IL CONTRIBUTO ITALIANO ALLA MISSIONE ARIEL

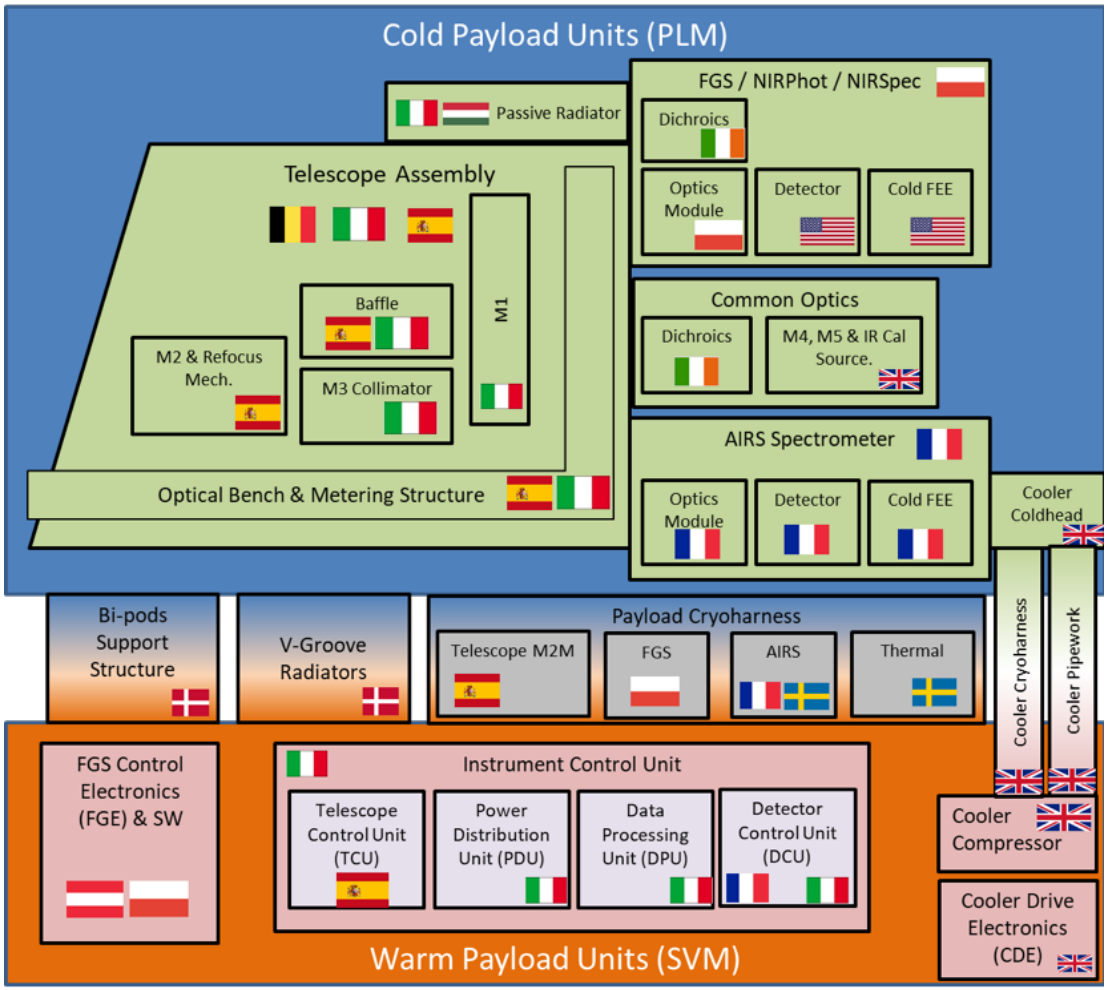
G. Micela

ARIEL – 1 WORKSHOP NAZIONALE

ROMA 2-3 Ottobre 2018

The Italian contribution to ARIEL

- Science
- Performance modelling
- Ground Segment
- Onboard Electronics
- Optics development
- Thermal Analysis



