Flocculated Universe is the Universe an Electromagnetic Entity?

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Abstract

The recent map of the Universe shows a cellular void structure that indicates a structural change from a homogenous early universe to an inhomogeneous one today. Experiments with flocculated smectite clay solution show similar structure building phenomena. Similarities between the largest structure of the Universe and that formed and evolved within mutually flocculated clay dispersion suggests that our Universe may be a dynamic entity dominated, shaped and driven, not by dark forces, but by chance and competition between electromagnetic and gravitational forces.

Keywords - *flocculated Universe, electric Universe, large-scale structure of the Universe*

I. INTRODUCTION

Since invention of the telescope at the beginning of seventeenth century and its use in astronomy by Galileo, the big picture of our Universe has shown its true blueprint. At the beginning astronomers gathered data in the relatively close neighbourhood of our Solar System. Developing ideas about our Galaxy marked the beginning of our understanding that the Universe is a much larger entity than it was realized, and that our Galaxy is only a tiny part of the larger picture. New developments in astronomy of the past two and half decades have made significant progress in understanding the large-scale matter distribution in space. De Lapparent et al. [1] for the first time showed how a slice of the Universe could give us information of the Universe in depth. The 2-degree Field Galaxy Redshirt Survey [2], and the Sloan Digital Sky Survey [3], gave us the first ideas about the distribution of galaxies in the local Universe with great detail. Discovery of galaxy strings, the "great wall" [4] and large empty space volumes were documented. A map of the Universe revealed [5] strange, three-dimensional spider web of filamentary-like strings of galaxies which surround large voids, drafting a new big picture of cellular-like structure of an always connected entity, called our Universe (Fig. 1). The "great wall" is made up of 830 separate galaxies that gravity has corralled into four super clusters, connected by massive filaments of hot gas. This creates a twisting structure that resembles a cosmic honeycomb (Fig. 2d).

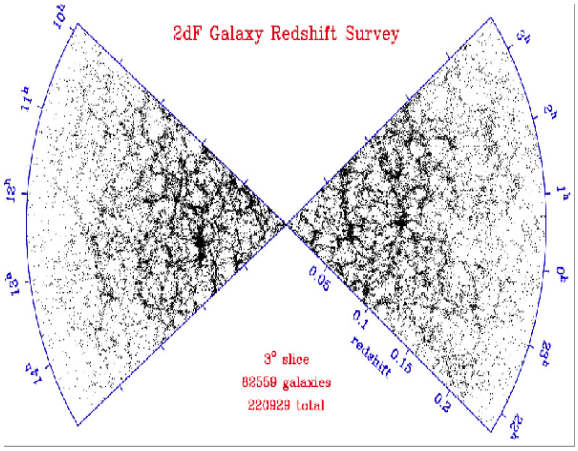

Fig 1: The cellular structure of the Universe fragment within 2.74 Gyr circle, from [5].

Origin of such a structure remains unknown and is still debated. Studies carried back close to the big bang time shows that matter within the early Universe was uniformly distributed and agglomerated in time into atoms, first stars, galaxies and ever growing empty voids between them [5]. The nature of this process is unknown and presumably is a property of space-time itself. Recently works of Wiltshire [6] proposed timescape effect, which may be responsible for voids increasing in volume. Within an accelerating Universe, time flows faster and accelerates within low-density matter volumes in comparison with the denser matter volumes within filamentary-like strings. This effect may accelerate the volume rise of voids within the web super-structure, which may appear like differences in space expansion between low and high matter density regions.

From Hubble's law, we know that the Universe looks like expanding. To explain such mysterious behaviour (except the mentioned timescape effect), the mysterious "dark energy" was invented ad hock, as a repulsing gravitational force. This expansion even accelerates. The mysterious nature of this dark energy is the biggest problem in cosmology today. So, gravity appears to be the only well known and accepted reason for the Universe large scale driving forces. However, as gravity is a monopole, we know it as an attractive force. The big question is, why the Universe expands, and if timescape is the only reason for this expansion effect, it may be that the Universe may be rather steady in the big picture.

