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Gaia as local cosmological probe

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The ESA mission Gaia is providing a detailed reconstruction of our Milky Way enabled through microarcsecond global astrometry.
At such level of accuracy, a fully general relativistic analysis of photon trajectories from the observational data back to the space-time origin of the emitting astronomical object is mandatory. This necessarily implies the dismissal of Newtonian straight lines and the adoption of a suitable general relativistic measurement 'toolkit' .
Then, ultimately, from Gaia onwards, high accurate measurements must include General Relativity at the very core of the data analysis to guarantee the scientific quality. Indeed, gravitational astrometry offer the unique possibility of establishing a laboratory for extensively testing the role of Milky Way in gravity theories, in other words a coherent frame to probe our whole Galaxy as the product of cosmological evolution shaped by gravity (Local Cosmology), i.e. the relations among baryonic structures (and their evolution) and the Universe dark components.
In this respect, the talk will discuss of the attempts at applying the accurate relativistic kinematics recently delivered by Gaia to trace the Milky Way rotation curves, focusing on the latest results obtained by comparing an exact general relativistic approach to (Λ)CDM and MOND analogues. Close to 1 million of Gaia-only sources have been selected according to the requirements for a proper 6-dimensional reconstruction of the phase-space location occupied by each individual star. The likelihood analysis shows that the different models appear equally consistent with the data and confirms, a posteriori, the hypothesis of validity of a relativistic model for the Milky Way. In brief, our findings tell that, the gravitational dragging deduced from the Einstein field solution could mimic a "DM"or MOND effect for the observed flatness of the Galactic rotational curve.

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