Direct Product of Sporadic Groups as a Symmetry Group of the Observable Universe at Maximum Expansion

Tomáš Ajdari
tomasajdari@gmail.com

Abstract:
The direct product of sporadic simple groups is a rather large group of the approximate order of 2.32×10^365, describing an object of d = 93.75 billion ly and mass of 9.63 × 10^53 kg, composed out of 6.15 × 10^121 3D knots - particles. This is the same mass as two classical electrons at Planck density minus the mass of all baryonic matter inside a local (late time) Hubble volume. The Compton wavelength of all baryonic matter inside the observable universe at maximum expansion is directly related to the order of this group. Two values of the Hubble constant - 73 and 65.5 km/s per megaparsec (Hubble tension) are recovered. Proton/electron mass ratio is recovered assuming precise baryonic matter/total matter ratio of 1/2π, which is inside contemporary estimates. This group is implicated as a source of Weyl/Dirac's/Funkhouser's large numbers.

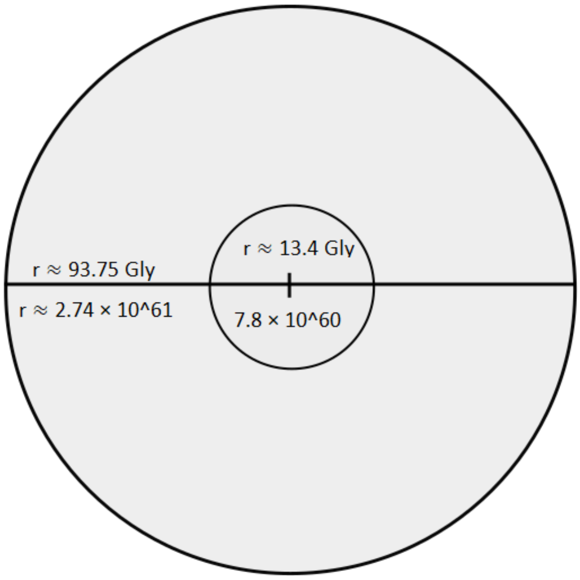
All finite simple groups belong to one of 18 infinite families, with the exception of 26 sporadic groups. These sporadic groups are somewhat of a mystery, having many interesting properties and connections to other areas of mathematics or physics. Even more so, their ability to separate themselves from de-facto infinity makes them a hypothetical mathematical equivalent to either a Big Bang or to the observable universe itself. In other words, the designation "sporadic" might be a preliminary one, there might be 18 infinite families and a "family" of groups that lead to all the symmetries of a finite object that can not be escaped — the observable universe. This paper will argue that there exists a series of coincidences that link the direct product of the 26 sporadic groups to several physical parameters — both concerning particles and large cosmological scales.

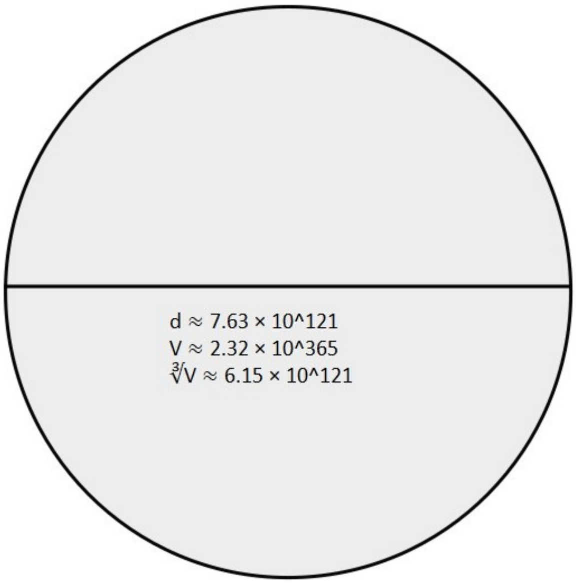
The direct product of all the 26 sporadic groups is a rather large group of order ~ 2.324184×10^365. An attempt to write down the elements of this group as points/cubical lattice in space will result in a sphere of diameter d = ~ 7.628308×10^121, with a cube root of the volume being ~ 6.148325× 10^121. These numbers are clearly related to the set of numbers being identified by Weyl/Dirac and Funkhouser. [1] [2] What is this object, exactly? Let's give each point of the diameter an inverse point. In other words, we'll take the square root of the order, thus bringing it to the Planck scale. Now, we see that the diameter d = 8.734018×10^60 (Planck length or 2πPlanck length) and the mass is m = 7.039582× 10^60 Planck mass (or 2πPlanck mass).