Since Vera Rubin [7] uncovered the discrepancy between the predicted angular motion of galaxies and their observed motion by studying galactic rotation

curves, we understand that stars within galaxies do not follow Keplerian motion around the galaxy centre, but rotate with equal angular speed, despite they distance from the galaxy centre. It may appear that stars have been pinpointed into gigantic, slowly rotating, rigid disks. This phenomenon became known as the galaxy rotation problem. The presence of the dark matter concept was introduced, where the dark matter gravity supposedly overwhelms the galaxy stars gravity and make them behave as if they were held within the glue-like medium. Also, we know now that, galaxies lie close together, relative to their diameters; nearly all have neighbors within a few disk diameters. The invented dark matter may overlap and span neighboring galaxies into larger entities.

Dark matter can also be seen as the driving force that stabilises galaxies and binds them into strings and walls, which enclose large voids, hundreds of millions of light years in diameter, and ever growing empty volumes of space. Such bizarre entities like dark matter and dark energy, which no one has ever seen or detected, and which does not even interact with our baryonic world (along with gravity) are believed to control the Universe structure and behaviour.

II. MATERIALS AND METHODS

Electron microscope investigation on clay mineral suspensions were conducted using JEOL-2100 Transmission Electron Microscope (TEM) with 200 kV accelerating potential. Scanning Electron Microscope (SEM) JEOL 6040 was used to investigate sample coated in platinum film with accelerating voltage 15-20 kV. For 3D imaging the Cryo-TEM was used with accelerating voltage 300 kV [8]. The aqueous suspension samples were vitrified in to the liquid nitrogen temperature by rapid plunging samples in environment stable camera (stable temperature and moisture content).

Transmission X-ray Microscopy (TXM) has proved to be an efficient instrument in interior three dimensional structure of nano-material owing to its large penetration depth and superior spatial resolution [9]. TXM which was used in this present study has been installed on synchrotron of NSRRC in Taiwan. This TXM provides two-dimensional imaging and three-dimensional tomography at energy 8-11 keV with a spatial resolution of 50-60 nm, and with the Zernike-phase contrast capability for imaging light material which lacks X-ray absorption contrast. This TXM allows aqueous specimens to be examined, owing to no vacuum requirement. TXM images were the space images and carry information about the suspension layer about 50 μm thick. Because all samples are uniform in composition the only differences seen from consequent images photographed from different angles can be information about flocks packing density. As density differs from water to particles or flocked aggregates, information about space particle packing can be transposed from 3D space image to diagram of flock dimensions as shown later in results.

III. RESULTS AND DISCUSSION

To explain all this unexplained behaviour of the ever-changing Universe, we propose a totally different approach. Because of this semi-rigid state of galaxies, we may treat them as discoid-shape particles (most of them looks like and behave as such entities from large distance). The large cellular macrostructure of the Universe seen in a map (Fig.1), may look in many ways similar to the cellular microstructure of a flocculated clay suspension in an aqueous solution. So the cellular type structure seen within the large scale Universe map, may be treated as the cellular, "honeycomb" model of the flocculated (nano-size) particles, within aqueous solution.

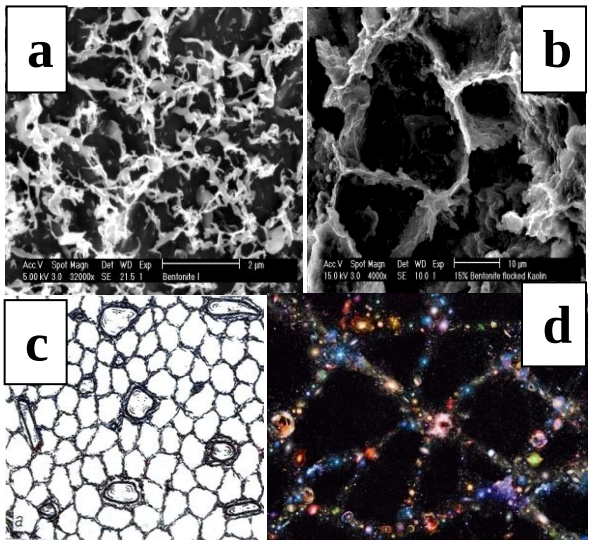

Fig 2: SEM micrograph of smectite platelet shaped clay particles, flocculated microstructure within aqueous solution. (a) Very homogenous, freshly flocculated suspension microstructure shows networking particles and with cellular voids between them not exceeding 2-3 times the average particle diameter. (b) Inhomogeneous, time seasoned flocculated suspension shows cellular microstructure where the voids diameters exceed 20-30 times the average particle diameter. (c) Model of the cellular "Honeycomb" microstructure in aqueous solution and similar, (d) cellular structure of the tiny fragment from visible Universe [10], Science Photo Library/Corbis).

