

Research project objectives

The aim of the project is to investigate the cosmic-ray driven dynamo process in spiral galaxies. The cosmic-ray driven dynamo model is currently a subject of intense research, and is one of the most advanced and promising models of magnetic field amplification in galaxies. The scope of the proposed research includes extension of the model with several important physical processes that were neglected till now: heating and cooling of the interstellar medium, gravitational instability and energy dependent transport of cosmic ray electrons. We plan detailed verification of the model, by comparison of synthetic radio-observations of modelled galaxies with the results of observations of real galaxies, collected by PLANCK and LOFAR instruments, and by SKA in future.

Research methodology

The research work will be conducted with the aid of numerical magnetohydrodynamical simulation code PIERNIK developed at Centre for Astronomy, Nicolaus Copernicus University in Toruń. PIERNIK is equipped with numerical algorithms commonly applied in computational astrophysics. A special feature of PIERNIK code is our original implementation of anisotropic transport of cosmic-ray transport in the fluid approximation. Numerical simulations will be carried out in national and European supercomputing centres.

Research project impact

Cosmic rays and magnetic fields are important components of the interstellar medium, however, their role in shaping the dynamics of interstellar medium and evolution of galaxies has not been fully understood. We propose realisation of the next stage of development of the cosmic-ray driven dynamo model. The project is relevant for understanding processes involving magnetic fields and cosmic rays in galaxies. and is also important for the studies conducted with the aid of modern scientific instruments in radioastronomy (FERMI, LOFAR, SKA).