

Design and characterization at microwaves of antennas, components and material at the Radio Lab of the Arcetri Astrophysical Observatory



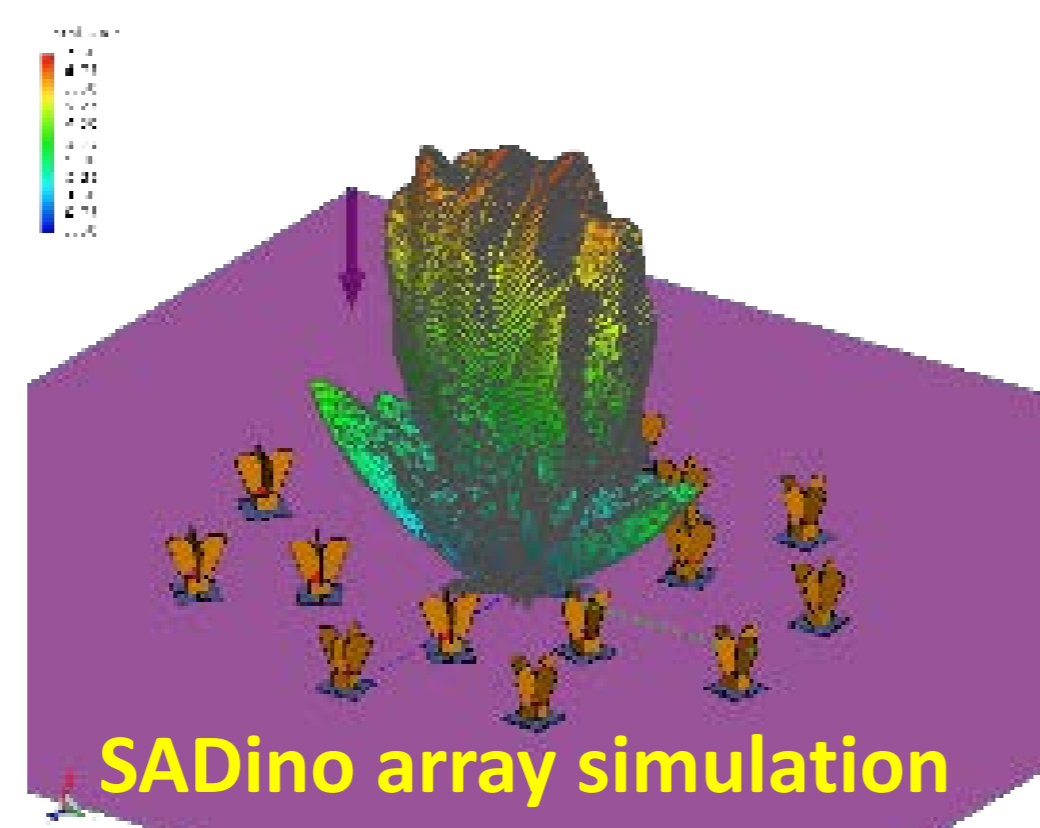