This corresponds to diameter d = 8.869498× 10^26 - 8.869695× 10^26 m = 93.7507 - 93.7528 billion ly. And weight of m = 9.626691×10^53 — 9.626478×10^53 kg. Based on the 2018 CODATA values of Planck length and mass, though this paper will argue that it is possible that the value of gravitational constant might lie slightly outside the upper border given by 2018 CODATA G = 6.674726 × 10^-11, more in line with the higher values that were obtained during the past 20 years. [3] This leads to 8.869879× 10^26 m (93.754698 billion ly (light years)) and m = 9.626279× 10^53 kg.

A cubic lattice has been chosen as the prefered type of packing because any other would imply some "other" volume outside our universe. However, if we choose to use spheres (r = 0.5) as our fundamental volume with the most efficient packing possible (in 3 dimensions), we'll end up with a sphere of d = 84.8156 billion ly, see section on Hubble tension.

This mass is quite striking, as it is very close to the mass of two classical electrons at Planck density, m = 9.663397× 10^53 (2018 CODATA), 9.662166×10^53 (2018 CODATA classical electron radius, slightly higher gravitational constant than 2018 CODATA).





However, this mass is not an exact fit. The mass difference from the pair of electrons at Planck density is 3.588725× 10^51 kg (2018 CODATA classical electron radius, and derived G = 6.674726× 10^-11) or 3.681287× 10^51 kg (2018 CODATA classical electron radius and 2018 CODATA gravitational constant).

Could this mass difference amount to binding energy of the two electron pair? And could this mass be the heaviest/largest compact object possible? Is it possible that this mass is related to baryonic matter — in other words the only type of matter that can undergo mass/electro — magnetic energy conversion as far as we know?

First, let us consider the ratio of baryonic matter to the total matter content inside our universe. The most restrictive Planck18 data (68 %, Planck TT,TE,EE +lowE+lensing) yield baryonic matter to dark matter ratio of 6.275311 — 6.454545. Let us assume that the true ratio is exactly 1 (baryonic matter) to 2π (total matter content). [4]
Then the volume of space that contains this much baryonic matter is a sphere of r = 13.3961 billion ly (1/ 2π ratio, slightly higher gravitational constant), r = 13.509 billion ly (1/ 2π ratio, 2018 CODATA gravitational constant) and r = 13.568 billion ly (1 to 6.364928, 2018 CODATA).

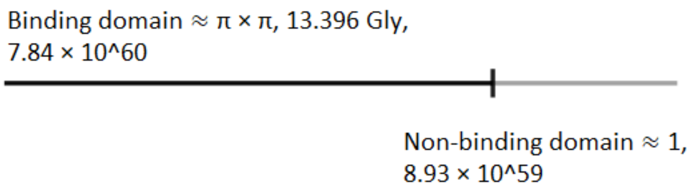
Why choose the specific value of gravitational constant that lies just outside the CODATA range (G is notoriously hard to measure precisely) and exact ratio of baryonic to total matter of 1/ 2π? Because only this ratio reproduces the exact CODATA proton to electron mass ratio (as a square of the difference in volumes between the observable universe and the local Hubble volume - and the number of particles (cube root of the order of the direct product of 26 sporadic groups) as a square of it's diameter in Planck lengths — which is remarkable. In fact, the square of the distance in Planck lengths is ~ 6.1483468567 × 10^121, which is very close to the derived number of particles (cube root of the direct product of sporadic groups): 6.148325× 10^121 – the difference is less than 1 part in 250 000, which can be expected given the large numbers involved in the determination of the direct product of the sporadic groups (possible limitations of calculator) or it can arise from some binding energy complication (not all forms of mass might be able to act as a constituent of the bond on a 1:1 basis) . Another possibility is imprecisely determined proton/electron mass ratio. [5]
Alternatively stated, the entropy of the surface area of this Hubble volume is very close to π × the cube root of the sporadics. If this close relationship is coincidental then it is proof of nature's own sense of humor.

This can suggest a physical mechanism determining the local Hubble radius — a single particle (Compton wavelength) can bear only as many "active" connections as there are elementary particles/masses in the universe before it breaks (i.e. its ends start to expand faster than light relative to each other).

