective forces from the star exist. And even the region just inside this shell shows only very small effective attractive forces. The star's attraction according to Newton's law at D_1 = 32600 AU is more than nine orders of magnitude smaller than on earth. Furthermore, this value is largely compensated by the almost equal value of the repulsive forces. Thus, material which has accumulated near the shell, can provide by its gravitational pull stable conditions for further material in a broad region on both sides of this shell. And in contrary to masses near the star, like planets and objects in the Kuiper belt, this material must not rotate on Keplerian orbits to withstand the gravitational pull of the star.

In summary one can state on the basis of the ARG: There may exist a broad shell with spherical symmetry where material can reside under stable conditions at distances of more than ten thousands times the astronomical unit. And there it can reside without the necessity to move on Keplerian orbits. Such a statement, however, is scarcely compatible with classical theories of gravitation. Is such a scenario compatible with observations?

At least since 1950, when J. H. Oort published his paper about a cloud of comets surrounding the solar system, it is suspected that there exists the so called *Oort Cloud* (WIKI), which is assumed to harbor large amounts of cold matter, at distances far away from the Sun. Of special interest is here the Outer Oort cloud which contains its matter in a spherical shell around the Sun in a region that may extend from distances of 20000 to 50000 AU. These findings really seem to be in best accordance with the above ARG expectations. One should, however, not expect that the ARG contemplation can present data of dimensions and distances with more precise values than the order of magnitude.

But there is still another severe reason which hampers an easy comparison between ARG expectations and published knowledge: The data of the Oort cloud are based mainly on the orbital data of comets. And these orbits are calculated using the fixed value of Newton's gravitational constant G, even close to those regions where due to the ARG the attracting forces of the Sun are negligible.

In analogy to the considerations about binary stars in chapter 23, the ARG may be used to think about objects much nearer to the Sun than those inside the Oort Cloud. These objects should move on Keplerian orbits. It may be expected, due to mutual gravitational interactions, that they gather in a disk-shaped region, like the planets around the Sun. These ideas are very close to the description of the so called *Hills Cloud* (WIKI)

26. NEW SPHERICAL SYSTEMS: MINICLUSTERS AND SUPERCLUSTERS

All the data about spherical systems, which were presented already in Fig. 4 by Albers (1998), also appear in Fig. 1 of this paper. But two new systems are added. At the low end the recently published data of miniclusters are added (Alexander et al. 2012). Their data are represented in Fig. 1 by the star-symbols, with abscissa-values between 2 and 10, corresponding to the number of stars in column 5 in Table 1 in (Alexander et al. 2012). The related diameters are the double values of the "physical radius, R_p" in column 9. The data of this new spherical system show the usual high scattering. But as can be seen from Fig. 1, they fit rather well to the earlier described systems. The addition of this new system may serve as an example, to show how simple necessary data can be achieved to construct mass-diameter relations, in contrary to the use of sophisticated dark matter models, as mentioned in chapter 19.

The second new system of spherical objects is located just opposite to the above discussed first one, at the upper end of all the other systems. The objects are superclusters, which were discussed already in (Albers 1998), but were not included into the mass-diameter figures. Due to their huge dimensions and their exorbitant long relaxation times, necessary to build a perfect spherical system, superclusters may be regarded not as real but probable future members of all the groups in Fig. 1 of this paper.

What is today the knowledge about superclusters, about 18 years after the mass-diameter relation was discussed in (Albers 1997b)?

One very recently published paper (Chon et al. 2015), should be mentioned here, due to the clear definition: "Superclusters are the largest prominent density enhancements in our Universe. In the framework of hierarchical structure formation, superclusters are the next objects up from clusters, but unlike clusters, they are not virialized." Furthermore, this paper presents quantitative values of relevant parameters, even from foregoing papers. The total mass of the Shapley supercluster is stated as $1.34{*}10^{16}$ M_{Sun}, inside a turn-around radius of 11.1 Mpc. This results in a M/R^2-value of 109 M_{Sun}/pc^2. Data are also presented from other authors, which allow the calculation of the corresponding M/R^2-values: Reisenegger et al.: 203 M_{Sun}/pc^2, Ragone et al.: 172 M_{Sun}/pc^2. The latter one is represented in Fig. 1 by a circle at a diameter of 16 Mpc and a mass of $1.1{*}10^{16}$ M_{Sun}, well on the straight line of the mass-diameter relation in Fig. 1.

