

OCEANIC BLACK HOLE'S TOPOLOGIES

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Abstract

Recently Haller has published paper about oceanic black holes with Eddie currents. Although, there is some confusion created there about nature of black holes, and analog black holes, it still makes sense to use some fruitful ideas generated by Haller. We will employ analogy between our parity doubling paper and Haller's plots. Vast ideas of vortices turbulence, Eulerian vortices, coherent vortices - whirlpools, Lagrangian vortices and black holes are at work. We will use analog of their photon sphere - surface on which light encircles a black hole without entering it. We have found the relation between our Magnification effect and Haller's photon spheres to trace light and particle's trajectory in black hole's vicinity.

I. Introduction, and View "Through the SLAC Wine Glass"

Black holes (BH) are one of the most intriguing objects in nature, both theoretically and experimentally. Being predicted in 1916 by Karl Schwarzschild, until recently there has been no clear experimental evidence of the black holes [1]. Black holes are akin to the quarks – the major building blocks of matter. Although Zweig had predicted quarks in 1964, nobody has seen them materialize so far. Even more interesting, according to the existing theory of quantum chromodynamics (QCD), colored quarks have to be *confined* to some finite radius (~ 1 Fermi), so all the observable hadrons are white.

In the case of black holes there is a total analogy *in reverse*—event horizons, located at $R_{\bar{h}} = 2M$ (M is the black hole's mass). If some material point, a human being, space craft or even light rays fall through the horizon, it will never again come outside of the black hole, and will be totally destroyed by the gravitational forces. Now, the radius of the black hole strongly depends on its mass and could vary from the billions of solar masses M_{\odot} to the scale of the proton's mass (1 GeV) and even less for the so-called elementary or quantum black hole. Here, on the proton's mass scale (PMS), these two seemingly unrelated phenomena merge. At this *quark-hadron scale* of a proton's mass and *higher*, chiral symmetry breaking is *restored* and the vacuum does not feel the apparent existence of quark and gluon condensates, which spoil the chiral symmetry from the start (the mechanism of spontaneous breaking of the chiral symmetry, SBCS).

At the PMS there is a general mechanism, let's call it *Quark-Black Hole Confinement* (QBHC), which is responsible for the dynamics. It is based on the appearance of the *critical radius* of the 1 Fermi scale and the appropriate generalized dynamics – effective *gravito-strong interaction* (see Figure 1). In gravity plus *electromagnetism*, there is another interesting mechanism possible – radiation trapping just on the horizon's surface – the formation of the so-called *horizon geon* (HG) [2]. We can show how the HG confinement picture (*confinement of light*) intertwines with quark's confinement mechanism, creating QBHC.

All together, this brings us to the concept of *Quark-Black Hole Duality* (QBHD). Quark-gluon and black hole bags are *dual* to each other. Quark-gluon confinement which traps matter from breaking inside out is dual to the black hole confinement which traps everything coming from outside to the black hole's mouth. This rich concept of duality will help in practice to compute observables in *time-like* regions, knowing the physics in *space-like* region and vice versa, which is in accord with M.C. Escher's duality [3]. All this could be working in the world with more than 4D space-time dimensions.

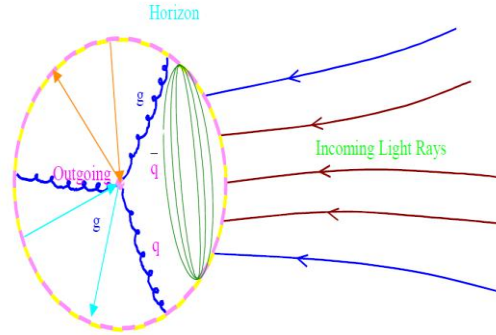


Fig.1 Quark - Black Hole Bag Duality

As we know very well, quark-gluon bags could be not only of spherical shape but cylindrical as well. This is well matched by a quark-black hole's self-consistent dynamics, leading to the different forms of black holes (even a *funnel shape* is possible). At this point let's return again to our quark-black hole bag. In considering these dual fields, the idea of *two scales* comes up naturally. We can divide all of the physics space into *two regions* – one is $0 < r < R_{\text{confinement}}$, and we term it *fast scale* (or short distance scale). The other is defined as $R_{\text{confinement}} < r < \infty$, and it is called *slow scale* (or large distances scale). In treating the dynamical problems, it is very convenient to separate the slow and fast degrees of freedom (Born-Oppenheimer approximation).

