Mathematical Physics

Fermi coordinates, simultaneity, and expanding space in Robertson-Walker cosmologies

David Klein, Evan Randles

(Submitted on 4 Oct 2010 (v1), last revised 23 Nov 2010 (this version, v2))

Explicit Fermi coordinates are given for geodesic observers comoving with the Hubble flow in expanding Robertson-Walker spacetimes, along with exact expressions for the metric tensors in Fermi coordinates. For the case of non inflationary cosmologies, it is shown that Fermi coordinate charts are global, and space-time is foliated by space slices of constant Fermi (proper) time that have finite extent. A universal upper bound for the proper radius of any leaf of the foliation, i.e., for the proper radius of the spatial universe at any fixed time of the geodesic observer, is given. A general expression is derived for the geometrically defined Fermi relative velocity of a test particle (e.g. a galaxy) comoving with the Hubble flow away from the observer. Least upper bounds of superluminal recessional Fermi velocities are given for spacetimes whose scale factors follow power laws, including matter-dominated and radiation-dominated cosmologies. Exact expressions for the proper radius of any leaf of the foliation for this same class of spacetimes are given. It is shown that the radii increase linearly with proper time of the observer moving with the Hubble flow. These results are applied to particular cosmological models.

Comments:	29 pages. This revised version includes two new remarks and minor revisions of the first manuscript
Subjects:	**Mathematical Physics (math-ph)**; Cosmology and Extragalactic Astrophysics (astro-ph.CO); General Relativity and Quantum Cosmology (gr-qc)
MSC classes:	83F05, 83C10
Cite as:	**arXiv:1010.0588v2 [math-ph]**

Submission history

From: David Klein [view email]
[v1] Mon, 4 Oct 2010 13:53:12 GMT (21kb)
[v2] Tue, 23 Nov 2010 15:16:06 GMT (20kb)

Which authors of this paper are endorsers?