OAS Monitoring and Control

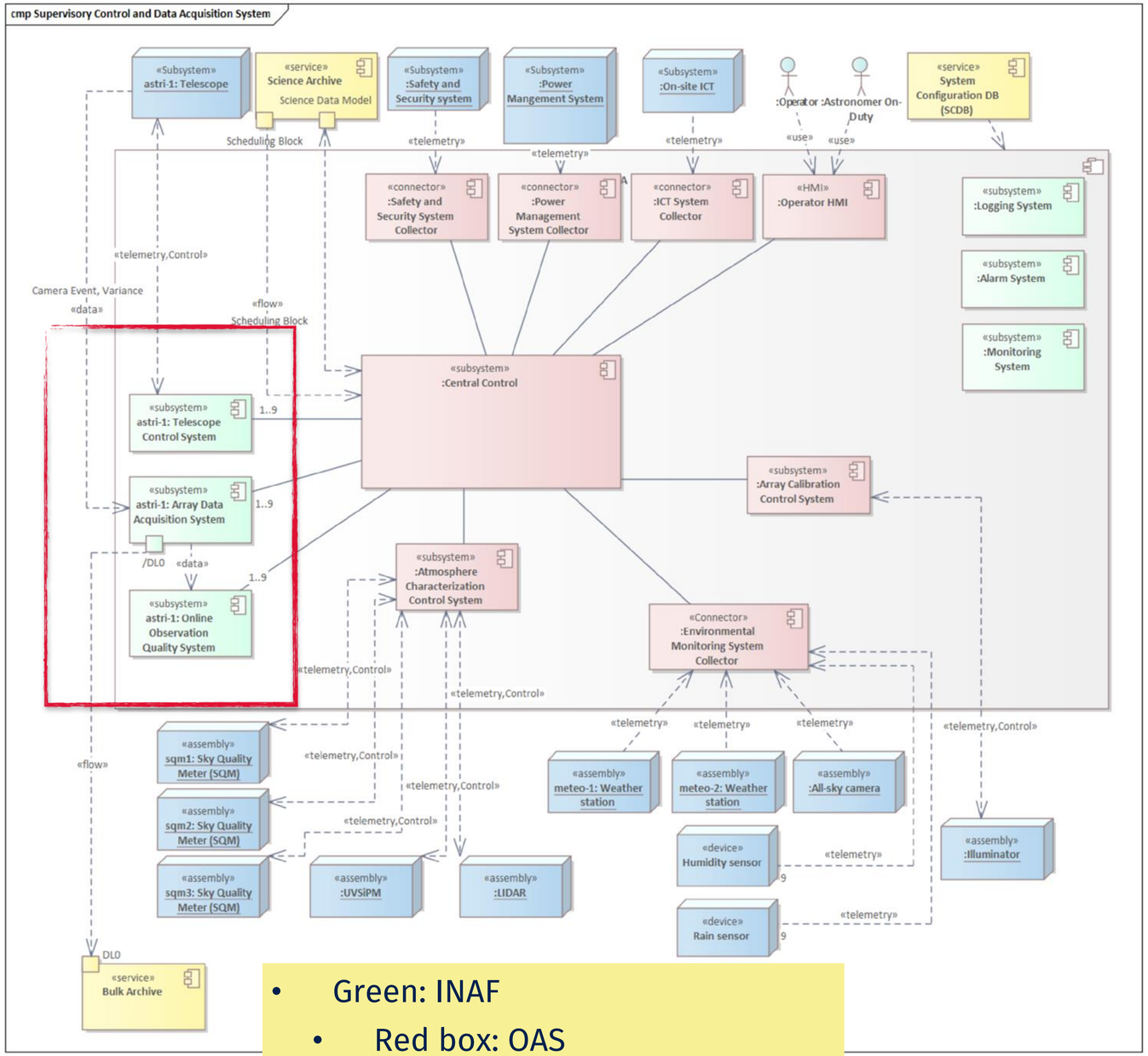
Astri Mini-Array and **Gamma Flash** are two OAS main projects involving technology for monitoring and control

- ASTRI – MA derives from the experience gained from the ASTRI HORN prototype installed in Serra La Nave in Sicily and deals with the implementation of an observatory of an array of 9 Cherenkov telescopes that will be installed at the Teide observatory in Tenerife.

- Gamma Flash derives from the experience gained from the AGILE project and is aimed at the development of airborne and terrestrial instruments, for measurements on TGF (Terrestrial Gamma Ray Flash).

