THE RELATIONSHIP BETWEEN THE ACTION OF BLACK HOLES AND SUPERNOVAS

By ARNOLD G. GULKO

Black holes are the most massive and most mysterious objects in the cosmos, and this writer considers them of great importance to the existence and character of the cosmos. Supernovas are the most powerful explosive releases of energy near us and are now considered to be the only observable event which might form a black hole. Despite the fact that black holes are formed by supernovas, astrophysics ignores the possibility that the actions of black holes and the supernova event might involve the same mechanism.

To consider the respective actions, we must establish the structure of a black hole, for we cannot consider how a black hole functions without understanding the structure of the hole. We must also consider the action of black holes in ejecting polar jets, for these jets and their formation is filled with mystery. Then we must consider the supernova event, for it also contains much that is confused. With these preliminaries in hand we must compare the formation and characteristics of the jets with the supernova event and its ejecta in order to ascertain the extent to which the two are the same or different. Lastly, we shall explain the common mechanism of action which this writer believes accounts for both the supernova event and the jets of black holes.

The Structure of Black Holes

In accepted theory, black holes form when a supernova leaves behind a collapsed matter core having a mass of at least 1.4 solar units, but all the black holes which have been found have a mass of at least about 5 solar units. While suns of various mass exist, the number of suns increases as their mass decreases, so the failure to find black holes of near the supposed minimum mass suggests the theory is wrong. Moreover, the pulsar in the Crab Nebula is a collapsed matter object having a mass of about 1.4 solar units, and despite this great mass it is a visible object slightly smaller than the District of Columbia.

The failure to find any black hole having close to the minimum mass calculated by accepted black hole theory suggests the structure of a black hole is not the singularity suggested by existing physics, for an extremely tiny size is necessary for a mass to provide a gravitational acceleration which equals light speed. In turn the failure of a black hole’s mass to be confined to a singularity suggests the capacity of the hole to prevent the escape of radiation is not a function of the presence of a gravity requiring an escape velocity greater than light speed. Instead the great mass of a black hole having a significant size suggested by its collapsed matter constitution reduces the pressure and density of the energy continuum filling space to such an extent as to prevent the propagation needed for the escape of radiation. This seemingly small change from accepted theory is important because it means particles can escape a black hole when appropriately propelled. This conclusion is supported by reference to a vacuum between two spaced-apart plates which would prevent the propagation of sound from one plate to the other. But while sound could not propagate in the evacuated space between the plates, a bullet can easily force its way from one plate to the other.

The Jets of Black Holes

To consider the action of black holes, these holes are well known to eject high speed narrow jets in opposite polar direction, so we must review the formation and character of these jets.

It is well recognized that black holes eject jets of particles which move at velocities which may approach light speed and which extend for enormous distances into space. These jets are extremely unusual for several reasons as discussed below.

The unusual characteristics of black hole jets

The jets under consideration are known to be oppositely directed twin jets which move at enormous velocity and remain narrow for vast distances. What would propel them away from the high gravity of a black hole or other collapsed matter object? Particle beams tend to spread out, especially when the particles in the beam are ions which repel one another. What would maintain these beams so narrow for so long a time? Astrophysics is bewildered by the high velocity and narrow nature of these jets. These jets ultimately spread out and form double-lobed regions in space.

More puzzling is the fact that these jets are gamma-ray active and so are the double-lobed regions in space which form when the jets finally spread out. Astrophysics today is particularly bewildered by the gamma-ray activity of these jets and does not even understand what is decaying to release these gamma rays. More particularly, these jets are not only known to emit substantial amounts of gamma radiation, but the number of black holes of solar mass and the density of this gamma radiation has recently been shown (via a 95 hour exposure) to provide a uniform gamma-ray background extending across the entire Milky Way galaxy. These jets thus contain a mass of particles some of which remain gamma-ray active for more than a million years when the jets finally spread out.

So these jets are quite mysterious. Astrophysics does not understand how the jets are expelled against the powerful gravity which is present, these jets are faster than makes sense, they should spread out immediately and don't, and they are gamma-ray active when there is no possible source of gamma radiation.