We can also draw a picture compatible with the following confinement scenario. From the Fig.1 one sees that the *horizon* is *dual* to the confinement boundary. This duality is performed via *lensing symmetry principle* [4]: quark's trajectories are trapped via horizon geon dynamics - they are "gliding" along the surface and are reflected back to the center. The boundary is acting as *reflecting* and *focusing* lens. Such a double boundary could have a different curvature – from almost *planar* hadron (high J), to the sphere, hyperboloid, etc: $q\bar{q}$ field lines are "closed" on the dual rays – as to be incoming to the black hole outside photons. Quarks are tracers and curled exactly on the quasi-shell $3M = R \sim R_{\text{conf}}$. This is exactly the mechanism realized in black hole "*knife-edge*" orbit. Evidently, the hadron became a *seashell*, closed on $R = 3M$ [5]. It will be a good idea to model a "*hadronic lenses*" which will give such regimes.

Einstein rings gave birth to the proper topology. The formation of multiple images of a single star work in favor of the *double-ring* idea. Einstein donut and diamond necklace created a double-radius topology. We see the diamond necklace in the center of the Einstein donut on the cover of the book [6]. As one can witness inside diamond necklace we see precisely the double-ring structure.

It is possible that the majority of hadrons can be *isomorphic* to the plane $2D$ structures, in a sense that all their major properties are described by the spherical or elliptical $2D$ -projection and this very *degeneracy* gives birth to the parity doublers. So, parity doubling is *synonymous* of the term degeneracy, and Escher gave an example of how one can establish $2D - 3D$ correspondence [3]. We see here again the road to the t'Hooft and Maldacena holographic model for HEP \rightarrow all the $3D$ properties could be inferred from the $2D$ domain (or *ring*) [7]. It will be a good idea to connect a *black hole's shells* with $R=2M$ and $R=3M$ with order of magnitude for radiuses R_1 and R_2 , which arises from DIS mechanism on k_t [8]. One can see that the Polyakov-t'Hooft (HP) monopole with winding number $N=1$ is *topologically equivalent* to the torus structure with internal rays \rightarrow which is exactly our double-radius hadron. The HP monopole with $N=1$ is also equivalent to our OZI seashell. The "ring structure" was recently discovered by Hubble for dark matter.

One can see how Haller picture [9] perfectly fit into our Quark-Black Hole Duality with funnel bags and expands into Goldman-Laughlin Island with fractional liquid of quarks (electrons). Photon spheres play role of our double horizon filled with Laughlin-Goldman liquid. Motion of light (quarks) through such a horizon shows Past \leftrightarrow Present Escher transitions [3]. If close enough particle comes in black hole orbit, it will "sneak" through the horizon and will never escape again, this is kind of backward confinement. Horizon geon will be formed here on surface. Haller light cone will merge with Gribov-

Rotenberg cones. *Light echoes* will help us to construct good trajectories of quarks and light around Inopin Holographic Ring (IHR) [10]. The best example is recent discovery of Tycho's Supernova light echoes by Subaru telescope in 2008.

