**Individual External Collaborator Project Proposal**

Project Proposer: Silvia Belladitta

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eROSITA\_DE Sponsoring Member: Julien Wolf

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Project ID Number for this proposer: 1

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

**Scientific Project description** (up to two pages, all included):

Blazars are jetted active galactic nuclei (AGN), with their jets aligned close to the observers’ line-of-sight. They are strong probes for AGN demographics, as it can be shown that for every blazar detected, one can infer the presence of 2Γ² analogous sources with their jets pointing in different directions, at the same redshift. This makes the search for blazars particularly interesting at z>4, where space density of quasars decreases exponentially with redshift, making the census of quasars challenging. We propose to exploit synergies between radio observations and the eROSITA all-Sky Survey, aim at characterising the high-redshift blazar population. We specifically limit our investigation to z>4. The following proposal encompasses three potential sub-projects:

1. **Radio follow-up of eROSITA (radio-loud) quasars at z>5.6:** We propose the radio follow-up observations of all quasars detected with eROSITA in the first Gyr after the Big Bang (i.e. z>5.6). The X-ray emission of quasars detected in eRASS can be produced either because of relativistic beaming of an aligned jet, or via inverse Compton of CMB photons on the jet content. To disentangle the nature of this emission and be competitive in finding high-redshift blazars, a systematic radio follow-up of the z>5.6 quasars detected in consecutive eRASS scans as well as in the cumulative eRASS catalogues is crucial. This will be closely related to the search for high-redshift quasars led by Julien Wolf. The array or telescope to be used will depend on the declinations of the object. Observing proposals with JVLA and VLBA will be submitted for objects at dec>-40°, while Australian arrays (e.g. ATCA) will be considered at lower declinations.

*Expected output: a section in a potential discovery paper by J. Wolf or a separate paper on the radio follow-up led by T. Sbarrato.*

1. **Cross-match of high-z blazar candidates and known blazars at z>4.** The aim of this sub-project is to characterize the X-ray and radio properties of the currently known distant blazar population, e.g. the impact of the iC-CMB effect on the space density of blazars (Ighina et al. 2019). The samples used for this project are:
   1. all known z>4 blazars in the literature (currently ~30 sources)
   2. z>4 blazar candidates out of radio quasar lists (e.g. the newly published SDSS DR16Q spectroscopic analysis, containing about 140 z>4 radio sources)

*Expected output: 1 paper co-led by S. Belladitta and T. Sbarrato*

1. **Systematic verification for eROSITA detections of new z>4 blazar discoveries in the DE footprint**: in addition to blazars and candidates from sub-project 2., we propose to match to the eRASS catalogues any new and upcoming blazar candidate at z>4 while the project is active, in order to have an indication of its X-ray properties and possibly constrain its relativistic jet features.

*Expected output: TBD*

***Specific contributions of EC***

*Dr. Silvia Belladitta is a specialist in the search and multi wavelength characterization of high-z radio-loud AGN, optical and near-infrared photometric and spectroscopic data reduction and analysis, radio proposals, data reduction and analysis, as demonstrated by 3 first author publications of newly discovered z>5 blazars, and many co-author publications on the subject in the last 4 years. Dr. Belladitta will contribute with newly discovered blazar candidate samples, expertise in submitting radio proposal, and multi-wavelength data interpretation.*

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

* eRASS:1, eRASS:4, eRASS2-5 source catalogues + multi-wavelength counterpart catalogues.
* Radio surveys: FIRST, NVSS, RACS, VLASS

We only request access to eSASS photometry and coordinates (+ cutouts) of individual sources identified in the project of J. Wolf and individual sources found and matched in the context of sub-projects 2 and 3.

**List of Potential Collaborators within eROSITA\_DE: Julien Wolf, Mara Salvato, Kirpal Nandra, Joern Wilms, Steven Hämmerich, Werner Collmar**

#### Expected Outcome: at least 2 papers (see detail in proposal)

#### Expected duration of the project: 1 year in order to cover all possible *cfp* for radio observations (possible extension request after 1 year)

#### Responsibility of the eROSITA member sponsor of the project: Julien Wolf, as sponsoring member, will ensure that eROSITA data are accessed and used for the purposes of this project only, and not in a way that would negatively affect the scientific interests of existing collaboration members.