Telescope Assy AIV & Cryo-testing

Payload Overall AIV, Env. Test & Calibration

Systems Team Leadership

Consortium Management & Coordination

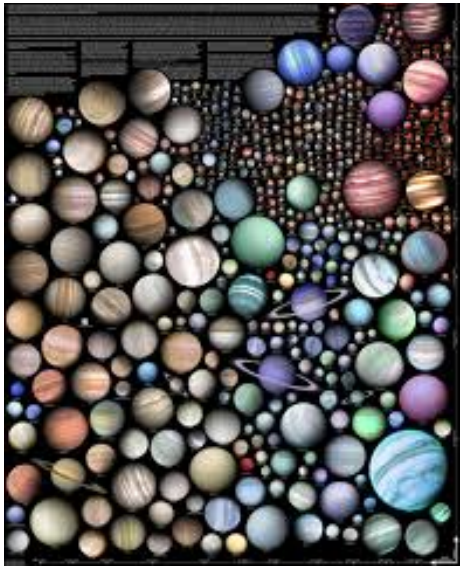
Science in Italy relevant to ARIEL

Some relevant assets

- Stellar astrophysics
- Planetary physics
- A cohesive exoplanetary community
- Several young researchers working in the field
- Several complementary projects from ground and from space

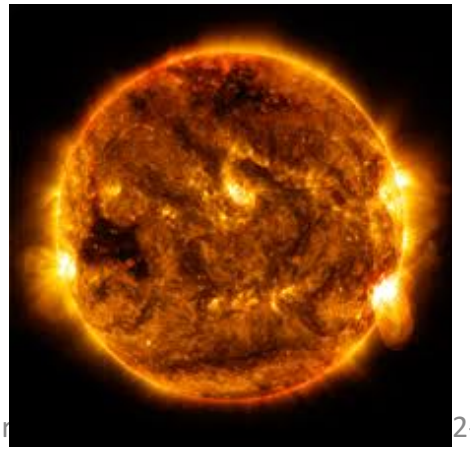
Science activities planned for phase B

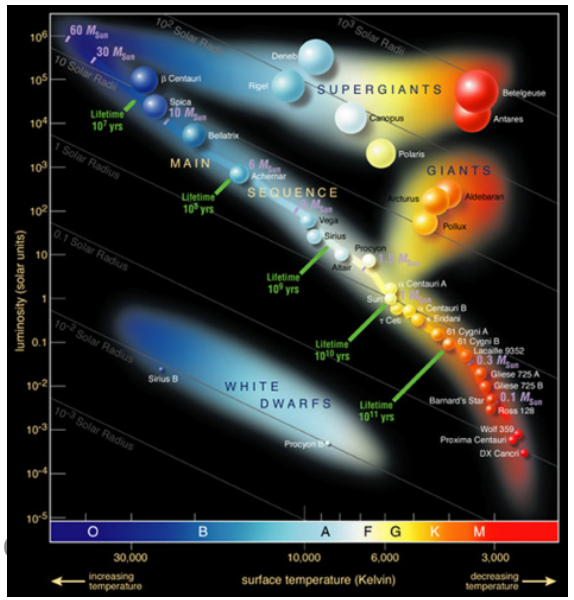
- Contribution to **target selection** and **synergy with other missions/programs**
  - ***Monitoring*** of recent discovered targets
    - Involvement in discovery projects
  - Coverage of the relevant ***parameter space***
  - ***Optimization*** criteria
  - ***Synergy*** with future missions
  - Strategy for the characterization of the ***stellar fields*** around the selected targets



