**ACT Stage Topic 6: Gravitomagnetic effect on long term stability of orbiting bodies**

## Stage topic Description

General Relativity predicts that for slowly rotating bodies and weak fields the gravitational force is composed by two parts, one representing the standard Newtonian interaction and an additional one, associated to the flux of matter. This means that the total gravitational force for this kind of systems is analogous to the Lorentz force in electromagnetism. The net effect of this force manifests itself in different ways, e.g. a torque of a gyroscope. At present, measurements of this effects are performed by the Stanford/NASA/KACST/Lockheed Martin mission "Gravity Probe B".

The long-terms effects of the gravitomagnetic potential are not fully understood, especially in relation to the dynamics of solar and planetary systems. The application of perturbative techniques (e.g., based on Lie series, Poincaré-Lindstedt, etc.) could provide novel insights, but so far such techniques have not been applied extensively to this specific problem.

## Candidate's tasks

The candidate's task will be to investigate the effect of this relativistic correction on standard newtonian celestial mechanics using perturbative numerical and/or analytical tools. The work will be organized in several parts:

- the analysis of the long-term gravitational stability of a two rotating-body system;
- the analysis of the gravitational stability of a three body system. Depending on the availability of time, the research work can also involve the investigation of the change in typical features of the three body problem e.g. the Lagrange points.

## The ideal candidate

- The student should have good knowledge of General Relativity and Hamiltonian mechanics;
- knowledge of Python or C++ or Matlab or Mathematica or equivalent software is required;
- knowledge of analytical perturbative techniques is an asset.

## References


- Ciufolini, Weeler "Gravitation and inertia" Princeton Series in Physics (1995)
- Morbidelli, Alessandro "Modern Celestial Mechanics: Dynamics in the Solar System" (2001) (http://www.oca.eu/morby/)
- http://einstein.stanford.edu/