The formation of structured networks within solution in a clay suspension (colloidal) is called, flocculation. When such a network spans all the volume within a vessel, the suspension is gelled. Mineral platelets within gel or within flocks, usually hinder the involved particles and encapsulate large volumes of water within the cellular structure. Slow evolution of the resulting micro-structures, as observed within a gelled suspension, leads to growth of the cellular voids from a relatively homogenous microstructure. Here voids are only few particle diameters within a freshly flocculated suspension (Fig. 2a), and these grow to inhomogeneous "honeycomb" microstructure, where voids measure 20-30 times the single platelet diameter (Fig. 2b).

The phenomenon of particle framework formation in suspension of the colloidal system, has been predicted and known since the work carried out by McEwen [11]. Given the size of clay constituents, the electron microscope has been the tool of choice for scientists who study the microstructure of clay suspensions [8] and in [12]. The study of microstructure can be dated to before the advent of the electron microscopy methods as shown in [13], [14]. The classic 'house of cards' model was suggested [15]. The first experimental information about clay microstructure was obtained with the advent of TEM) and SEM technique, [16], [17].

In presented here experiment, conducted within the aqueous suspension of smectite clay particles, observations were done using the synchrotron powered transmission X-ray microscope (TXM), cryogenic scanning electron microscopy (cryo-SEM) and cryogenic transmission electron microscopy (cryo-TEM). Results from these observations, shown in Fig. 2a&b can be interpreted as follows. When present at low solids content, in freshly prepared suspension, individual particles are fully dispersed and stabilised by Coulombic repulsion. These particles also undergo the Brownian movement and gravity sedimentation according to Stokes' law.

While single valence ions may provide colloidal stabilisation, charge migration in time, and other higher valence ions presence within the solution, cause formation of much more compact oriented aggregates. Such destabilisation create a significantly increase in the aggregation rate. This aggregation triggers suspension destabilisation in some volumes and dispersion becomes inhomogeneous. In some places, densification becomes higher than the critical particle concentration in a suspension thus producing a gel. In such suspensions, the closest particles start interacting with each other forming a three-dimensional structure or gel. As smectite is comprised of sheets that are highly flexible, individual particles interact by a combination of Coulomb forces, where edge attraction and basal plane repulsion forces building an expanded and extremely voluminous cellular network composed of chain-like platelet assemblies as observed in Fig. 2a&b as well as in the "honey comb" structural model (Fig. 2c). Such an extended network may fill the entire volume of a vessel. In such a case the suspension becomes gelled. There was no free settling in this system and further compacting its filamentary-like stringy clay walls may proceed slowly by structural rearrangement of the entire network where large cellular voids were growing.

All structure building phenomena in the colloidal system describing the behaviour of dilute clay suspensions are based on the DLVO theory of colloid stability [18], [19], where competing electrostatic (Coulomb) and van der Waals forces generally determine whether particular colloidal clay suspensions will be stabilized (in sol form) or flocculated (in gel form).

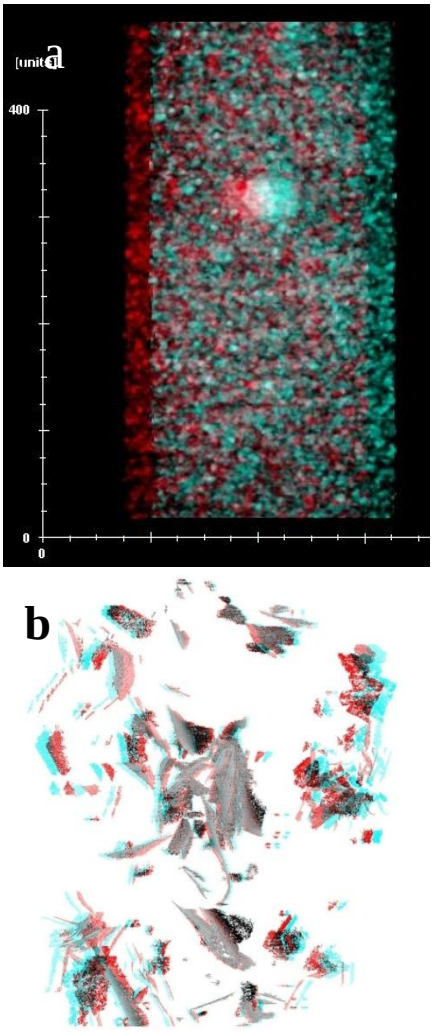

Fig 3: (a)- TXM & (b)- Cryo-SEM anaglyphic 3D micrographs (seen through blue & red glasses): Highly-voluminous EE connected framework forms in smectite gel in aqueous solution.

