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Testing general relativity in the solar system: present and future perspectives

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The increasing precision of spacecraft radiometric tracking data experienced in the last decade, combined with the huge amount of data collected from space missions and the long time span of the available datasets, has enabled a refined analysis of the Solar System dynamics. High precision tests of General Relativity can be performed through the measurement of the post-Newtonian parameters, including the Nordtvedt parameter η, and the Compton wavelength of the graviton. In this work we investigate the relative contributions to these tests provided by the most relevant past, present and future interplanetary missions, with the goal of assessing the accuracies that can be realistically reached in the next 10–15 years.

A semi-analytical model, validated by means of a comparison with well-established numerical models, has been developed to compute the signatures generated by the parameters of interest in the measurements and to assess the precision of their retrieval. We also revisit some of the hypotheses and constrained analysis schemes that have been proposed until now to overcome geometric weaknesses and model degeneracies, proving that many of the previously adopted strategies introduce model inconsistencies.

We apply our semi-analytical model to perform a covariance analysis on three groups of interplanetary missions:
(1) those for which data are available now (e.g. Cassini, MESSENGER, MRO, Juno),
(2) those expected in the next years (BepiColombo) and
(3) those still to be launched or proposed, such as JUICE and VERITAS (the latter, chosen as a representative of a state-of-the-art Venus orbiter).

Finally, we describe the preliminary results of a more rigorous and general procedure: a global, multi-mission data analysis.

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