Solar System Peculiar Motion from Mid Infra Red AGNs and its Cosmological Implications

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1st-Feb-2021

The Cosmological Principle

- According to the cosmological principle, the universe to a comoving observer should appear isotropic, without any preferred directions.
- However a peculiar motion of the solar system, might introduce a dipole anisotropy in some of the observed properties of the Cosmos.
- The peculiar motion of the solar system, determined from the dipole anisotropy in the Cosmic Microwave Background Radiation (CMBR), gave a velocity 370 km/s along l=264, b=48 degrees.

Dipoles determined from AGNs

- The NRAO VLA Sky Survey (NVSS), comprising 1.8 million radio sources, has shown a dipole asymmetry giving a velocity ~1600 km/s, 4 times the CMBR value.

- The TIFR GMRT Sky Survey (TGSS), comprising 0.62 million sources, showed a very significant dipole anisotropy, amounting to a velocity ~10 times the CMBR value.

- A homogeneously selected DR12Q sample of 103245 distant quasars has shown a redshift dipole with a velocity ~6 times the CMBR value.

Dipole direction

- Though the magnitudes of the CMBR and the AGN dipoles differ with each other , the observed dipoles in all cases, seem to point along the same direction.
- A common direction for all these dipoles, determined from completely independent surveys by different groups, does indicate that these dipoles are not merely because of random statistical fluctuations, or due to some systematics in the observations or in the data analysis.
- Because of the large variations seen in various dipole values, it is important to get more independent estimates of the dipole.

Our MIRAGN sample

- Here we determine the peculiar motion from a sample of ~0.28 million AGNs, taken from the Mid Infra Red Active Galactic Nuclei (MIRAGN) sample comprising more than a million sources.

- For our purpose we have restricted the MIRAGN sample to an upper limit of magnitude, W1 <15.0, because there is a differential number density over the sky, due to deeper coverage in some regions of the sky.

- However, due to the completeness of the basic survey for stronger sources, the number density distribution in the sky at low infrared magnitude values remains unaffected since a deeper coverage adds sources only at fainter levels or higher magnitudes.

