BLACKHOLE AND COSMOLOGY- sink as source

Prof. Suresh Kumar S Chief Scientist CSIR rtd,India

Abstract.

The paper argues that supermassive spinning black holes at Galaxy centers are spinning whirlpools which translate impulse energy acting towards blackhole centers as cosmological expansion energy and gravitational energy,one almost balancing the other.
The blackhole interiors are quantum entangled with spin coupled states high in mutual information,leading possibly to negative information,that can express as dark matter.
The cosmological fluids in blackhole interiors have quantum vortex flows and turbulence,so that the ergodic boundaries can cause negative temperature states,with dark energy like effects in blackhole interiors,prior to onset of turbulent vortex flows and ultrafast thermalization of event horizons,with coalescence of white hole like entities,associated with worm holes or ER bridges as Susskind equivalents of quantum entangled states.

Introduction.

There is now some observational evidence for black holes as supermassive entities,a few million to billion times the size of our Sun,in the interiors of galaxy centers.

Much of the mass in black holes is locked away in these supermassive ones at Galaxy centers,engulfing matter and energy from around and growing bigger.

They are also spinning at phenomenal velocities,at near relativistic values,so that ultra high angular momentum and impulse towards center is generated.

Curved and dynamical, spacetime responds to the motion of matter,as spectacularly confirmed by the discovery, via the LIGO/VIRGO collaboration, of gravitational waves coming from black hole collisions. This discovery also provides the best evidence for the existence of black holes.

Black holes are regions where the universe is collapsing. Our universe is generally expanding.In the interior of black holes, it is collapsing. The process that gave birth to the universe at the beginning of the Big Bang is reversed in the black hole interior,which can have wormhole geometries,associated with white hole like radiating high energy objects.

The boundary of the collapsing region is called a horizon,which can be entangled with the white hole,and other parts of the environment,so that galaxies could be tunnelling through spatial distances in blackhole interiors

The blackhole interiors and entanglement.

But black holes emit thermal radiation once quantum effects are taken into account. This is also possible even if a black hole is just made out of empty space,with vacuum energy,with empty space itself having a temperature. The thermal nature of black holes is related to the fact that black holes have a horizon which divides the vacuum into two regions: the exterior and the interior,such that an external observer has only access to the outside.

An interesting property of the vacuum in quantum field theory is that, though it is a single definite state, it cannot be split into single definite states locally,with coupled and quantum correlated nature of vacuum energy fluctuations,which causes quantum 'entanglement'.

When an observer stays outside a horizon, she is only observing part of the vacuum and that is the reason for its thermal nature. It is possible to quantify how much randomness, or entropy, is generated by the presence of the horizon.In an ordinary quantum system, the increase of entropy is only an approximate notion; it only arises because we are limited to doing only coarse measurements. The system evolves in a complicated way and we lose our ability to predict its behavior because of our limitations on the measurements we do.

There is possibility for supermassive black holes to have interiors which are entangled,so that there is a non local quantum mechanical nature,with entanglement entropy and information.

Supermassive black holes might look as separate entities at Galaxy centers with vast distances separating them,though quantum mechanically entangled through their interiors,due to concepts like worm holes,ER bridges as Susskind equivalents of entanglement,or thermofield theories,with sharing of interiors across vast distances,as if tunnelling through space.

In quantum physics there are two types of entropy. One of them is the precise ignorance that we have about the system. For example, we could have a qubit that entangled with another one outside our control. In this case we have some amount of ignorance that is irreducible. No matter how well we measure this qubit, we will not be able to determine its state. This is what we call 'fine grained' entropy. On the other hand, we could imagine that we have some set of qubits and we only decide to make coarse measurements. In this case there will be many states that can potentially reproduce our measurements. The number of such states is called the 'coarse grained' entropy. This is the entropy that increases under the second law. The fine grained entropy remains constant under evolution. So, the area of the horizon should be interpreted as a coarse grained entropy.

One notable development in black hole physics was a proposal, initially by Ryu and Takayanagi, and then by Hubeny, Rangamani and Takayanagi, of a geometric formula for the fine grained entropy. They proposed that this entropy is computed by the area of an extremal surface in spacetime. As expected, this area is smaller than the area of the horizon and it is a surface that

typically lies behind the horizon of the black hole. This is non-zero in cases where the interior of the black hole is geometrically connected to other universes or environment in general.

This has divided the interior of a black hole into
further regions. The region outside the horizon is the region where we can do measurements in an easy way. The region behind the horizon but outside the extremal surface can be probed by doing more complicated measurements, assuming we have complete control over the black hole degrees of freedom.

An interesting geometry that has been studied intensively in recent years is the full two-sided Schwarzschild geometry. This is actually the solution that Schwarzschild originally found more than a hundred years ago, but maximally analytically extended beyond its coordinate singularities. This was fully done only about fifty years later. But it was understood that it describes two black holes rather than one black hole. In other words, the solution contains two spacetime regions that can be viewed as black hole exteriors and one region that is the interior region, which is common to both black holes. This is a surprising solution in general relativity. If we had such a solution, we would have two objects looking like ordinary black holes from the outside, but they share a single interior.