27. FILAMENTS AND GREAT WALLS

According to the principles which are the basis for the existence of the stable spherical systems, there may be assumed, however, also the existence of pseudo-stable mass arrangements. The spherical systems in Fig. 1 have undergone a mass enrichment towards a stable state along all three axes of a coordinate system. A mass arrangement with rod-shaped symmetry and an infinite length can also exist, however, as a pseudo-stable object. If already the mass concentration along short distances and according short relaxation times has occurred along the two coordinate directions perpendicular to the rod axis, no further contraction along the rod-axis must occur. This is because all masses inside the rod don't feel forces along the rod-axis.

Disturbances of the highly symmetric mass distribution, however, can lead to slowly developing new structures. As a possible disturbance, a crossing of two rods may be considered. In this case the unstable non-spherical mass-arrangement around the crossing point may transform towards a stable spherical system. This should be expected, if one accepts here the same processes by which the well developed smaller spherical systems developed from non-spherical mass concentrations. In the case, that the components of the rods are galaxies, this spherical system of course will be a galaxy cluster.

Another pseudo-stable galaxy arrangement may be expected. A large, plate like system wherein the mass accumulation along the direction perpendicular to the plate has already relaxed, can also be stable for long times, because in an infinite large plate the masses inside the plate don't feel any force to move and concentrate inside the plate. Do there exist any observations which are compatible to these considerations about one- and two-dimensional pseudo-stable mass arrangements?

Instead of telescope-pictures, the graphical output of an extensive computer-simulation may be cited here (MPA 2015). The simulations show that on large scales filaments of galaxies must be expected with galaxy clusters at their crossing points. This is just that, what according to the above considerations is predicted by the ARG.

Why can such simulations, which are based on classical theories, produce a result which is compatible as well with the astronomical observations as with the expectations of the ARG? The reason seems to be the introduction of a suitable amount of dark matter which is equivalent to the increase of the gravitational potential according to the ARG at places where the luminous matter concentrates.

In the case of the above discussed pseudo-stable plates of mass accumulations, as an example the detection of the so called *CfA2 Great Wall* (WIKI) may be mentioned. This object is a plate-like concentration of galaxies which possesses dimensions of about 500 pc in two dimensions and only 16 pc perpendicular to the plate. Also, this finding is well compatible with the above discussed expectations from the ARG.

28. LUMINOUS MATTER FOLLOWS DARK MATTER?

The above mentioned simulations are governed by the mutual attraction between all particles of luminous matter and an even larger amount of dark matter. The results not only lead to large scale structures as filaments and walls but also to the conclusions like: "Luminous matter follows dark matter". From the perspective of the ARG such a statement is not unexpected. The increased gravitational potential which classically is produced by dark matter is produced according to eq. 4 by the concentrated amount of luminous matter. Thus, this increase of gravitational potentials is directly linked locally to the luminous matter. If one explains this correlation in classical theories by the appropriate amount of dark matter, then the basis of the statement in the headline of this chapter is evident.

From the view of the ARG the conclusion from these simulations, that "Luminous matter follows dark matter", and not vice versa, is absolutely inappropriate. Especially because since now, more than 80 years after their postulation, the dark matter could not be proved by any other property than an increased gravitational effect, just as it is expected from the ARG. The statement "Luminous matter follows dark matter" includes the message, that the amount of luminous matter increases at places, where the dark matter shows increased values. One may ask, what facts speak against the opposite direction of this correlation between the two components? In any case it is of interest to compare this statement with other findings.

In a huge number of publications, dark matter is used to explain the unexpected details of rotational curves of spiral galaxies. In these cases, the decreasing density of luminous matter at larger radial distances is coupled not to a decreasing, but to an increasing amount of dark matter. No wonder, that a concept, which can be adapted with such a chameleon-like ability to every fitting process, could survive for more than 80 years.

