



# Elettronica e rivelatori

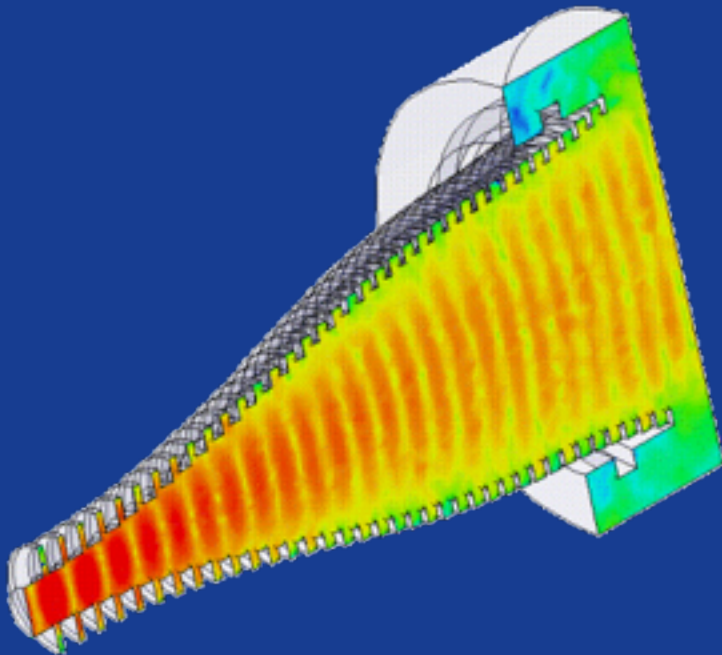
**Luca Olmi**

INAF - Arcetri

# Arcetri Radio Group



## End-to-end electromagnetics R&D for radio astronomy



## Realizzazione di componenti passivi a microonde e sviluppo di tecnologie innovative per applicazioni radioastronomiche

**PIs:** P. Bolli, R. Nesti, L. Olmi

### Attività specifiche:

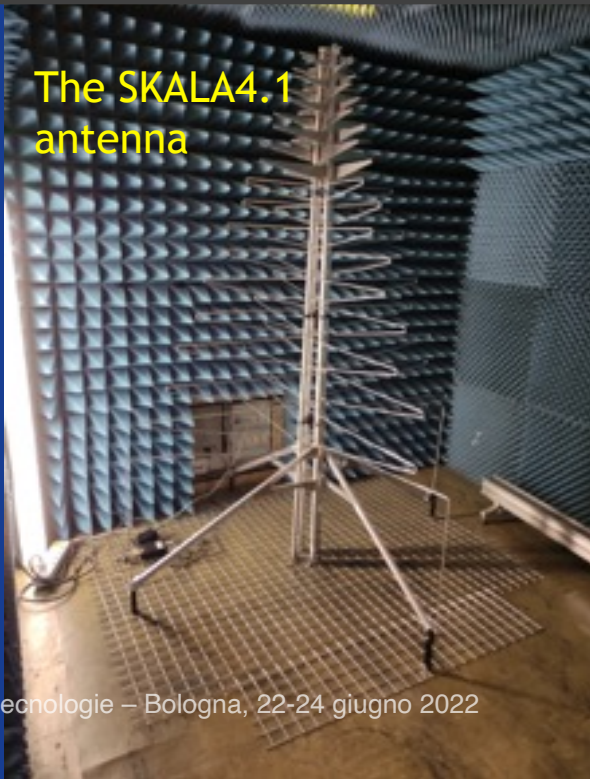
antenna optics/EM, microwave components, calibration techniques, cryogenics, novel technologies and observing methods