The spatial distance between the two could be very large in the ambient space, but is very short through the interior. This type of geometry is sometimes called a ‘wormhole’. But it is a wormhole that cannot be crossed. It is a time dependent solution, describing a collapsing region of the universe. You can enter it but, once you enter, you cannot exit it on either of the two sides.

Now, we had said that we can think of a black hole as a quantum system with many degrees of freedom. How should we think about the full Schwarzschild wormhole? In 1976, Werner Israel suggested that it should be viewed as a kind of entangled state, one that arises naturally from a mathematical construction designed to simplify computations in thermal systems. In such cases, it is convenient to double the thermal system, introducing two copies of the original system and setting up an entangled state such that, when we restrict to measurements on one of the systems, then, from the point of view of that system, we have just a thermal state. These states are called ‘thermofield doubles’. This type of state can, in principle, be constructed for any system. In particular, it can be constructed for the quantum systems that describe black holes. In that case, we expect that the geometry would become connected.

Conclusion.

One can wonder how difficult it is to produce such a state. For some systems it does not appear complicated to find a state that is close enough to the thermofield double state. This can be done relatively easily for strongly interacting quantum systems that have some features in

common with certain black holes. For this reason, we expect that perhaps there is, at least in principle, some relatively easy way to do it with actual blackholes too.

The interest in this wormhole geometry arises because, in this system, the interior spacetime seems to be arising from entanglement. The worm hole geometry could possibly lead to a blackhole as a time reversed white hole like state,with a coalescence of event horizons as quantum critical external surfaces.

The angular momentum and the vortex flows with inward impulse energies could cause correlated states of quantum entanglement,with enhanced information storage in blackhole interiors,contributing to maximum aerial surface spread,commensurate with size .

The impulse energy acting towards blackhole centers in spinning ones with ultra high angular momentum due to whirlpool vortex action of blackhole interiors as cosmological quantum fluids could be tantamount approximately to energy values for each summed over the total,given the observational status from a distance.

Say for about a possible maximum number of supermassive blackholes,with average masses of 10^40 kgs,over a billion times the size of our Sun,the impulse energy acting towards center given whirlpool like vortex fluid flows in blackhole quantum interiors, with phenomenal angular momentum, would be in the range of 10^60-65 joules or say 10^70-72 ergs.

This corresponds to the approximate energy density for the universe,given its observed size,with its cosmological expansive energy being almost balanced by gravitational energy.

The black holes would thus act as spinning whirlpools of vortex flows of cosmological quantum fluids in blackhole interiors in entangled state for supermassive ones,though they are observed seperately located at galaxy centers,spanning huge distances in between.

The impulse energy due to angular momentum as spin energy of vortex whirlpools with central action is translated as cosmological constant or dark energy,matter and gravitational energy to balance the expansion to the extent observed.

The black holes are entropy sinks and information associated with mass and energy in the black holes are spun back to energy and mass and cosmological expansion with space time structure and gravity potential representing an evolutionary expression of the information.
Information has a non local quantum nature in blackhole interiors due to entanglement.

The blackhole interiors could be considered as equivalent to white holes connected to worm hole geometries,given a coalescence of blackhole and white hole event horizons,with possibilities for negative mass like effects given spin orbit coupling in quantum fluid vortex flows. There is thus a halo of high energy radiation flux in blackhole vicinities. The white hole acts as

energy and mass centers in a time reversed blackhole scenario for cosmological expansion and attractive gravity of matter and radiations,emanating from it.

The blackhole and white hole horizons can have a coupled status given the quantum mechanically entangled nature of blackhole interiors,and the special wormhole like geometry associated with Ireversed blackhole scenarios equivalent to white holes. There is a coexistence of time forward and time reversed scenarios in quantum critical domains of blackhole interiors.

The complexity of entangled information could indicate negative information states with spin coupled mutual information of quantum correlated entities in blackhole interiors as cosmological fluid vortex flows,having negative temperature states,in the regodic boundary prior to onset of turbulent vortex flows. This can account for dark energy like states,so that blackhole interiors can have behaviour like thermodynamic engines,contributing to fast thermalization of white hole horizon,giving rise to ultra high radiations in blackhole vicinities. The negative information states can simulate dark matter.

There are energy and matter flows from the blackhole interiors,with the dark energy as cosmological expansion potential countered almost equally by the gravitational potential,deriving from the impulse energies of blackhole interiors,as well as functionality as thermodynamic engines,leading to high energy radiation potential on event horizons. The negative information apparently appears as dark matter, the presence of which is highly fuzzy,and more inferred than possibly measured.

Thus,the blackhole as the entropy sink or end of universe is also the origin in its own time reversed double in its interiors ,quantum entangled with its own time reversed double and the environment through a special wormhole geometry as a sequel to spin correlated quantum vortex flows in blackhole interiors.