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COSMIC MICROWAVE ANISOTROPY PROBE (WMAP) REVEALS A DIFFERENT UNIVERSE THAN BIG-BANG

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ABSTRACT

Associations of WMAP ILC warm spots with neutral hydrogen clouds moving close to the galactic equator as well as high and intermediate velocity clouds moving at high latitudes have been found. Apart from these associations many warm spots are also found to have their origin in dust created by star formation - especially in the region around Canis Major, where a dwarf galaxy merging with the galactic disc has been recently observed. While on the one hand the warm spots arise due to contaminations from our galaxy and its nearby hydrogen clouds, the cold spots reveal the imprints of a spiral structure, which spans over the entire nearby universe. The core of this structure lies at the Great Attractor region and its center is positioned a little south of Norma cluster. The streaming motion of the superclusters observed in the nearby universe may be explained by the rotation of its spiral arms. It is suggested that this spiral universe is made mostly of dark component like cold moelcular hydrogen existing in fractal structures which are very difficult to detect. The 2.73^o K CMB radiation could be caused by the hydrogen molecules which freeze at this critical value at the density of the gas necessary for stability against gravitational collapse and thus leave the clouds dark without any luminous structures.

Subject headings: Cosmology: cosmic microwave background —dark matter — galaxies: molecular gas

1. INTRODUCTION

Presently there exists a consensus about the model that best describes the origin of the universe and how the structures in the cosmos have been formed. This model is based on the assumption of a homogeneous and isotropic universe which is expanding since its inception from a singular point where the entire universe once was concentrated about 13 billion years ago. The observations of the shifts of the spectral lines emitted by galaxies which indicated that the galaxies were moving away from us and the detection of radiation in microwaves coming from all directions of the sky provided the main experimental supports to this big-bang model. The recession of the galaxies was taken as proof of an expanding universe. The Cosmic Microwave Background Radiation (CMBR) was interpreted as the relics of the fireball generated by the primordial explosion which had cooled down to 2.73^o K at the present time after undergoing expansion for so many billions of years. The original big-bang had to be revised in the beginning of 1980s by an inflationary model (Guth 1982; Linde 1982, 1983; Albrecht & steinhardt 1982)which introduced the idea of an exponential inflation in the very beginning after which the universe slowed down. Without this inflation the old big-bang model could not create a universe which would be causally linked. Recently this inflationary model has undergone changes and replaced by a concordance model (....) that introduces the idea of the existence of the dark energy. This newest revision was necessary when it was discovered that the universe, instead of predicted slowing down, was, in fact, being accelerated. By introducing the idea of dark energy one could create an accelerating universe from a slowing down phase.

However, the main challenge of these different big-bang based models was to answer the question "How could all the clumpy cosmic structures like galaxies, clusters, and super-clusters etc. could have formed from an initially homogeneous fireball?" The idea of quantum fluctuations in the fireball generated in the inflationary phase came into vogue (Hawking 1982; Guth & Pi 1982; Starobinskii 1982). It was argued that the primordial quantum fluctuations had grown with the expansion of the universe which could provide the mechanisms behind the formation of cosmic structures. Standard inflation also predicted that the density fluctuations were a realization of homogeneous and isotropic Gaussian random field, which should leave Gaussian imprint on CMBR. In fact, COBE Satellite observations in the early 1990s (Smoot 1992) confirmed the existence of fluctuations in the CMBR. More refined measurements of these fluctuations started only a few years ago after Wilkinson Microwave Anisotropy Probe (WMAP) was launched. WMAP observations since 2003 (Tegmerk et al. 2003) generated tremendous enthusiasm among the scientists who were hoping to decipher the mystery of the birth of the universe. In the 3-yr WMAP Internal Linear Combination (ILC) map (Hinshaw et al. 2007) they saw the fingerprints of the primordial big-bang.

The purpose of this paper is to throw new lights on the WMAP fluctuations cleaned from galactic contamination by comparing it with the features seen in all-sky neutral hydrogen map, infra-red map at 9 microns and 408 MHz radio map.