### Principali progetti:

- SKA-LOW
- ALMA
- SRT, MED, NOTO

## End-to-end electromagnetics R&D for radio astronomy

The SKALA4.1  
antenna



### Personale:

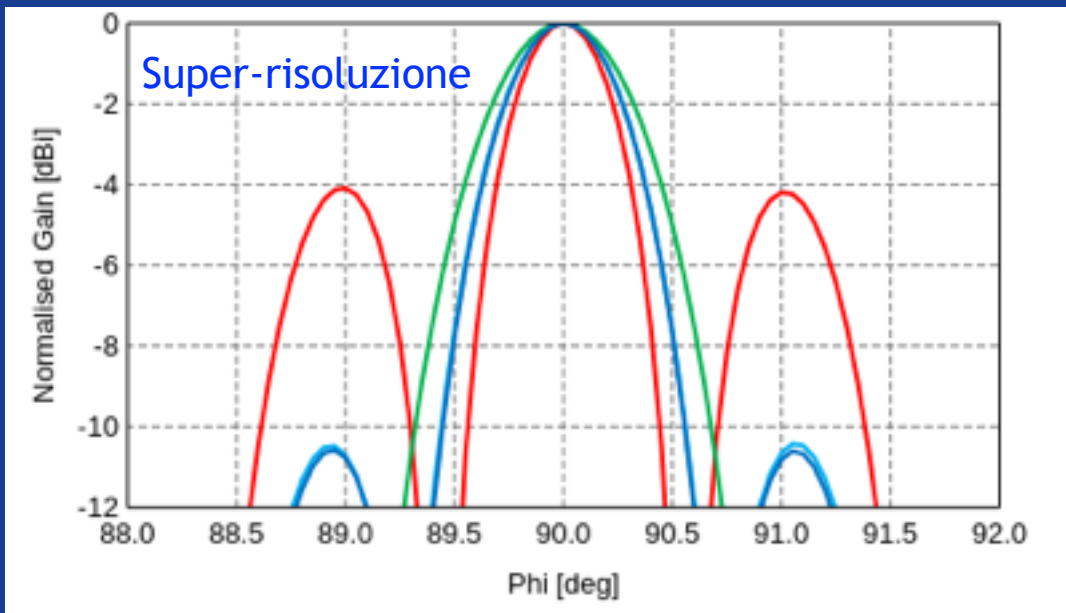
- Tecnologi (staff): 4
- PhD student: 1
- Post-doc: 1
- Tecnici: 1
- Associati: 1

### Attrezzatura di laboratorio:

- Camera **anecoica** (> 2 GHz): 4.5 x 3 x 3 m. Misure in campo vicino/lontano
- Strumentazione RF: **analizzatore vettoriale** di rete fino a 116 GHz
- **Dewar** di laboratorio per caratterizzazione componenti MW operanti a 20 K
- **Software** di analisi EM/ottica: FEKO, HFSS, GRASP, Zemax



## End-to-end electromagnetics R&D for radio astronomy



## Risultati recenti 1/2

- Sviluppo antenna **SKALA4.1** e caratterizzazione (numerica e con osservazioni astronomiche) delle prestazioni della singola stazione di SKA-LOW
- Test di diagrammi di antenne di Low Frequency Aperture Array con ausilio di **sistema UAV**
- Sviluppo componenti passivi per **ricevitore banda C basso (SRT)**
- Sviluppo sistemi per aumentare il **potere risolutivo** dei radio telescopi

## End-to-end electromagnetics R&D for radio astronomy

### UAV tests



## Risultati recenti 2/2

- Partecipazione al progetto **PON di SRT** in OR1 (ricevitore multi-pixel a 100 GHz) e OR4 (ricevitore simultaneo tri-band)
- Sviluppo **filtri planari** basati su superconduttori ad alta temperatura
- **Trasferimento expertise** in progetti esterni (identificazione presenza di virus SARS-COV-2)
- **Attività conto terzi**: misure in campo vicino/lontano di specchi parabolici e feed. Misure di trasmissività di radome

## Radio frequency signal processing



## Realizzazione di sistemi digitali per elaborazione di dati radioastronomici e di beam-forming

### Personale:

- PI: G. Comoretto
- Tecnologi (staff): 2
- Post-doc: 1

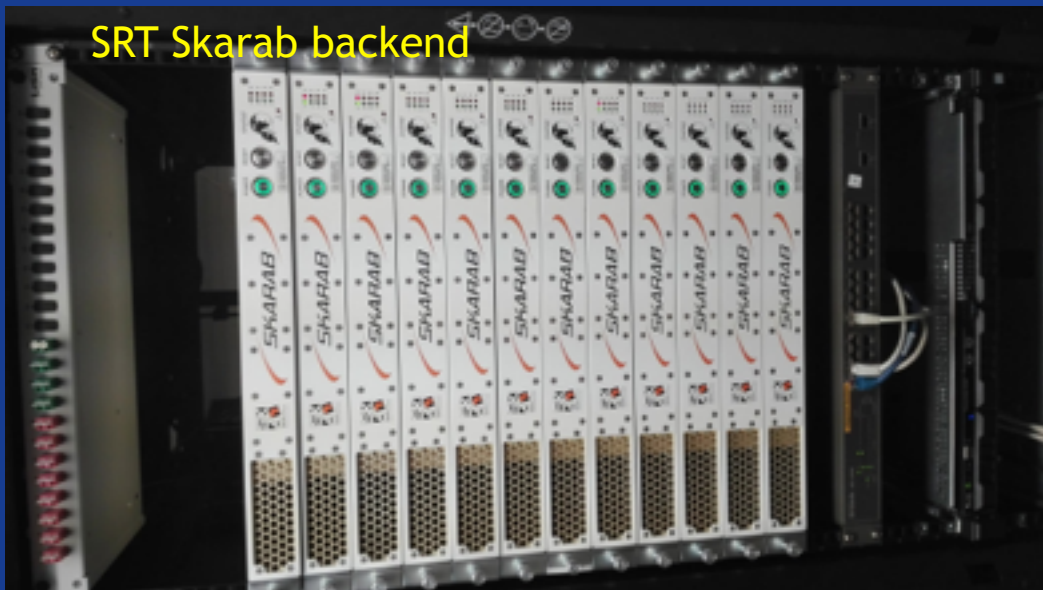
### Attività specifiche:

Electronics, Digital processing, FPGA/VHDL programming, novel technologies

### Principali progetti:

SKA, ALMA, SRT

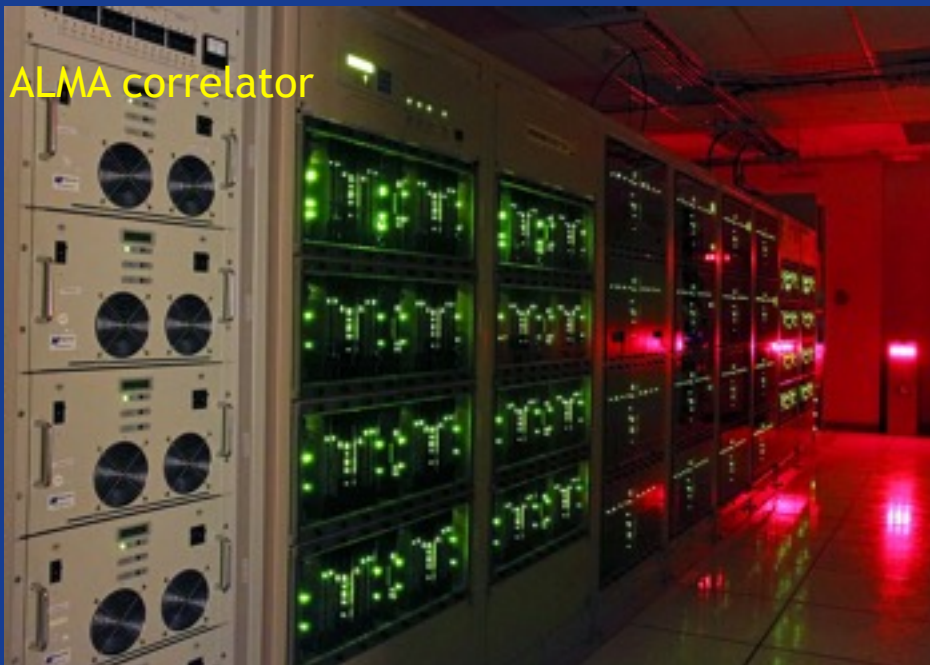
## Radio frequency signal processing



- **Backend signal processing:**
  - spectral analysis, spectropolarimetry
  - pulsar search/timing
  - Beam-forming
  - RFI detection and excision
- **Technological development:**
  - New algorithms & VHDL implementation for fast (GHz) and parallel ( $10^5$  pixels) digital platforms
  - Program FPGA boards & on-chip RF system
    - Custom boards: ALMA, SKA Low
    - Casper consortium: SKARAB, Roach
    - Commercial solutions: Xilinx Alveo, Abaco systems



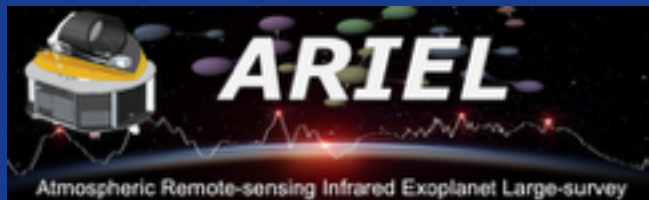
## Radio frequency signal processing



## Risultati recenti

- **ALMA correlator**: hybrid correlator concept (1999-2006)
- **SKA Low beamformer**: 512 stations with 256 antennas each. Total processing flow 0.2 PB/s [2x global world Internet] (2014-)
- **SRT**: backends for multi-feed receivers with 40 wideband signals – 2 GHz BW (2018-)
- **SKA Phased array** feed advanced program (2021-)

