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A GENERAL RELATIVISTIVEXPLANATION OF THE PIONEER ANOMALY AND THE UTILITY OF A MILLI-C NEP MISSION ON VALIDATING THE OBSERVATIONS

Abstract

Straightforward general relativity in an expanding cosmos with a center of mass offers a simple explanation for the Pioneer anomaly, an unexplained small deceleration of spacecraft (such as Pioneer 10 and 11) moving outward far beyond the solar system. If a large volume of empty space surrounds the matter of the cosmos, then the matter is in a deep gravitational potential well. If the expansion of space is spreading the matter outward, then the depth of the well is decreasing. According to both an existing approximate metric, and a new exact metric similar to the Schwarzschild metric, the decreasing depth shortens "radar" distances within the well with the observed apparent acceleration. This simple explanation cannot work within the framework of the Big Bang cosmology, whose starting assumption allows no center of mass and therefore no changing large-scale gravitational potential. In the absence of other plausible explanations for the Pioneer anomaly, this explanation suggests that one of the foundations of the Big Bang cosmology may be incorrect.

That possibility should be checked with further observations. A high speed (0.001 c) space probe, feasible with near term nuclear electric propulsion, should be able to rapidly surpass the distance (currently about 70 AU) of the Pioneer probes before ceasing propulsion, thereby reducing the influence of the sun and solar system's contribution to the local spacetime curvature, and verifying that the deceleration is independent of distance from the sun. Second, such a probe could help determine if the putative Oort cloud exists and is a substantive contributor to the Pioneer anomaly, as some authors have proposed. Third, it could give more confidence that the anomaly is not due to possible heat radiation or gas leaks from particular features of the Pioneer spacecraft, as several authors have proposed. Last, the new probe could be sent in a direction orthogonal to the (nearly opposite) directions of the Pioneer probes, checking further to see if there is any anisotropy in the effect. Such data would give us more confidence in our understanding of the anomaly and could have a dramatic impact on our picture of the structure of the cosmos.