As investigations of structure building phenomena in aqueous solutions has found, major forces acting in such systems were of electric nature [20]-[22]. Platelet-like particles have diverse electrical charges between edges and flat surfaces. Through some distance these charges orient and join particles in ways to compensate their net charge. In many cases, these particles even do not need to touch each other but act through the long range hydration contacts. By connecting each other, particles form filamentary-like, long interconnected chains that encapsulated large volumes filled by solution. This design resembles cellular structure as shown in SEM micrograph of gelled nano-clay flocculated system in Fig. 2a&b. Note that idealised cellular structure shown chain of discoidal galaxies, fragment from web of large Universe structure, also resemble a similar cellular design (Fig. 2d).

Observations within the aqueous suspensions were also conducted using (TXM) [20], and cryogenic transmission electron microscopy (cryo-TEM), [22] are shown in anaglyphs in Fig. 3. In the 3D anaglyph of the smectite platelet-like particles in the aqueous solution, a small group of flakes clearly displayed a flocculated microstructure. Individual smectite flakes form a voluminous space network, in which most platelets connecting close to each other edges. All of the flake-like particles seen in this micrograph measure less than 100 nm in the lateral dimension and can be classified as nano-clays. They display near edge-to-edge (EE) contact, in which the subsequent flakes within a chain tends to be in perpendicularly twisted orientation; therefore, each flake sensing electrostatic forces from surrounding particles, positioned itself at different angle within net of neighboring flakes. This framework of twisted chains of smectite flakes form ribbon-like structural elements, is seen in the micrograph (Fig. 3).

Such a structure is an effect of flock building phenomenon. At the beginning, separate particles look stabilized by uniform charge (Fig. 3a). Then, because of polarization, charge relocates on particle surfaces, platelets becoming oriented and start assembling to build structure. As polarized particles attracting each other on edges, they repel themselves from flat surfaces. The expanded cellular structure observed in the smectite clay suspension presented in this contribution may form slowly by structural rearrangement, when attraction between edge particle surfaces occurs concurrently to the face surface repulsion. Therefore long strings of clay walls, by repelling each other, contribute in constant structure transformation that result in the cellular volume increase. This process in time leads to expanding cellular structure, where large voids grow and walls between them thicken. This process, when observed from inside, may looks like all individual mineral particles around, would be receding with speed increasing with distance. Such a picture can looks the same independently of the observer position within that gelled system. Similar evolution model of nano-particles in solution was proposed in [23] where the strongly repulsive interaction between strings of charged particles appeared in formation of so called the “repulsive gel”.

The intergalactic empty space, in analogy to aqueous solution is not electrically neutral and not empty at all. It is packed with energy, in fact it is thickened with potential energy scalar field. This energy fluctuates as explained in [24] and this may influence energy status to all entities within this field, like the baryonic matter. Casimir in [25], discovered potential energy in the empty space, which is measurable now as the Casimir force and subsequently well studied. Electrodynamics micro-engine was also developed using this energy from presumably "empty space".

In the recent times fundamental changes in our way of understanding Universe can be clearly visible. Constable [26], introduced Earth environment as highly electromagnetic environment. Fontani et al., [27], discovered underestimated role of magnetism within Universe. When investigating born high-mass stars, multiple systems, they demonstrated that the fragmentation of large molecular cloud due to self-gravity is dominated by the magnetic support. These observation were based on the evidence that the overall morphology of the fragmenting region is filamentary, and this is predicted only in case of a dominant magnetic support.

