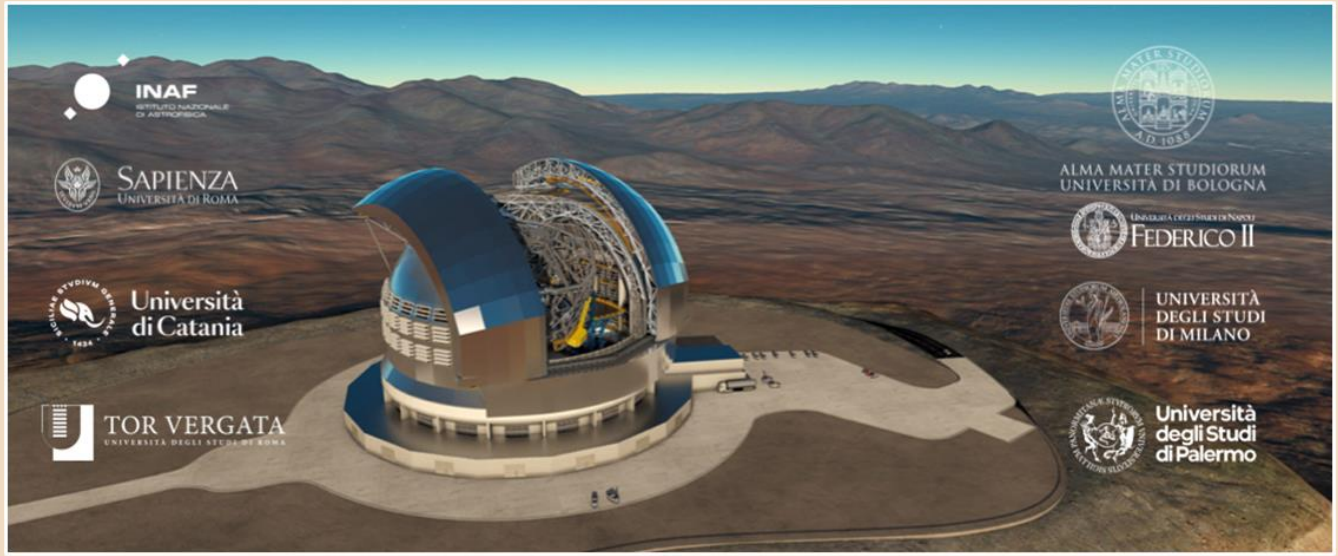
Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA
Progetti PNRR

STILES

Strengthening The Italian Leadership in ELT and SKA

WP 3000

Information Technology



M. Brescia

on behalf of the WP 3000 Members

Bologna, 1 ottobre 2024

PNRR STILES – IR0000034, CUP C33C22000640006
Missione 4 – Componente 2 – Investimento 3.1

WP3000

who ←

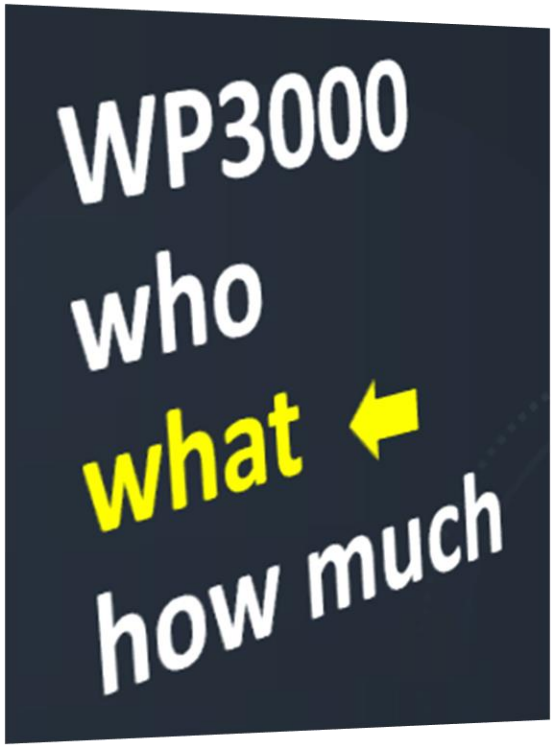
what

how much

M. Brescia

This WP includes the participation of several INAF Institutions and Universities through a series of **23 activities**:

- INAF
  - OA Abruzzo: *3401* (AL M. **Canzari**)
  - OA Arcetri: *3402* (AL E. **Giani**)
  - OA Brera: *3202* (AL M. **Riva**)
  - OA+IRA Bologna: *3303* (AL L. **Schreiber**), *3331* (AL I. **Prandoni**)
  - OA Cagliari: *3332* (AL A. **Possenti**)
  - OA Capodimonte: *3201* (AL E. **Cascone**), *3404* (AL G. **Capasso**)
  - OA Catania: *3333, 3403* (AL S. **Riggi**)
  - OA Padova: *3301* (AL C. **Arcidiacono**), *3405* (AL A. **Baruffolo**)
  - OA Palermo: *3311* (Al S. **Benatti**), *3312* (AL C. **Cecchi Pestellini**)
  - OA Roma: *3302* (AL R. **Piazzesi**), *3304* (AL G. **Fiorentino**), *3321* (AL E. **Merlin**)
  - OA Trieste: *3406* (AL P. **Di Marcantonio**)
- Dip. Fisica, Università Federico II di Napoli: *3101, 3102* (AL G. **Russo**), *3103* (AL G. **Longo**)
- Dip. Fisica e Chimica, Università di Palermo: *3313* (AL G. M. **Palma**)
- Dip. Statistica, Sapienza Università di Roma: *3322* (AL P. **Brutti**)



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This WP is devoted to deploy IT facilities to support the activities necessary for the development and exploitation of new generation astronomical instrumentation.