Science activities planned for phase B

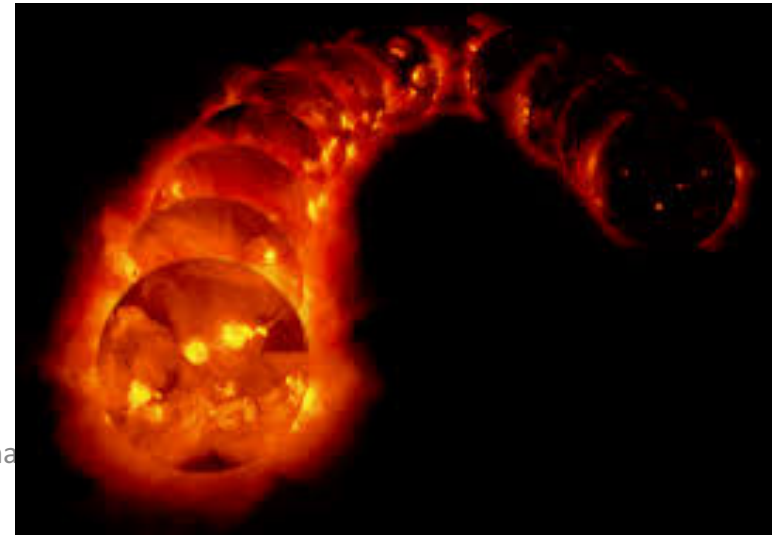
- **Stellar hosts**
  - Star fundamental ***parameters***
  - Stellar ***activity***
  - Planning of preparatory ***new observations*** for target characterization
  - ***Ancillary data***





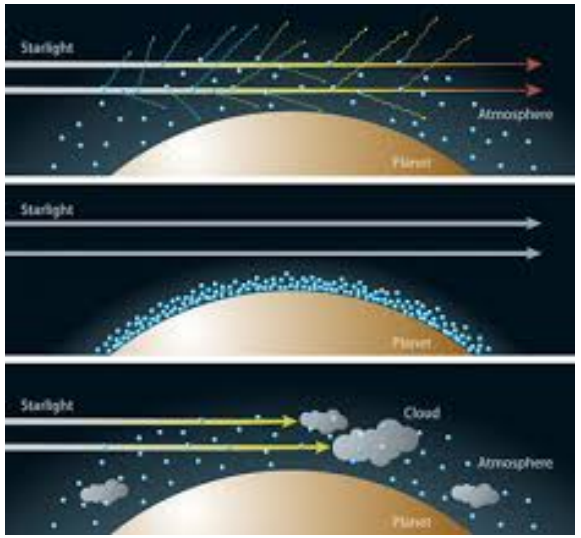
Science activities planned for phase B

- **Stellar activity**
  - ***Modeling*** and ***observations*** of stellar activity for various stellar types
  - Identifications of activity ***diagnostics***
  - ***Corrections/Mitigations*** of the induced “noise” on atmospheric observations



Science activities planned for phase B

- **Planetary atmospheres**
  - Planning the development and use of ***codes*** in simulating “ad hoc” planetary atmospheres
  - Applications of ***Solar System*** Planetary Atmospheres studies to exoplanets
  - Identification of diagnostics of atmosphere ***evaporation*** and of ***star-planet interaction***



Science activities planned for phase B

- **Planetary formation**
  - Study of the ***atmospheric footprint*** of planetary formation
  - ***Disc properties*** role
  - ***Environment*** role

Science activities planned for phase B

- **Laboratory activities**

  Planning of ***laboratory experiments*** to simulate planetary atmospheres

  Exploring various ***gas mixtures***

  Exploring the effects of ***stellar radiation***

Science activities planned for phase B

- Other ideas?
- **Everybody** may contribute

- A shared area with information and documents
- To access this area send an email to ***rossella.muscolino@inaf.it***

Performance modeling

- Crucial to *understand* the real capabilities of ARIEL and *optimize* the scientific programme
- EXOsim (ARIELsim): A simulator of exoplanetary obervations from *realistic observation to science*

(ref. E. Pascale)

Ground Segment

IOSDC

ARIEL Consortium (*distributed model*)