Our analysis leads us to draw a dramatic conclusion: First, most of the warm fluctuations seen in the cleaned 5-yr WMAP originate from the Milky Way and the high and intermediate velocity clouds around Milky Way. Second, the colder spots reveal the imprints of a dark spiral structure that embodies the entire nearby universe: The core of this spiral structure lies in the region of the Great

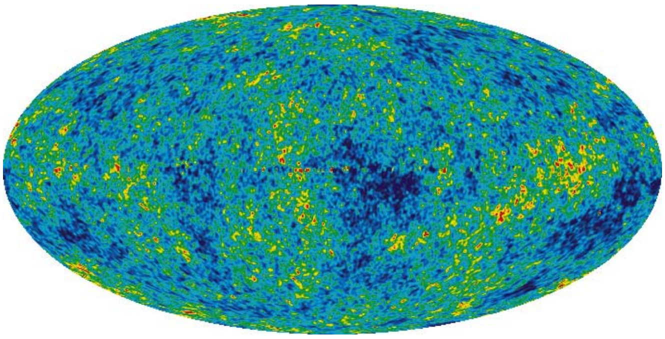

FIG. 1.— 5-yr WMAP after foreground cleaning

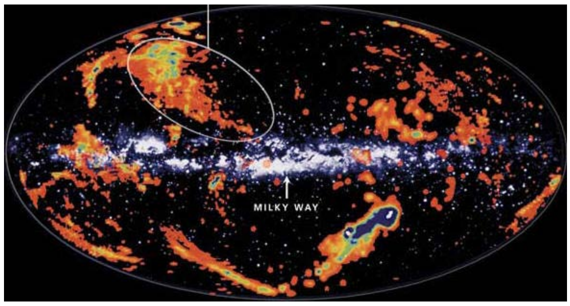

FIG. 2.— HST map of the high velocity clouds around our Milky Way galaxy. To the south appearing as white spot is the Large Magellanic Cloud. The figure is courtesy of . . . .

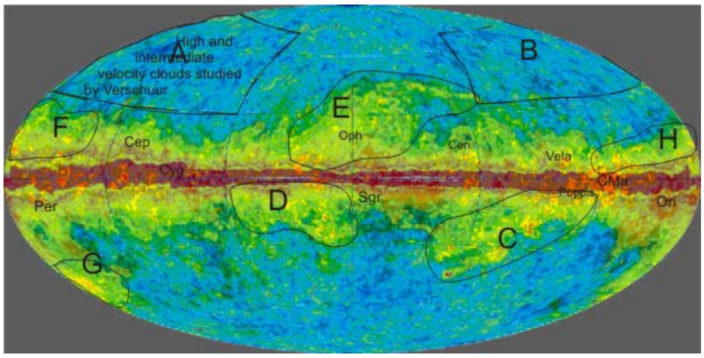

FIG. 3.— WMAP fluctuations laid over HI distribution map. Stronger yellow and red spots indicate the WMAP fluctuations. The associations between the HI clouds and ILC map have been found by Verschuur in regions A and B. The regions C, D, E, F , G, H show how clouds appearing in higher densities along the interfaces formed by cloud-cloud collisions, or clouds at the boundary, where they have made impact with the surrounding media, correspond to the warm spots of WMAP.

Attractor towards which the superclusters in the nearby universe have been observed to be streaming like rivers of galaxies. We shall argue that the observed CMBR originates from this cosmic structure mostly made of dark matter and propose cold hydrogen molecule as the candidate for this dark unseen matter that fills most of our universe.

2. WARM SPOTS AND GALACTIC CONTAMINATION

The main challenge in the WMAP analysis is the problem of cleaning the data from the foreground contamination (Bennett et al. 2003) coming from our Milky Way galaxy. When free hot electrons ($T \geq 10^4$ K) moving inside H-alpha clouds in our galaxy get accelerated by the ions they emit thermal bremstrahlung and generate microwave radiation over a frequency range of ∼15 -75 GHz (Bartlett & Amram 1998; **?**). Similarly dusts generated around new star forming areas in the galaxy create radiations which dominate galactic emission above 90 GHz (Draine & Lee 1984; Kogut et al. 1996; Schlegel et al. 1998). Synchrotron radiation from relativistic electrons accelerated in the magnetic field is another source of foreground contamination that mainly contributes in low frequencies less than 20 GHz (Davies & Wilkinson 1998; Smoot 1999). Radiations from spinning dusts (Draine & Lazarian 1998a,b, 1999) have also been put forth as the fourth source that may contaminate the foreground. By using different templates of H-alpha map, the 408 MHz Haslam map and FDS 94 GHz dust map WMAP team has tried to clean these foreground contaminations and finally presented the fluctuations, which should represent the long sought fingerprints of the fluctuations from the inflationary era.