Main deliverables:

- AD HOC (Astrophysical Data HPC Operation Center): archiving and processing multi-band data by means of data science and Astroinformatics paradigms (**UNINA** *3101, 3102, 3103*)
- Advanced Software facilities:
  - producing an ensemble of SW tools for the scientific exploitation of AO data, ELT PSF reconstruction, stellar fields analysis (**OAPD** *3301*, **OAR** *3302, 3304*, **OAS** *3303*)
  - image topological analysis, and source deblending (**OAR** *3321*, **UNIRO** *3322*)
  - deep analysis of the origin and evolution of planetary atmospheres and the possible impact of biological processes (**OAPA** *3311, 3312*, **UNIPA** *3313*)
  - upgrading existing radio interferometry data reduction and analysis tools, optimizing them for either low and high frequency data (**IRA** *3331*, **OAC** *3332*, **OACT** *3333*)
- Support for instrument design: development of a INAF-wide Concurrent Design Facility, which will transform the way INAF develops its own instruments (**OACN** *3201*, **OABR** *3202*)
- Support for instrument control systems: a network of facilities for prototyping of control software (**OAAb** *3401*, **OAAr** *3402*, **OACT** *3403*, **OACN** *3404*, **OAPD** *3405*, **OATS** *3406*)

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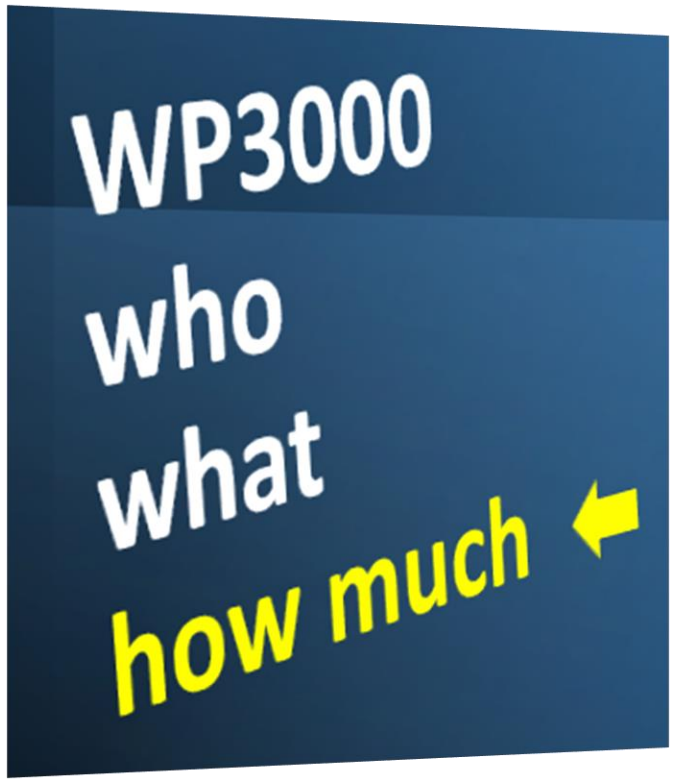
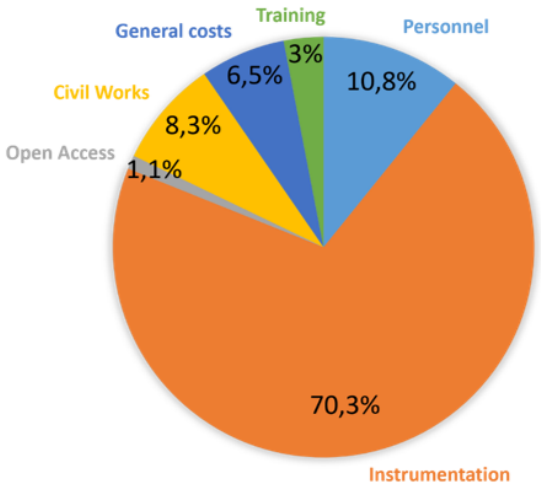
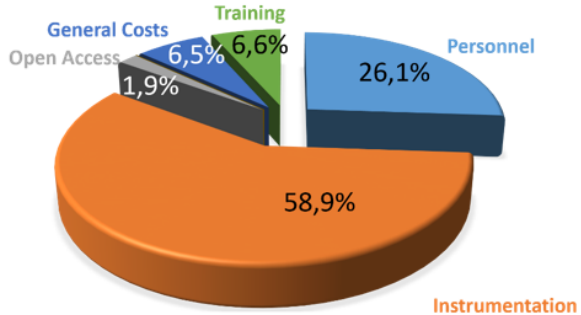


WP3000 – Cost Distribution



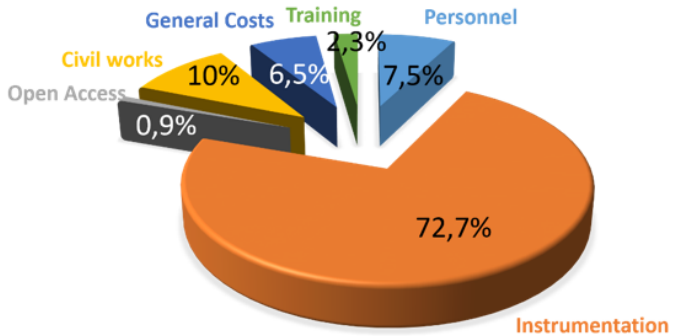
Total Budget € 10.984.263,69
~16% of STILES budget

Northern Italy



Budget € 1.932.314,80
~5% of Northern total budget

Southern Italy



Budget € 9.051.949,20
~27% of Southern total budget

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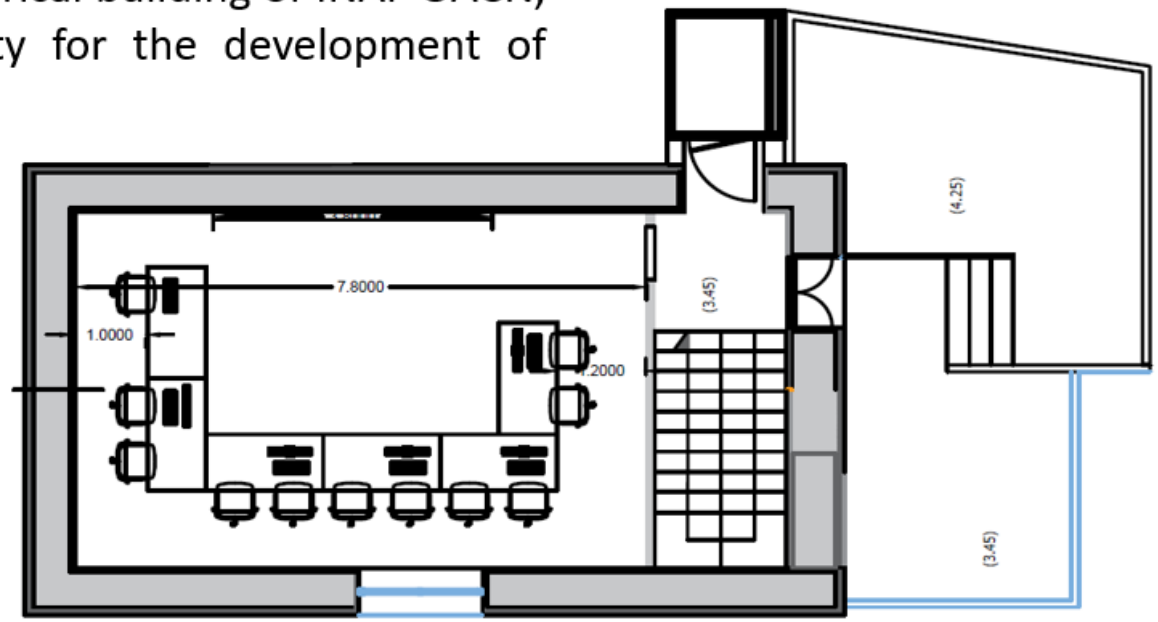
Support for instrument design

Activity 3201 is focused on the renovation of a historical building of INAF OACN, to be converted into a Concurrent Design Facility for the development of astronomical instrumentation.

