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DENNIS PHILIPP: General Relativistic Geodesy: concepts and effects

Wednesday, 19 February 2020 16:00 (30 minutes)

The Earth's geoid is one of the most important fundamental concepts to provide a gravity field-related height reference in geodesy and associated sciences. To keep up with the ever-increasing experimental capabilities and to consistently interpret high-precision measurements without any doubt, a relativistic treatment of geodetic notions (including the geoid) within Einstein's theory of General Relativity is inevitable.
Building on the theoretical construction of isochronometric surfaces and the so-called redshift potential for clock comparison, we define a relativistic gravity potential as a generalization of known (post-)Newtonian notions. This potential exists for any stationary configuration and observers who rigidly co-rotate. It is the same as realized by local plumb lines. In a second step, we employ this gravity potential to define the relativistic geoid in direct analogy to the Newtonian understanding. In the respective limits, it allows to recover well-known (post-)Newtonian results. However, the framework does not involve any approximation regarding the field strength and we can, thus, also speak of the geodesy of other (compact) objects.
Further generalizations such as relativistic normal gravity, height measures, and the proper time of observers on the geoid w.r.t. IAU resolutions will be discussed as well. To illustrate the concepts, some particular exact solutions of Einstein's field equation as well as a parametrized post-Newtonian metric will be investigated. Moreover, a comparison to the Newtonian results sheds light on the magnitude of relativistic effects.

Session Classification: SHORT TALKS

Track Classification: SYMPOSIUM ON BLACK HOLES AND GRAVITATIONAL WAVES