Assume single point interface between IOSDC and SOC/MOC

Spacecraft

Ground Station

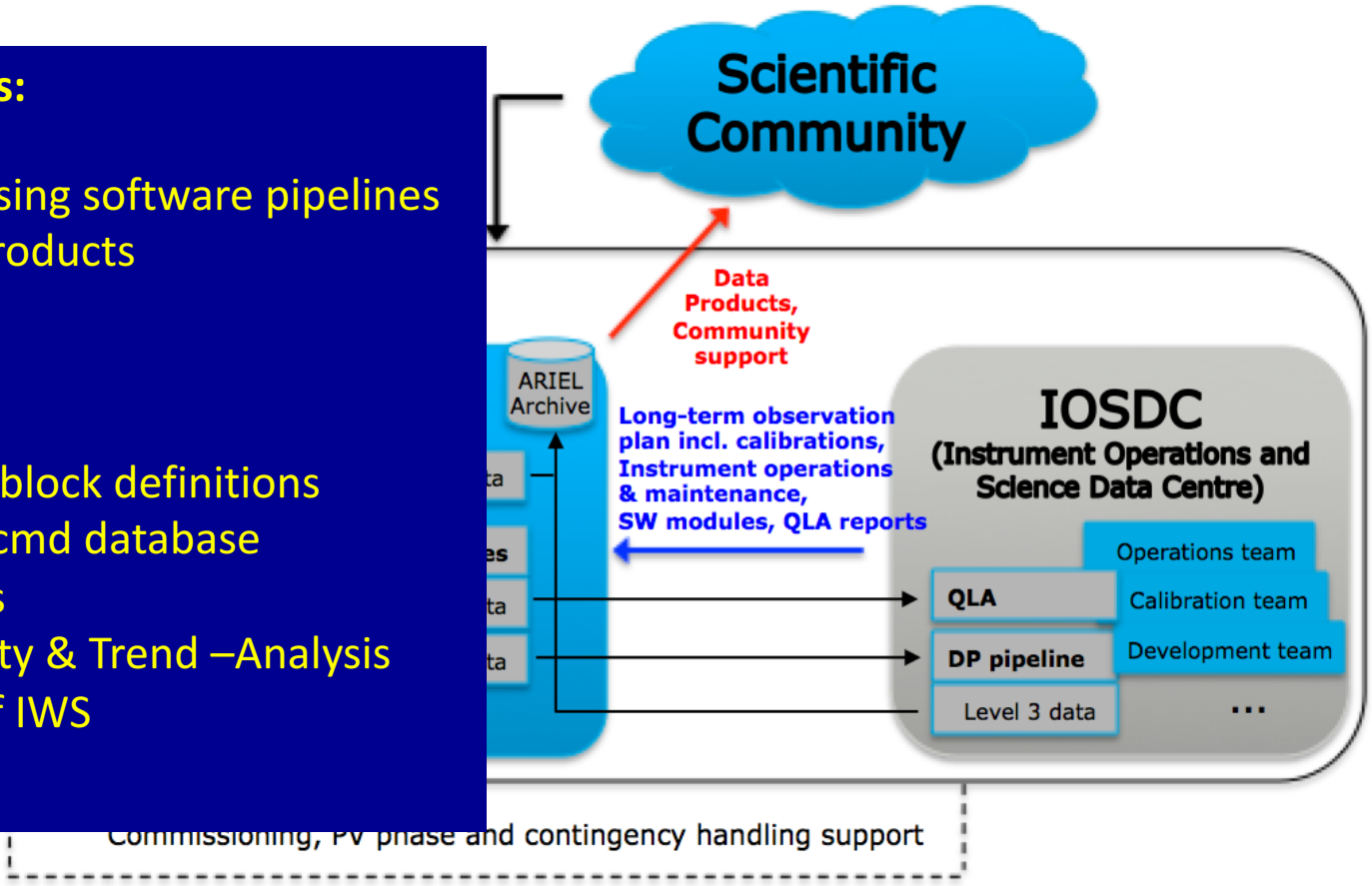