AL E. **Cascone (NA)**



AL M. **Riva (MI)**

Activity 3202 is aiming at procuring and implementing the necessary hardware and software to make the Concurrent Design Facility auxiliary node fully operational.

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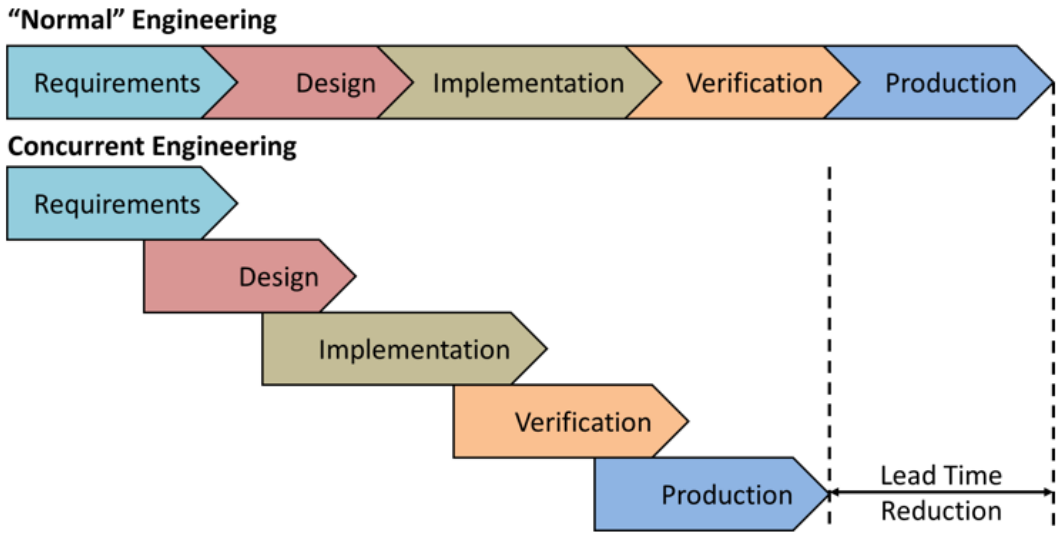
Support for instrument design

Concurrent Design Facility

A ***Concurrent Design Facility*** is the set of infrastructures, devices, methodologies and processes that allows **engineering teams** with people from different backgrounds to **work closely together**, at the **same time**, on all the aspects of the design.



This coordinated effort helps to achieve complex design definition **more easily and quickly**, through an engineering management protocol, compared to a "step-by-step" approach, which is the traditional method used both for small and big projects, where each team works individually with only little direct interaction with each other.

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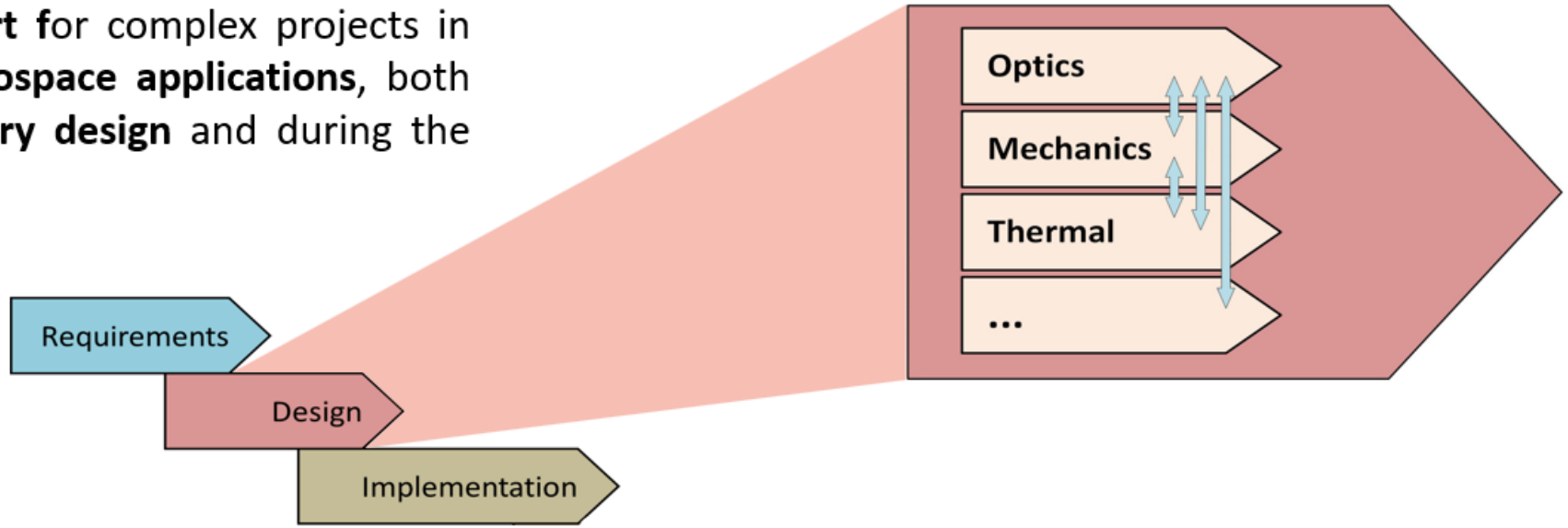
Support for instrument design

Concurrent engineering has been proven to be **extremely efficient in terms of time and effort f**or complex projects in various fields, and especially in **aerospace applications**, both for **feasibility studies** and **preliminary design** and during the following phases.



The main effort of the Activity 3201, other than the creation of the CDF itself, is aimed at **creating a standard** for concurrent engineering that is tailored to the design of **astronomical ground-based instrumentation**.