ASTRI Mini-Array: SCADA

- **The Supervisory Control and Data Acquisition (SCADA)** is an on-site software system controlling all the operations carried out at the MA site.
  - is a distributed software system based on Alma Common Software (ACS) that shall manage start-up, shutdown, configure, supervise and control of all site **assemblies** and **subsystems**.
  - SCADA is responsible for the execution of the observations and shall normally perform the operations in an automated way but is supervised by the **Operator** located in one of the ASTRI Control rooms.
  - SCADA collects monitoring points; manage alarms raised by any assembly; check the health status of all systems and acquire scientific data.
  - SCADA shall collect scientific data provided by the scientific instruments, logging, monitoring points, and alarms provided by the ASTRI MA assemblies, and provide online observation quality information to the **Operator** in order to assess the quality of data during the acquisition.



- Green: INAF
  - Red box: OAS
- Red: industrial contract
- Operator HMI: University of Geneve

Telescope Control System

An intuitive description for the TCS...

- **TCS offers Interfaces for control and monitor**:
  - Telescope Mount
  - Cherenkov Camera
  - PMC (Pointing Monitoring Camera)
  - Stellar Intensity Interferometer Inst.
  - Telescope Health and Safety …

OPC-UA OPC-UA OPC-UA OPC-UA OPC-UA OPC-UA OPC-UA OPC-UA OPC-UA OPC-UA OP

ALMA COMMON SOFTWARE

- **Local Control systems for the management of Hardware devices**
  - Telescope Mount
  - Cherenkov Camera
  - PMC (Pointing Monitoring Camera)
  - Stellar Intensity Interferometer Inst.
  - Telescope Healt and Safety …

Telescope Control System

ASTRI Mini-Array

ASTRI › SCADA › telescope-control-system

telescope-control-system

Project ID: 680 Leave project

172 Commits **3** Branches **1** Tag **26.4 MB** Files **1.3 GB** Storage

dev telescope-control-system / + History Find file

Adding test case scripts for running PMC test
Federico Russo authored 3 weeks ago

README GNU LGPLv3 CI/CD configuration Add CHANGELOG Add CONTRIBUTING

Configure Integrations

Name	Last commit
CDB	roll back MountDeviceConnector to previous generated one (new gener...
Connectors	added geOpcUa both in IDL and PMCDeviceConnectorBaseImpl (using r...
IDL	added geOpcUa both in IDL and PMCDeviceConnectorBaseImpl (using r...
MATel01	added PMC to compilation process
MountSupervisor	linked PMCsupervisor to lifecycle start chain

The actual status of the TCS is progressively growing following the Use Cases document.

- Management of high level commands and implementation of the workflow **from the highest interface**, represented by the SCADA Central Control (which is now simulated by Junits) **to the lowest interface**, represented by Local Control Software (which is now simulated by opc-ua simulator).

  I.E. command for tracking, pointing, jogging motion, parking, requests for telescope assemblies state change etc.

- Implementation for Cherenkov Camera high level commands:
  I.E. Put online the Camera LCS, Stop the Camera LCS, Perform Camera Calibration and Perform a Cherenkov Observation.

- Centralized management for errors, alarms and logging.

- Hardware monitoring.

- Script for automatic execution for on site tests
  (I.E. automatic execution for stress test pointing AZ/EL…).

The TCS will be also used for Teide Observatory test activities

ASTRI Technological activities @OAS

- ASTRI Mini-Array
  - ASTRI software Deputy Software coordinator (A. Bulgarelli)
  - Responsibility of SCADA (A. Bulgarelli)
    - SCADA people: F. Russo, V. Conforti, N. Parmiggiani, V. Fioretti, L. Baroncelli, V. Pastore
  - Responsibility and development of the SCADA subsystems:
    - Telescope Control System (F. Russo)
    - On-Line Observation Quality System (N. Parmiggiani)
    - Array Data Acquisition System (V. Conforti)
  - Responsible of the on-site ICT (F. Gianotti)
  - Integration and deployment test bed (F. Gianotti, V. Conforti)
  - Software engineering activities and members of the software engineering team
    - Release Manager (V. Conforti)
    - Software Quality Assurance (V. Conforti)
    - Requirement, Architecture, Interfaces (A. Bulgarelli)
  - Interface Manager (A. Bulgarelli)
  - Responsibility of software in the ASTRI Data Center
    - Automated scientific analysis pipeline (N. Parmiggiani)
    - Cherenkov Camera Preprocessing (V. Conforti)

