The Cosmic Gamma-Ray Halo – New Imperative for a Dialectical Perspective of the Universe

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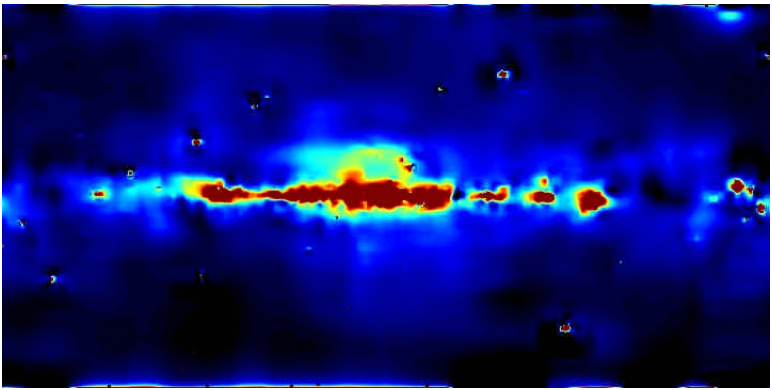
From the galaxies to man, natural science has so far sketched in the main outline an evolutionary picture of nature that is mediated by chance and necessity. Cosmic gamma-ray halo and the other observed cosmological phenomena must therefore, be viewed as the manifestation of the same evolutionary process of nature.

Keywords: Gamma ray halo, "Big Bang" theory, dialectical perspective.

Introduction

A halo of gamma-rays originating in and surrounding the Milky Way galaxy extends into outer space. D. Dixon and co-workers reported this finding in a meeting of the High Energy Astrophysics Division of the American Astronomical Society, held on Nov. 4, 1997, at Estes Park, Colorado. This discovery (1) along with few other cosmological



The Milky Way's Gamma-Ray Halo (Dixon et al.)

phenomena such as the cosmic microwave background radiation, the accelerated expansion of the universe, quasars etc., comprise the observational base, which any theory of cosmology has to contend with.

The existence of a gamma-ray halo surrounding Milky Way galaxy (and possibly other galaxies as well) is a unique astronomical observation in the sense that it cannot be attributed to a past event in the universe such as the "Big Bang" or to a compact source in the galaxy. This phenomenon must then be an ongoing *process* occurring at present throughout the *whol*e Milky Way galaxy.

There are at least three distinct cosmic gamma ray sources a) the known (and generally accounted for) sources at the galactic centres, b) the diffuse gamma ray source occurring at large distances from the galactic core, and c) random gamma ray bursts (GRBs).

In this false colour all-sky gamma ray image (by Dixon et al) of the Milky Way shown above, the brown and green regions indicate brighter, known sources of gamma rays. The galactic centre and plane are clearly outlined, as are some distant galaxies seen near the top and

bottom of the picture. The dim, blue regions above and below the plane correspond to the unexpected gamma-ray halo. According to Dixon et al. these gamma ray halo provides the first evidence that some sort of high-energy process is occurring at large distances from the galactic core. These processes probably also occur at the galactic core in addition to the known more dominant processes for generating gamma rays.

Gamma ray bursts are short (~10 ms to ~100s) random flashes of gamma rays at cosmological distances. Most of their energy is emitted around 1 MeV, with only a small fraction in the X-ray band. According to the "fireball" model, GRBs are generated by very high-energy electrons and positrons produced in an initial explosion [2]. The most probable value of the peak energy of (redshift-corrected) GRB emission in the rest frame is reported to be very close to the electron-positron pair rest mass of 1022 keV [3].

Explanations of the diffuse extragalactic halo based on the currently accepted "Big Bang" paradigm, that the gamma-ray halo supposedly have its origin in the mysterious "dark matter" or in rapidly spinning neutron stars or is due to the interaction of cosmic rays with lower energy photons from the galaxy (an inverse Compton effect) are only after-thoughts.

