Dark Matter and Dark Energy in the Universe model by Serapioni

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This paper is the third of a series dedicated to the relativistic theory proposed by Sergio Serapioni. Here we briefly summarize the idea of a 5-dimensions space-time that is the theory background and we then show the idea of time and the reduction of all the possible motions to simple rotation in this 5-dimensional space-time. This is fundamental for the actual derivation of the idea of dark matter and also dark energy as proposed by Serapioni. The interesting aspect is that both 'naturally' arise within the theory and they assume numerical values that are in good agreement with current state of the art observations.

We already introduced the space and time theory developed by Eng. Sergio Serapioni along his activity that lasts almost 40 years (e.g. *Il sorriso dell'Ingegnere*, Emmeciquadro n.49 and *Macro e micro cosmo nell'Universo di Serapioni*, Emmeciquadro n.57). We therefore remind the interested reader to those papers. Here we briefly summary the main points of the proposed theory. This starts from the work of the Italian mathematician Luigi Fantappiè, dear friend of Enrico Fermi. The very fundamental question is related to a unified vision of the physical reality that according to Fantappiè is achieved by a proper geometrization of physics. In this process it is possible to understand in a very natural manner the concept of time that even today in theoretical physics is source of unsolved issues. Let us think for a moment the time as something that exists from the beginning and that we simply insert into our theory to parametrize the temporal evolution of the state of a physical system. But, on the other hand we can also think time as something that 'emerges' from the theory itself under some circumstances and therefore it is a fundamental property of the theory. These two are indeed the bases of the two mostly successful physical theory we have nowadays: general relativity and quantum mechanics. In the first we have no predefined structure of time: it is indeed a background independent theory, without any stage on which events occur. On the other hand, quantum mechanics needs a quantity, the time, to properly describe how the state s of a system S changes.

The attempt of reconcile these two apparently disagreeing visions is one of the efforts on the modern theoretical physics. The Universe, all the reality is indeed an unity and we therefore believe that there should be a theory able to describe such a unity. However we have no assurance that such a theory could be reached and understood.

The vision of time for Serapioni

In this very sense I think it is interesting to analyze and study the work by Serapioni and specifically the new approach to the concept of time. Time within this framework is thought as the result of a motion and precisely a rotation. Before proceeding let us introduce a mathematical concept that is fundamental for a proper physical description of the reality: the notion of group. A group in mathematics is a set of elements with an operation by which we can combine elements of the group and to obtain another element of the group that satisfy some conditions (known as assioms) such as the closure (i.e. operating on the elements of the group we always find another element of the group), associativity, the existence of the identity

element as well as, within the group, of the inverse of a given element (that combined with the element itself gives the identity). It seems quite complex but indeed we usually have experience of such groups: integer numbers with addition. There are several groups in mathematics: the symmetry group for a geometrical objects like a square or a polygon, or groups that arise from some physical laws. For example classical mechanic is well describe by the group of Galileo's transformation. It is therefore clear that by means of groups we can describe physical phenomenon and even the Universe itself. Sometime it is possible to find groups within other groups and the former are called sub-groups. Indeed we know that Galileo's transformation group is indeed a sub-group of a more general group that are Lorentz's transformation used to describe electromagnetic effects described by Maxwell equations and by Einstein's special relativity. Lorentz transformation reduce to Galileo's ones when assuming an infinite value for the speed of light. In this change of group we intrinsically move from a 3D space to a 4D space-time where time is no more absolute but it is a variable like the usual Cartesian coordinates and also depends from the physical state of the system. Similarly Fantappié found out that Lorentz group is itself a sub-group of a more general and un-reducible group. Such a group is characterized by two parameters: speed of light c and the radius R_u of the cronotopos and this is a 5D group. Lorentz group is obtained from this more general one by imposing a infinite value for the radius.

The very basic idea in Serapioni physical model is that the only thing that matters is motion (already pointed out by Heisenberg) and that the only possible motion are indeed rotations. For this reason the group of Fantappié and the 5D space are well suited for the proposed model. Moreover the final goal of the theory is to proved in a simple and geometrical manner, the derivation of physical quantities such as charge and mass that would be otherwise accepted from the experience both for their existence and their numerical values, but without any viable theoretical support.