## Electronics for Space and Ground-based applications



## New technologies for space and ground-based Astrophysics

### Personale:

- PI: M. Focardi
- Tecnologi (staff): 3
- TD: 1
- Post-doc: 1

### Attività specifiche:

Electronics, CCD/CMOS technologies, robotics, machine learning

### Principali progetti:

Ariel, Plato, Proba3, Solar Orbiter

# Arcetri ASTL Group



## Electronics for Space and Ground-based applications

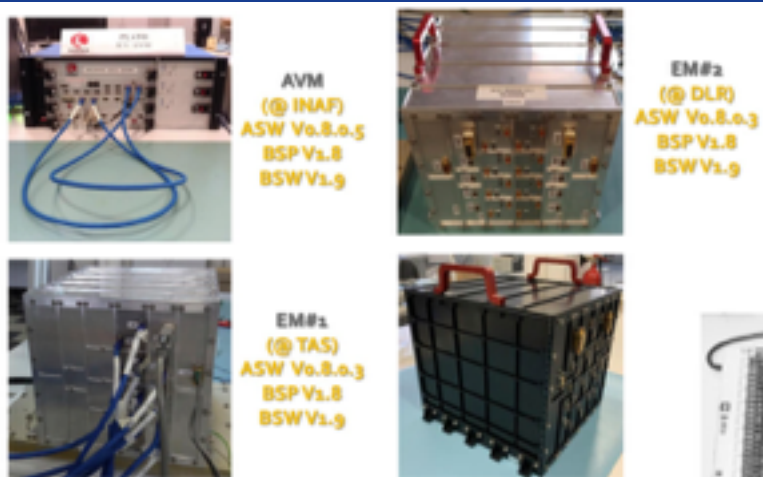


Figure 1: PLATO ICU models developed with Kayser Italia (Livorn)

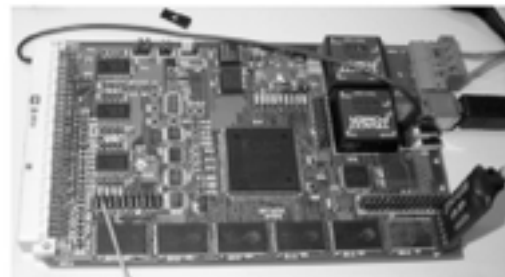


Figure 2: Prototipo di controller digitale per camere CCD (Eurocard board)

### Scientific targets:

- Exoplanets detection and characterization
- Spectroscopy (stars, exoplanets, ...)
- Life science experiments
- Exobiology (synergy with OAA Astrobiology Lab)

### Technological targets:

- Space-based (new) technologies (electronics, opto-electronics, cryogenics, opto-mechanics)
- Space and ground-based VIS-NIR FPAs development
- CCD & CMOS cameras
- Technology transfer to small-medium enterprises
- Software development
- AIV automatization
- Robotics and machine learning
- EMC/EMI analyses

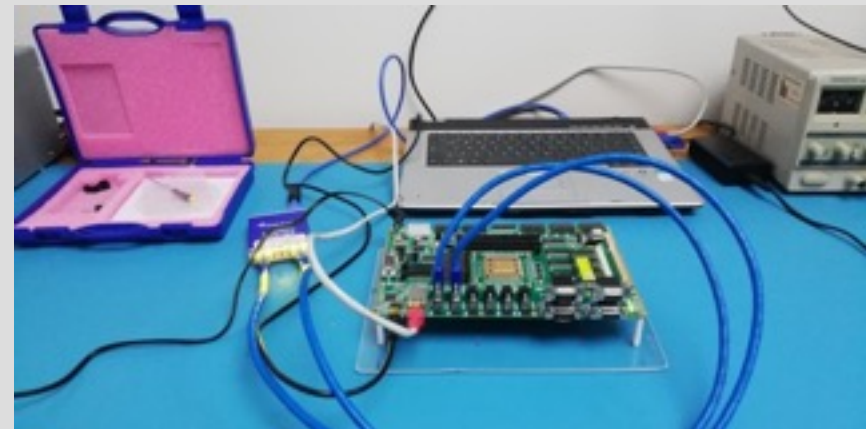


## Electronics for Space and Ground-based applications



### Electronics Lab (in allestimento)

- HW and SW prototypes design, breadboarding, manufacturing & testing
- Purchasing laboratory equipment
- Additional personnel being hired



GR712RC dual core processor evaluation board (as selected CPU for Ariel – ICU)