Astrophysics concludes that black holes have an event horizon. Once one passes through this event horizon on the way to the object forming the hole well-accepted theory (based on the object forming the hole being a singularity) insists it is impossible for anything to exit the hole for this would demand an exit velocity greater than light speed . The particles drawn in by gravity surround the hole to form relatively flat layer called an accretion disk. This disk is a large swirling region in which the velocity of the particles increases as they move closer to the hole and approach the center of the disk. As the particles gain velocity they are observed to emit X-rays as would be expected from their considerable speed.

The particles in the disk are thus gravitationally drawn toward the polar regions of the hole and when they reach these polar regions they are pulled downwardly toward the hole. This action is suggested by astrophysics to create intense friction and heat, and as a result the particles are suggested to somehow get supercharged and shot away in jets. It is true the particles are shot away in jets, but the conclusion that this is the result of the intense friction and heat to which the particles are subjected is unfounded speculation.

So matter swirls downward toward the object forming the hole while being accelerated inwardly by the hole's great gravity, but how does that matter get turned around to be ejected in high speed jets? It is obvious that the friction and heat generated by particles accelerated into the hole by gravity cannot cause particles moving rapidly in one direction to turn around and speed away in the opposite direction against the gravity which was drawing them into the hole.

So the ejection of particles from the accretion disk in the form of high speed polar jets presents a curious action which must be explained even though, on its face, the action is impossible if we rule out (as is done by modern astrophysics) some interaction between the incoming particles from the accretion disk and the substance of matter constituting the hole. The problem for astrophysics is their assumption (which astrophysicists are not allowed to rebut) that once the incoming particles have passed through the event horizon, they cannot possibly get out of the hole. So whatever turns the incoming particles around to expel them in a narrow jet at high velocity must act before the particles reach the event horizon, and nothing is present in that region to fulfil that function. Things become progressively more mysterious as we delve further into the character of the jets.

These jets are well known to be ejected in two opposite directions (normally perpendicular to the plane of the accretion disk). These opposite directions have been termed the polar regions of the hole. It is interesting to recall that the black hole of conventional astrophysics is a singularity having no significant size. The lack of size makes it curious for a black hole to possess polar regions, but the observed action of the accretion disk and the fact that jets are normally ejected in two opposite directions, each at a right angle to the plane of the accretion disk, make it clear the black hole possesses polar regions. Astrophysics concludes the black hole is rotating, and this writer agrees, though how a singularity might rotate and influence anything nearby to form a flat swirling mass of particles as a result of that rotation presents still another unexplained curiosity.

So the particles swirling in the accretion disk are rapidly drawn by gravity into the polar regions of the black holes, but observation of the accretion disk establishes that the particles in the disk are not gamma-ray active. How do particles drawn toward an object (but which never come within its event horizon) become gamma-ray active by merely being turned around, heated by friction, and ejected at high speed? We are not able to make stable particles gamma-ray active by merely speeding them in our laboratories on Earth, and we have no difficulty accelerating particles to close to light speed.

As a matter of interest, the first-discovered twin jet object (SS 433 which is close enough for careful observation), acquired material for its accretion disk from a nearby sun and the jets were found to include large amounts of un-ionized hydrogen. This astonished the investigators because the high temperature suggested by the high velocity of the jets should have eliminated the presence of any un-ionized atoms or molecules. This apparently impossible fact raises the question of how hot much of the material in the jets actually is?

The supernova explosion

We shall now consider the nature of supernovas so the curious aspects of supernovas can be compared with the formation and character of black hole jets.

When an aging sun of great mass explodes in a supernova event, the material at the outer portion of the sun implodes, and implosion is followed by the supernova explosion. This implosion has long been attributed to a reduced rate of hydrogen fusion in the solar core as the hydrogen content of that core is depleted. The depletion of hydrogen in the solar core is clearly correct as is the fact that this depletion will reduce the number of energy-releasing fusions in the core. However, the suggestion these action will produce an implosion which is a rapid and uncontrolled collapse (an implosion) is an obvious stretch.