First we have matched the cleaned 5-yr WMAP image (fig.1) obtained from http://www.map.gsfc.nasa.gov with the All-Sky neutral hydrogen (HI) map from Leiden-Argentina-Bonn (LAB) Survey (Kalberla et al. 2005). By image enhancing the HI map we can demonstrate that the warm fluctuations seen in areas marked by C, D, E, F,G and H (fig. 3) clearly coincide with the distribution of the HI clouds. The association of the neutral hydrogen clouds with WMAP has been discussed by Verschuur (Verschuur 2007). He has shown how several of the high latitude high and intermediate velocity clouds are associated with warm spots in two regions marked by A and B(in fig.3): One bounded by $l=60^o$ & 80^o, $b= 30^o$ and 70^o and other bounded by $l= 180^o$ & 300^o, $b= 40^o$ & 70^o. The clouds in the region A were found to be as close as 100 pc from the sun. Fig. 2 shows the HST map of the high velocity clouds. In his paper the region C, that contains the long feature starting from $(l,b) = (255^o, -15^o)$ in Puppis and stretching to $(l,b) = (310^o, -35^o)$, and the region G centred around $(l,b)= (160^o, -40^o)$ are mentioned. We point out that very similar associations can be found in D, E, F and H regions too. In fig.4 an fig. 5 the associations of warm spots with the HI cloud morphology are shown for C and D.

The ILC peaks are located at the boundaries of HI features which imply that they occur at the interface created by HI structures colliding with other surrounding HI clouds. Verschurr has argued that where two HI feature interact current sheets are created while causing particle accelerations which generate emissions seen in WMAP. Legache (Legache 2003) has examined the relationship between WMAP and the interstellar HI and suggested that excess WMAP emission could be associated with small, transiently heated dust particles. Apart from emission from collision induced acceleration, the emission from spinning dust, formed by shocks at these interfaces, could also be the source of the peaks. From the associations of structures seen in the regions mentioned above where shock fronts correspond to warm spots, shock generated emissions either causing acceleration or spinning of the dust, seem to be the plausible explanation for ILC spots.

As said before, dusts heated by UV from young stars are also another major contributor to WMAP. The

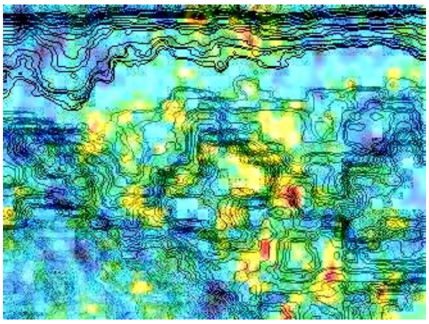

FIG. 4.— The associations of ILC warm spots with the HI cloud morphology are shown: A part of the region D in fig.3. The contours are traces of different color values of the HI map from the LAB Survey.

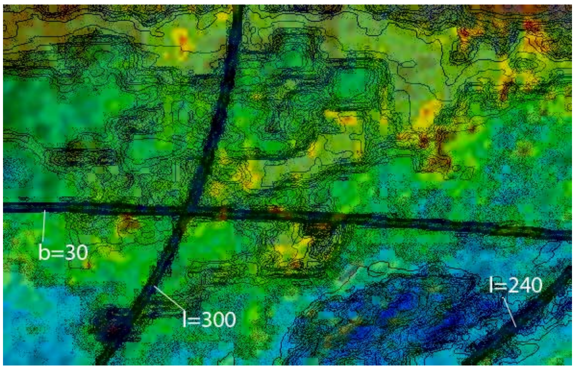

FIG. 5.— The associations of ILC warm spots with the HI cloud morphology are shown: Region C of fig.3. The contours are traces of different color values of the HI map from the LAB Survey.