29. ANOMALOUS GRAVITATIONAL EFFECTS; UPDATED

The ARG let expect anomalous gravitational effects at every place, where the luminous matter is highly concentrated. This aspect was already discussed in detail in an earlier paper (Albers 1998). Since that time, a huge amount of publications appeared, which are related to this topic. Because the discussion of several of these new findings and their comparison with the ARG would too much delay the completion of this paper, only one subject, the most impressive one to the opinion of the author, will be discussed here: The relation between the masses of spherical systems and the masses of the black holes, which are assumed to exist at the centers of these systems.

Anomalously increased gravitational effects were observed already in almost all spherical systems in Fig. 1. In the huge systems, especially the clusters of galaxies, the reason is seen in the existence of dark matter. Within two smaller systems black holes are assumed to be responsible for this effect: In globular clusters intermediate-mass black holes (IMBH) are seen as source, in elliptical galaxies the larger super-massive black holes (SMBH) play this role.

The interesting finding is, that there seems to be a strong relation between the mass M_{SP} of the spherical system and the mass M_{BH} of the embedded black hole. Fig. 2 in a recent paper (Lützgendorf et al. 2015) shows data of both spherical systems, which span a region of impressive 7 orders of magnitude of masses as well of M_B as of M_{SP}. The relation between both types of masses is rather well linear. The M_{BH} values are typically .3 % as high as the M_{SP} values. A theoretical foundation of this behavior on the basis of classical theories could not be found anywhere. Which statements, however, may be expected from the ARG in connection with these findings?

It is difficult to compare statements from classical theories with statements from the ARG, because there exists no easy way to convert parameters of one system to those of the other one. In spite of this problem, in the following some plausible remarks may be made. If an observer with modern optical equipment is able to determine local gravitational effects with sufficiently high spatial resolution, he will notice an increase of these effects with decreasing distance r to the center of the spherical system. At the latest at a distance r_1, where the gravitational factor G_f in Fig. 2 reaches a value of $2G_u$, it becomes clear, that the increased gravitational effects can not be explained by luminous matter. If one now introduces a black hole to solve this problem, it is necessary to determine the mass of this black hole. This can be done e.g. by calculating in the usual way the attracting forces from all masses inside the sphere with radius r_1. These forces are of course also increased, compared to those which can be expected from the luminous matter alone. If this increase corresponds e.g. to a factor 2, then the black hole must have the same mass as the luminous matter inside r_1.

The crossing points of the horizontal dashed line with the data curves of the different spherical systems in Fig. 2 appear at $G_f = 2*G_u$ and a r_1-value of about $.01*R$. Due to the mass-diameter relation the amount of luminous matter, and therefore also that of the black hole, M_{BH}, is 10^{-4} times that of the spherical system, M_{SP}. This linear relation is valid for every spherical system, from the smallest globular cluster to the largest elliptical galaxy. And thus it is very well in accordance with the observed black hole-bulge relation.

The difference beteen the small amount of 10^{-4} instead of the above value of .3% should not be seen to critically, because the fitting point at the distance r_1 was chosen quite arbitrarily. A value of r_1, defined by $G_f=1.5G_u$ would much better correspond to the .3% value, but also a fitting at this point can not be calculated quantitatively.

Two special findings in connection with this topic, however, may be mentioned here, which can be expected from the ARG and which already could be observed. First: If due to the higher spatial resolution, e.g. of the Hubble Telescope, a fitting of the observed data to the black hole model at a smaller distance r_2 seems to be appropriate, there may appear an astonishing result. In Fig. 2 the dotted horizontal line corresponds to a distance $r_2=10^{-.5}r_1$. A fitting of the black hole mass at this distance from the center leads to a value of M_{BH}, which is about ten times smaller than the above calculated one of $10^{-4}M_{SP.}$ The second point: If a small spherical system is located close to the center of the next larger one, e.g. a globuler cluster inside a galaxy, or a galaxy inside a cluster of galaxies, the increases of G_f from both systems superimpose. This lets expect an increased value of the black hole mass of the small system. And this expectation can be confirmed by observations. E.g. in Volonteri et al. (2012) one can read, that the black holes hosted in central galaxies of clusters appear to be over-massive.