The sky distribution of 0.28 million AGNs in our sample

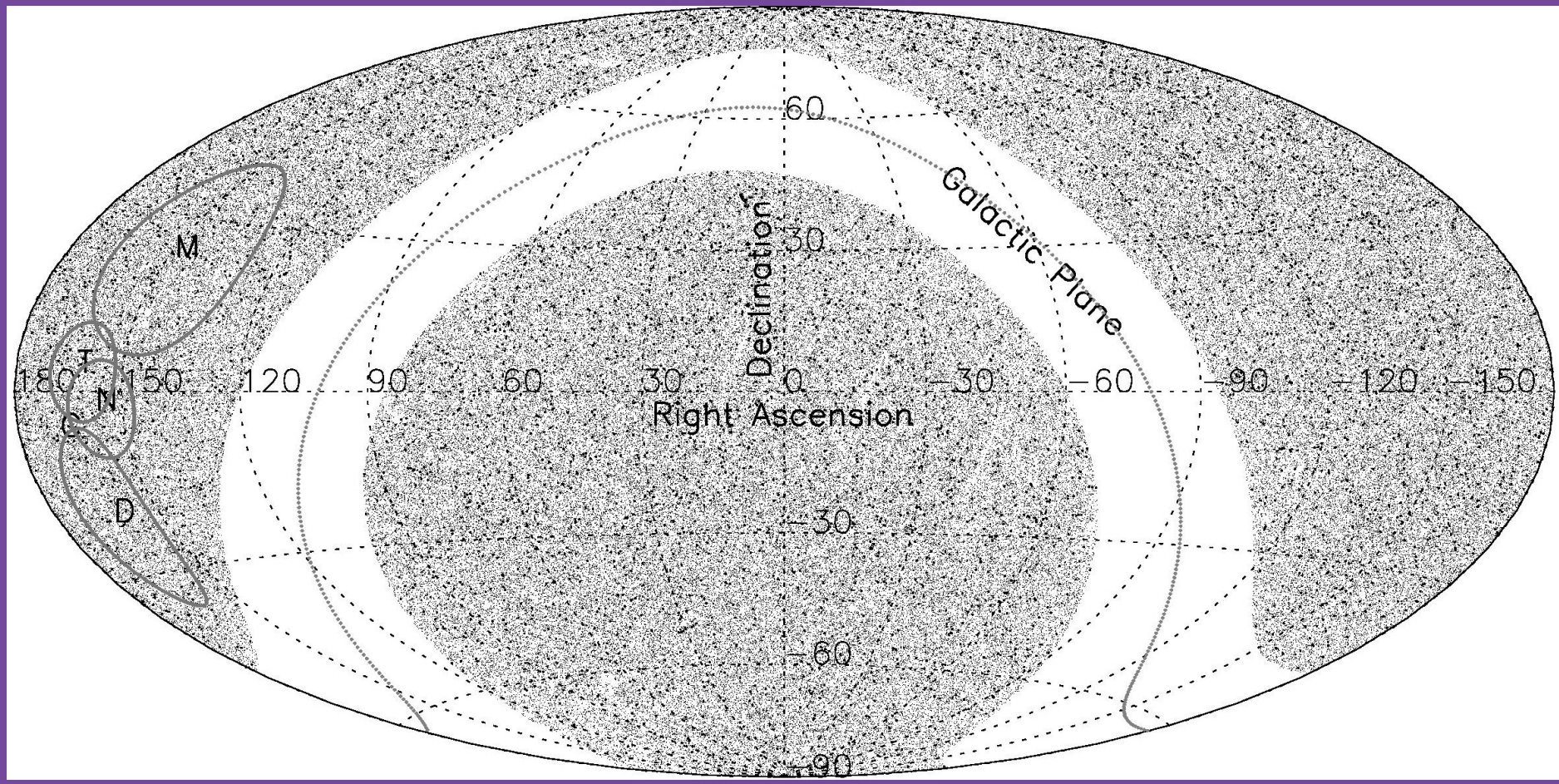

Figure 1. Pole positions of various dipoles are shown in the sky map by M (MIRAGN), C(CMBR), N(NVSS), T(TGSS), D(DR12Q), along with their error ellipses.

Table 1

Magnitude Range	*N*	D	RA	Dec	Speed
W1		(10^{-2})	(°)	(°)	(10^3 km/s)
15.0 >W1≥12.0	279139	3.0±0.3	148±19	23±17	1.7±0.2
15.0 >W1≥14.7	102822	4.1±0.5	157±20	23±18	2.3±0.3
14.7 >W1≥14.3	086035	2.9±0.6	132±21	32±19	1.6±0.3
14.3 >W1 ≥12.0	090282	2.1±0.6	143±21	11± 19	1.2±0.3

Comparison of Various Dipoles

- From the sky positions of the poles of the dipoles, as seen in Figure 1, it does seem that various AGN dipoles are pointing along the same direction, as the CMBR dipole.

- On the other hand their amplitudes differ by an order of magnitude. From Table 1, even the present MIRAGN dipole is ~4 times larger than the CMBR dipole.

- However, a common direction for all these dipoles, determined from completely independent surveys by different groups, does indicate that these dipoles are not merely due to some systematics in the observations or in the data analysis.

Implications for the Cosmological Principle!

- The peculiar velocity of the Solar system should not depend upon the specific data or the technique used to determine it.
- The discordant values of the inferred peculiar motion from observed dipoles, may imply that we should instead look for some other possible cause for the genesis of these dipoles, including that of the CMBR dipole.
- A common direction for the dipoles derived from different data using various techniques is a pointer toward the presence of an inherently preferred cosmic direction (axis!), implying perhaps an anisotropic universe, in conflict with the cosmological principle, a cornerstone of the modern cosmology.