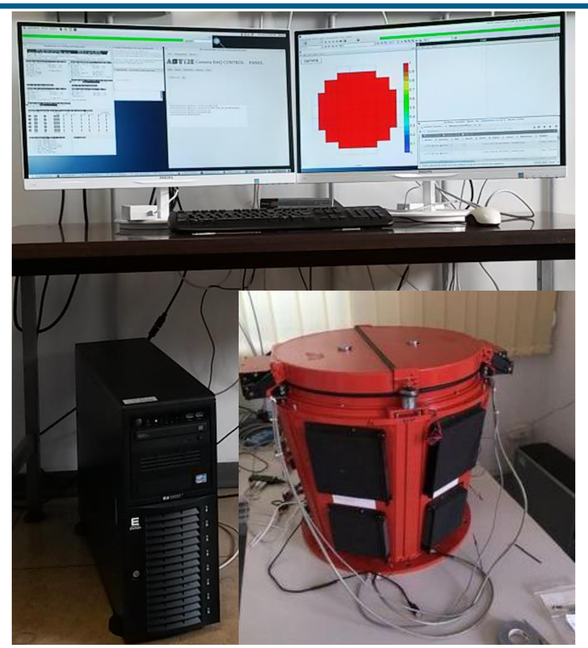
Science Ground Segment

SE/PA/QA

Tecnologie Informatiche

CTA & ASTRI Technological activities @OAS

- **ASTRI Horn** (M. Trifoglio, F. Gianotti, V. Conforti, V. Fioretti, F. Russo, A. Bulgarelli, N. Parmiggiani)**:**
  - Software for Development and test
    - Camera development and testing through an Instrument Workstation
    - Active Mirror Control
    - Software Development and Testing infrastructure
  - Software for Operations
    - Data stream Acquisition, pre-processing and storage
    - Engineering quick-look
    - Operator Control Room
  - ICT responsibility
  - Development of a prototype of automated science analysis



Gamma-Flash

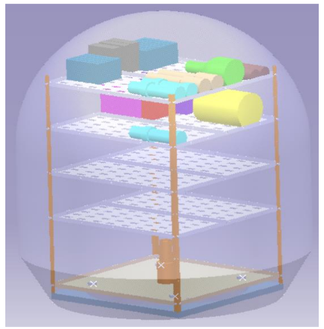
Gamma Flash is an Italian project funded by the Italian Space Agency and led by the National Institute of Astrophysics, dedicated to the observation and study of high-energy phenomena, such as terrestrial gamma-ray bursts, produced in the atmosphere during thunderstorms.

- hardware / software data processing pipeline was developed located at the “O. Vittori ”on the top of Monte Cimone (2165 m, central-northern Italy).
- Red Pitaya ARM-FPGA boards for capturing events at different energies from photomultiplier tubes and a main computer that receives data using a low-level TCP socket and runs a software pipeline in real time.
- It performs different data processing steps such as data reduction level, waveform selection algorithms and finally produces the cumulative energy spectrum of gamma radiation collected by the PMTs

Gamma-Flash project: gamma-rays and particles in thunderstorms and lightning

– Short emission (< ms) of gamma rays (MeV) linked to lightnings
– Bremsstrahlung from e- avalanche accelerated by ELM field of the lightning
– **Heritage of AGILE**

Gamma-Flash ground detector
installed at Mt. Cimone (Modena, 2165 m a.s.l.)

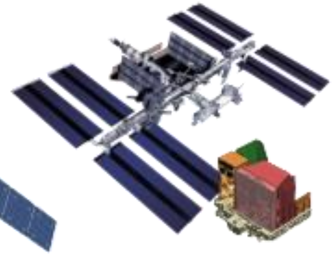


Terrestrial Gamma-ray Flashes detected from space experiments, aircrafts and ground