The implosion is suggested to produce enough gravitational and other energy to reverse the inward motion and produce an enormous explosion, but this conclusion is also curious on its face, for the need for outer material to rapidly implode suggests an enormous release of energy would be needed to turn the imploding material around and eject it at considerable velocity.

The reduced fusion rate is suggested to cool the solar interior so it cannot maintain the sun's large size, and while this conclusion is correct it is supposed to be the source of the implosion. As will appear, both the implosion and the ensuing explosion present puzzles causing the above description of a supernova to make little sense when carefully considered.

It is conceded that as a sun ages the hydrogen in the solar core will be depleted, and with less hydrogen to provide energy by fusion the solar core will begin to cool. But as the solar interior begins to cool the sun must begin to contract. Contraction provides gravitational energy which will heat the contracting sun. So one should expect the sun will contract slowly as gravitational energy supplied by contraction replaces the reduced energy output in the solar core resulting from the reduced rate of hydrogen fusion in that core.

So while existing knowledge does suggest cooling of the solar core and contraction of the sun, it presents little which might cause the rapid and uncontrolled contraction which is an implosion. While the existence of an implosion is an established fact, it has no satisfactory explanation, much like the various facts surrounding the jet formation action of black holes.

The implosion event is supposed to create high speed impacts and incredibly high interior temperatures leading to the formation (by the fusion of lighter elements) of the heavy elements which are explosively spewed out into the surrounding space when the supernova explosion occurs. This also fails to make sense.

When rapidly moving nuclei of moderate mass violently impact one another in the laboratory, the usual result is the shattering of these nuclei. This is the opposite of fusion, so the formation of large amounts of heavy elements (as is the actual result) is not to be expected. Moreover, if the heavy elements were formed by fusion caused by impact, the action would be a rapid one taking place during the brief period of the implosion. A brief period of heavy element formation would provide little opportunity for capturing the large number of neutrons which characterize the heavy elements which are ejected. Moreover, fusion to produce heavy elements is endothermic (heat-absorbing), and exothermic actions are needed to provide the added energy needed to cause an explosion to follow the implosion. These facts regarding the implosion and the ensuing explosion suggest the supernova event is now based on theory which does not fit available knowledge.

It should now be evident that astrophysics must have had a hard time finding a mathematical model which might support their concept of the supernova event. No wonder physics had to work for about 20 years to assemble a mathematical model in which implosion was followed by explosion. In view of the broad perspectives and inconsistencies noted above, that mathematical model must be concluded to be extensively contrived and to possess little intrinsic merit.

Comparison of the formation and characteristics of the jets with the supernova event and its ejecta

When we consider the formation of the jets with the supernova event it is clear that several common facts are present, as will now be discussed.

In both actions the first thing which happens is that particles are gravitationally accelerated inwardly. With black holes the inward action is confined to polar regions while in the supernova implosion the inward motion is from every direction. Nonetheless, in both events particles from the outside are accelerated inwardly by gravity and in both instances the particles moving inward carry with them the energy provided by gravity. Second, in both actions the inwardly moving particles are not gamma-ray active. Third, in both actions the inwardly moving particles are turned around and propelled outwardly against the force of gravity which had accelerated them inward. Fourth, the outwardly moving particles include some which are gamma-ray active. Fifth, the outwardly moving particles appear to provide some sort of artificial gravity. Thus, the jets hold together and remain narrow when they ought to expand because high speed particles ionize to form positive nuclei which repel one another. The supernova ejecta tends to clump, an action which is more easily visible when viewing the shells of ordinary novas. Lastly, the jets ultimately spread out to form gamma-ray active regions in space. These gamma-ray active regions in space are so similar to the ejecta of a supernova that for many years they were mistaken for supernova remnants.

The large number of common actions set forth above intrinsically suggest the two actions under consideration have a common mechanism, but astrophysics does not recognize any such possibility.

