The Highly Collimated Jet Stream of Quasars

Abstract: Basic facts common to quasars:

(1) Highly compact both in mass and energy,
(2) Having a supermassive material center,
(3) Excluding the material center, the general existence of mass is in a state of plasma,
(4) Rapidly spinning,
(5) Periodical variation in luminosity,
(6) Highly remotely located from Earth with high value of redshift.

In addition to the above common facts, a high percentage of quasars are also found containing jet streams. The strange thing is that the jet always comes in a set, with one from the set pointing in the opposite direction of the other, and both jets are highly collimated.

As a rule of thumb, the higher the energy content is found in any physical entity, the higher chance of randomness is associated with this entity. Qualitatively, this view can be described through a system's entropy S, which is written as $S = K_B ln\Omega$, where K_B is the Boltzmann's constant, and Ω is the total possible microscopic states of the system, or the internal chaos of the thermodynamic system in interest. We know that S is a quantity carrying the dimension of energy divided by temperature, and so does Boltzmann's constant. When the temperature dimension on both sides of the equation $S = K_B ln\Omega$ cancels each other, what is left to us is a mathematical relationship telling us how energy on one side of the equation is matched by the chaos, i.e. the randomness, shown as Ω on the other side of the same equation. Special filtering mechanism must be presented for orderly output of anything to come out of an entity consisted of chaos. So, for those quasars with the extraordinary energy density that we know of, what special filtering mechanism could be there for their jet stream pair to have formed and been staying so highly collimated?

In modern science, when high energy and high speed are involved, it has been so natural for many people to apply Einstein's Theory of Relativity to explain many puzzles that classic physics seemingly appears to them incompetent in explaining. As such, when superluminal movement are observed with the jet streams from the group of quasars, called blazars, many physicists conclude it as an illusion, an effect enabled by what is taught by special relativity. Then, what if relativity is proven invalid, and the invalidity is proven led to by its own self-refutation?

If relativity must lead us to explain the superluminal movement born with the blazars as **Illusion,** it should first clear itself from how it has implicitly forced only one speed value ***v=0*** between all inertial frames that relativity devises for its mathematical study. When such implicit value is proven exclusively unique and indisputably existing in relativity's calculation, relativity must be further responsible another disastrous outcome brought up by its own calculation, which is ***c=0*** for the speed of light. No more elaboration is needed regarding the invalidity of relativity if ***c=0*** is inevitably led to by relativity itself. The main body of this article will further present to the readers the corresponding argument.

Obviously, then, nature and relativity cannot tolerate each other! This then must potentially leave us room to accept that superliminal movement is a material fact in nature.

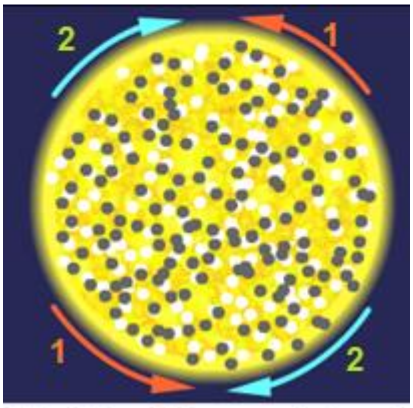
Key Words plasma, spinning, electric field, magnetic field, neutron core, superluminal movement, relativity

Material Distribution in a Quasar Disk The typical characteristics of a quasar include huge quantity of mass, extraordinary high rate of self-spinning, intensive heat and illumination, and having jet streams pointing away from it along the spinning axis of the quasar. The intensity of the heat and illumination alternates periodically. The heat and illumination from them can be so intense that, for example, a quasar named 3C 273 is said to shine in the sky as brightly as our Sun if it is placed at 33 light-years from us.

It may be considered controversial as to how the quasars to have obtained their power, both kinetic and electromagnetic, to begin each of their lives, nonetheless scientists all accept that the major substance state within the quasar is of hot plasma.

Rapid self-spinning is an inevitable consideration if no one can reject that the birth of a quasar is a result of some off-center collision between some huge quantities of mass. To give support to this speculation, many theories suggest that the Andromeda Galaxy and our own Milky Way Galaxy could collide and form a quasar someday in the remote future. If this becomes fact, a new and huge material formation inheriting a formidable residual angular momentum must be the result; its self-spinning shall be extraordinary. Let's simply imagine what amount of gravitational energy these two galaxies could contribute to the collision when their rectilinear movement must subsequently end at said collision; if the materials from both galaxies contract into a small conglomeration due to the overall elevation of gravitational force after the collision, the new formation so raised must spin at high angular velocity.