largest and most prominent concentration of warm spots in WMAP are in the region of Canis Major (CMa), where a dwarf galaxy merging with the Milky Way galactic disc has been recently observed (Martin et al. 2004; Martinez-Delgado et al. 2005). Though there is an on going debate (Moitinho 2006) whether it is the closest galaxy to our Milky Way, or a phenomenon pertaining to the disc of our galaxy itself, the Infrared All-Sky map by AKARI at 9 micron which we have downloaded from the European user support page at http://www.ir.isas.jp (Akari page at ESAC/ESA) show clearly dust structures in Canis Major which match very well with the ILC warm spots around CMa. The warm fluctuations in Canis Major and Perseus, Cepheus region give, in convincing details, an association with the dust structures and star formation activities. The streaming seen from Canis Major towards Monoceros also confirm this view. In fig. 6a and fig. 6b we have overlain the ILC warm spots with the optical and infrared images of the Canis Major region and in fig.7 shown the dust association in Perseus (Per) and Cephus (Cep) regions. The contours seen in fig. 7 represent traces of different color values of the IRC map.

Another source is synchrotron emission.We have found such association in North polar spur. The warm spots trace the morphology of the ejections from the galactic centre moving in Ophiuchus towards Lupus. The northward outflows from the galactic centre forms an arc above the galactic bulge and pour down towards Vela-Puppis and Canis Major where they feed star formation activities in the outskirt of the galaxy. In fig.8 the correspondence between the gases outpouring from the galactic nuclei and the WMAP fluctuations are shown.

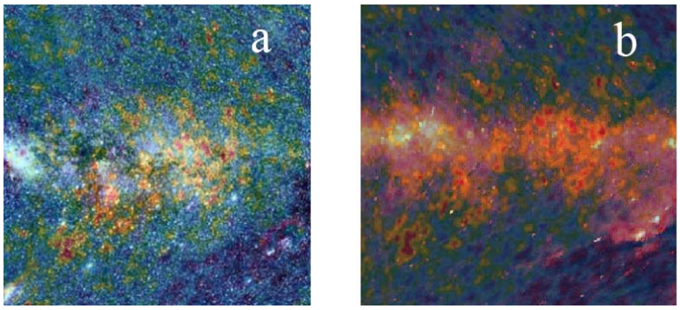

FIG. 6.— a) WMAP image overlain on the optical image of Puppis and Canis Major region, b) WMAP data overlaid on AKAR IRC image at 9 micron of the same region.

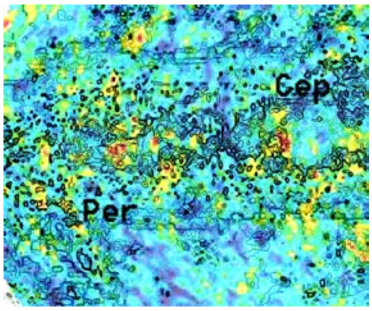

FIG. 7.— The ILC warm spots and dust distributions between Perseus and Cephus are shown.

Apart from what we have mentioned here there are several areas of warm fluctuations at high galactic latitudes which correspond with neutral hydrogen clouds as shown by Verschurr (regions A and B). From these findings we conclude that the warm fluctuations are nothing but results of contaminations from our galaxy and its nearby clouds.

3. COLD SPOTS AND GREAT ATTRACTOR

While the warm spots have galactic and near galactic origin, quite amazingly the most prominent concentration of cold spots of the ILC map has striking coincidence with the region of the Great Attractor, which hides behind the Milky Way bulge. It is believed that the streaming flows of clusters and superclusters in the nearby universe are caused by the pull of the Great Attractor (Lynden-Bell et al. 1988). The Local cluster, where our Milky Way galaxy belongs, is moving towards the centre of the Virgo supercluster, which in turn is streaming towards the Great Attractor. The colder spots which we see near the centre of the WMAP image are, in fact, the imprints of this hidden dark structure in the universe, which has so far remained undiscovered. In fig.9 and fig.10 we have marked the great Attractor region which corresponds with the concentration of the cold spots in ILC map near the galactic centre and shown how the Norma supercluster in the Great Attractor region (Kraan-Korteweg 2005), lies inside the marked area.