However, our above determined number of elementary particles, alongside with the total mass, suggests a somewhat lower mass of the lightest particle, i.e. one with a slightly longer Compton wavelength.

The precise value is (2pi×7.039582 × 10^60)/6.148325× 10^121 = 7.193991× 10^-61 planck mass or 1.5657×10^-68 kg (2018 CODATA planck mass) or 1.5657 × 10^-68 kg (Planck mass derived G from this work). This leads to Compton wavelength of about 14.9215 billion ly, which is the derived diameter of the observable universe at maximum expansion divided by 2π.
The mass of the lightest particle (Wesson's mass) has been identified with Compton wavelength of the same value as is the Hubble radius! [6] Thus, we've recovered Hubble tension. It seems that the Compton wavelength of the lightest possible particle composes from (at least) two parts — a binding domain capable of having connections to all the particles in the observable universe and probably a non-binding domain (the part of the particle under "Hubble tension" 73 km/s vs 65.53 km/s per megaparsec). The ratio of the binding domain and non-binding domain is very close to π×π : 1. What's more, the non-binding domain would have the same volume as a ~ 0.8907 fm radius sphere, if it was taken as a column with diameter of 1 Planck length. This radius is close to the larger estimates of proton's charge radius and/or a neutron's radius. If we extend the rod throughout the diameter of the entire observable universe, then the column will have a volume almost identical to the volume of 2 classical electrons (or the fundamental volume derived from the direct product of sporadic groups). It seems that the non-binding domain is related to the cube root of the direct product of the sporadic groups divided by about the mass ratio of a proton to two electrons, though this fit is quite imprecise.

It is possible that the Hubble tension has some relation to sphere packing. One can imagine that nature can choose between a cube and a sphere as the basic element of the group. While it is hard to imagine how this would work for the entire observable universe (using adjacent spheres would lead to volumes "outside" of our universe) it is easy to imagine such a mechanism taking place inside the Hubble volume, as the Hubble volume can trade its volume with the rest of the observable universe. Let's imagine that the local Hubble volume of r = 13.396 Gly has a cubic lattice packing while the global Hubble radius uses the most efficient packing of identical spheres in 3 dimensions. The volume of the original local Hubble volume would be joined with the all the empty space outside the spheres, leading to r = 14.807 Gly, which is close to the r = 14.9215 Gly obtained either from the Compton wavelength of the lightest particle or from the direct product of 26 sporadic groups when using only Planck length.



Situation inside a global Hubble volume:
A global Hubble volume of r = 14.9215 billion ly will hold 2× the cube root of the sporadics (2 × 6.148325× 10^121) of the above derived fundamental volume (6^{th} root of the sporadics, 1/2 of 4.4230997× 10^61 Planck volumes) + 2× the cube root of the sporadics (2 × 6.148325× 10^121) times a sphere of r = 8.363×10^-16 meters, corresponding to the lover estimates of the proton's charge radius. It's possible that this difference might be related to the proton radius puzzle, though the probability is not high. This assumes 100 % packing efficiency.

Compton wavelengths
One can use the Compton wavelength of a particle to derive a cubical volume by equating the diameter of a sphere with the corresponding Compton wavelength. There are two cases for Compton wavelengths – we'll take the Compton wavelength of all the baryonic matter inside the observable universe and the Compton wavelength of the total matter content inside the observable universe. By definition – the Compton wavelength of a mass (7.039582× 10^60 2π × Planck mass) is the same as the basic length unit divided by that mass, the number of "baryonic matter volumes" inside the observable universe will be the same as the order of the direct product of the 26 sporadic groups. While the number of "total matter volumes" inside a global Hubble volume will be the same as is the order of direct product of the 26 sporadic groups. This assumes 100 % efficient packing. The value obtained from the mass of the direct product of the 26 sporadic groups and slightly higher than 2018 CODATA G is 2.296026×10^-96 meters. The Compton wavelength of all baryonic matter together – 1.532 × 10^53 kg (assuming the 1 to 2π ratio) is 1.442636×10^-95 meters.

Other relationships

There are many more links between the direct product of the sporadic groups and for example: nucleon binding energies, subatomic particle Compton wavelengths, Chandrasekhar limit and the size of atoms. However, they are beyond the scope of this limited presentation.