This writer's explanation

This writer's theory, in line with existing theory, suggests the high temperature core of a normal sun progressively forms heavier and heavier nuclei as the hydrogen content in the solar core is reduced. It follows that the fusions which are involved must become progressively less exothermic as the average proton content of the nuclei increases. So as the core of the sun contains progressively heavier elements, the high temperature in the core enables endothermic fusions which cause the solar core to cool at a progressively greater rate as the proportion of heavy elements and their average mass increases. Especially at the start, this leads to a core which is cooling slowly and in which there is plenty of time for neutron capture (which is exothermic) and for fusion to form nuclei of progressively greater mass. This explains the high neutron content of the heavy elements which are ejected.

Nuclei are positively charged and will repel one another. So when smaller nuclei fuse to form heavier nuclei the cooling process becomes more rapid and, at the same time, the presence of fewer independent nuclei reduces the number of nuclei repelling each other which causes a reduction in size.

It is stressed that the described process starts slow because the contracting sun brings in gravitational energy to replace the energy consumed by a small number of endothermic fusions and because neutron capture supplies additional energy. At this point this writer believes the situation changes. As the solar core slowly cools and contracts the progressively heavier nuclei in the solar core are pushed together and the closer spacing forces the fusion process to become more rapid and to produce nuclei containing an enormous number of nucleons. This rapid action provides a core which cools rapidly at the same time that it rapidly becomes much smaller due to the reduced number of separate nuclei. It is this combination of rapid cooling and rapid contraction of the core which forces the observed implosion to finally make sense.

So we now have a realistic basis for the implosion which leads to a supernova. But the implosion produced as described produces very different actions than were previously attributed to it. The implosion was previously supposed to cause fusion to produce the heavy elements. But it should be evident that extensive fusion to increase the mass of nuclei in the solar core took place prior to implosion. The heavy elements which are ejected are instead formed when the collapsed matter at the surface of the solar core is fragmented by the gravitational energy brought in by the imploding normal matter.

It is important to stress that the supernova ejecta is filled with heavy elements having a high neutron content. This is itself well known. But if those heavy elements were formed by the fusion of lighter elements, then one encounters a serious inconsistency with established fact. The light elements contain more neutrons than protons in their nuclei, but the number of neutrons in excess of the number of protons is small. The heavy elements in the supernova ejecta contain far more neutrons than is supplied by the fusion of the lighter elements. One cannot simply assume these additional neutrons were captured somehow during the brief period of the implosion when there is no satisfactory explanation of how so many of them might have been rapidly captured by the heavy elements which are ejected.

It follows that the heavy elements in the supernova ejecta cannot have been formed by the fusion of lighter elements, and must instead have been formed by the fragmentation of the collapsed matter at the surface of the solar core by contact with the incoming material resulting from implosion. This means that the formation of a collapsed matter core prior to the implosion not only produced the implosion, but fission of the material at the surface of that collapsed matter core provided the heavy elements in the supernova ejecta. Fragmentation causes the collapsed matter at the surface of the collapsed core to expand enormously (many smaller nuclei occupy enormously more space than a few nuclei of enormous mass), releasing energy as it expands (just as great energy is released when heavy elements fission).

So we have an enormous and rapid expansion combined with the energy released by fragmentation, and this combination of events creates the observed supernova explosion. This explosion throws out into the surrounding space the material which imploded together with the heavy nuclear fragments which have a high neutron content acquired before the implosion took place. The explosion also leaves behind a small collapsed matter object which, if it has enough mass, forms a black hole.

Now that we understand the mechanism of a supernova event, we can compare the supernova event with the jet action of black holes.

Comparing the supernova action with the jet action of black holes

Let us first consider the capacity of the polar jets to include gamma-ray active particles which were not present in the accretion disk which supplied particles to the jets. The radioactivity of the jets and the double-lobed regions of space which they ultimately form are gamma-ray active, and this is very like the gamma-ray activity provided by the ejecta of a supernova. Indeed, these gamma-ray active regions in space were considered by astrophysics for many years (before twin jet objects were discovered) to be supernova remnants. Turning from the jets to the supernova event, it is stressed that the particles near the outer surface of an imploding sun are not gamma-ray active, but the ejecta formed by the inward motion of the outer portions of the sun which are turned around and ejected by the supernova include gamma-ray active particles.