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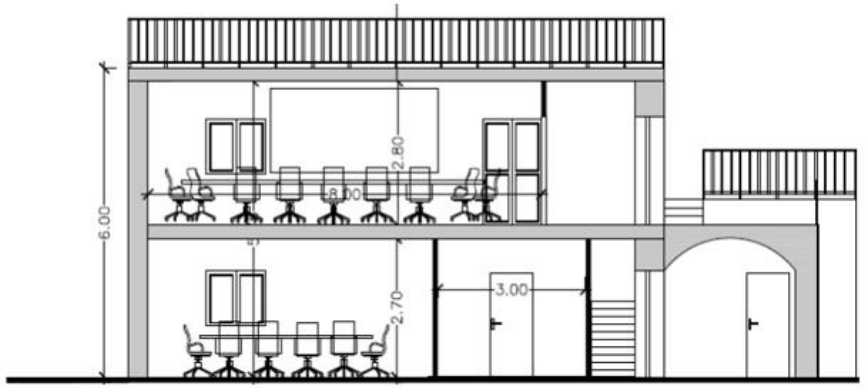
CDF @Napoli



A historical building at INAF - Osservatorio Astronomico di Capodimonte has been selected to be converted into a ***Concurrent Design Facility*** **(CDF)**. The foreseen CDF will be equipped with hardware, software and communication tools that bring the ***multidisciplinary work*** together in a pragmatic and guided way.

With the growth in size and complexity of astronomical projects in INAF, the standard approach is becoming more and more difficult to apply in an effective manner. Adopting the concurrent engineering methods can be an effective answer to the current and future challenges of the design process.

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Progetti PNRR

Our ICT @ Università degli Studi di Napoli Federico II

AD HOC

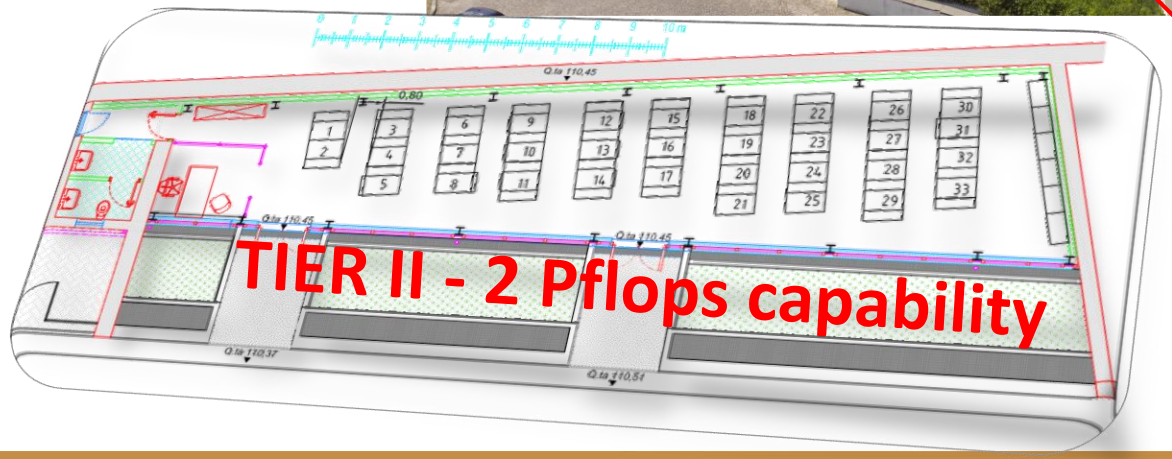
Astrophysical Data HPC Operation Center

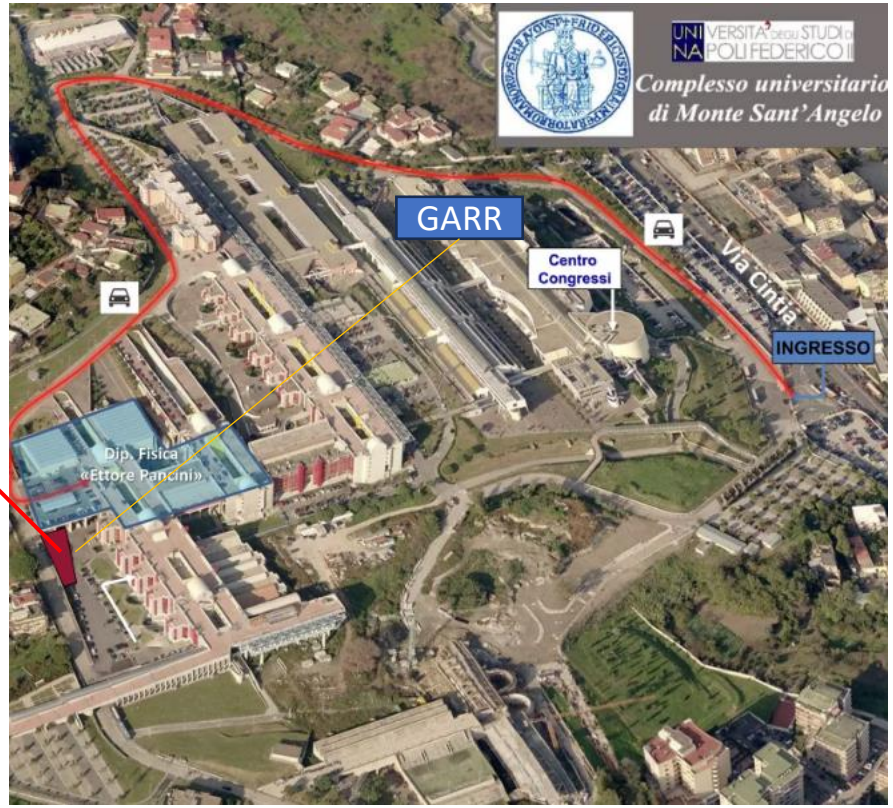
M. Brescia

Designed, developed and hosted by Dept. of Physics
Regulated by a next MoA between INAF and Dept.
Director: G. Russo (M. Brescia since Nov 1, 2024)

Data/processing Science services:
bio- geo- astro- informatics

Data/processing services for astrophysics:
ELT, SKA, VST, ALMA, Rubin-LSST





Funded by NextGenerationEU (~ 7 M€)