Rotations, time and events

In such a space in rotation in itself, let us introduce the concept of "event": this is the time that a point needs to describe its own orbit. In the 5D space we have a set of possible rotation, each one in a plane normal to the other ones and with radii $\Delta T_i, i=1,\ldots,4$ defined as

$$\Delta T_i = 2\,\Delta T \int_0^{2\pi} \sin^i(\theta)\, d\theta$$

such that their product equals the volume of the i-dimensional hypersphere of radius ΔT. This quantity is related to the classical electron radius (defined as $\pi\lambda_0$) and hence

$$\pi \Delta T^4 = R_{CL} = \pi\lambda_0$$

We can now introduce the concept of time. This flows from the past to the future, passing to a present not-null time without any preferred direction of motion. In a 5D space where motions are indeed rotations, we have a motion with an acceleration that time-by-time modified its directions i.e. it is a centripetal acceleration. The instant is defined as the time required to modify the direction of the acceleration. But how many acceleration are we talking about?

Using the 5D structure of Fantappiè group – generalization of both Galileo and Lorentz groups – we can defined a total of 5 accelerations normal to one another. Therefore a part from the usual 3D space (XYZ) which is our normal experience, in this model we suppose the existence of another space, normal to the first one, with only two dimensions that are extremely small (ST). This is indeed the most original part of the work of Serapioni. There is indeed a well defined ratio between the rotations time of the point in the 3D and in the 2D space. In Fantappiè group we know that *c*, speed of light, is the speed by which points (entities) actually rotate. Let us suppose the an entity is rotating with velocity ω_{XYZ} in the 3D space along a circle of radius ΔT. We can write $R_1 = c\,t_1$ make an explicit connection between the radius and the time required to circle it while $\omega_{XYZ} = d\theta/dt$ is related to the angle θ described in the time t_1. We obtain a differential equation that leads to the ratio between t_1 and a fundamental time t_0. But we are still missing the rotation in the 2D space. If we imagine that the distance actually is another circle with radius R_2 traveled by an angular velocity ω_{ST} we find

$$\frac{t_2}{t_1} = e^{4\pi^2}$$

From this number we have already shown it is possible to derive the age of the Universe that results in very good agreement with the latest measurements obtained from observation of the cosmic microwave background radiation made by WMAP and Planck.

Coriolis

As stated above we are dealing with centripetal accelerations, the ones required to describe the motion in the 5D space. Such accelerations are all cinematic ones of the same kind of that related to the Coriolis force. Furthermore in Serapioni's model it is possible to describe both the electrostatic and the gravitational forces to mathematical expression similar to that of the Coriolis force. Specifically if we consider the motion of entities that build up particles like the electron, position, etc., we discover a variation in the orbit radius of about $\Delta R = \pm\pi\lambda_0$, that creates a variation in the angular velocity. With simple algebraic passages and classic mechanics we find that for this rotation the Coriolis force is given by

$$F_{Coriolis} = \pm\frac{e^2}{R^2}$$

that is exactly the electrostatic force. It is important to note the double sign in previous expression that comes from the orbit radius variation expressing the nature of the charge as related to the clock and anti-clock wise rotation of the entities along the orbits. In a similar manner considering now the rotation in the 2D space we obtain the expression (formally identical) of the Coriolis force expression now the gravitational force.

Polar Vectors

We are now in the position of introducing other important quantities for the mathematics treatment of the model. These quantities are related to the rotors that actually describe the rotations in the 5D space. However we have to be careful in this respect. As we now from our

experience, rotation could be clock- and anti-clock wise that they could right or left handed. In a 3D space the composition of a left-handed rotation with a right-handed one of the same amplitude results in a null rotation. However in a 5D space where rotation happen on normal planes, the composition will produce a not null rotor that identify directions normal to the usual 3D space. Such rotations will be described by suitable defined “polar vectors”. Overall we have a total of 9 polar vectors for each single plane of rotation. Since we have a total of 10 planes in the 5D space, we have a total of 90 possible rotations. It is interesting to note the emergence of this factor of 90 since it has strong link with both Dirac’s number and the usual π. Let us keep in mind this factor since it will come along again when we are about to explain the dark matter and dark energy of the Universe.