The obviously very different dependence on the distance r of the curves in Fig.2 and the effect of the classically assumed black hole, makes a determination of M_{BH} rather difficult. E.g., even the values of the black hole in the very nearby galaxy Andromeda cover a range from .3 to $23*10^7$ M_{Sun} (Menezes 2012). This chapter may therefore be closed by an appropriate statement of Haggard et al. (2013): "Do globular clusters (GCs) harbor intermediate-mass black holes (IMBHs; ~ 10^2 - 10^6 M_{Sun})? Despite nearly four decades of study ... this fundamental question in black hole astrophysics remains unanswered."

30. ARG: GRAVITY WITHOUT SINGULARITY

According to the ARG the gravitational attraction is due to a shielding effect. The gravitational radiation I_0, produced by all the masses of the universe, is partially absorbed. If the absorbed part, described by $A*I_0$, amounts to a significant part of I_0, then the behavior must be described not by a linear but by an exponential law. From optics it is known that the part I_a, $I_a = (1\text{-}A) * I_0$, which is absorbed when the radiation is transversing a plate with an absorbing material, is described by: $I_a = I_0*e^{-(d/d_0)}$. If the thickness d of the plate equals d_0, about 63% of I_0 are absorbed by the plate. If the plate is four times as thick as d_0, more than 98% of I_0 are absorbed. And even if the thickness of the plate is increased by a factor of one million to $d = 4*10^6 * d_0$, the absorption will not increase by more than additional two percent.

These considerations about absorption may be applied to the gravitational ideas of the ARG. If in a sphere with a radius R a mass M is included which already absorbs more than

98 % of the gravitational radiation, then the introduction of additional masses with $10^6{*}M$ will not increase the absorbed radiation by more than two percent. And because the gravitational effects according to the ARG are proportional to the absorbed radiation, it follows that gravitational effects are not compatible with the ideas of singularities.

Classical theories of gravitation, however, assume that the gravitational effects, produced by the masses inside the above mentioned sphere with radius R increase proportional to the included masses. And because a relation like Newton's law of gravitation doesn't set any limit of gravitational forces or mass-density, one must not wonder that today the literature is flooded by papers about objects, with masses down to the Planck mass of about 22 micrograms of a *micro black hole* (WIKI), with densities which are unimaginable for a solid state physicist like the author of this paper. Even the well accepted Big Bang theory seems not to be realistic on the basis of the ARG. And therefore, a statement "Everything we know about the Big Bang could be wrong" by Romano (2015) is not judged as being absurd.

31. BLACK HOLES

From Mößbauer spectroscopy it is well known that photons suffer a redshift, when escaping the pull of a gravitational potential. If such a potential is deep enough, no photon can escape from the mass which produces this potential, that means, there exists a so called black hole. Classically, such a black hole can be produced by accumulating more and more mass M into a sphere with a fixed radius R, until M/R^2 grows to a certain value, which defines the horizon of a black hole with the radius R. According to the alternative reflections, such an accumulation of mass also produces an increased gravitational potential due to the absorption and shielding of the radiation, which is produced by the luminous masses of the universe. But this, however, does not lead to a type of singularity, because a mass increase beyond a value which already causes an almost complete absorption of this radiation doesn't increase the gravitational potential remarkably, as already was discussed in the foregoing chapter. Until now no calculations exist on the basis of the alternative reflections, whether even a complete absorption and the related screening effect can produce a black hole.

Compatible with the alternative reflections however, seem to be huge spherical mass-accumulations which mainly consist of stable elements like iron which can't support nuclear fusion. Such objects don't produce a repellent radiation which would prevent a further mass accretion. So it is also understandable, that there exist metal-rich massive stars with masses which are about two orders of magnitude higher than that of our Sun. In this paper therefore the existence of “black” or "dead" objects, especially at the centers of mass-accumulations are not excluded and denoted here for simplicity as black holes.

32. CONCLUSIONS

Newton's law of universal gravitation and Einstein's General Theory of Relativity, the latter now just known since 100 years, govern the field of gravitational physics today. This is quite reasonable because both theories describe very precisely the main effect of gravitation, the attractive forces acting between different masses. But both theories are pure mathematical concepts which are not derived from well known physical effects and principles.