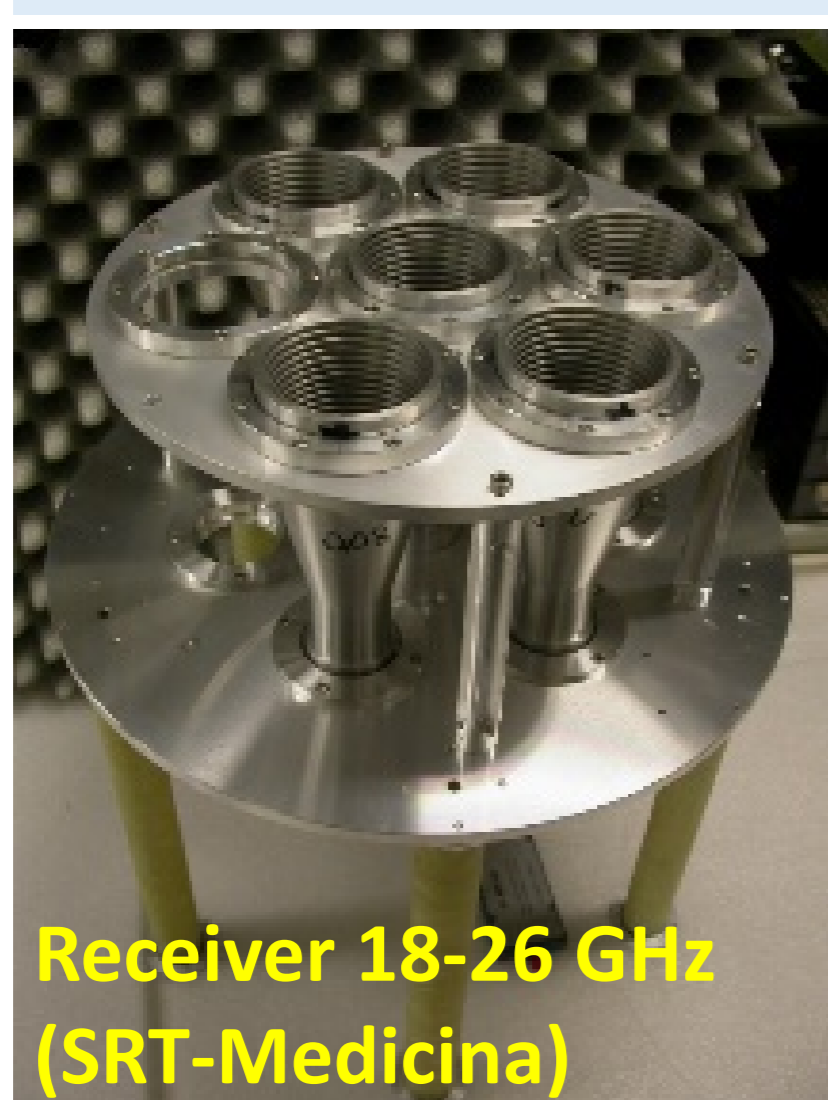
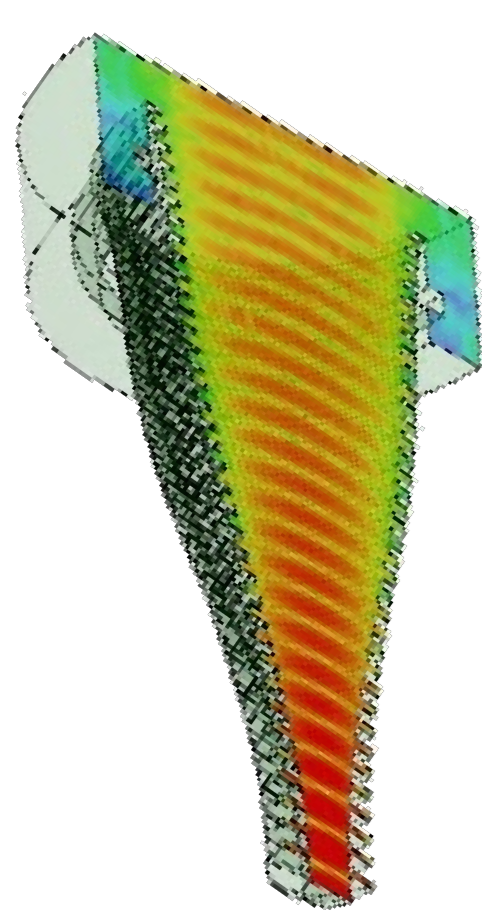
Paola Di Ninni, Luca Cresci, Renzo Nesti and Aldo Sonnini
Arcetri Astrophysical Observatory - INAF

