INAF Trieste Astronomical Observatory Information Technology Framework

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ABSTRACT

INAF Trieste Astronomical Observatory (OATs) has a long tradition in information technology applied to Astronomical and Astrophysical use cases, particularly for what regards computing for data reduction, analysis and simulations; data and archives management; space missions data processing; design and software development for ground–based instruments. INAF – OATs participated, since the beginning, in Italian Grid and Cloud initiatives gaining a major role in Italy and in Europe in large projects for the development of a multidisciplinary platform for distributed computing and data resources sharing. Recently it participated in EU EGI.eu projects, coordinating the Astronomy and Astrophysics community, for the development of a cloud based infrastructure in Europe with the aim to spread the IVOA standards based interoperability with CANFAR in Canada. INAF – OATs deployed a computing centre that offers HPC and cloud resources for internal users, INAF and large international projects. Now INAF – OATs is active in the design of the SKA regional centres. In this poster we describe our technological stuff and main computing activities.

Computing and Data Infrastructure

The computing resources at INAF-OATs has been acquired thanks to DHTCs project and other EU funded projects.

INAF-OATs has two main computing resources: a HPC/HTC cluster and a cloud stack.

The HPC/HTC HOTCAT Cluster

- **1400 INTEL Haswell E5–4627v3 cores**
- **6GB RAM/Core (8.5TB RAM total)**
- **500 TB parallel storage (BeeGFS)**
- **Storage Nodes INTEL Haswell E5–4627v3 256GB RAM per node**
- **Infiniband ConnectX–3 Pro Dual QSFP+ 54Gbs**

The Interconnect allows high throughput and low latency (1 microsec). Storage is distributed on 4 BeeGFS nodes guaranteeing 2 GB/sec of throughput.
It is equipped with more than 60 software environment for Astronomical **data reduction** and analysis. It offers tools for software development, **profiling and debugging**.

The CloudCAT Cluster is a OpenStack stack with a swift object storage

- **400 INTEL Westmere E5620 @ 2.40GHz cores**
- **8GB RAM/Core**
- **75 TB Object storage (BeeGFS)**
- **Infiniband 10Gbs**

It is provided to users with Virtual Machine pre–configured with Astronomical Software (e.g. ESO Scisoft) and remote desktop capabilities to allow easy access and usage.

It is compliant with EGI–Federated cloud resources.

Path towards ExaScale

INAF is one of the leading institutions participating to the design and prototyping of new **Exascale supercomputers** in Europe.

ExaNeSt European funded project is developing, evaluating, and prototyping the physical platform and architectural solution for a unified Communication Storage Interconnect, plus the physical rack and environmental structures required to deliver European Exascale Systems. http://www.exanest.eu/

EuroExa funded project brings a holistic foundation from multiple European HPC projects and partners together with the industrial SME to co–design a ground–breaking platform capable of scaling peak performance to 400 PFLOP in a peak system power envelope of 30MW; over four times the performance at four times the energy efficiency of today's HPC platforms. Further, it targets a PUE parity rating of 1.0 through use of renewables and immersion–based cooling. http://www.euroexa.eu

ESCAPE & EOSC Integration

ESCAPE (European Science Cluster of Astronomy & Particle physics ESFRI research infrastructures) is a European H2020 project to integrate IVOA (International Virtual Observatory Alliance) compliant VO (Virtual Observatory) services within the EOSC (European Open Science Cloud) hybrid cloud scenario and to test containerization of VO aware applications.