The ideas developed in the context of the ARG, however, are very well based on physical effects and principles. And on this basis not only Newton's force law can be derived, but also a lot of plausible explanations of effects which are difficult to explain classically.

Especially during the last decades a lot of new and interesting observations are reported. And very often the authors write in their papers sentences similar to: "Although the details ... have not yet been fully understood ..." (Wang and Liu 2014). Such papers may be useful sources for a comparison with the ARG-ideas, because for the understanding of the ARG only a sound basic knowledge of physics is required. Thus even persons with interest in astrophysics, but without the necessary knowledge to really understand the concepts of big bang, antimatter, dark matter, dark energy, wormholes, multiverses, or the string theory, may reveal new relations, similar to those described in this paper.

There exist some fundamental contradictions between the above mentioned two theories of gravitation and the ARG. Both classical theories assume that the attracting force between every two masses exist, even if there exist no further masses in the universe. The ARG, however, assume that in such a case two non-luminous, dead masses would produce no force at all. And two luminous masses, typically stars, even should produce a repulsive instead of an attractive interaction. The observed attractive force is only possible due to the existence of all the other luminous masses in the Universe.

In order to give new insights into this field, a proposed experiment seems to be of extremely high value. After about a decade of unsuccessful search of CAST for axions with detectors, sensitive to radiation belonging to the electromagnetic spectrum, new experiments with a detector, sensitive to mechanical forces, are planned (Baum et al. 2014). The authors expect that a positive result will confirm the existence of a postulated new particle, the chameleon. From the perspective of the ARG, however, a positive result of these experiments would reveal an effect of much higher importance: The fundamental source of gravitation on the basis of the proposed ALPs. But probably it will take some time until the results of these experiments can be published.

On the basis of classical theories, e.g. the Primakoff effect, transversal magnetic fields play an essential role in the conversion of axions or ALPs. From the observation of the influence of magnetic fields as described in chapters 7 to 10, one may assume, however, that also longitudinal magnetic fields can produce gravitational forces by the transformation of ALPs. May be that these fields are even more efficient than the transversal ones. Therefore, it seems to be favorable to test this assumption by a short-term feasible experiment which can be performed without difficulties and large financial expenses. Every technician who is in charge of a strong laboratory magnet and who is allowed to use this equipment at least for some days may perform such an experiment. The only necessary additional experimental component, a highly sensitive torsion pendulum may be borrowed from somewhere, especially from almost every high-school.

The axis of the laboratory magnet may be oriented horizontally towards the positions of sunset or sunrise. One mass of the resting pendulum should be placed behind the magnet and centered on its axis. If an increase of sensitivity or a higher angular resolution are desired, several magnets may be arranged in a line. Although the success of such an experiment of course can not be guaranteed absolutely, a comparison of expense with possible output strongly recommends its implementation. With a positive result such an experiment and its operator will probably be unforgotten forever, comparable with Foucault and his pendulum.

Since the publication of the ARG-papers (Albers 1997a,1997b and 1998), a huge amount of new astrophysical observations and possible explanations has accumulated. It is interesting to observe how well many of these new findings are compatible with the ideas of the ARG. Thus, it seems desirable to collect more and more such compatible results, also during the coming years. But at the age of the author of this paper one should take care that a bit of the new results has been published, before a sudden incident may prevent a publication forever. For this reason, however, some further interesting themes can not be included for a discussion in this paper.

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Apologies: The readers of this paper should not be repelled too much by the broken English and also not by some mistakes which probably are included. For both the author alone is responsible. He herewith asks for apology. The author decided, not to call endanger of any other person resulting from the connection to this paper. This also includes the consequence, that it will not be sent to a refereed journal. As with the foregoing three papers it will be sent to the arXiv-database, with the hope that it will be accepted and thus be achievable for really everybody, easily and without any charge.