So the two actions under consideration are the same where they are both mysterious. More particularly, the turn around against the force of gravity, the resulting forceful ejection of what had been moving inwardly, and the presence of gamma-ray active material in the outwardly moving ejecta are all exactly the same for both the supernova event and the jets ejected by black holes. These common aspects of the two events cry out for a common mechanism to account for both, especially where astrophysics has failed to give us a plausible mechanism for either.

The writer's explanation

Let us start by considering the narrow nature of the jets and the fact that these remain narrow for long periods of time even though the presence of high energy particles which must ultimately ionize should cause the jets to expand.

The collapsed matter in a neutron star or black hole is like that which this writer has explained is formed in the core of a sun and which causes that sun to implode. That this is so is suggested by the fact that it is the dense core of the sun which the supernova leaves behind and which provides the black hole when the core is sufficiently massive.

What should happen to the collapsed matter formed by endothermic fusion when gravitational energy is brought in? One would expect this added energy would replace the energy lost in the endothermic fusion which formed the collapsed matter and thus fragment the collapsed matter. Fragmentation provides many nuclei which enormously expand the space which is occupied. Also, and like the action which takes place when uranium fissions, considerable energy should be released when fragmentation takes place.

Some of the nuclear fragments produced by fragmentation of the matter at the surface of the collapsed matter core can be expected to be incompletely expanded and to slowly absorb energy from the surrounding space. Absorption of energy should produce an artificial gravity which attracts everything toward the low pressure established by the absorption. In an ordinary nova (where the ejecta is thinner than in a supernova which enhances observation) one can see the clumping action in the shells produced by the absorption of energy under consideration which varies from place to place within these shells. In a polar jet energy absorption produces a low energy pressure within the jets which provides an artificial gravity causing the particles at the outside of the jet to encounter a higher pressure remote from the axis of the jet. This pressure gradient pushes the particles toward the center of the jet - and this explains how it remains narrow. This is the same gravitational action which accelerates any particle in a pressure gradient toward low pressure.

As these incompletely expanded fragments continue their expansion they will fragment and add gamma-ray active material to the jets long after the jets were formed. This enable us to understand how the material in the jets can continue to emit gamma-radiation long after the jets have come into existence.

This brings us to the question of why the black hole jets are high speed and narrow while the supernova explosion throws out material in every direction at a much lower velocity.

Turning to the formation of the black hole jets, when the particles drawn into the hole reach the collapsed matter object within the hole and which is spinning rapidly, we find that the object is expanded at its equatorial region and drawn in at its polar regions, exactly as here on Earth as a result of its rotation. The greater gravity at the poles causes particles coming onto the collapsed matter object to concentrate at the poles because that is where they are arriving and because gravity is greater in those regions. So the gravitational energy arriving with the drawn in particles is concentrated in the polar regions and the resulting fragmentation of the surface material forms axial holes at the poles.

When additional particles are drawn into the polar regions of the black hole, they fall into the previously formed axial holes where they cause fragmentation of the material lining these holes. This forces the enormous expansion caused by fragmentation and the energy released by fragmentation to be concentrated within these polar holes. The result is the particles from the accretion disk together with the nuclear fragments released from the surface of the polar holes are both concentrated within these holes and are ejected at high speed, like bullets from a rifle, in the form of a narrow jet.

In contrast, in a supernova the entire outer material of the sun strikes the entire surface of the collapsed matter object in the solar core and the progressive action needed to form polar holes is not present. This forces the explosion to spread out over the entire surface of the collapsed matter object so the rifle effect which forms high speed narrow jets is not present and the velocity of the ejecta is moderated.

We now see how it is that the supernova ejecta moves away from the supernova in all directions at moderate velocity, while the black hole ejects material at far greater speed as a narrow jet extending in a polar direction.

Those desiring a wider ranging discussion of this subject will find it in this writer's texts and, more recently, in an article by this writer in *Infinite Energy* magazine issue No. 79 (2008) at pages 48-57.

October 18, 2008