

# Individual External Collaborator Project Proposal

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**WG(s) involved in the project:** eROCompact

## **Scientific Project description:**

The population of over 2,800 neutron stars observed in our Galaxy is remarkably diverse. A better sampling of the sources that are silent in the radio and gamma-ray regimes, which include the “magnificent seven”, magnetars, and central compact objects in supernova remnants, is essential to test alternative evolutionary scenarios of neutron star evolution, constrain the galactic rate of supernova type-II explosions, and have a comprehensive view of the neutron star phenomenology.

After four years of all-sky survey, eROSITA will be about 30 times more sensitive to neutron stars than the ROSAT Bright Source Catalogue. The selection of newly proposed INS candidates among the myriad of eROSITA-detected sources and transient phenomena will be challenging: their identification and characterization will require synergy with large-scale, multiwavelength, photometric, and spectroscopic surveys. State-of-the-art observing facilities, in particular 8-m-class optical telescopes, the XMM-Newton and Chandra observatories, are crucial for dedicated follow-up campaigns to be conducted already in the immediate aftermath of the eROSITA survey.

After the successful Spektr-RG launch in July 2019, the 4-year all-sky survey of eROSITA started in mid-December 2019. As of April 2020, the first astrometrically corrected catalogues are being released within the eROSITA\_DE Consortium. We expect to use the early data to test search algorithms and define strategies for coordinated follow-up campaigns, mainly in the optical and in X-rays. This work will pave the ground for future INS searches performed at full survey sensitivity. The work is to be taken over and further developed by the PhD student to be hired in project P4 of the eRO-STEP proposal submitted to the DFG.

On the short term this proposal also covers the PV phase observation of the middle-aged radio pulsar PSR B0656+14. The eROSITA PV phase observation, performed simultaneously with XMM-Newton TOO in October 2019, focus on a detailed investigation of the neutron star atmosphere, the SED, and of phase-dependent absorption features reported in the literature. Updates of those initial investigations were submitted to the wiki page of the corresponding PV phase observation.

The analysis of the PV data is ongoing. To fully assess the performance of the telescopes and instrumental response at soft energies, we are making use of other targeted PV and calibration eROSITA observations of well known INSSs.

**Required data, supporting datasets and/or tools:**

Standard catalogues eRASS:1 and eRASS:2, Gaia, SDSS, PanSTARRs

**List of Potential Collaborators within eROSITA\_DE**

The team analyzing the PV phase observations of PSR B0656+14 (eROPUB #87) is composed of Axel Schwope (PI), Frank Haberl, Chandreyee Maitra, Klaus Werner, Valery Suleimanov, and Werner Becker

The team initiating the search for neutron stars in eRASS data (eROPUB #116) is composed of Axel Schwope, Frank Haberl, and Werner Becker.

**Expected Outcome**

The expected outcome is a scientific paper describing the results of the simultaneous eROSITA/XMM-Newton observations of PSR B0656+14. The anticipated result of the second topic, the search for new INS candidates in the first year of the eROSITA All-Sky Survey, will likely be a catalogue of candidate objects for dedicated multiwavelength follow-up campaigns.

**Expected duration of the project**

One year