Abstract

The technological activity of the radio laboratory team at the Arcetri Astrophysical Observatory counts design, prototyping and characterization of antennas and microwave components for radio astronomy receiver front-ends. A peculiar aspect of this Lab is the possibility to measure electromagnetic properties of materials. The experience gained over the years in these research fields has enabled the team to tackle successfully national and international R&D projects for radio astronomy applications, fundamental-research projects, patents, networking with the local companies and public engagement activities. This contribution aims at showing the SW and HW facilities of the radio laboratory team and at mentioning their use for some of the projects the team is involved in. Details in terms of the local available HW are given in order to clearly show the know-how and, at the same time, to highlighting the complementarity with the other facilities available in INAF for possible collaborations with the other INAF institutes.

Antenna design SW

EM & mechanical design



Custom tools (author: R. Nesti)

- CHORN (horn crrugati)
- RECTHORN (horn rettangolari)
- COAXHORN (horn coassiali)

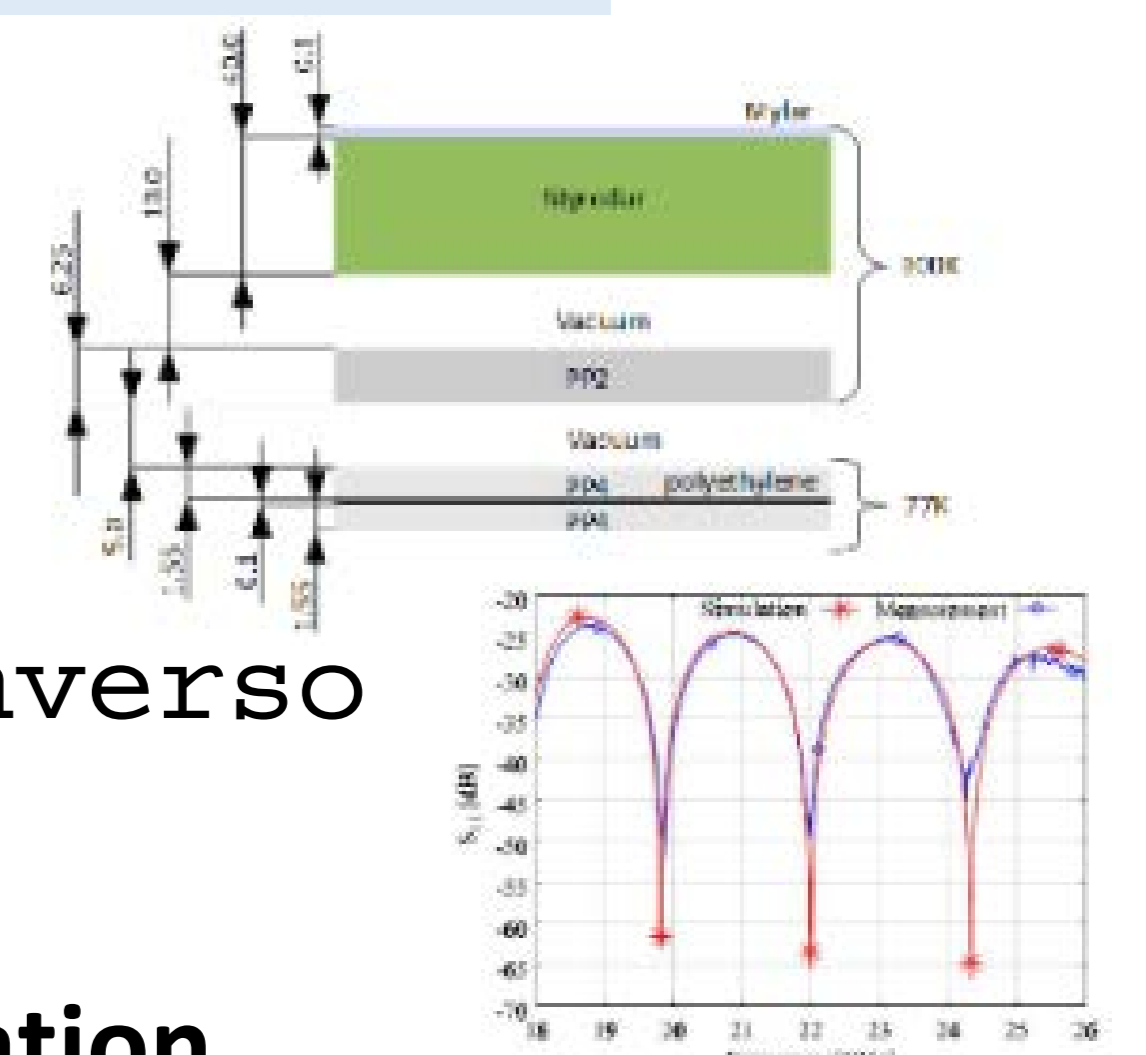
Commercial tools

- HFSS (ANSYS)
- FEKO (Altair)
- GRASP (TICRA)

