

# Gravity and Cosmology Seminar

Departament Badań Podstawowych  
Narodowego Centrum Badań Jądrowych

September 11, 2024 (Wednesday), h. 11:15

The seminar will be held in room 207 @Pasteura 7

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## **Exact solutions for differentially rotating galaxies in general relativity**

**ABSTRACT:** We present a general framework for solving Einstein's equations for stationary axisymmetric gravitationally bound differentially rotating matter distributions with internal pressure. A new quasilocal Newtonian limit is extracted for nonrelativistic relative velocities. The self-consistent coupling of quasilocal gravitational energy and angular momentum leads to a modified Poisson equation. The coupled equations of motion of the effective fluid elements are also modified, with quasilocal angular momentum and frame-dragging leading to novel dynamics. The phenomenology of collisionless dark matter for disc galaxies is reproduced, offering an explanation for their observed rotation curves. Halos of abundant cold dark matter particles are not required.

A full class of exact solutions is found in the general case of negligible internal pressure. A new geometrical structure is found - the rotosurface - which provides a rigorous general relativity answer to the question: where is infinity? The Milky Way's rotosurface leads to new astrophysical predictions, including possible synchrotron radiation from diffuse charged particles at 500-700 kpc from the galactic centre.