According to the "Big Bang" theory, the universe was created about 15 billion years ago through a cataclysmic explosion. Space-time, matter and all that exists in the universe emerged from a primordial entity about the size of a proton through this single event and it is expanding ever since. The discovery by Edwin Hubble that the galaxies are receding from one another, the observation of a residual microwave background radiation and the relative abundance of low mass chemical elements such as hydrogen, helium etc. are in accordance with the "Big Bang" theory. This is presently the only

viable theory of the universe and is purported to follow from the General Theory of Relativity propounded by Albert Einstein in 1915.

Philosophical Implications

The "Big Bang" hypothesis, as well as the General Theory of Relativity is based on a line of thought which G.W.F.Hegel termed *Metaphysical* or the view of *understanding,* as opposed to his *dialectics* or the view of *reason*. *Understanding* views the world as a complex of ready-made *things* "created at one stroke" and "perfect in themselves". Nature in this view is essentially deterministic and a product of cause and effect, necessarily requiring a "first cause" or a creator; it has extension in space and only undergoes cyclic changes (if there are changes at all) but has no successive stages of *development* in time. *Dialectics* or *reason* on the contrary insists that the world must be comprehended as a complex of *processes* in which things go through an uninterrupted change of "coming into being and passing out of existence" brought about by an interplay of chance and necessity and that they develop in successive stages. This distinction first came into sharp focus in natural science in the difference of views of Isaac Newton and Immanuel Kant about the cosmos. Through his theory of "cosmic evolution" Kant pointed to the dialectical development of the cosmos, that the celestial bodies and everything they contain *evolved* in time and that nature has a history not only of coexistence in space but also of development and succession in time. This was in sharp contrast with the previously held Newtonian view of the "perpetual" and "harmonious" motion of the heavenly bodies after an initial divine impulse. Our present understanding of the evolution of the solar system and the evidence for the evolution of the galaxies as a "bottom up" or a clustering

rather than a "top down" or a fragmentation process [4] vindicates the dialectical views of Kant.

Darwin's theory of evolution and more recent developments in quantum mechanics, astrophysics, geology, palaeontology, biology and all other terrestrial sciences, point to a nature that is in eternal motion of evolution, development, change, brought about through a conflict of the opposites residing together in its elements, and that although at narrow particularity cause and effect has a role, at all levels of generality nature is governed by blind chance events, but with the iron necessity that is inherent in chance.

Dialectical View of the Universe

In the light of the present development of quantum mechanics, it is probably possible to extend the intuitive ideas of early dialectical thinkers and those of Hegel, and to look at the universe as a *process*, as something that "comes into being and passes out of existence". If one naively assumes the universe to be an infinite void in which matter spontaneously "comes into being" in the form of some fundamental particles from "nothing" and similarly vanishes into "nothing" in the literary sense of the first Hegelian triad of "being-nothing-becoming" then there must always be some finite matter in the universe, because Uncertainty Principle forbids a perfect vacuum. If this spontaneous appearance and disappearance of matter is an eternal and everyday phenomena of innumerable "free lunches" instead of the quantum mechanically much less feasible one-time mighty "big bang" "free lunch", then the dialectical view of the universe becomes realistic and all of these fantastic mathematics and awe inspiring cosmology of "Big Bang" genesis becomes unnecessary. If the appearance and disappearance of matter is facilitated, so to speak catalyzed by the presence of existing matter as

the graininess of the universe suggests and as quantum electrodynamics indicates the increasing concentration of virtual particles close to an atomic nucleus, and if such matter particles collects (like water molecules in the cloud) under the attractive force of gravity to form nebulae, galaxies, stars and so on then we can appreciate the anticipating poetic wonderment of Lucretius : "How is it that the sky feeds the stars!"[5].

Further, gravity cannot be only an attractive force, but according to the dialectical law of the *unity of the opposites*, must also possess a repulsive nature [6]. If the repulsive force of gravity at long distance overwhelms the relatively short-range attractive force, then the general dispersion of matter as observed by Hubble and the acceleration of this dispersion as observed recently, can be explained without invoking a primordial push from a "Big Bang".