In a plasma, all subatomic elementary particles, being in a charge state or neutral, just move in a 'lawless" manner, declining any summoning for forming steady association from any others (Fig. 01). As to protons, with their pronounced mass as well as positive charge, they are potentially designated to concentrate at the outskirts of the spinning bulk as much as possible by two forces: Force one is the centrifugal force produced out of the spinning; force two is their own electrical repelling force they exert on each other. However, whether or not they would finally occupy that area would also be determined by another force: magnetic force. We will elaborate this further a little later.



The disk could have spun in the red direction (1) or the green direction (2)

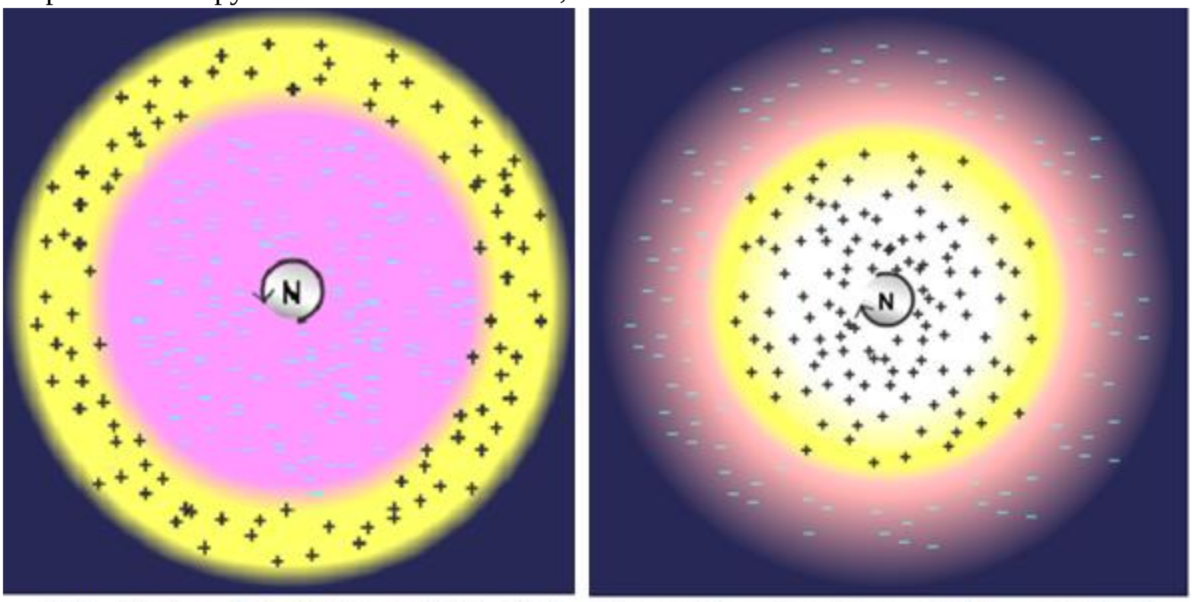
White Particles = Protons;
Dark Particles = Neutrons

Fig. 01 A Quasar Disk at Its Early Stage

Lacking the electrical repelling force, but with mass compatible to that of protons, neutrons stealthily move toward the central region of the spinning bulk. The sinking movement may be slow at the beginning, but gravitational principle would sooner or later accelerate this process, because few of them have an opportunity to get closer than others and to come together subsequently forming small gatherings here and there. As such, tiny gathering of neutrons gradually increases its population across the entire plasma. Some gravitational predators would eventually come into shape and accelerate the aggregation processing until only one can exist and rein itself at the center of the plasma, or the quasar disk.

Lacking a repelling force between each neutron member, which grants the gravitational force an opportunity to dominate, is not the only reason for the neutron aggregate to become highly compact. Observation tells us that all neutron stars carry strong magnetism. Although the reason why neutron stars carry strong magnetism is not yet clear, the magnetism so unexceptionally carried by all of them, however, would tell us that any formation rich of neurons must be some potential candidate of magnetic body. Driven by the magnetic force, all the members in the aggregate must clench each other as much as possible. At the very early age of the quasar, when both the protons and the neutrons are spread across and thus share the same area, the bulk of protons and the bulk of the neutrons must also share about the same magnitude of angular momentum of the entire quasar. However, gradually the bulk of neutrons sinks into a small aggregate and become a core body at the center of the quasar. The original momentum possessed by the entire neutron bulk must now enable the small core to spin at a rate far above that of the bulk of the protons, which is the major material occupier of the far spread disk. In other words, the spinning revolution rate between the neutron core and the material bulk spreading away from the core are contrastingly different from each other.