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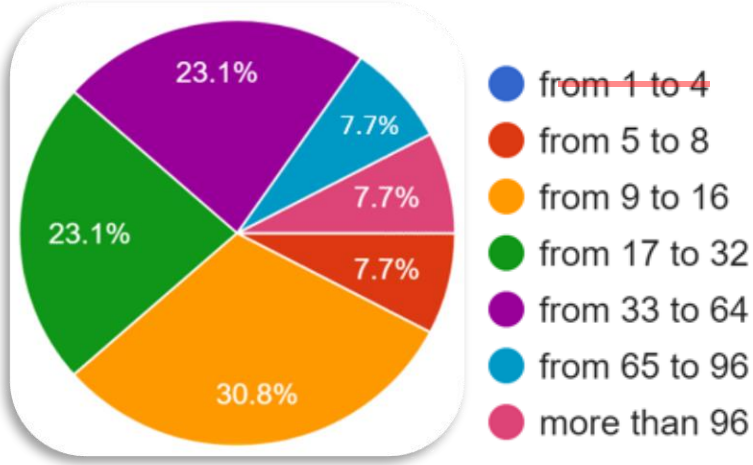
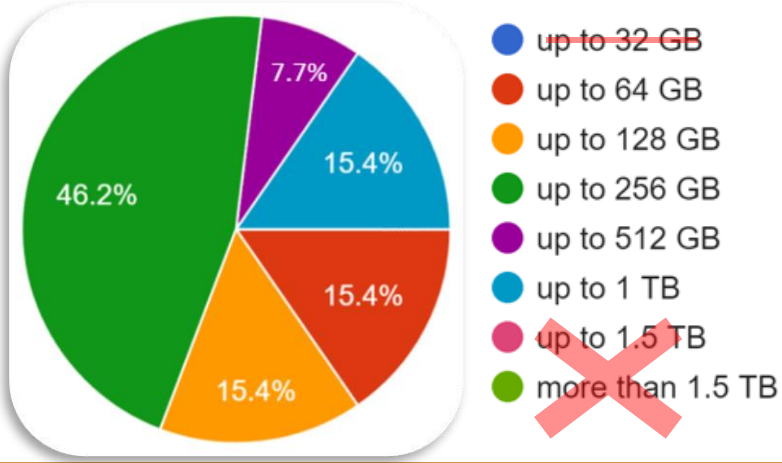
Nr. of CPU's cores requested



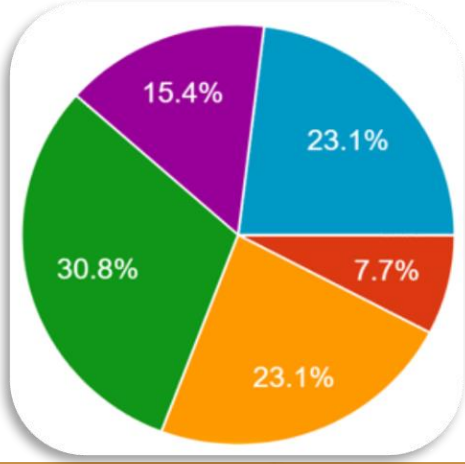
Primary projects involved

Nr. of GPUs requested

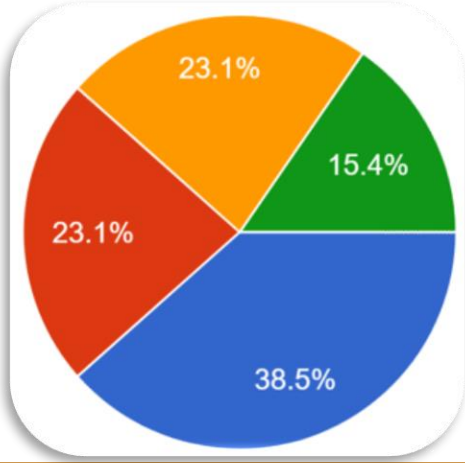
RAM requested



Storage requested



GPU's RAM requested



User Survey (15 answers)

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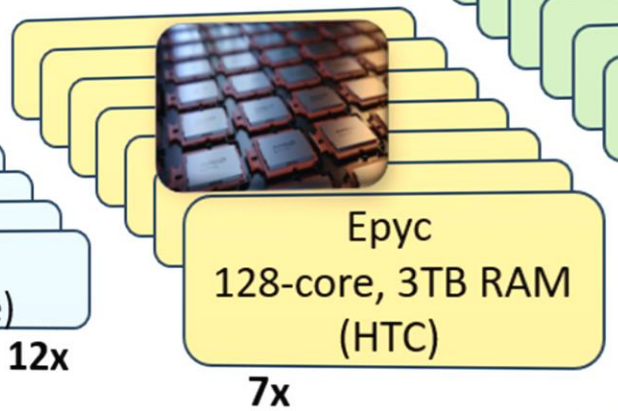
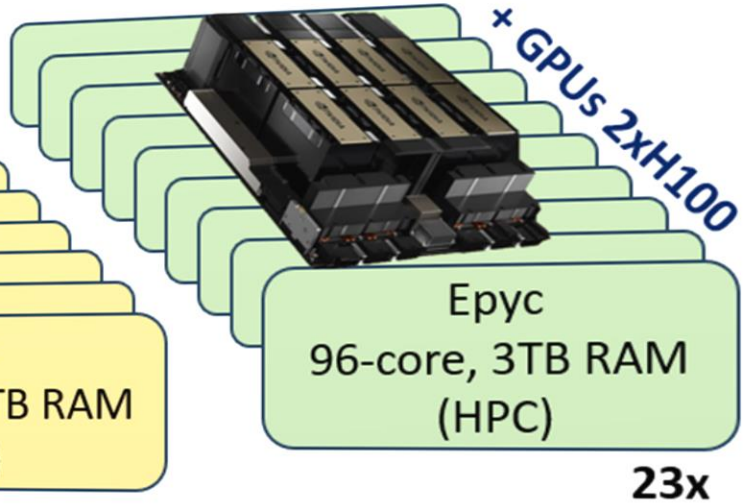
AD HOC