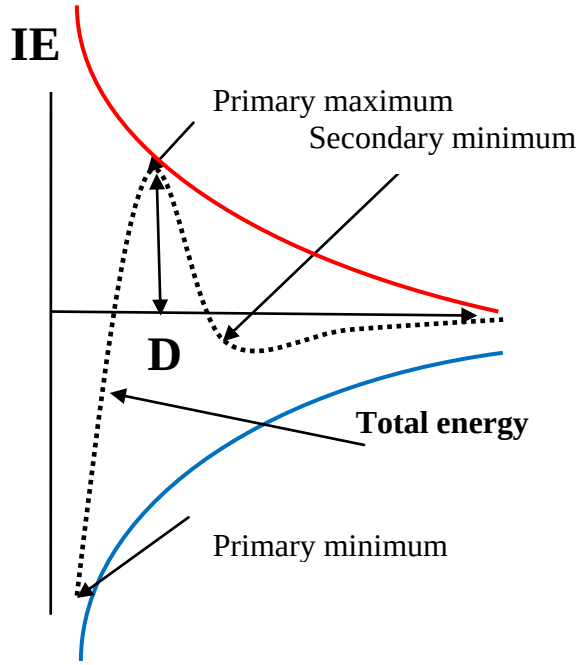

Fig 4: Dependence between Interaction Energy (IE) and distance (D) between galaxies as an result of balancing gravitational and electrical forces (not to scale). Red line represents electromagnetic repulskon, blue line represents gravitational attraction.

Recently discovered galactic magnetic fields become a major agent in the interstellar and intergalactic medium [28]-[34]. The cosmos is filled with ionised matter in form of plasma, which is the most common state of baryonic matter in the Universe. Electrically charged star wind plasma flows through galaxies, as well as powerful galactic jets exchange electrically charged particles between nearby galaxies, proving the cosmos as a highly electrical system. All this electrically alive and sophisticated system is placed within fragment of super-large magnetic monopole which may extends far beyond the horizon of our observable Universe. Knowledge about magnetic and electrical properties of the Universe, at this time is in its infancy and needs to be studied. But it is becoming clear that electromagnetic force, being much stronger than gravitation, may play the driving force shaping the large structure of the visible Universe.

The electric and gravitational force laws are both inverse square laws. For the electron and proton, the gravitational force is 39 orders of magnitude weaker than the electrical force. However accordingly to some scientists it makes no sense to even ask what is the relative strength of gravity and electromagnetism. Electromagnetism would only have a large effect on large scales if there was an imbalance in +ve and -ve charges [35]. (Large accumulations of +ve charged particles separate from negatively charged ones, or more of one than the other.) There are no so far evidence for that. Whatever will be the answer on above question, as shown in the drawing (Fig. 4) competition between electromagnetic repulsion, and gravitational attraction may produce the total energy pool, in which galaxies expanding from the primary maximum driving by strong electromagnetic repulsion. Such repulsion may have prevailed in the early Universe when newly formed galaxies were largely isometric in form. Such isometric colloidal particles in our analogy solution, display a uniform distribution of electric charge which support particles repelling each other. Later on in evolution, receding galaxies evolved into discoid forms. Distribution of charge in such platelet-like particles in our analogy solution, is diversified. They repelled each other by flatter discoid surfaces and were attracted by their edges. Such particles are similar to mature galaxies, become trapped within the secondary minimum of energy. This may trigger their "flocculation" in a very similar way to colloidal particles, as predicted by DVLO theory. This described mechanism may explain the dynamic structure forming phenomenon observed in the map of the Universe. Within such a structure, early galaxies recede because they repel each other. Later on, flattened, matured galaxies may still repelling each other by flat surfaces, but attract each other with their edges where diversified electric charges exist. Competition of diversified electric charges on galaxies and gravity interact within space, which results in a three-dimensional network. These networks are shown in the map of the Universe, where enlargement of great voids and matter densification into strings between great empty voids can be clearly visible (Fig. 2d). Such a similar network to the "expanding gel" is in motion. This motion in conjunction with other space-time phenomena, such as the "timescape" effect may support a thesis of the "flocculated Universe" described in this communication. In such a view, if Universe was created from singularity [36], so consequently, it may exists now as a Brane, fragment of the event horizon, which was form when singularity appeared. If such a surface, is electrically charged, as may be the electrically charged black hole, than electromagnetic forces may play more important role in shaping fabric of the cosmos than estimated now .

IV. CONCLUSIONS

Our coincidental analogy between colloidal flock microstructure with the macrostructure of the Universe, perhaps is not necessarily and straightforwardly relevant, but because of their similar behaviour, may provide a clue to the presumption that the Universe, is dynamic entity dominated, shaped and driven, not by dark forces, but by chance and competition between electromagnetic and gravitational forces. So, is the Universe mutually flocculated and an electric entity?

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