MOC – ESA

SOC - ESA

ref. G. Malaguti

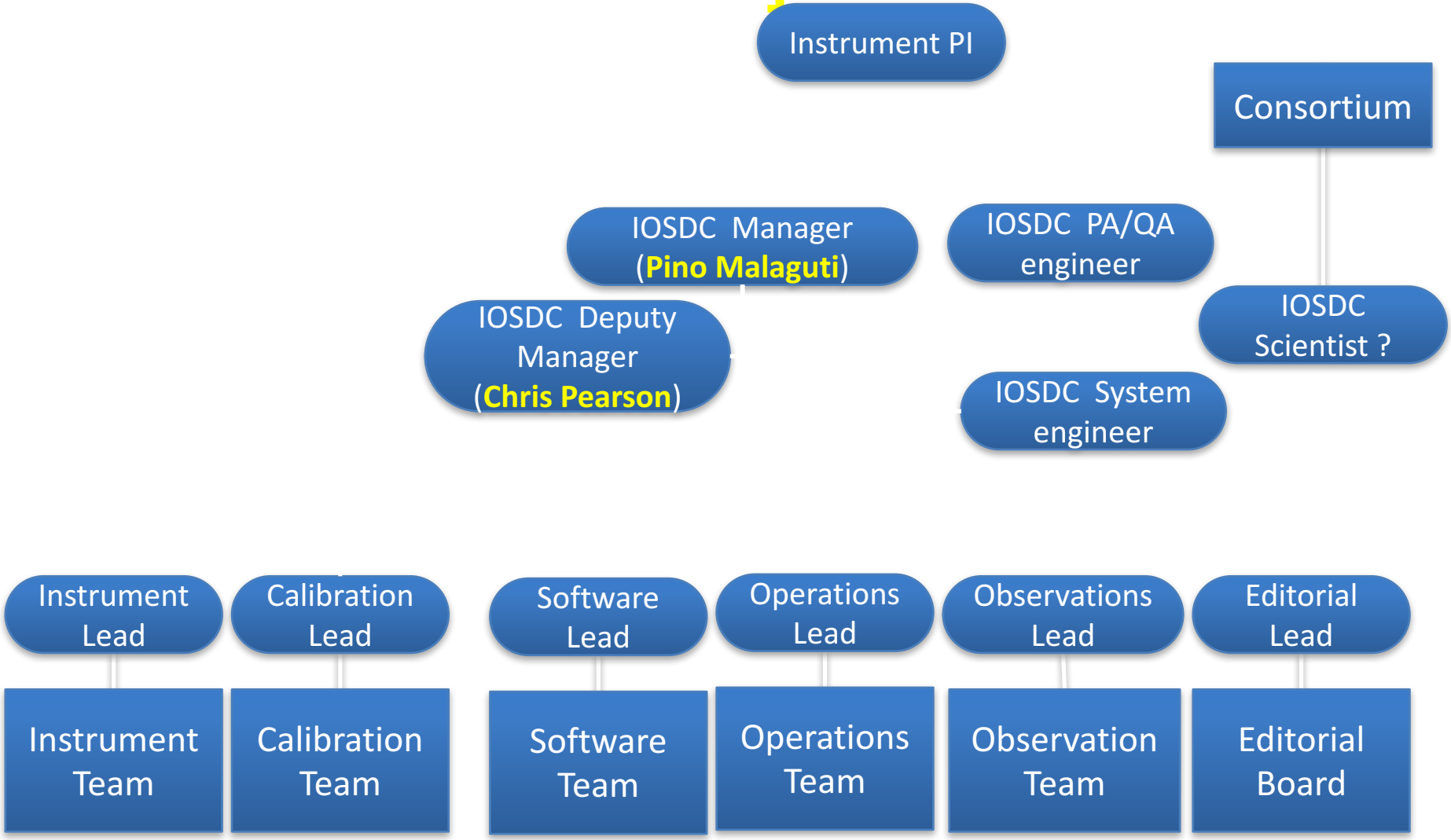
IOSDC key responsibilities:

- Provision of data processing software pipelines
- Associated calibration products
- Quick Look Analysis
- EGSE environment
- Payload OBS
- Command, obs building block definitions
- Test bed for changes to cmd database
- Calibration Observations
- Payload Health and Safety & Trend –Analysis
- provision and running of IWS
- provision of Level 3 data



ARIEL GS interfaces and data flow. SOC is the nominal point of contact to MOC during in-orbit operations, exceptions include commissioning and performance verification phases (and contingency handling), where a direct link between IOSDC and MOC can be established through the instrument workstation

IOSDC Development Phase



IOSDC Phase B1

Main ongoing activities:

- Input to ESA for SOCD (Science Operation Concept Document)
- Science Data Levels definition

- Protopipeline development

- **Tight interaction with:**
  - **Simulation team for simulation tools development and optimisation**
  - **Calibration team for calibration plan and calibration products input to pipeline**
  - **Instrument teams for input to pipeline**

IOSDC Team Structure

Instrument Team: Ground testing and instrument OBS, interacts closely with other teams during PV/commissioning

Calibration Team: Calibration plan for flight operations. Should also support testing. Probably initially independent but should be absorbed within IOSDC

Operations Team: In charge of operational Procedures and Interactions for instrument including; Instrument Operation Logging Health monitoring and Trend Analysis Test Support Observation planning including commissioning plan

Software Team: Produces QLA and Data analysis pipelines

Observations Team: Interface between instrument/software and science side including; Input for Observers Manual, science validation of observations, pipeline validation. Could initially be absorbed within Operations Team and become independent at a later date. Important to involve members of the community

Editorial Team: Oversee all documentation for ARIEL IOSDC and interaction with instrument and the SOC and implement the production of the ARIEL observers manual (if any) and later Data Reduction Guides.

IOSDC Phase B1

Meeting SGS Italia:

- Mid November, Roma (TBC)
- To:
  - **identify** possible contribution areas for Phase B1 and Development Phase in general
  - **share** activities
  - **formulate** proposals

