

Mach Principle and the nature of Inertia

Tuesday, 12 December 2023 15:30 (30 minutes)

The gravitational mass is a local property of particles like the electric charge, while the inertial mass is the resistance to acceleration, quite a different property. Mach's principle states that inertial forces should be due to the interaction of a body with all the other masses in the universe. In General Relativity this principle is not fully present and is replaced by the equivalence principle, according to which inertial and gravitational masses are linked by the gravitational constant, which is a fixed number. However, according to a strict interpretation of Mach's principle, the inertial mass should be non local and depend on all the other masses of the universe and their positions. In this perspective the gravitational constant cannot be just a fixed number. In 1918 Thirring studied the metric inside a rotating spherical mass shell and it was clearly inspired by the conceptual problem of Mach's principle. This study revealed the appearance of a force with the structure of Coriolis force. No centrifugal like force was present but there was also a curious vertical force. In 1973 we considered a cylindrical rotational symmetry and extended the approach to second order in the gravitational constant. We found that a rotating cylinder leads to a metric which gives exactly the Coriolis term and the centrifugal one with the correct relations. Recently we have reconsidered this problem extending to the case of a linear acceleration. All these results strongly point to the idea that real inertia is the outcome of a relative motion and this would require a generalization of GR theory.

Primary author: PIETRONERO, Luciano (CREF, Sapienza University)

Presenter: PIETRONERO, Luciano (CREF, Sapienza University)

Session Classification: Special Event