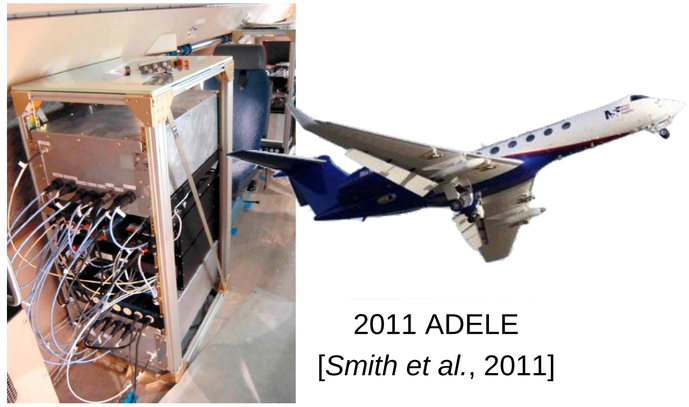
2002 - 2018
RHESSI
>5000 TGFs
[*Smith et al.*, 2005]

2007 -
AGILE
>5000 TGFs
[*Marisaldi et al.*, 2014; *Lindanger et al.*, 2020; *Maiorana et al.*, 2020]

2008 -
Fermi
> 5000 TGFs
[*Briggs et al.*, 2011]



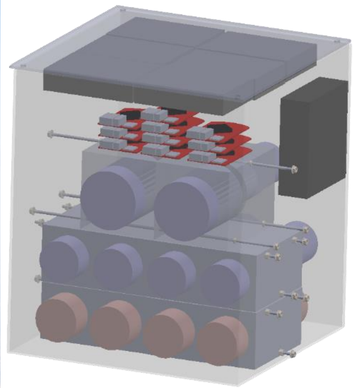
2018 -
ASIM (on ISS)
> 1000 TGFs
[*Østgaard et al.*, 2019]



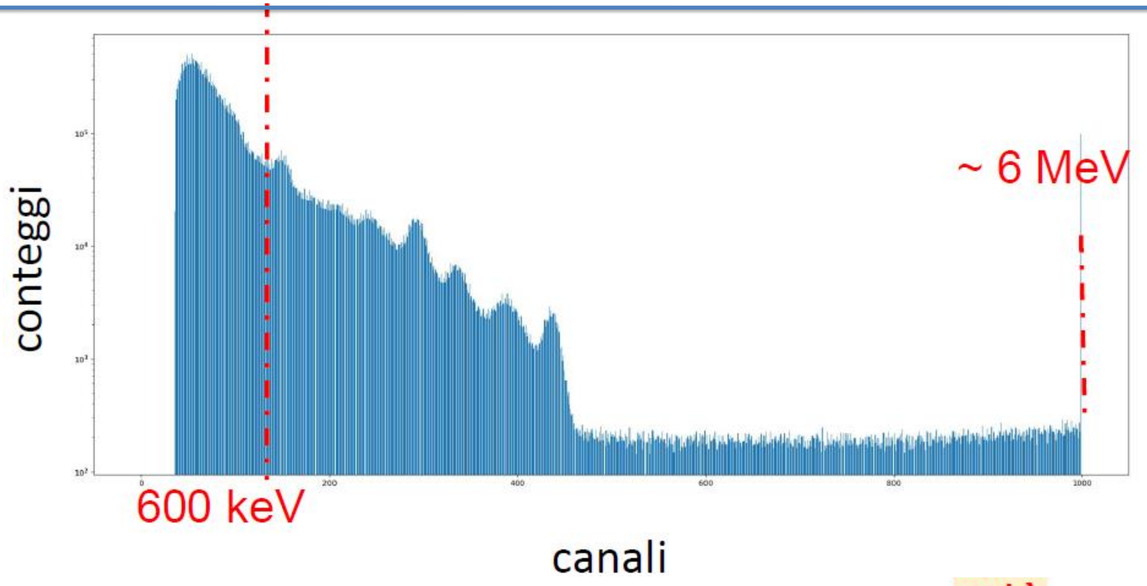
2011 ADELE
[*Smith et al.*, 2011]