Performance assessment

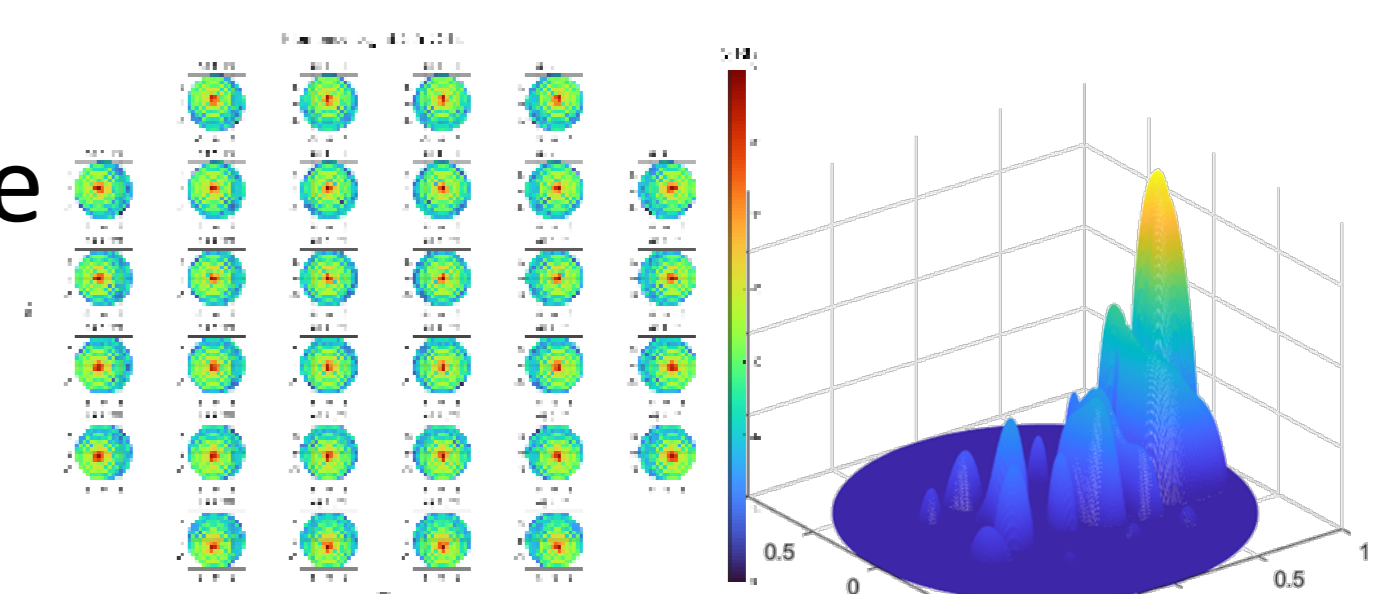
Dielectric properties characterization (author: R. Nesti)

- Wgmloss_chkdlg (for inorganic material)
- CovidTest_s2p_ProblemaInverso (for organic material)