Electrons, as an entire bulk of substance, may have two ranges in the disk for them to reside. If, as we mentioned above, the dynamic situation of the quasar disk happens to have the protons occupy the outskirt of the disk, the electrons will be located in and around the



"+" = Protons; "—" = Electrons; "N" = Neutron Core. Viewer is stationary with the outskirt of the disk but directly faces the North pole of the magnetic field generated by the neutron core.

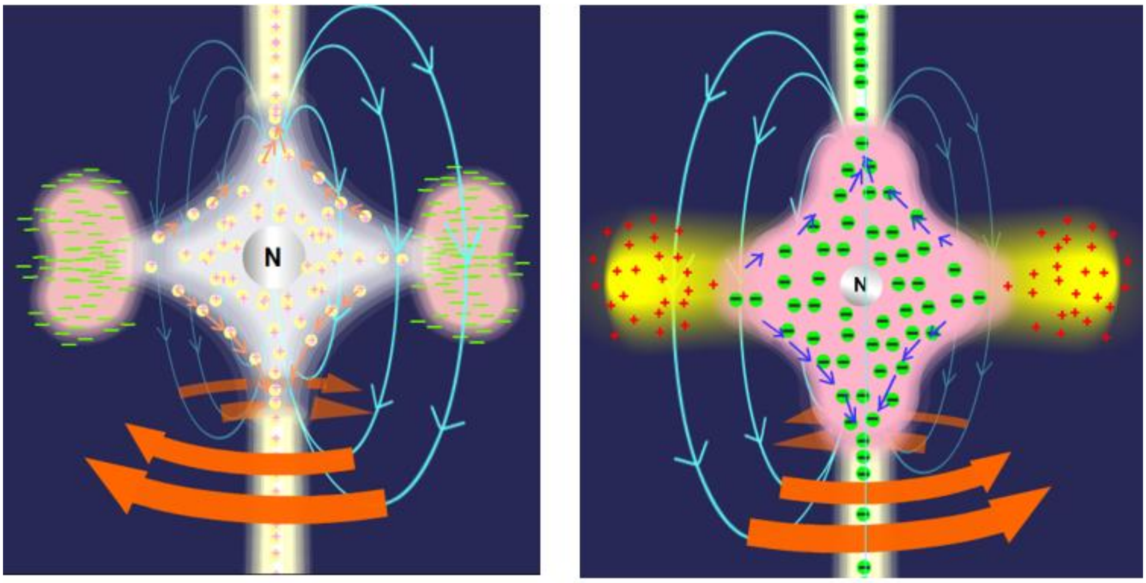
!!! Different rotation direction of the core causes different distribution of the charge particles !!!

Fig.02 Bird's Eyeview on a Quasar Disk

central region of the disk. If the dynamic situation of the quasar disk had designated the protons to stay about the central region, the electrons will take the outskirt. Which of these two types of mass distribution would prevail is solely determined by one dynamic factor: The spinning direction of the neutron core that must have carried a strong magnetism.

With all that is illustrated above, an observer stationary to the outskirt of the quasar disk can have two different dynamical views in his observation, depending on which spinning direction of the neutron core appears in his detection. Fig. 02 would tell him that he may have detected either clockwise or counterclockwise direction for the neutron core if he takes a bird's eye-view on the disk while facing the north magnetic pole of the neutron core. If, for example, the neutron core spins in a counterclockwise direction, as shown in the left diagram in Fig. 02, the magnetic flux from the core will herd all the positive charge particles, majorly protons, to go far away from the core and thus stay at the outskirt of the quasar disk. Likewise, electrons are herded to stay in the central region about the core by the same flux. If the core is found to spin in opposite direction, the protons and electrons will change their residing locations.

Formation of the Jet Streams In the upcoming paragraphs, the illustration focuses on one dynamical situation: The spinning of the core has caused the central region to be the place where the major bulk of protons is found, while the electrons stay at the outskirt of the disk. So, naturally in such situation, the central region of the quasar can only be an electrical field of exceedingly strong positive potential. Any positively charged particle entering this region would be compelled to move along a designated direction by two forces: (1) electrical repelling force and (2) electromagnetic force. While force (1) should result in an isotropic scattering movement, force (2) would decline any scattering movement but confine all particles to move along the axis of the magnetic field as much as possible. Both forces working together then compel the particles to leave the disk with high speed but at a definite direction; a jet stream is thus constructed. The force for the positive particles to leave the disk is so strong that no gravitational force can ever hinder their movement. Force (2), being produced by a



The direction of a spinning magnetic field has not only caused different material distribution in a quasar disk, but it has also inevitably caused different substance to form the jet streams

Fig. 03 The Formation of Jet Streams

spinning magnetic field, causes a helix path to appear in the jet for the movement of the protons. With the same reason that one jet stream can be constructed on one side of the disk, another jet must also be constructed on another side of the disk. This is why jet streams always appear in pair for the quasars.