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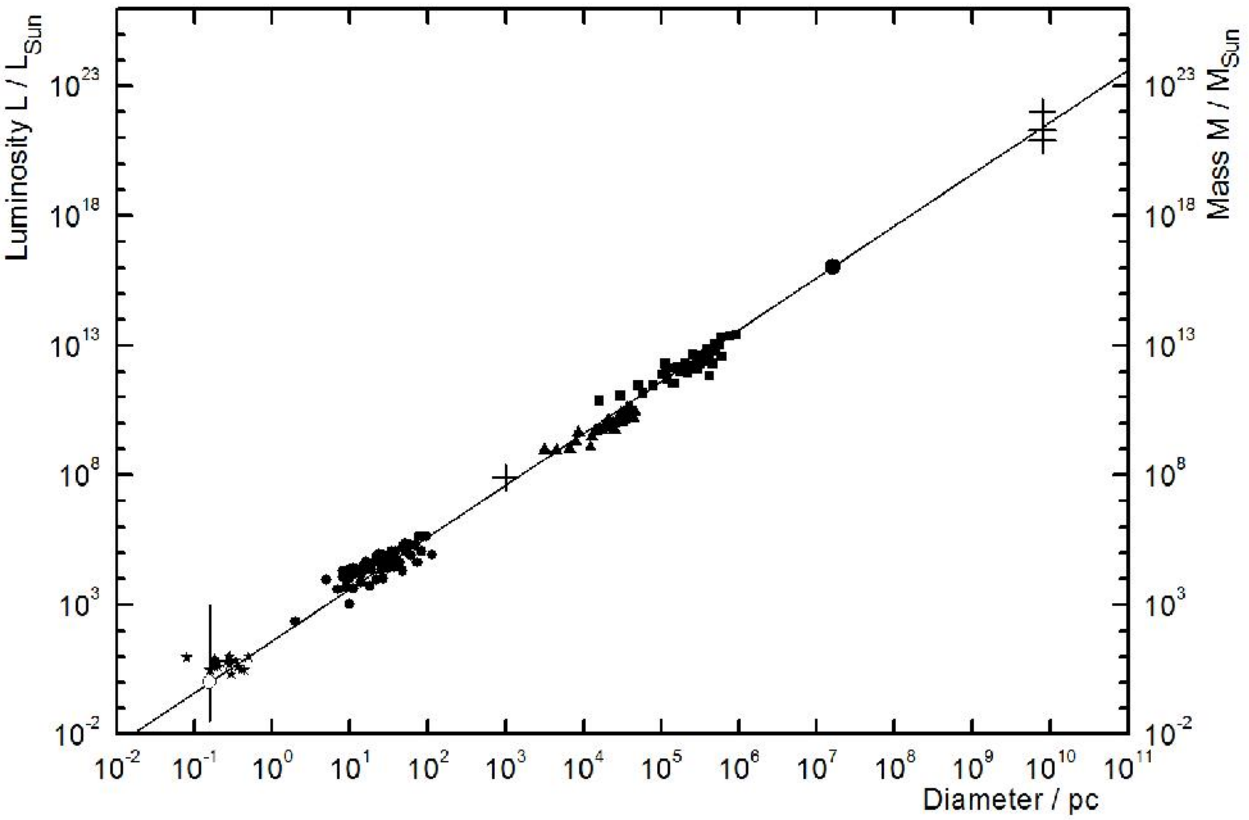

Fig. 1. Dependence of luminosity L and mass M on the diameter of different spherical objects in the universe. Circles: globular star clusters; triangles: elliptical galaxies; squares: spherical clusters of galaxies (all data from Albers 1997b). The cross at 1000 pc represents the bulge of our Galaxy. The three crosses at a diameter of 8 Gpc correspond to the universe and result from different literature data of density or mass as described earlier (Albers 1998). Fig. 1 contains thee new entries: First, an open circle at M = 1 M_{Sun}, representing the sphere of influence of a single star (described in chapter 23). Second, the miniclusters, with masses from 2 to 10 stars (discussed in chapter 26). Third, a filled circle at a mass of more than 10^{16} M_{Sun}, representing the systems of superclusters (also discussed in chapter 26).

