Scuola di Dottorato in ICT

PhD School in ICT

Research project for a PhD curriculum in ICT – Computer Engineering and Science

**Tutor**: Prof. Domenico Beneventano

**(\*) Italian Co-tutor:** Ing. Andrea Bulgarelli (INAF)

**(\*\*) Foreign Co-tutor:**

**Proposed Title of the research:**

Data management for astronomical data and science alerts

**Keywords: (5)**

Astronomical Data, Data Warehouse, Big Data**,** Data Analysis, Data Visualization

**Research objectives: --(max 10 rows)**

**Gamma-ray** astronomy is the astronomical observation of gamma rays, the most energetic form of electromagnetic radiation. A **gamma-ray transient** of an astrophysical source is a variable behavior, i.e. a significant change in the level of gamma-ray emission; in general, they are associated with catastrophic events involving compact objects, such as white dwarves, neutron stars, and black holes. To understand these phenomena they must be observed during their evolution and communicated immediately to the international astrophysical community. For this reason, the speed is crucial, and automated data analysis pipelines are developed to detect gamma-ray transients and generates **science alerts** (a significant detection of a transient source that requires a follow-up strategy) immediately. The objectives of this research will be the optimization of **data retrieval, analysis and visualization** techniques for the management and identification of science alerts.

**Proposed research activity -- (max 10 rows)**

The research activity will start with the study of the existing approaches for science alert generation and management. A **database for astronomical data and science alerts** will be implemented with a related Data Warehouse: optimization techniques for **Big Data** management will be studied for data access and retrieval using in-memory and key-values database (e.g. Redis - <https://redis.io>). The science alerts and the sky maps will be represented using the HEALPix **spatial representation** of the celestial sphere (Hierarchical Equal Area isoLatitude Pixelisation,  
<http://healpix.jpl.nasa.gov> ). This representation will be used to prepare the data for **Analysis** techniques to search and recognize gamma-ray transient in the sky that will be integrated into a **real-time scientific analysis pipeline**. **Visualization techniques** of the sky connected with the proposed technologies will be studied. The development will also be done on an available Power8+ machine with two GPU P100 (<http://www-03.ibm.com/systems/power/hardware/s822lc-hpc> ).

**Supporting research projects (and Department)**

AGILE (<http://www.iasfbo.inaf.it/space/agile>) and e-ASTROGAM (<http://eastrogam.iaps.inaf.it>)

**Possible connections with research groups, companies, universities.**

Istituto Nazionale di Astrofisica (INAF)

(\*) optional

(\*\*) optional/to be completed on the second year