With more protons or other positive particles having departed from the quasar, nothing else can play the role to retain the excessive electrons to continue staying with the disk; they must evaporate from the quasar under their own mutual repelling force in addition to the expelling force generated by the spinning magnetic field. The more positive particles that have left through the jet, the more electrons will subsequently vaporize. Gradually, more and more loss of mass will bring the quasar to meet its day of disappearance, leaving only its neutron core, namely, a neutron star, to witness the historical location of the bygone quasar.

In a likewise manner, but with opposite spinning direction of a quasar's core with respect to an observer stationary to the outskirt, it would be the electrons that have been "jailed" in the central region of the quasar disk and to form the jet stream as shown in the diagram on the right of Fig. 03; protons are now located at the outskirt.

Overall, that the axial line of a magnetic field is where the strongest magnetic force is found is the reason for the jet stream being so highly collimated, regardless of whether the particles forming the jet are of positive or negative charge.

Alternating luminosity As the plasma rapidly spins, the protons, or other positive particles, must oscillate between two distances with respect to the neutron core. They are either moving closer and closer to the core or farther and farther away from it. Generally, they tend to move toward the core because of the overall gravitational pull of the entire quasar; the neutron core always exerts its pronounced gravitational influence on all materials at its vicinity as well. When the protons are too close, however, the electrical repelling force between each of them increases, and the centrifugal force on them also increases due to excessive angular momentum for an ever shortening spinning radius. When these two forces reach certain magnitude, the bulk of protons must begin to push all elementary members to get away from each other; the bulk then expands its territory. When the members get too far away, their rotation about the core slows down and the distance between each particle increases. Subsequently, the centrifugal force is reduced and their mutual electrical repelling force is weakened. Then the gravitational force once again dominates their movement, pulling them back toward the center. This back and forth moving pattern of protons must be persistent and will not lose itself no matter whether the protons have occupied the outskirt or the central region of the quasar disk to start the oscillation. Of course, whether the protons have occupied the central region or the outskirt to begin the oscillation will cause a different amplitude as well as different extremes of the amplitude with respect to the center of the quasar for the oscillation.

The aforementioned oscillation causes the periodical alternation of a quasar's brightness. The closer the material members of the plasma get to each other, the more illumination of the quasar is concentrated at a smaller area, making the quasar appear brighter, and conversely, dimmer during the period of expansion as the same amount of illumination being diluted in a bigger area.

As of today, about 200,000 quasars are detected at distance of billions of light-years from us. Given the remote distance they are from us, the reason they can show up in our observation is because of their extraordinary power output. The power of some of them, called blazars, are so strong that superluminal motions of the jet materials are seemingly displayed in our observation. It is due to relativity that such superluminal motion is declined to be accepted as a reality, but instead, explained as an illusion.

The so called illusion concluded with relativity mainly relies on two concepts: relativistic aberration and relativistic beaming. Unfortunately, aberration as a conceptual understanding was misled ever since James Bradly propose his explanation in 1727, and this erroneous explanation was further "confirmed" and exploited by Einstein's relativity. To redress how stellar aberration should be re-examined needs many pages of analysis. For this purpose, a reader is cordially invited to visit http://huntune.net/the-self-ruined-relativity.html —>> **3. Relativity Is Self-defeated (3 of 3)—***Lorentz Factor, Aberration, and Ether* (19 pages). As to the relativistic beaming, if special relativity is shown being self-refuted in calculation, and thus time-dilation is an invalid concept, this so called relativistic beaming concept would inevitably thaw itself. To see how relativity is self-refuted in calculation, please refer to http://huntune.net/the-self-ruined-relativity.html—>>**1. Relativity Is Self-defeated (1 of 3)—***in Terms of Mathematics* (6 pages). Of course, the "illusion" explanation must depend on another concept which claims that the material nature of light is photon. Hope that the two papers aforementioned above would lead to a peek at how a concept of Aether should be more creditable than photon in illustrating the behavior and material nature of light. As a topic outside of this paper, please allow this author to mention that Aether is a substance no one can deny its existence, and that Aether is the source of all forces we find in the nature, from gravitational force, to electromagnetic force, to nuclear force... This author would put up a paper with detailed illustration concerning this substance in about Aug. 2018.

