A Softer Universe: Black Holes as Quark-Gluon Plasma Spheres

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Email Excerpt

… Thanks! That's a fascinating set of papers. I was amused to note that the bottom line of their much-improved black hole simulation goes something like this:

> *"To get models that match observations, we must insert and manually adjust a term — nominally 'friction' — that pushes energy outwards. However, despite labeling it 'friction,' the truth is we have no idea what that force is or what causes it."*

I've made some progress recently on new tools that should be relevant to black hole dynamics, the main one being the interpretation of rotating frames of reference as locally excited states of matter. Matter generates an associated spacetime at the local frame level instead of being "embedded" in an independent spacetime.

This "new phase of physics" (n-pop) rips Quantum Field Theory away from spacetime and attaches it to energy, even at levels as minute as single photons. By "energy," I mean the Pythagorean sum of rest-mass-energy (mc^2) and momentum energy (pc). That's the is the same quantity accelerator folks call $\sqrt{s}$.

If all the complexity of quantum field theory is attached to energy instead of the vacuum, it turns out energy is strikingly complicated. It means one photon's worth of energy contains not only the QFT "genome" for the entire Standard Model but also the rules for generating the space-like and time-like local frames in which the QFT fields fed enough energy express particles.

By detaching QFT particle genomics from its traditional textbook abode of an inexplicably pre-existing, omnipresent, and nominally (but not really) "empty" spacetime, n-pop instantly removes several frame paradoxes and energy inconsistencies that arise from attaching particle genomics to empty space.

It also just kind of makes sense. In biology, cells keep their genes with them. They do not scatter their genomes throughout spacetime in anticipation of needing it later at remote locations. So why shouldn't $\sqrt{s}$ — the energy used to create all particles — be similarly conservative and have its own set instead of hoping on spacetime?

N-pop erases even the possibility of spacetime singularities at the centers of black holes. Singularity thinking ignores that curving space requires not just space but energy. It's always the energy that does the curving, never the space.

The view that energy, not space, contains the genome for particles and spacetime profoundly impacts black hole theory. Based on LHC results, I now suspect that the event horizon of a black hole is not a portal at all. Instead, it becomes a quark-gluon plasma (QGP) shell at extraordinarily high Lorentz factors. The higher the Lorentz (γ) factor, the larger and colder the black hole becomes. The idea of an interior becomes a non sequitur due to the QGP devoting all of its frame definition resources to the quasi-2D event horizon

shell. Alternatively, you can think of the interior as a single unit of space magnified to stellar scales.

Why QGP? I suspect from some CERN Large Hadron Collider data I've seen (Lappi, Liu, others) that the QGP is where causal time breaks down into its three more momentum-like color-electric (or chromoelectric — both terms sometimes get used) components. In 2016 and earlier, Lappi et al. called these units momentum domains. I don't think Lappi et al. are ready to claim their color-electric domains are singular, grand-unified charges in which the electric (only) separates at lower energies and greater distances, but they're on the right track.

In my notes, I've called these momentum domain units "colours." The British "u" reminds me they are still "unified" with electric charge. The three colours are the mutually orthogonal unit vectors of a charge 3-space that includes both color and electric charge, so they are not the same as the angles that define the RGB colors and CMY anti-colors of the Standard Model. However, since each colour unit vector and anti-vector lies on one of the color angles of the Standard Model, it's hard not to associate them with Standard Model colors. Sometimes I call the six colours ijk and IJK to avoid that association.

In both LHC-created QGPs and black hole event horizons, time more-or-less breaks down into three momentum axes. In the LHC, these (Lappi et al.) "momentum domains" knock colour-charged quarks sideways to produce wider scatter cones than expected by theory. In contrast, Liu emphasized in 2020 that the electroweak particles — the gamma photon, $W^{\pm}$, and Z — slip through the QGP easily. I suspect that's because the electroweak particles combine their colours in charge space rather than in xyz space.

(That same xyz-vs-charge-space flip also, amusingly, makes the proton into a symmetry of the positron and the neutron into a symmetry of the anti-neutrino.)

In black holes, the extreme Lorentz values of event horizon QGP should max out this momentum-domain scattering effect to the point where the QGO always diverse incoming quarks sideways into orbit in the event horizon shell. Curiously, and assuming other factors do not override it, that may mean light (but not quarks) can enter the interior of the black hole. Perhaps black interiors are bright?

The LHC may eventually provide answers to such possibilities. In the much-mellower energies of n-pop, the LHC is already breaking down and exploring the structure of spacetime itself. For example, those "perfect fluid" QGPs are likely tiny fragments of black hole event horizons.

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