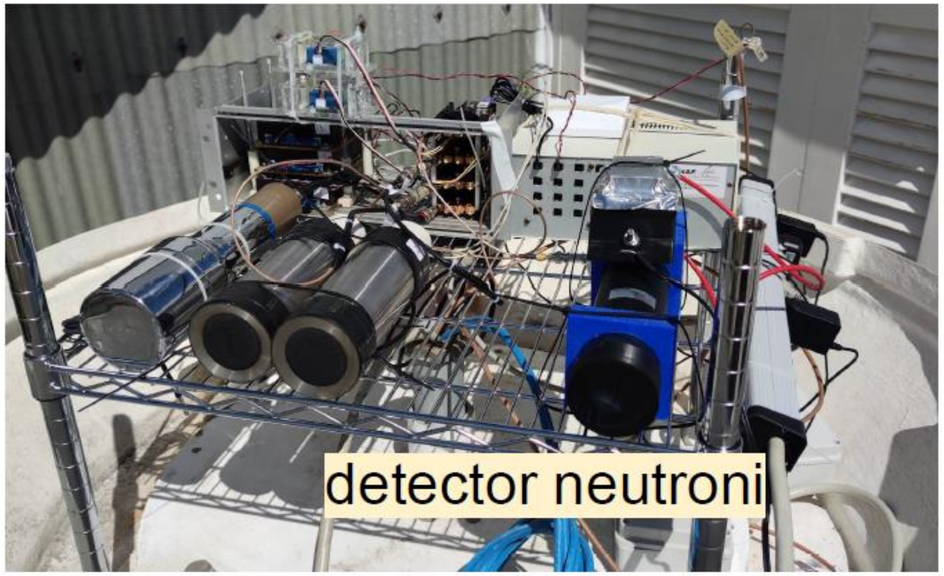
Neutron in thunderstorms [*Enoto et al.* 2019]

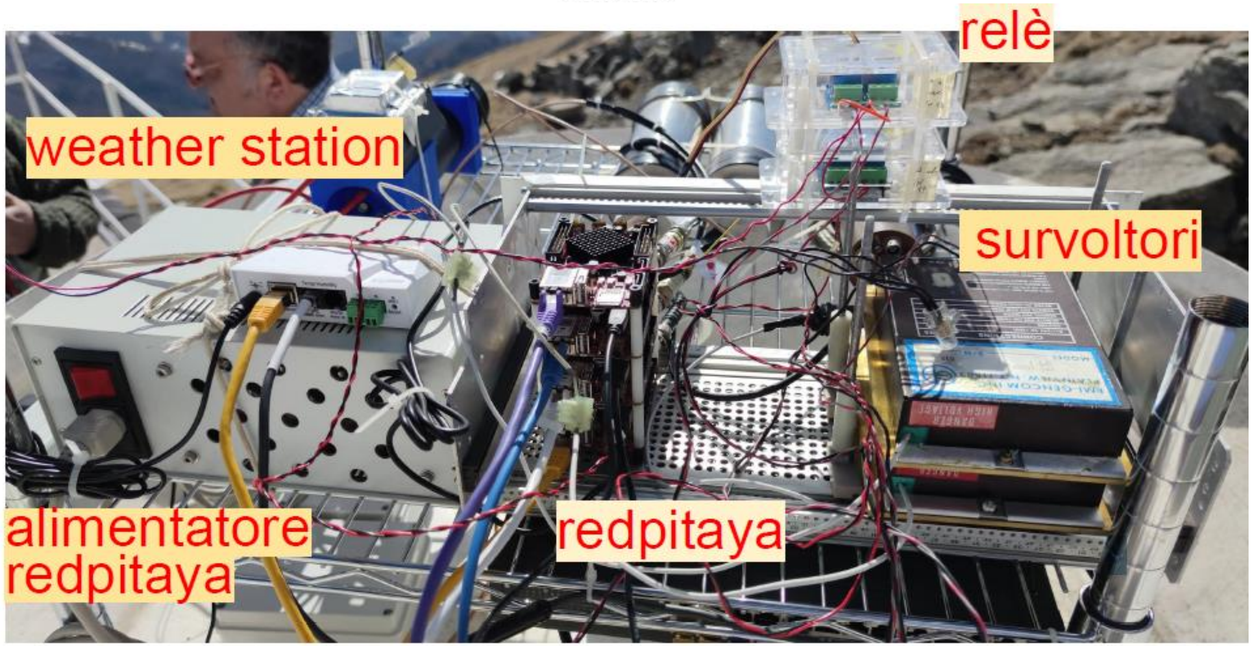
Gamma-Flash airborne detector
on a CESSNA Citation Mustang airplane



set-up sperimentale M.te Cimone







Gamma-Flash project People:

Enrico Virgilli	(Coordinator and developer for gamma detector)
Andrea Bulgarelli	(IT Manager)
Antonio Addis	(IT Developer)
Riccardo Campana	(Gamma Ray Detector Developer)
Adriano De Rosa	(IT Support)
Fabio Fuschino	(Gamma Ray Detector Developer)
Claudio Labanti	(Gamma Ray Detector Developer)
Ezequiel Marchesini	(Calibration team member)
Alessio Aboudan	(IT developer)