Towards a fully general relativistic geodesy

Claus Lämmerzahl
ZARM, Department of Physics and Electrical Engineering
University of Bremen, Am Fallturm, 28359 Bremen, Germany

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Geodesy is about the determination of the gravitational field and its characteristics of a nonsymmetric gravitating body. Within a Newtonian framework this means the determination of the Newtonian potential and the related notion of a geoid. Here we propose a corresponding formalism in the framework of full General Relativity. Based on the notion of a stationary rotating rigid body the notion of a geoid is introduced. This geoid generalizes the Newtonian geoid in that it is realized by gravimeters based on falling objects but also by the redshift of clocks - both classes of instruments define the same geoid [1]. Since the relativistic gravitational field possesses more than one degree of freedom one would expect also more than one geoid. In fact, independent from the first geoid a further geoid can be defined, which is related to the rotational degree of freedom of the gravitational field. One operational way to realize this geoid is the Sagnac effect, measured with light or with atom interferometry. The importance of this second geoid for geodesy on Earth is discussed.

References

[1] Dennis Philipp, Volker Perlick, Dirk Puetzfeld, Eva Hackmann, and Claus Lämmerzahl: Definition of the relativistic geoid in terms of isochronometric surfaces, *Physical Review* **D 95**, 104037 (2017).