Astrophysical Data HPC Operation Center

20 PB of Data Storage (raw)
52 HPC/HTC multi-core servers
46 GPUs H100 (80 GB/device)
20 GPUs L40 (48 GB/device)

6PB @ Bologna 2PB @ Napoli



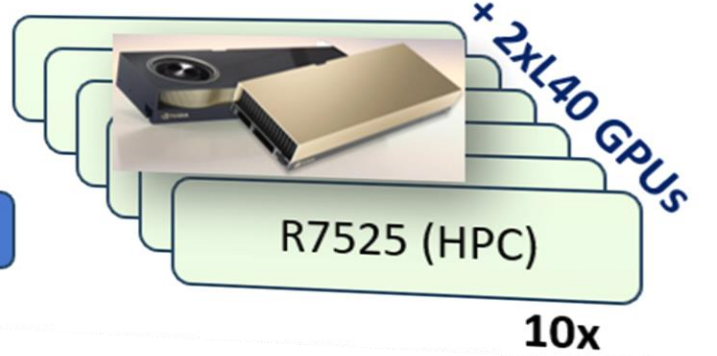


2x NAS - 72 TB

Printer A3 col 3x

Printer A4 b/n 3x

Plotter A1



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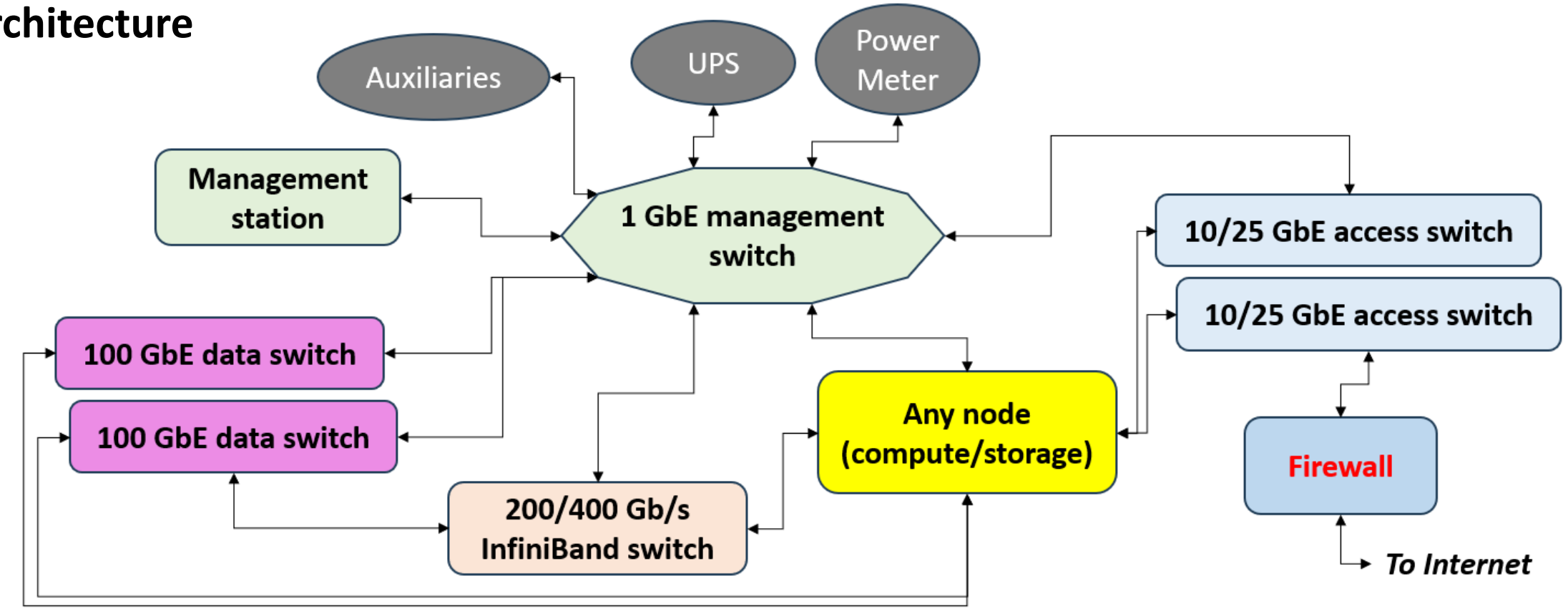
Astrophysical Data HPC Operation Center

Network system model architecture



Power/Cooling system architecture

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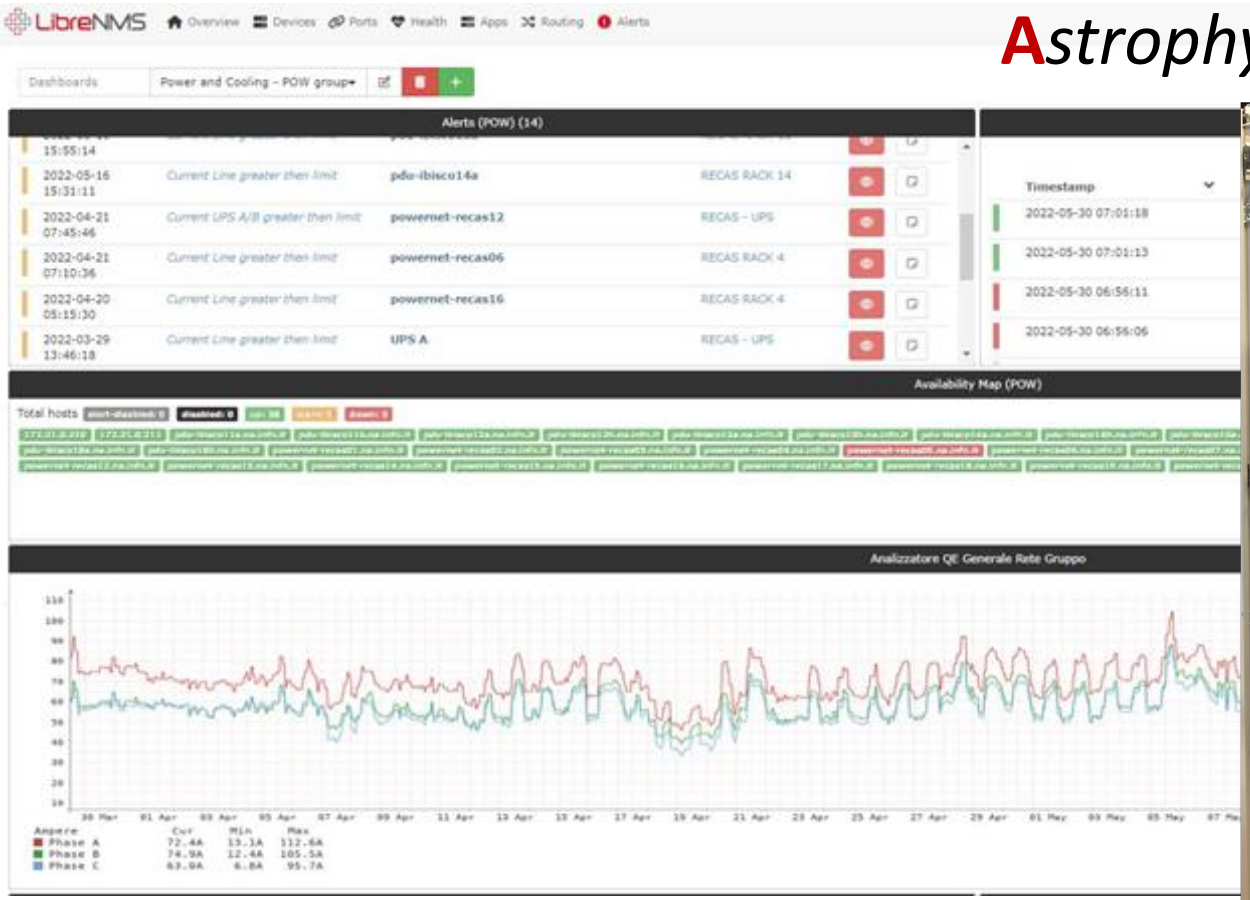