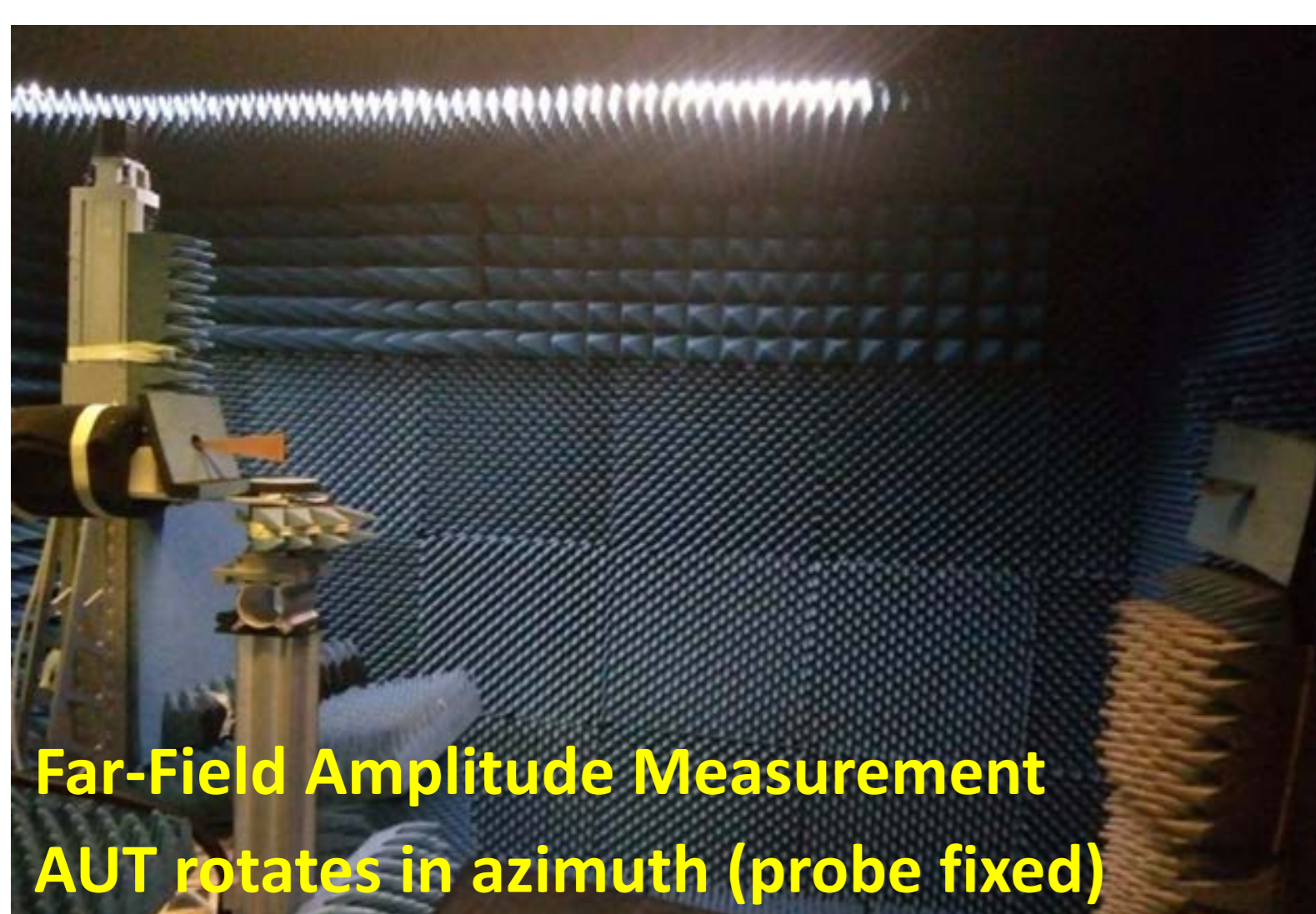
Sensitivity & Polarization characterization (author: P. Di Ninni)