It is interesting to note that the position of the Norma cluster, which is one of the biggest and the densest clusters in the universe matches exactly with one of the

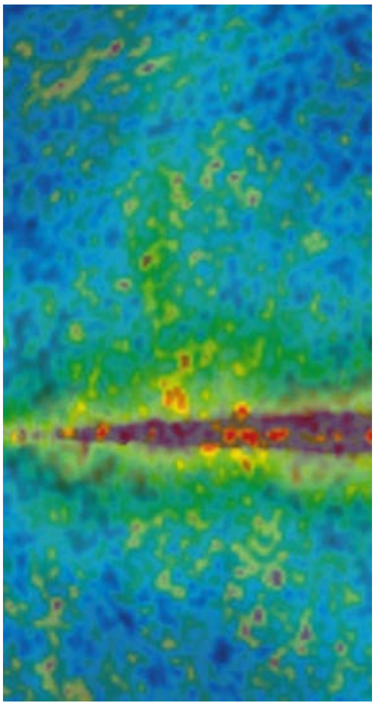

FIG. 8.— WMAP overlain on 408 MHZ map (Haslam et al.1982) of the outflow from galactic center. The region is left of Ophiuchus (Oph). The dark green and light blue colors show the radio emission while the yellow, red and dark spots bounded by yellowish boundaries are from warmer fluctuations of WMAP.

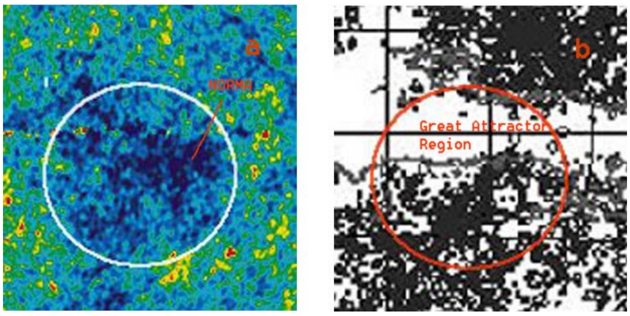

FIG. 9.— a) The region close to the galactic center with highest concentration of WMAP cold spots is marked by a white circle, b) the same region is marked in the HI galaxy distribution map in the Great Attractor region hiding behind the Milky Way disc.

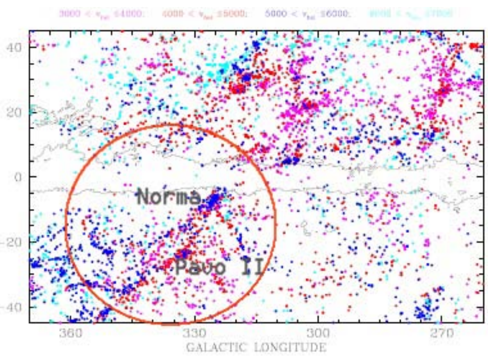

FIG. 10.— Major clusters of the Norma supercluster running as elongated strings through Pavo cluster (Kraan-Korteweg 2005) are shown to lie within the marked area.

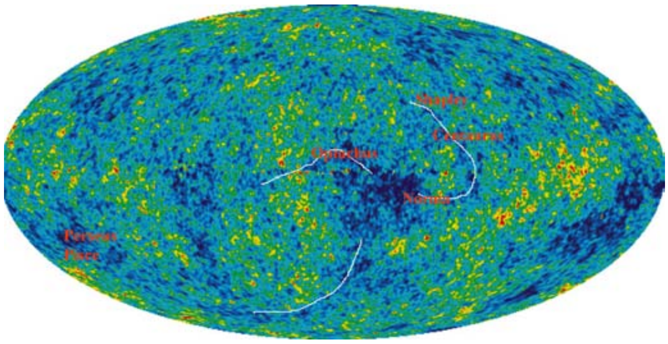

FIG. 11.— A spiral structure with the Great Attractor as its core.

largest cold spots in the region. It may be understood as resulting from the Sunyaev-Zeldovich effect (Sunyaev & Zeldovich 1972) that predicts dip in the microwave temperature caused by hot electrons in galaxy clusters. If temperature decrement is indicative of the presence of dense clusters then there should exist several such enormously rich clusters to the left of Norma cluster in the direction of Lupus, Pavo and Sagittarius. In fact the densest cluster in the universe, which sits at the centre of the core, that we see from an inclined angle, lies between Norma and Pavo II.