Instantaneous quantities and Dark Matter

In Serapioni’s theory the concept of the instant has a very prominent role. This is quite different from the concept of present already introduced. The instant is defined as the micro-time, infinitesimal with respect to the present, in which a given entity would not be able to travel closed complete orbits but only micro displacements with direction along the 5 axes of the space (XYZ and ST). Such movements in the instant describe a set of micro surfaces in 2D and micro volumes in 3D as many as the possible projections of a 5D motion are in 2 and 3 dimensions.
In the ST space section it is possible to find instantaneous products of such micro displacements along S and along T and the instant Δt with physical dimension of a velocity (time to the third power). On the other side in the 3D space we will obtain a similar instantaneous produce with dimensions of a distance. So overall given the 10 possible projections we will have 10 possible velocity vectors and 10 possible distance vectors all of the of instantaneous nature with which we form the product

$$V_{ST} \wedge L_{XYZ}$$

that represents the 10 instantaneous rotations (dimensions of time to the seventh power). From these we can create 5 other independent products that are simple scalar quantities (dimensions of time to the 14^{th} power) that we will call *instantaneous masses* or *dark masses*.

We call them instantaneous since in every instant they are created in a given space point *D* and then they disappear to reform anew in new set of space point. Although they do not leave a trace of their presence, they will inevitably shows their presence by their gravitational force. It is important to remind that the concept of mass in the theory always arise from the vector product as described. The very difference with the real and visible masses is related to the velocity and real related displacements to entities during their motions. But the nature is exactly the same. Therefore we conclude that the actual content of the instantaneous (dark) matter is about 5 times larger that the visible matter in the Universe. This result has been obtained with purely theoretical arguments and it is in very good agreement with dark matter measurements by cosmic microwave background observations. This is indeed an indirect probe of dark matter but other experiments under construction are aiming at a direct detection of dark matter in the attempt to discover its real nature.

Dark Energy

We have described the existence of instantaneous masses and how they can generate dark matter in agreement with current observations. But there is another interesting aspect of the cosmological science that triggers the interest of a large fraction of the international scientific community and it is the observed, better deduced, acceleration of the expansion of the Universe. These measurements are made by means of very distant supernovae of a very specific kind the so-called Type Ia supernovae that are thought to be almost standard candles i.e. objects with the same intrinsic light curve since the stars from which they form are of the same kind. At the very moment of their explosion it seems that the expansion of the Universe occurred at a smaller velocity than today and hence the interpretation of the accelerated expansion. Such a behavior cannot be explained in terms of the normal constituent of the Universe (e.g. baryonic and dark matter and radiation). It is instead accomodated with the introduction of a new mysterious kind of energy dubbed *dark energy* that has a negative pressure (just like a repulsive gravitational force) responsible of the observed accelerated expansion. However we do not have any kind of physical theory able to predict the existence and the characteristic of such an energy. It is indeed an indirect evidence and there are several different approaches under scrutiny and experimental data verification.
However dark energy quite naturally takes its plane within the proposed model. It is strongly related to the fine structure constant i.e. to the very microscopic world. Without entering into much detail of the micro-physics let us show the estimation given within Serapioni's model. From Type Ia supernovae and CMB data we know that the total amount of dark energy density in terms of the critical density is about 0.683. Therefore more than 95% of the actual energy content of the Universe is under a form, dark energy and dark matter, which we do not know anything about. In the 5D space the dark energy contribution could be derived from that of the dark matter converted into energy and weighted for a suitable term involving the entropy. Indeed all the structures in this Universe are ordered structures and therefore they require a given amount of energy to be formed. In the case of the fine structure related to the dark energy such a factor is about $\gamma^{90}=2.6192$. The exponent 90 has been already introduced in the context of polar vector and it is related to the total number of rotation with different velocity that a given entity could do. Therefore the total contribution of dark energy have to be weighted for the entropy giving:

$$\frac{MOc^2}{\gamma^{90}}=\frac{7.594\cdot 10^{77}}{2.6192}=2.89935\cdot 10^{77}\,erg$$

We have also to compute the total amount of the real energy (that due to real masses and not to the imaginary ones). Therefore we have

$$\frac{Mc^2}{\gamma}=\frac{1.517\cdot 10^{77}}{1.010756}=1.5019\cdot 10^{77}\,erg$$

And the total energy of the universe would be the sum of the two. This gives a total ratio for the dark energy of 0.658 which is in agreement within 2% with the observed value.