



# Report from the Short Term Mission – STM

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<b>PERSON NAME:</b>	<b><i>GABRIELE BRUNI</i></b>
<b>HOME INSTITUTE</b>	<i>INAF – ISTITUTO DI ASTROFISICA E PLANETOLOGIA SPAZIALI (ROME, ITALY)</i>
<b>HOST COLLABORATOR</b>	<i>Dr. Tiziana Venturi</i>
<b>HOST INSTITUTE</b>	<i>INAF – ISTITUTO DI RADIOASTRONOMIA (BOLOGNA, ITALY)</i>
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# Report:

## 1. TOPIC

- *The goal of the visit was a training on the reduction and interpretation of GMRT (Giant Metrewave Radio Telescope, India) data for a sample of 14 giant radio galaxies (GRG). The key experience of the host on wide-field imaging at low frequencies was the main reason for the visit, allowing the dissemination of this expertise.*

## 2. PROPOSED AND PERFORMED WORK

- *Radio imaging of complex structures like GRG requires deep knowledge of the instrument and the imaging synthesis technique in interferometry. The collaboration with T. Venturi started in 2014 with the definition of a sample of these objects, selected from their soft-gamma ray flux as detected by Swift/BAT and INTEGRAL/IBIS space-based telescopes. The IBIS detector (Imager on Bord the INTEGRAL Satellite - Ubertini et al. 1996, Proc. SPIE Vol. 2806, p. 246 ), is the instrument to which the IAPS group in Rome has devoted much effort in the past years, including the definition of a sources catalogue in the soft gamma-ray band. GMRT observations for the defined GRG sample were obtained to study the puzzling larger fraction of these objects found by our group in the combined INTEGRAL/IBIS-Swift/BAT catalogues (Bassani et al. 2016, MNRAS 461, 3165), and cross-correlate their extended morphology visible in the MHz range with the nuclear properties in the soft gamma-ray band.*
- *During the visit, calibration and imaging of GMRT data were performed for one of the most promising objects among the 5 observed (IGR J14488-4008), revealed to be a newly-discovered GRG by our group (Molina et al. 2015, MNRAS 451, 2370). Also data from low-frequencies surveys were inspected (GLEAM, TGSS), in order to collect all the possible information from 70 to 325 MHz. The well-detected extended structure found for this object was used as a testbed for the optimization of the data reduction process for our targets. Imaging of the remaining sources is ongoing, and will be included in a publication on the MHz-domain properties of our entire sample of 14 GRGs.*

## 3. CROSS-DISCIPLINARITY

- *The transfer of the radio expertise from IRA to IAPS will favor a cross-disciplinary approach of the project, bridging the high-energy astrophysics community with the radio one. IRA is historically the leading institute for Radio Astronomy in Italy, and has been offering its facilities to the international scientific community since the early '80s. Its commitment spans from single-dish observations to Intercontinental VLBI projects, also contributing to the R&D technological efforts for the next generation telescope as SKA. The extragalactic group hosting the visit (T. Venturi, D. Dallacasa et al.) has been studying extended radio galaxies and their connection with X/gamma-ray emission during the past decade. IAPS, where G. Bruni is based, is an institute devoted to high-energy astrophysics performed from space, and contributed to many space-based missions (AGILE,*



*INTEGRAL*), managing and developing telescopes in the X/gamma-ray bands. After 15 years in space, *INTEGRAL* has contributed to the most complete catalogue of soft-gama ray sources, from which the GRG sample has been extracted. Thus, it is of paramount importance to perform a joint study of these objects in order to implement the complementary information collected in the radio and soft gamma-ray bands with different instruments, joining the expertise of both working groups.

- Lately, the AGN field has greatly benefit from a multi-wavelength approach: this project will include other radio facilities like VLBA, Effelsberg, EVN, and JVLA, trying to address the fundamental questions about jet formation and collimation, and the duty cycle of the radio phase in AGN.

#### **4. IMPACT**

- *The outcomes of the project, thanks to its study of the correlation between Radio and soft gamma-ray emission, could help in defining the future projects making use of the next generation Radio (SKA) and X-ray instruments (ATHENA), giving possible inputs on the exploitation of future facilities for the AGN field studies. Instrument configuration, resolution, and sensitivity needed to study these objects at the end of the radio-life track will receive important contributions from projects developed with previous generation telescopes, like this one, for which the community has nowadays reached a deep knowledge and expertise.*

#### **5. PUBLICATIONS**

- *Results from the GMRT analysis will be published in a refereed journal in the next months (most probably A&A), or even more paper in case peculiar properties will be found for some sources.*
- *“Soft gamma-ray selected GRGs seen in the MHz domain”, G. Bruni et al. 2018 (in prep.)*