The dark spots also imprint a spiral structure with three arms emerging from the Great Attractor region. It tells us that the Great Attractor is the nuclear part of a huge structure that embodies our entire local universe. The streaming of the galaxy clusters, which one observes in the nearby universe, could be explained as arising from the dynamics of the spiral motions of these arms. This spiral is indicated in fig.11 where one arm moves towards Hydra, another towards Lupus and third moves southward and bends towards Perseus-Pisce. The streaming of the superclusters indicates that the local universe is rotating in an anti-clockwise direction.

4. ORIGIN OF CMB RADIATION

If the superclusters in the local universe are embedded inside such a huge cosmic spiral, why have we not been able to discover it before? The reason could be that it is made of dark matter, which is very difficult to detect. The most reasonable assumption about the nature of this dark matter should be cold hydrogen molecule, which are extremely difficult to detect by using available instruments. Several authors have already proposed cold molecular hydrogen as the possible candidate for dark matter (Sandford & Allamandola 1993; Pfenninger et al. 1994; Stephen White 1996). Recently dark galaxy made of hydrogen has been discovered where no star formation has taken place (Minchin et al. 2005). Similar to this dark galaxy this cosmic spiral that spans the entire nearby universe, could be made of cold hydrogen gas. If this gas exists as fractal, gravitational collapse leading to structure formation, which may illumine the cold cloud, may be avoided. The fractality, proceeding down to the scale of the size of the solar system, may ensure the stability of the clouds against collapse for billions of years (Pfenninger et al. 1994). Such fractal hydrogen clouds are observed in the interstellar medium. It is argued that cold molecular clouds exist outside the optical discs of the galaxies as fractals. In such region cosmic rays will be the only heating source. It has been calculated that absorption of cosmic rays in such fractal clouds of solar system sizes will help the clouds to cool down further instead of warming them up.

The CMB temperature of 2.73^o K may be linked to the chemistry of such hydrogen clouds where once the density of the clouds reach above 3 x10^5 cm^{-3} the hydrogen molecules may freeze and form snowflakes on hydrogen ice crystals formed on dust grains at a temperature very close to the CMB temperature (Sandford & Allamandola 1993; Pfenninger & Combes 1994; Schaefer 1994; Combes & Pfenninger 1997). Such a cloud will be able to radiate as a black body.

Another possibility of the origin of 2.73^o K radiation has been proposed by Shpenkov and Kreidik (Shpenkov & Kreidik 2002) who have theoretically calculated the temperature of the background radiation that the orbiting electron in a hydrogen atom in zero-point exchange mode will emit. Their calculated value (2.728..) agrees up to several decimal point to the actual CMB temperature (2.728).

5. DISCUSSION

Immediately after the cleaned WMAP data was analyzed one discovered several peculiar features in it, which were difficult to explain by known cosmological models. They included the bothering question of large angular anomaly (de Oliveira-Costa et al. 2005; Schwarz et al. 2004) aligned with the "Axis of Evil"(Land & Magueijo 2005). The data showed that there was lack of correlations in CMBR from different parts of the universe when the sky was analyzed in large scales (larger than 60^o). These anomalies appeared in the power of radiation coming from the quadrupole and octopole components in the angular spectrum - as if the largest structures were not contributing to it. It generated the speculation that the universe could be small and has a toroidal topology, or the contributions were mostly coming from the nearby superclusters. Moreover, cold and warm spots seen in quadrupole and octopole seemed to lie in planes. These planes in turn were aligned with the orbital plane of Earth around the Sun (Ecliptic plane) giving rise to further speculation that our solar system may have something to do with it. The motions of our galaxy towards the Virgo cluster, which was a part of the Local supercluster moving towards the Great Attractor, caused Doppler shift of the CMB radiation. This Doppler shift, observed in the dipole measurement of CMBR, showed that the Local group of galaxies were moving at a speed of over 600 km/s with respect to the microwave background radiation in the direction of the Great Attractor. This velocity was in agreement with the motion of the local group pulled by the Great Attractor. It indicated that the Great Attractor could be at rest with respect to the CMBR.

