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GENERAL RELATIVISTIC GEODESY - A NEW SHAPE OF THE EARTH

Abstract

Owing to new highly sensitive devices like clocks, freely falling corner cubes, spinning tops, and laser and atom interferometers on ground and in space the relativistic gravitational field of the Earth can now be measured with unprecedented accuracy. This requires a relativistic formulation of the gravitational field and, thus, of geodesy. In this presentation a fully general relativistic scheme for geodesy is developed. Starting from stationarity of the Earth, two potentials can be defined for the Earth - one is related to the norm of the underlying Killing vector, the other related to its twist. The first potential can be defined and measured with clocks (on ground and in space where for the measurements in space a special approach is needed taking the nonstationarity of the moving clocks into account), falling bodies, or atom interferometry. The second potential can be measured with spinning tops or by measuring a Sagnac effect with laser or atom interferometry. While the first potential can be used to introduce a height system, the second potential defines a latitudinal system. So, it is the gravitational field of the gravitating body itself which defines the reference system of the gravitating body. Finally, based on analyses by Hansen, Simon, and Beig a scheme is presented for measuring the full general relativistic gravitational field of the Earth using laser interferometry employed by GRACE Follow On.