The **ESCAPE** project collects outcomes of previous cluster projects ASTERICS (Astronomy ESFRI & Research Infrastructure Cluster) and AENEAS (Advanced European Network of E–infrastructures for Astronomy with the Square Kilometer Array (SKA)).
ASTERICS brought together researchers, scientists, specialists and engineers from astronomy, astrophysics and astro–particle physics to develop instruments implementing common solutions to common challenges.
AENEAS was to develop a science–driven, functional design for a distributed, federated European Science Data Centre (ESDC) to support the astronomical community once the Square Kilometre Array (SKA) becomes operational. Goal of ESCAPE is to integrate the results of these projects in a platform satisfying the requirements of SKA and the ESFRIs, ready to be part of the EOSC.
The INAF–OATS computing facility will be used as an integration testbed in the scope of ESACAPE WP4 (Connecting ESFRI projects to EOSC through VO framework) and WP5 (ESFRI Science Analysis Platform) to integrate IVOA compliant VO standards and services within the EOSC hybrid cloud scenario and to test the containerization of VO aware applications. Aim of this integration is to provide Astronomical community the availability of a VO compliant framework integrated in the EOSC platform.

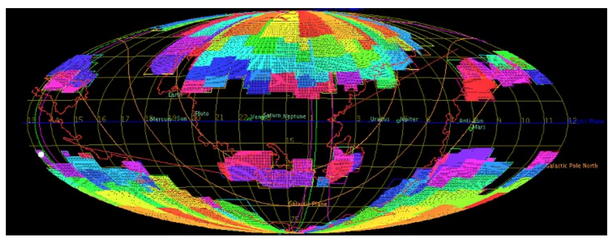
CHIPP 2017–2019

The main purpose of INAF CHIPP project is to provide HTC and HPC resources (for small/medium size programs) to the INAF community using the already existing infrastructures. **INAF at Trieste** and Catania already make available Tier–2/Tier–3 systems (1,200 CPU/core) for all the INAF community. See P6.8

Programs HighLights

EUCLID

Euclid is an European Space Agency (ESA) space mission. Scheduled for 2022, it will place a telescope in space with the aim of studying the geometry of the dark universe. Euclid will collect many millions of images for at least 30 Pbytes of data, which will then have to be combined with other large data archives of images acquired with ground–based telescopes.

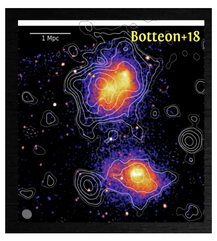


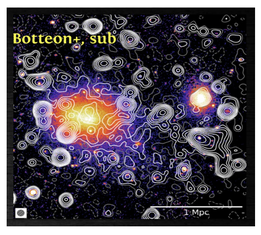
Credit: Euclid Consortium

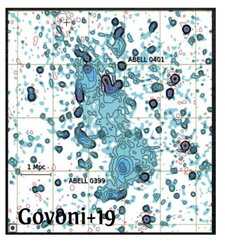
INAF-OATS is involved in the Euclid Consortium Science Working Groups and in the Euclid Consortium Science Ground Segment (ECSGS). It offers computing resources for the distributed computing Infrastructure of Euclid.

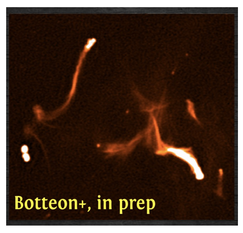
LOFAR

In 2018 INAF becomes member of the International LOFAR Consortium. LOFAR (Low–Frequency Array Telescope) is a radio telescope consisting of stations located in various countries in Europe. It operates between 10 and 240 Mhz allowing detailed sensitive high–resolution studies of the low–frequency radio sky. With its sensibility LOFAR is the most important SKA low frequency precursor.









INAF–OATs implements and coordinates a distributed computing and data infrastructure in Italy to process LOFAR big data and to support scientists for the data reduction and analysis activities.

Numerical experiments

The combination of a pre–exascale HPC infrastructure, joined by the development of novel paradigms for massively parallel computing applied to cosmological simulation codes, will enable scientists to carry out a multi–year simulation campaigns, whose final aim will be to provide a unifying interpretative framework for the cosmological experiments of the next two decades.
A set of simulations interlaced in dynamic range (mass and force resolution) and cosmic time coverage would be designed to study cosmic evolution from the pre–ionization era, to the low–redshift universe. **2.0M core_hours** of INAF-OATS HPC cluster has been used for numerical experiments.

http://tiny.cc/193eaz

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