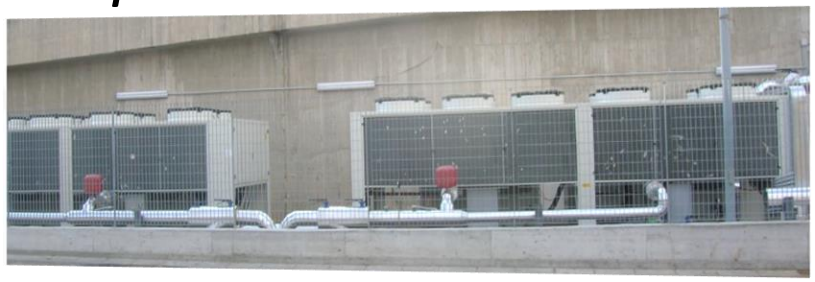

Power Usage real-time monitoring
2 420KW UPS
37 LCP columns
30°C in-Rack full load conditions
2 Chillers of 400 thermal KW

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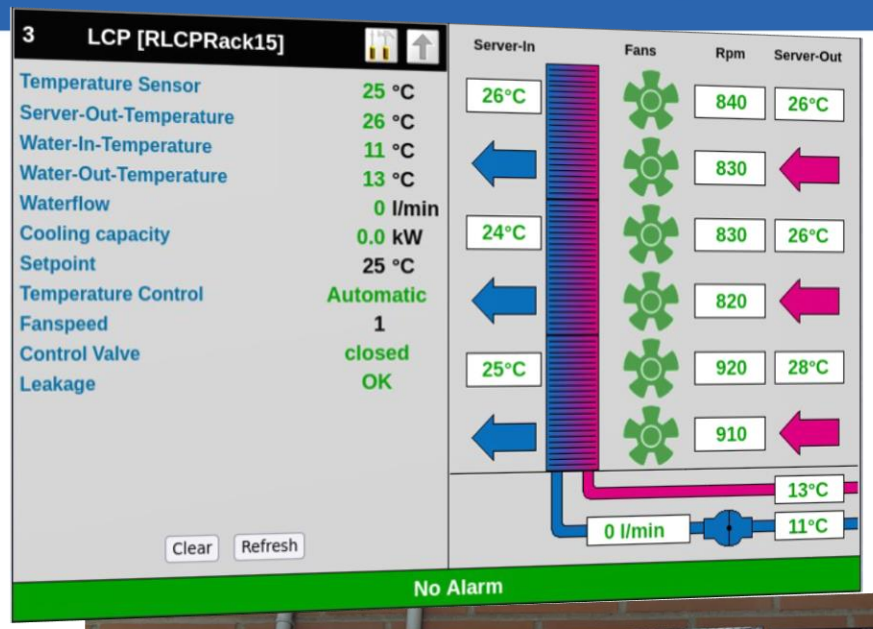
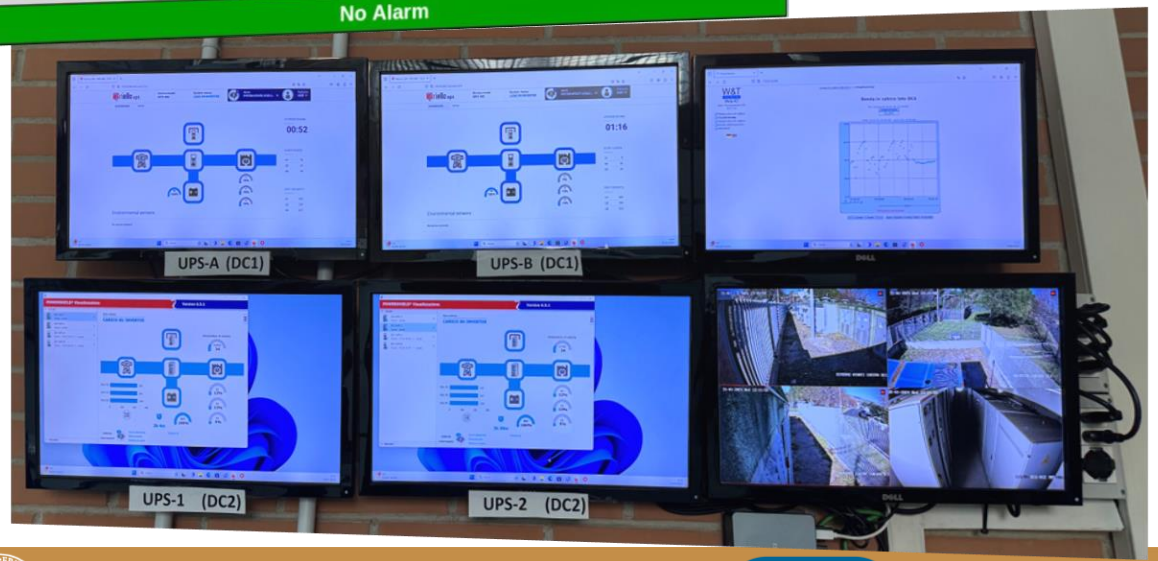
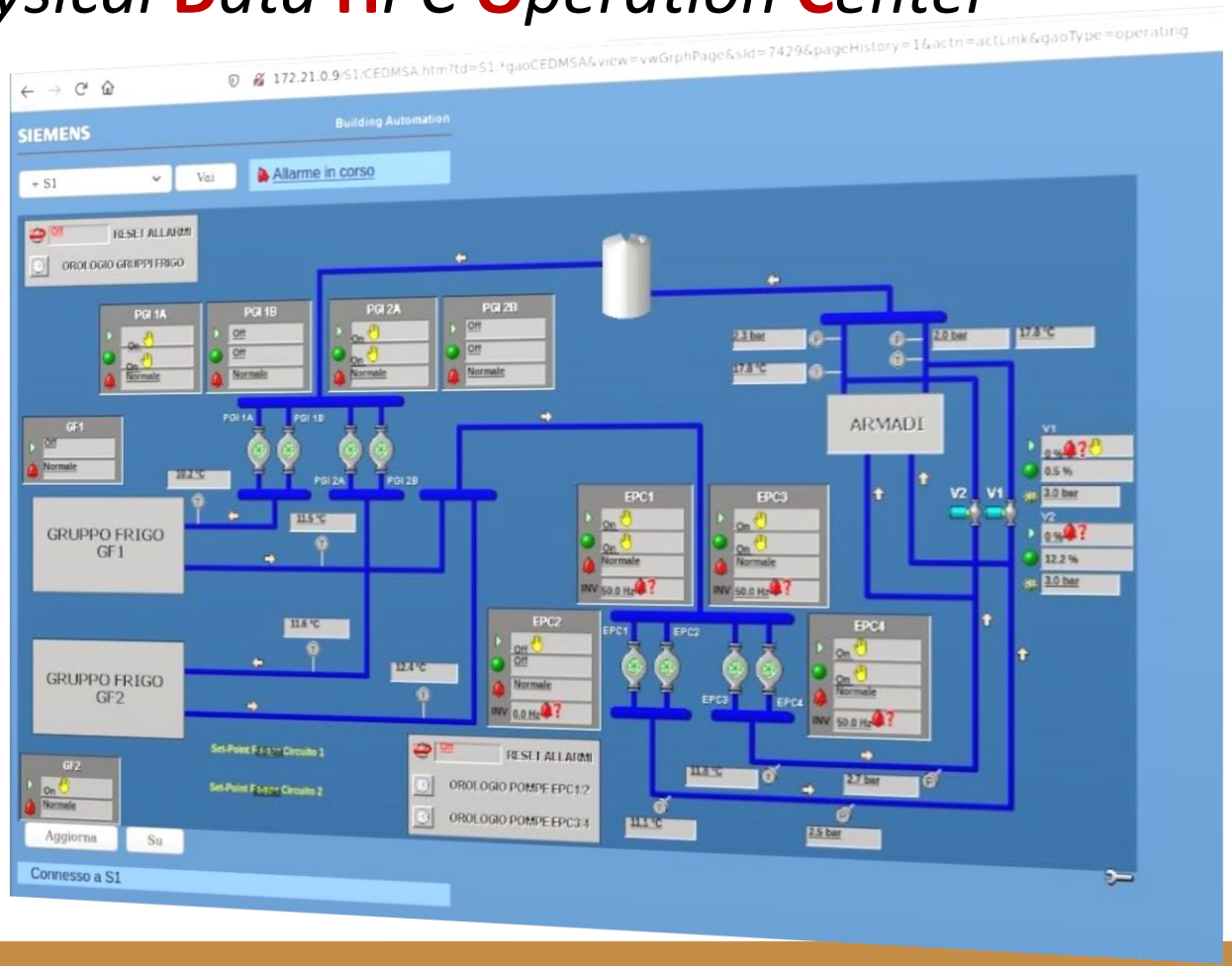
Monitoring system