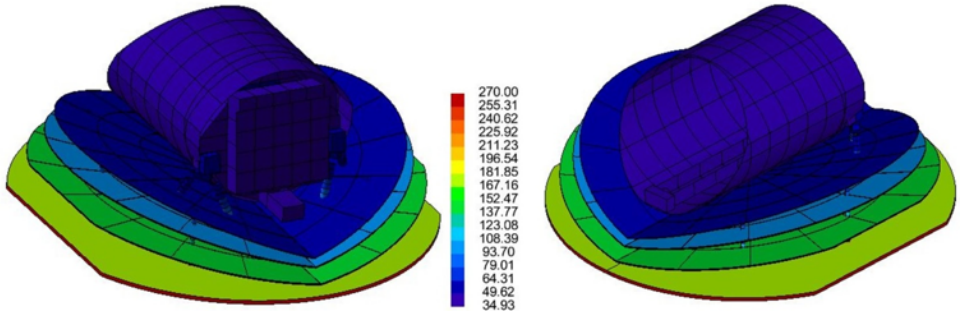
PAYLOAD CONTRIBUTION

- System
- Telescope
- Electronics

System activity

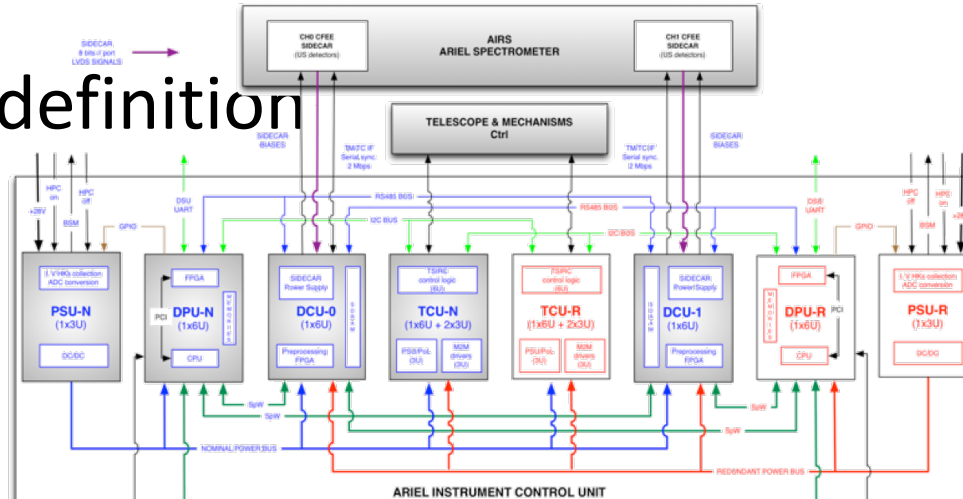
- PLM thermal architecture and analysis
- Analytical analysis and modeling to consolidate the approach and verify the requirements
- Simulations of the thermal hardware
- *Heritage from previous missions*

Ref. G. Morgante



Electronics

- Responsability and coordination of the ICU
- Development of the architecture of the ICU
- Data flow, operation analysis and onboard software
- Detailed architecture of the Control and Data Processing Unit (CDPU),
- Interface requirements definition



Ref. E. Pace

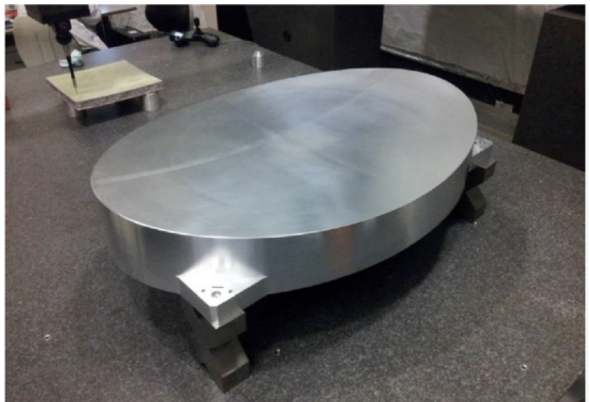
Telescope

Responsibility of the optics

Design and realization of the primary (1-min aluminum) mirror – New technology – Needs for a pathfinder

Realization of the telecopes structure

Ref. V. Da Deppo



Consortium activities

Main Italian Institutes

- INAF
- University of Florence
- CNR-IFN
- La Sapienza Università di Roma

Key people

coPi: G. Malaguti, G. Micela

Management: G. Micela, E. Pace (NPM)

Science: G. Micela (SAT), D. Turrini (SAT)

Performance and Simulations: E. Pascale (TS)

Electronics: E. Pace, A. Di Giorgio, M. Focardi

Telescope: E. Pace, V. Da Deppo, P. Zuppella

Thermal System: G. Morgante

Ground Segment: G. Malaguti

Science activities

Contribution to several WGs

- Stellar Variability (obs & th)
- Target list Selection
- Atmospheric chemistry (gaseous planets)
- Atmospheric chemistry (super-Earths)
- Laboratory simulations of planetary atmospheres
- Cloud Modelling
- Spectral Retrieval Simulations
- Data Analysis Techniques
- Planet formation
- Preparatory follow-up observations from the ground
- Synergy with Plato/Cheops/TESS/Gaia/ELT
- Upper atmosphere/escape processes
- …

Tinetti et al 2018 ExpAstr in press

A chemical survey of exoplanets with ARIEL

Puig et al. 2018 ExpAstr in press

The phase a study of the ESA M4 mission candidate ARIEL

https://ariel-spacemission.eu/

- To access to the shared area contact ***rossella.muscolino@inaf.it***