CSC-RUB PhD Project Proposal

Title: A multiwavelength study of gaseous galactic halos

Sector of research: Physics/Astrophysics

Degree awarded: Dr. rer. nat.

Keywords: evolution of galaxies, galactic halos, circum-galactic medium, multi-wavelength observation, galactic fountain flow, radio astronomy, X-ray astronomy

Supervisors of PhD project:

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Prof. Dr. Hendrik Hildebrandt, Astronomical Institute, Faculty of Physics and Astronomy, Ruhr University Bochum (RUB); co-director of the German Centre for Cosmological Lensing (GCCL)

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 radio-telescope projects with participation in appropriate Key Science (KSPs) or Large Survey (LSPs) Projects, respectively, at those telescopes. Research in this field 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:


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

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<th>Summary of research plan:</th>
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**Background:**
The observed properties of galaxies in the nearby universe cannot be explained by accretion into a dark matter potential over cosmological times without additional feedback processes required to redistribute the angular momentum of the baryons. For less massive disk galaxies feedback resulting from the energy and momentum release by star formation through, e.g., stellar winds and supernovae is expected to contribute to the large-scale exchange of matter between the disk and halo (or circum-galactic medium) resulting in a multiphase interstellar medium in galactic halos. The detailed physical processes of the material transport, however, are not well understood and the project will observationally address some of the open questions. One focus in particular will be on the role of cosmic rays for the heating of the diffuse ionized component.

**Study objective:**
Very sensitive radio-continuum observation will be used to trace down the cosmic rays streaming from the disk into the galactic halos. Properties of the cosmic ray component of the interstellar medium (ISM) such as spectral index or the magnetic field structure (regular vs. turbulent component) will be compared in selected regions of the galaxies under study with properties of other phases of the ISM (e.g., ionization and excitation of the diffuse ionized medium). Possible connections to the hot, X-ray emitting phase of the ISM will be explored.

**Expected Results:**
The analysis will, e.g., allow to constrain the possible influence of CRs on the ionization and excitation of the diffuse ionized gas in galactic halos. The results will be published in refereed journals.

**Methods:** The project will make use of new observations obtained at international radio-observatories such as the Jansky Very Large Array (JVLA) or MeerKAT, combined with archival data, e.g., from X-ray satellites and optical observatories.

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

**Motivation for CSC application:**
The radio-continuum part of the project is connected to the CHANG-ES project, a radio-continuum study of galaxies conducted with the JVLA by an international team. The prospective student will become a member of this team 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; this is offered by the faculty as well as by the Ruhr University Research School RURS (https://www.research-school.rub.de).