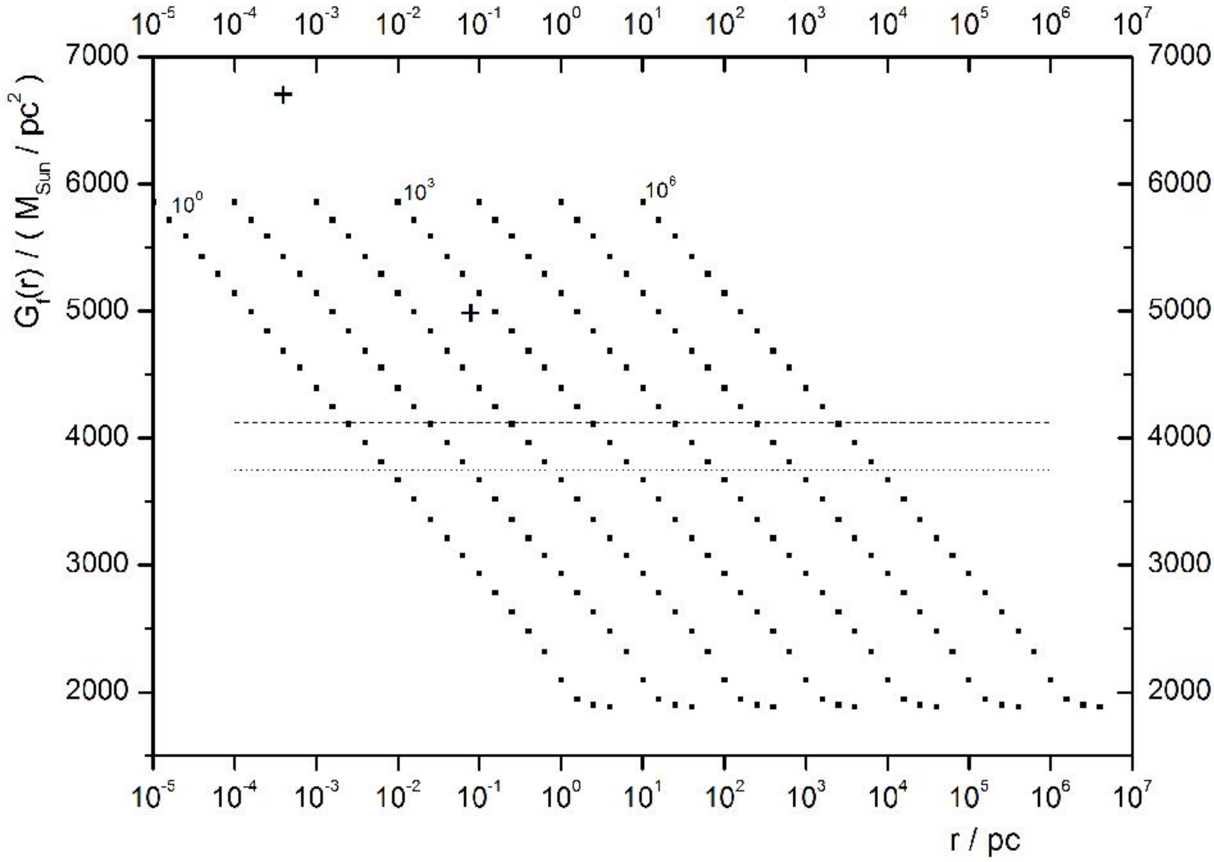

Fig. 2. Dependence of the gravitational factor $G_f = G_{sp} + G_u$ (contributions from spherical systems and the universe) on the distance r from the center of spherical systems with different radii R. R is drawn next to the individual curves and is given in pc. Besides the data points (from Fig. 4 in Albers (1998)), Fig. 2 contains 4 new entries: Two large crosses are placed at distances of 80 AU and .08 pc (see chapter 15), away from the center of the bulge in the Milky Way. The dotted horizontal line crosses the data curves at a height of 3750 M_{Sun}/pc^2, two times as high as the value of G_u. The dashed line crosses the data curves at r-values, which are $10^{-.5}$ smaller than those of the dotted line.

Postscriptum: This paper was sent to arXiv.org on 4 Sept. 2015. Despite the notice "Your article is scheduled to be announced at Thu, 17 Sep 2015 00:00:00 GMT.", the paper was removed on 22 Sept. The author is indebted to arXiv for their recommendation to submit the paper to a conventional journal. But due to his experience with conventional journals and papers, far away from mainstream, the author prefers to send it to viXra.org.