Other issues which came in the forefront of the debate around CMBR anisotropy was the asymmetry between the north and south of the galactic equator, and the existence of non-gaussanity in the spectrum. However, if one takes note of the origin of the warm fluctuations arising from our galaxy and its surrounding clouds most of the problems around WMAP anisotropy, debated so hotly these days, would disappear. And with it the idea of the origin of CMBR anisotropy from the primordial big-bang will vanish too. In this paper we have pointed out that the microwave background radiation may have origin in the dark matter in the universe. It could be the radiation emitted by a cold dark giant spiral structure which does not come into view except in microwaves. The core of this spiral structure lies in the region of the Great Attractor, and this nuclear part alone is as huge as an area nearly covering 50^o x 50^o in the sky. From our observational point of view the spiral structure is tilted like the view of Andromeda galaxy from us, and the boundary that encompasses its very central part appears elliptical in shape. This central cluster, deep in the heart of the core, has not yet been observed in any other wavelength so far. The Norma cluster which has been believed to lie at the centre of Great Attractor is positioned slightly off the real centre, which lies at a position (l,b)=325^o,-17^o between Norma and Pavo II clusters instead.

More precise measurements of CMBR like the PLANCK satellite observation should be able to decipher more details of this spiral structure printed by the cold spots in microwave and help us to understand the mystery of the dark matter which has puzzled the scientists for a long time.

6. PREDICTION

The densest and the most spectacular cluster in the universe lies at (l,b)=325^o,-17^o between Norma and Pavo II. If the challenges posed by the dense clouds from our galaxy obstructing our view can be met, more sensitive HI studies of galaxies at this place must be able to reveal this spectacular cluster sitting at the heart of our local universe.

7. CONCLUSION

5-year WMAP cleaned up image of the CMBR fluctuations does not show fingerprints from primordial fluctuations from the inflationary era of big-bang. The sources of large angle anomalies are mainly contaminations from the Milky Way galaxy, and its nearby hydrogen clouds. The warm spots arise from collisions of neutral hydrogen clouds and star formation dusts together with some synchrotron emission. The colder spots reveal the imprint of a ghostly dark spiral structure with its core coinciding with the region of the Great Attractor. This dark cosmic spiral embodies the entire nearby universe, and the streaming of the superclusters may be caused by the dynamics of motions of the spiral arms which span over several hundreds of millions of light years. This spiral is inclined to our view, while its centre lies slightly off the Norma cluster.

The microwave background radiation has its origin in the dark matter that constitutes this spiral. The idea that this dark matter could be made of cold dark hydrogen molecule, which has been previously mentioned by several authors, appears most appealing to us. The stability of such a cold hydrogen structure against the spiral dynamics as well as the absence of gravitational collapse giving rise to illumined regions can be understood if the cold hydrogen molecules form "snowflakes" and exist as fractal clumps in cosmic scales differing by many orders of magnitudes where the smallest fractal structure is of the order of the size of our solar system. The 2.73^o K temperature could be related to the property of parahydrogen which freezes at this critical temperature once a particular gas density is reached. Such frozen hydrogen can radiate as blackbody.

So our results lead us to conclude that we live inside a whirlwind of cold " hydrogen snow storm" embracing the entire nearby universe, which is dark and invisible to us except in microwaves. From this cold dark stormy womb of the universe the cosmic structures, which illumine the sky, have risen to shine upon us as spots of clusters of lights moving together as chains and filaments of galaxies of hundreds of millions of light years long.

This paper is dedicated to my parents Mr. Debabrata Rej and Mrs. Aruna Rej, our son Ånun Lund Rej and my wife Ragne Birte Lund.

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