Lensing universe merged with *quark - black holes* scenario via *Haller oceanic eddies* (see Fig.2). We have to prove mechanism, generalizing our paper [5], based on powerful inclusion of Haller deep-down model from ocean surface to floor. New *black hole singularity* is arising this way. Our notion of horizon will change a bit. We are introducing **Gravito - Liquid - Strong interactions** and web of *new Trialities* and set of *new Dualities*. We can choose such a new dual pairs -

Cosmic Universe <-----> *Ocean Ring*
Bottom Singularity <-----> *Cosmic Universe*
Ocean Ring <-----> *Bottom Singularity*

These dual pairs will hail new physics in it's own way. Now striking analogies come to our mind. We know the principle of strong gravitational lensing, where we can obtain "SLAC Wine Glasses" figures dynamically. One can see gross similarity between Haller-Inopin major topology and SLAC wine glasses. Another venue will be recent topological geons structure, which is basically Haller-Inopin creature rotated for about 90 degrees. Yet another Topology-like creature arised via Giant Bubble structures. Closing this Gallery will be recent double-pulsar, which can be born from Haller-Inopin structure, rotated for an arbitrary angle. What would be the general mechanism, explaining such an unusual set of events? It seems like a phase effect of some kind.

In our new *Supermembrane* plot we will use deep relations between long- and short-range interactions and appropriate order parameters. Strong, electromagnetic and gravitational forces have different ranges and deep symmetries which are spontaneously broken for the birth of new particles. Our membrane looks the same from all the directions. Constellation of ABC phase symmetries give a key, link to understanding all of these phenomena, because everything could be understood as motion of quasiparticles via some *loop* or *contour*. Light rays in transformation optics are curling very hard and finally focused into the bright ring-shell, exactly in accord with our Inopin-Laughlin-Goldman (GIL) interferometer scenario. Creation of 2,3,4 images from two Galaxies gives an extra opportunities to arrange Confinement solutions and extend the scope of our magnification effect [10].

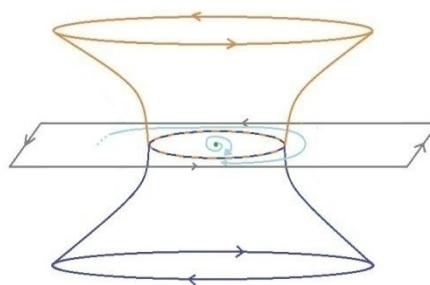


Fig.2 Haller-Inopin New Topological Creature and IHR

Let us now discuss what one can see at Fig.2. Two big flipped funnels going up and down from IHR. But at the center, literally corresponding to ocean surface, they are merged via IHR. All major physics is originated in IHR and going radial and orbital in plane and also up and down via funnels. This interrelation of high cosmic and down to Earth oceanic physics of black holes is a trademark of our model.

In the last few years there has been quite a development on fractional charges, fractional statistics, non-Abelian quantum Hall states, fractional quantum Hall effect (FQHE), topological quantum computation,

Berry phase, anyons, Aharonov-Bohm, Aharonov-Casher effect, etc. It is clear by now that all these notions and effects are the many facets of the one phenomenon, and we term it - "*Fractional Physics*" (FP). We also have discovered that fractional physics intertwines strongly with "fractal physics"- which is nothing more than physics of objects with "fractional dimensions". We will show that Laughlin quasiparticles in $2D$ interferometer are precisely analogous to the quarks with fractional charges in our $2D$ space (see V. Goldman, **PRB** v.72, 075342, 2005). It can be seen that our proposed holographic ring (IHR) is an exact map of the inner-outer ring of the $2D$ Laughlin interferometer. So the holographic ring is *dual* to the fractional physics.

In the framework of FP it is possible to conceive a "quarks gedanken interferometer" (QGI), which provides the possibility to extract fractional quarks' electrical charges, quark's color charge and correct statistics in $2D$ space. In this QGI we will have an outer-inner particles with different fractional charges, so from outer to inner circles and the center of island the effective quark's charge will diminish all the way to the center, becoming *zero* precisely at the center. So, we have shown a fundamental property of the non-Abelian gauge theory of the strong interaction via completely different mechanism - QGI with fractional physics. This whole new paradigm will give us an opportunity to show and prove fractional quark's confinement, which will be some kind of *phase effect*. One can also think of "meta hadrons" a la Dr. Veselago and arising of the *chiral superlensing* scenario for confinement.

Acknowledgement

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