CSC-RUB PhD Project Proposal

Title: Kinematics of HI gas in interacting disk galaxies

Sector of research: Physics/Astrophysics

Degree awarded: Dr. rer. nat.

Keywords: galaxy evolution, kinematics, HI 21cm line observations, disk galaxies

Supervisors of PhD project:

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Prof. Dr. Anna Franckowiak, Chair for Multimessenger Astrophysics, Faculty of Physics and Astronomy, leader of Helmholtz Young Investigator Group at DESY Zeuthen

Research focus of supervisor:

The scientific interests are in observational extragalactic astronomy with an emphasis on the physics of the interstellar medium in the disk-halo interface and the circum-galactic medium of star-forming disk galaxies as an important aspect of galaxy evolution. The observational experience ranges from X-rays to radio-observations and a strong focus currently is on studies of magnetic fields and cosmic ray propagation in galactic winds from radio-continuum polarization. This is supported by the involvement in the German participation in the LOFAR and MeerKAT telescope projects with participation in appropriate Key Science (KSPs) or Large Survey (LSPs) Projects, respectively, at those telescopes. Research in these fields is complemented by studies of the stellar components in disk galaxies from deep surface photometry and optical spectroscopy, e.g., with integral field units (IFUs) and Fabry-Perot spectrometers.

Publications:

Jozsa, G. I. and 30 colleagues incl. Dettmar, R.-J., 2021, Anomalous gas in ESO 149-G003: a MeerKAT-16 view, Monthly Notices of the Royal Astronomical Society 501, 2704

de Blok, W. J. G. and 45 colleagues incl. Dettmar, R.-J., 2020, MeerKAT HI commissioning observations of MHONGOOSE galaxy ESO 302-G014, Astronomy and Astrophysics 643, A147

Narayan, C. A., Dettmar, R.-J., Saha, K., 2020, Wobbly discs - corrugations seen in the dust lanes of edge-on galaxies, Monthly Notices of the Royal Astronomical Society 495, 3705

Marasco, A. and 11 colleagues incl. Dettmar, R.-J., 2019, HALOGAS: the properties of extraplanar HI in disc galaxies. Astronomy and Astrophysics 631, A50

Kamphuis, P. and 7 colleagues incl. Dettmar, R.-J., 2015, Automated kinematic modelling of warped galaxy discs in large H I surveys: 3D tilted-ring fitting of H I emission cubes. Monthly Notices of the Royal Astronomical Society 452, 3139

45 refereed papers in the last five years with h-index of 14

Summary of research plan:

Background: The 21cm line emission of neutral hydrogen (HI) is one of the most important tracers of gas kinematics in galaxies. With the new radio-telescope arrays built as precursors of the Square Kilometre Array (SKA), namely ASKAP in Australia and MeerKAT in South Africa, several survey projects have been initiated to document the baryon content of the universe on all scales much better than ever before by measuring this prevalent component of the interstellar medium. These surveys also cover a number of galaxies that have been identified as interacting or even merging. The new observations at higher sensitivity and better angular resolution will be used to study the internal kinematics of interacting galaxies. This will contribute to the topical discussion of "infall" vs. "outflow" of baryonic matter in galaxy evolution.

Study objective: Case studies of selected target galaxies will allow to quantify a number of parameters for the gas kinematics relating the HI gas to evolutionary processes in disk galaxies. Examples of such parameters are the lagging of gaseous halos or the radial inflow of gas from the outskirts of the disk into the bar/bulge region. The use of pipeline processing will allow to analyze a larger sample of galaxies. This sample will be used to perform a parameter study for a statistically significant sample of targets in order to address, e.g., the influence of bar-strength or the environment on the gas flows.

Expected Results: Individual case studies as well as a global analysis will be published in refereed journals.

Methods: The project will make use of new observations obtained with the MeerKAT telescope in South Africa. The TiRiFiC Code (https://gigjozsa.github.io/tirific/) will be used to model the gas kinematics.

Candidate Requirements: MSc in Physics or Astronomy, good English language skills.

Motivation for CSC application: The observational part of the project is connected to two so-called Large Survey Projects at the MeerKAT radiotelescope in South Africa organized by international teams: the Fornax cluster survey and MHONGOOSE. The prospective student will be working closely with members of these teams and will thus work in a very international environment. The group at RUB is very experienced in using observational data in various wavelength regimes and the PhD candidate will thus receive on the spot training by his/her peers. In addition, participation in appropriate training programs run by several observatories is encouraged and supported. The PhD program of the faculty of physics and astronomy requires a minimum of credits in interdisciplinary skills development; appropriate courses are offered by the faculty as well as by the Ruhr University Research School RURS (https://www.research-school.rub.de/).