But please note that the critical acceleration in MOND is closely related to the baryonic content of the observable universe at a specific moment (derived from the mass of the group). An object falling at the critical acceleration of MOND of ~ 1.2 × 10^-10 m/s^2 (conf. Interval of 0.94 – 1.46 × 10^-10 m/s^2) for 2π × Planck time would fall about 6.9 × 10^-96 m, which is the Comton wavelength of a 3 × 10^53 kg mass – twice the baryonic matter content calculated above (1.53 × 10^53 kg). [7]This is also a mass of classical, non-rotating black hole with Schwarzild's radius of about 46.875 billion ly. Or one can imagine two points being pulled apart in opposite directions at the critical acceleration of MOND for the above—mentioned 2π × Planck time interval (shortest interval of a circular clock). This will produce a 1.38 × 10^-95 m gap – the Compton wavelength of about 1.6 × 10^53 kg — again, very close to the contemporary baryonic matter content of the universe — or the one calculated from the direct product of sporadic groups (1.53 × 10^53 kg).

Note that an object accelerating at an acceleration of 1.3 × 10^-10 m/s^2 would fall the distance of Hubble tension (1.525 billion ly) if it was falling for the duration of Hubble time (global Hubble radius, 14.9215 billion ly). Note that an object accelerating at about 1.25726×10^-10 m/s (enough to cross the Compton wavelength of a 1.532 × 10^53 kg mass in 2pi×Planck time) would cross the entire diameter of the universe d = 93.75 billion ly in 84.23 billion years (assuming classical dynamics), which is almost exactly 2pi × local Hubble time (13.396 billion years) – 84.17 billion years.

Discussion

Obviously, the standard model of cosmology involves an expanding universe that has both, increasing diameter and increasing mass (as new regions of space become visible).
The best current estimates of the diameter of the observable universe place the diameter at about 92.8 billion ly. This is very close to the above derived diameter of d = ~ 93.75 billion ly. In fact, it is different from the derived volume by almost precisely one local Hubble volume, that is if we subtract one local Hubble volume from the total volume, we'll get d = 92.76 billion ly.
So why is the volume nearly the same? There are four possible answers. One is that the formation of civilization is absolutely extremely while requiring a specific (exponential) ladder of events. Thus if a Big Rip scenario occurs every time, we should find ourselves in the final moments of the universe — during maximum expansion. The other possibility is that the abundance of heavier elements in the universe has been sufficient to allow civilizations to arise just a few billion years after the Big Bang. If the universe is cyclic and gave rise to many technological civilizations (that don't directly colonize baryonic matter), we should find ourselves right in the middle of a such pulse — right during the moment of maximum expansion. The fact that the apparent transient equilibrium between accelerated and decelerated expansion took place just about in the middle of our universe's lifetime gives supporting evidence to the idea that our place in time is not completely random. [8] The third possible option is some kind of variable speed of light mechanism taking place. The fourth possibility is a sum of all other more exotic explanations.

Conclusion

This work establishes several connections between the direct product of the 26 sporadic groups and several cosmological parameters, most notably the diameter and mass of the observable universe at a specific moment in time — very close or identical to the currently measured diameter and mass of the observable universe. It is probable that the universe uses sporadic groups as some kind of distance/mass measuring mechanism. These connections might be accidental, though the closeness of these parameters makes a completely coincidental relationship fairly unlikely.

References

[1] Dirac Paul Adrien Maurice. 1938 A new basis for cosmology. Proc. R. Soc. Lond. A165199–208

[2] Funkhouser Scott
2008 A new large-number coincidence and a scaling law for the cosmological constant. Proc. R. Soc. A.4641345–1353

[3] J. D. Anderson, G. Schubert, V. Trimble and M. R. Feldman. "Measurements of Newton's gravitational constant and the length of day." EPL 110 (2015) 10002, doi:10.1209/0295-5075/110/10002

[4] Planck 2018 results. VI. Cosmological parameters, arXiv:1807.06209

[5] Robert A. Wilson, Possible uses of the binary icosahedral group in grand unified theories, arXiv:2109.06626

[6] Wesson, P.S. (2003). Is mass quantized. Modern Physics Letters A, 19, 1995-2000.

[7] McGaugh S., Lelli F., Schombert J., 2016, Physical Review Letters, 117, 201101

[8] Frieman, Joshua A.; Turner, Michael S.; Huterer, Dragan (2008). "Dark Energy and the Accelerating Universe". Annual Review of Astronomy and Astrophysics. 46 (1): 385–432. arXiv:0803.0982