Energy Source of Superluminal Movements According to documents, quasars usually appear not much bigger than the solar system, which can have a radius as large as 30 AU (Neptune's mean orbital radius). It then means that some electrical charge in the quasar disk can have an opportunity of being at a distance of 30 AU away from the neutron core. When it is swept toward the neutron core by the spinning magnetic field, it has a path of 30 AU to gain and accumulate kinetic energy during the movement toward the axial line of the ever escalating magnetic field. This field is not only a strong one by any measure, but also rapidly spins with a rate, i.e. the spinning rate of the neutron core, in the order of several hundred turns per second for many of the quasars. When this particle is finally delivered near the axial line of the magnetic field and then expelled as part of the jet stream, the huge energy it has ever so accumulated must now propel this charge particle to move with extraordinary speed.

Let's qualitatively examine some moving potentials that observations have been offering us so far. The energy $\boldsymbol{E}$ that a charge particle $\boldsymbol{q}$ can acquire from the movement of a magnetic field of strength $\boldsymbol{B}$ is

$$E = \int_a^b F \cdot dR = \int_a^b qvB \cdot dR \qquad (Eq.\ 1)$$

In (Eq. 1), dR is the distance element of the entire moving path R of the charge. $\boldsymbol{R}$ covers a distance from point $\boldsymbol{a}$ to point $\boldsymbol{b}$, where $\boldsymbol{a}$ can be as large as 30 AU suggested by observation and $\boldsymbol{b}$ can be any infinitesimally small value. Besides 30 AU being a formidable distance in the equation for a charge to be accelerated, speed v in the equation can be another astounding figure. This speed v, which is tangential to $\boldsymbol{R}$, is the relative speed between the moving magnetic flux and the charge particle. Let's assume the relative difference of the angular velocity between the neutron core and the material bulk of the disk to be 400 revolutions/second. At 30 AU, the linear speed v matching this angular velocity will be $1.13 \times 10^{13} km/second$, a value in front of which the speed of light is absolutely dwarfed. When $\boldsymbol{E}$ is obtained with all these extraordinary figures and converted to kinetic energy according to $E = \frac{1}{2}mV^2$, where V is the velocity for the charge particle pointing directly at the center of the quasar, can we imagine what value V can reach? It is equipped with this energy that the charge particle is found riding on the jet and leaving the quasar disk! It is with the speed enabled by this magnitude of energy that a jet stream takes good care of its collimation because particles of the same electrical charge moving in the same direction must keep their traveling path staying together; the higher the speed, the longer the parallelism will survive. This is why blazars can shows collimated jets of millions of light years long.

Of course, the understanding of (Eq. 1) actually needs to be restricted by two more considerations. (1) We cannot be certain whether the assumed figure of 30AU is the dimension covering the area including even the most outskirt of the disk or just the "ball" of the same charge hovering about the neutron core. But even if 30 AU is for the entire quasar disk while only 20 AU is for the ball of the same charge, such huge ball of the same charge is an astonishing phenomenon to be comprehended with our daily experience obtained on Earth. (2) The relative tangential speed $1.13 \times 10^{13} km/second$ between the magnetic flux and the charge particle at 30 AU distance should not be a value obtained as straightforwardly as we have shown. Because of the manner of propagation of electromagnetic waves, the angular speed of the flux corresponding to the revolution rate of the neutron core but at a distance 30 AU away from the core must be substantially lagging behind, and the corresponding linear speed is then substantially lower than $1.13 \times 10^{13} km/second$. However, further discussion on the nature of propagation of electromagnetic waves is not in the scope of this paper. Therefore the quantitative discussion on (Eq. 1) with precise detail is unable to be explored in this paper. However, the qualitative conjecture based on all these possibilities presented so far should have made us feel difficult not to accept the superluminal movements as a material fact; neither can any theory prevent us from accepting it as material fact.

In the above discussion, we use 400 revolution/second as an assumed figure to illustrate the relative spinning movement between the neutron core and an observer staying at the outskirt of the quasar disk. That this is can be so assumed is based on that neutron stars are all rapidly spinning. For example, the fastest-spinning neutron star known as PSR J1748-2446ad is spinning at a rate of 716 times a second. This easily leads us to a conjecture that when these neutron stars still served as the neutron core of so many bygone quasars in the old days, they should have been spinning at far higher rate with respect to the inertial frame we human beings are riding on. However, through a long history of ejecting so much material into the space via jets streams, the spinning energy of each neutron core was dramatically dissipated, because the neutron core's spinning is the only source of kinetic energy to support the material ejecting. So, the "716 times a second" is actually a baby figure left behind by a previous spinning core.

Reference

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