The speculation about the creation and disappearance of matter as elementary particle, if true, must involve both matter and antimatter. If in one tiny region of the infinite void, matter gets pre-eminence over antimatter by purely chance events but with a necessity that chance entails, then the development of an island universe like the one in which we live in to be composed of only matter is perfectly feasible, because any anti-matter that forms is continuously eliminated through reaction with existing matter by the well known annihilation process, producing gamma-rays, – a sort of "natural selection" as is the case in the biological systems.

The observed gamma-ray halo may possibly be attributed to such an annihilation process going on in the Milky Way galaxy and its surrounding dust, because the creation of new matter and antimatter is more likely to be facilitated at centres where patches of matter already exist in the universe. The intensity of such gamma rays originating from a galaxy may, therefore, be proportional to its mass. The recent report by Caleb Scharf and Reshmi Mukherjee [7] that galaxy clusters

are the main source of gamma ray in the visible universe is in conformity with such a possibility. The symmetrical nature of the gamma-ray halo with respect to the mass concentration in the Milky Way Galaxy, and other nearby galaxies observed by Dixon et al. also indicates the proportionality of gamma-ray intensity with the mass in this galaxy.

The origin of the high-energy radiation (X-rays, gamma rays etc.) at the galactic core with its wide emission band is usually attributed (among other things) to Bremstrahlung caused due to the super acceleration of galactic mass falling into the massive black holes. However, in such a case one would probably expect to observe relatively more compact sources due to the presence of a limited number of such black holes in the galaxy. But as the above image shows, the more intense gamma radiation from the galactic core and its immediate surrounding (the brown and green regions respectively) are also diffuse and symmetrical along the whole stretch of the galactic plane like the distant blue halo. The diffuseness, the proportionality of the gamma ray intensity with the increasing galactic mass concentration and its broad emission band is consistent with the above hypothesis that appearance – disappearance and the subsequent particle – antiparticle annihilation of newly evolving elementary matter/quanta is proportional to the existing mass distribution in the galaxy.

Another strong support of the above hypothesis comes from the discoveries of Halton Arp and others on the high-energy radiation from the center of the Local Supercluster [8] and on the quasars [9]. The strongest high-energy radiation (X-rays, gamma rays and ultra high-energy cosmic rays) in the sky coming from the direction of the Local Supercluster, was shown by Arp et al. [8] to originate from the centrally located Virgo Cluster with its associated Active Galactic Nuclei (AGNs) such as 3C274(M87), 3C273, 3C279 and Makarian

421. The creation-ejection of new mass/quanta from the active galactic core in the form of Planck-energy particles and quanta has been suggested as a possible explanation for this radiation source.

If the hypothesis of spontaneous appearance and disappearance of matter as elementary particles is correct, then one would not expect to observe any dramatic appearance or disappearances of ponderable galactic mass. It would be rather like a living animal whose cells die and new ones form as an ongoing process. Disappearance of galactic matter would not be observed because it would leave no trace, however newly appearing matter may, chance-accumulate for some time to a critical mass, when it can manifest itself in a catastrophic way as in the quasars reported by Halton Arp [9]. More over, as seems to be the case, one is more likely to observe the origin of the quasars at the galactic core, because according to this hypothesis new matter is more likely to form where already there is concentration of mass. It may be that the origin of the high-energy sources, the GRBs and the quarsars are (in different scale) manifestations of the same basic on going process occurring at the galactic core and it's surrounding dust.

The energy created by the matter-antimatter annihilation process and through other processes must decay during its lifetime to form a background radiation or so to speak, some "zero-point" energy in the universe also mandated by quantum mechanics. This "zero-point" energy can represent the cosmic microwave background radiation, which is touted as the incontrovertible proof of the 'big bang' theory.

Conclusion

If such a simple picture of the universe is correct then it will be similar to the development of galaxies, solar systems and life or other processes in terrestrial nature, in all of which science so far has found

to follow dialectical laws of development. This naïve but essentially correct way of looking at the world by the early dialectical thinkers, (and which can be perceived by any individual with some reflection), is being more and more reinforced with the development of natural science. The discovery of the gamma-ray halo in the Milky Way galaxy is a new and a significant affirmation of the dialectical view of the world.

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