- Phased Array Feeds performance
- Aperture Arrays performance



HW facilities

Anechoic chamber

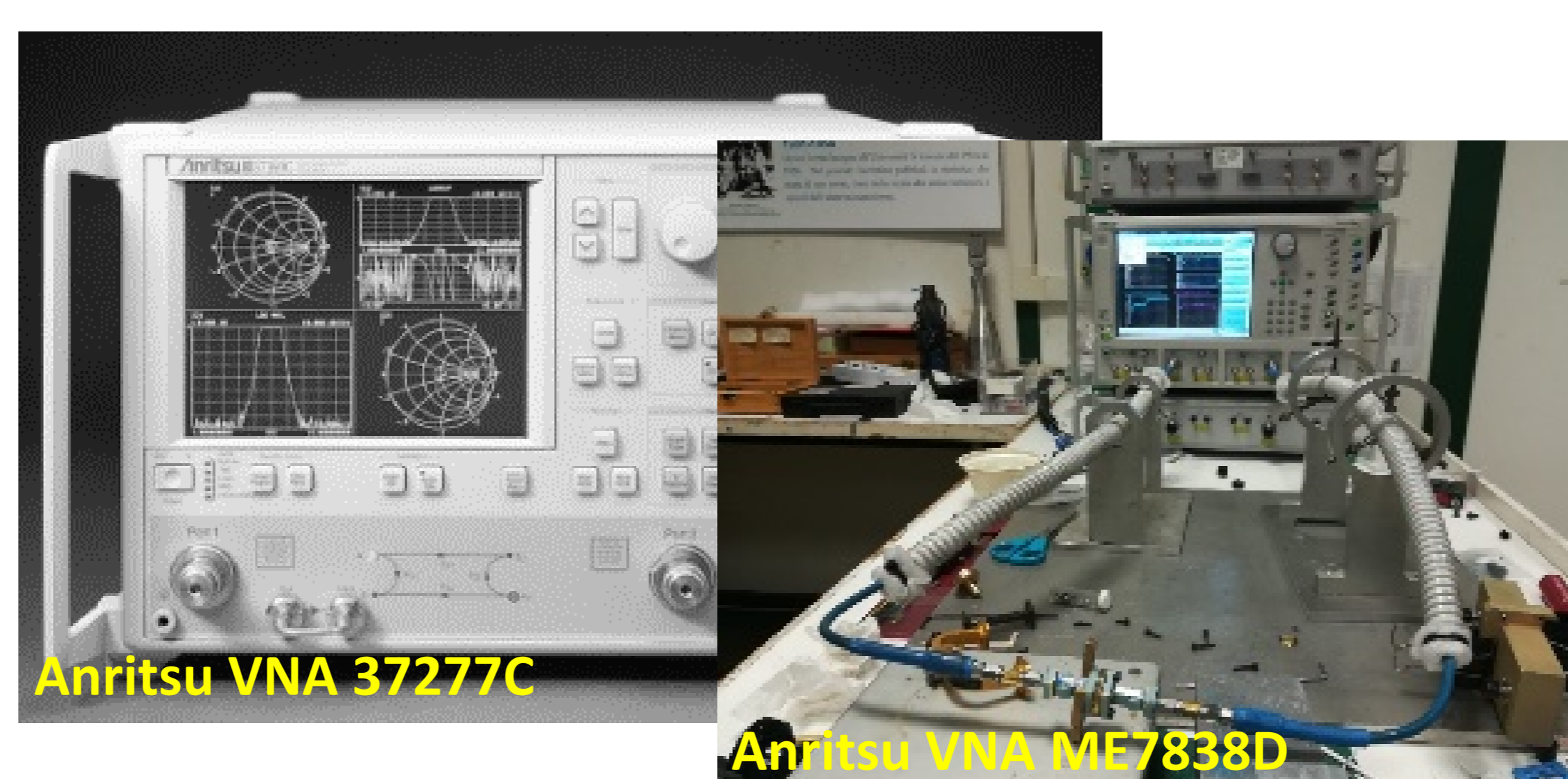


Measurements: amplitude/phase
Dimension (LxWxH) $\approx 4 \times 3 \times 3 \text{ m}^3$
Movement:

- Azimuthal for FF measurements
- Planar for NF measurements

 FF measurements > 2GHz
 NF measurements > 2GHz

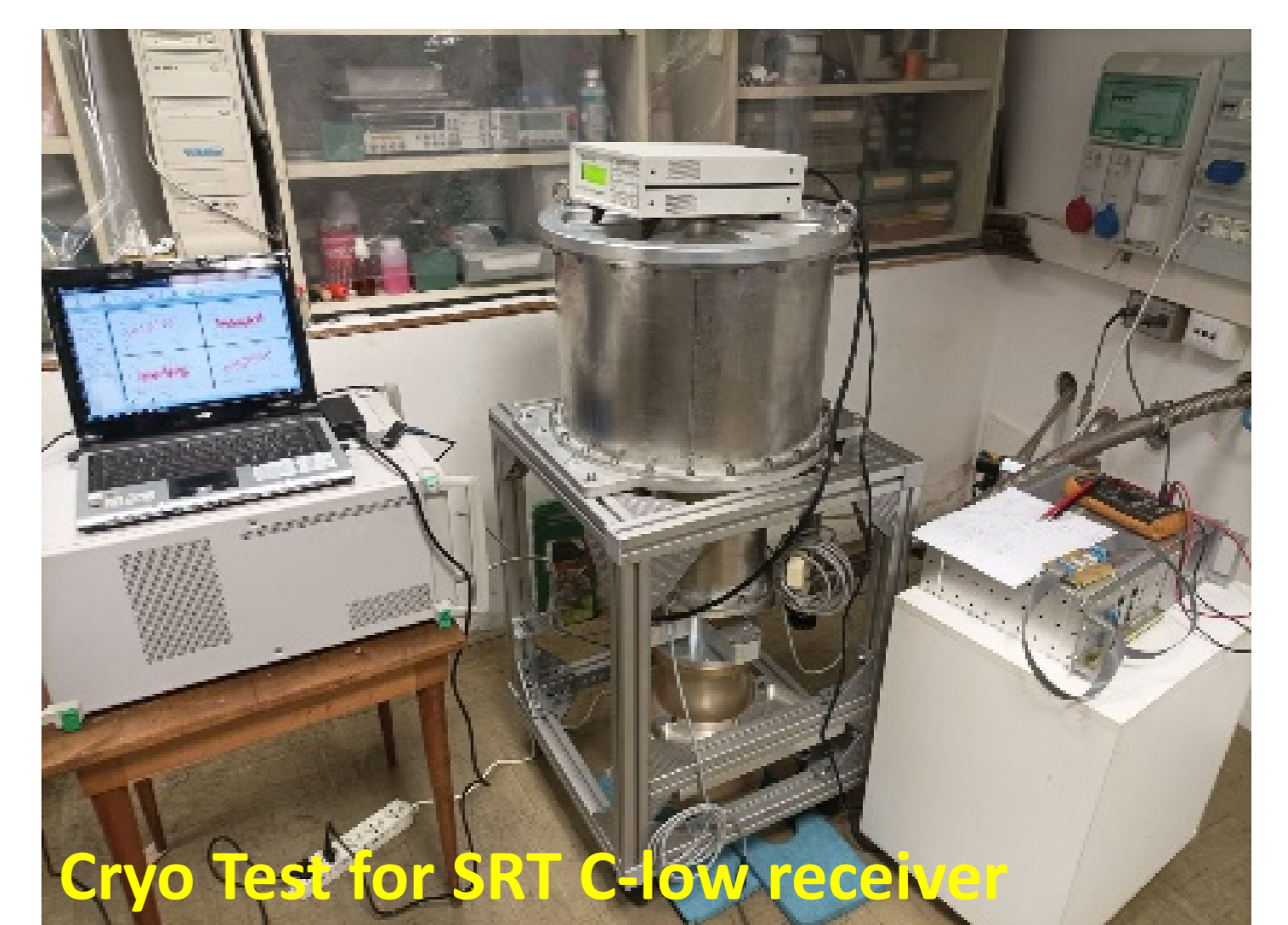
Vector Network Analyzers



Measurements: Scattering Parameters
 Devices : receivers, OMT, LNA
 Vector Network Analyzer

- 40 MHz – 50 GHz
- 40 MHz – 110 GHz

Cryogenic system



Cryostat Dimension $\approx 1 \text{ m}^3$
 $T_{\min} < 20 \text{ K}$
 Typical pressure: 10^{-7} mbar
 Two stages – closed cycle helium

References

- <https://doi.org/10.3390/electronics10151844>
- <https://doi.org/10.1051/0004-6361/201936777>
- [10.1117/12.3019956](https://doi.org/10.1117/12.3019956)

Info contatto

renzo.nesti@inaf.it
 paola.dininni@inaf.it