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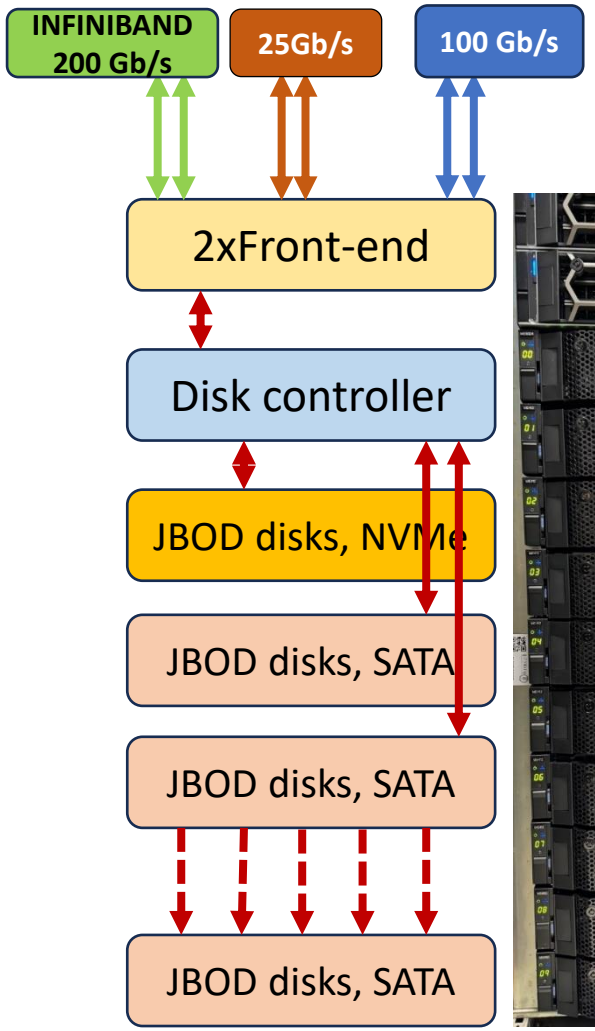
Astrophysical Data HPC Operation Center



Disk Storage system (12 PB)

- 500 SATA disks, 22 TB each (11 PB)
- 135 NVMe disks, 7.5 TB each (1 PB)
- 12 enclosures, 3x single FC-AL controller
- Two server every 3 PBytes as a front-end
- multiple networking options:
  - 2x25 GbE, 2x100 GbE, 2x200 Infiniband

8 (6+2) PB Tape long-term Storage system

AD HOC

Astrophysical Data HPC Operation Center

M. Brescia

Boss war fort

Control Room

O' Core Team

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Research Fellow
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ICT Researcher
INFN Napoli

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INFN Napoli

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Thank You!

(Part of) The research activities described in these slides were carried out with contribution of the Next Generation EU funds within the National Recovery and Resilience Plan (PNRR).
Mission 4 - Education and Research, Component 2
From Research to Business (M4C2), Investment Line 3.1
Strengthening and creation of Research Infrastructures,
Project IR0000034 – "STILES - Strengthening the Italian Leadership in ELT and SKA".