

Development of high performance
optics
for the **STR**atospheric **I**talian **P**olarimeter

Dott. Francesco Del Torto

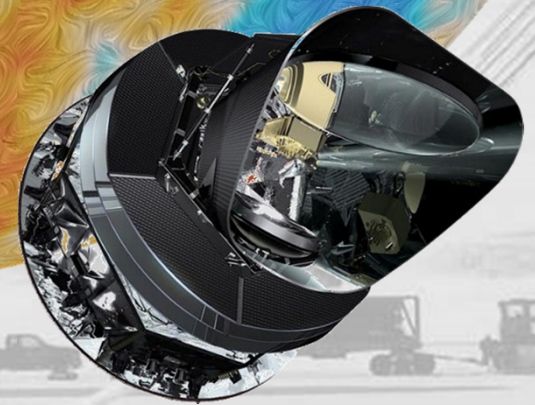
Dott. Cristian Franceschet

CMB POLARIZATION ANISOTROPIES

- ❑ **Quadrupole anisotropies** in the photo-barion fluid (Thomson scattering)
- ❑ **Perturbations of primordial gravitational field** result in different polarization patterns:
 - **E-modes** (density waves)
 - **B-modes** (gravitational waves)
- ❑ **No evolution** from its origin:
 - information on **last scattering epoch**
 - information on **reionization** of the Universe

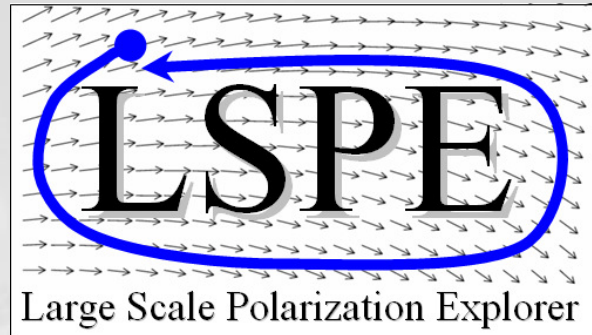
CMB POLARIZATION ANISOTROPIES

**Polarization anisotropies measured at angular scales $> 1^\circ$
with sensitivity $\sim 5 \mu\text{K}$**



Credits: The Planck Collaboration

THE LARGE SCALE POLARIZATION EXPLORER

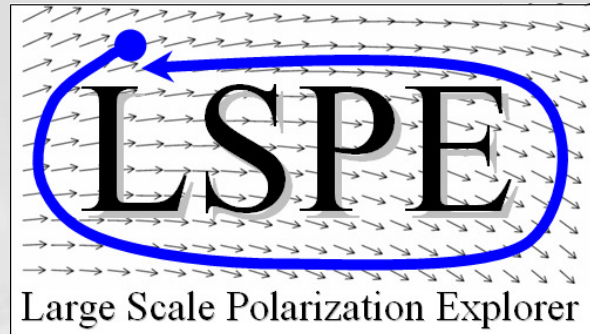


SAPIENZA
UNIVERSITÀ DI ROMA

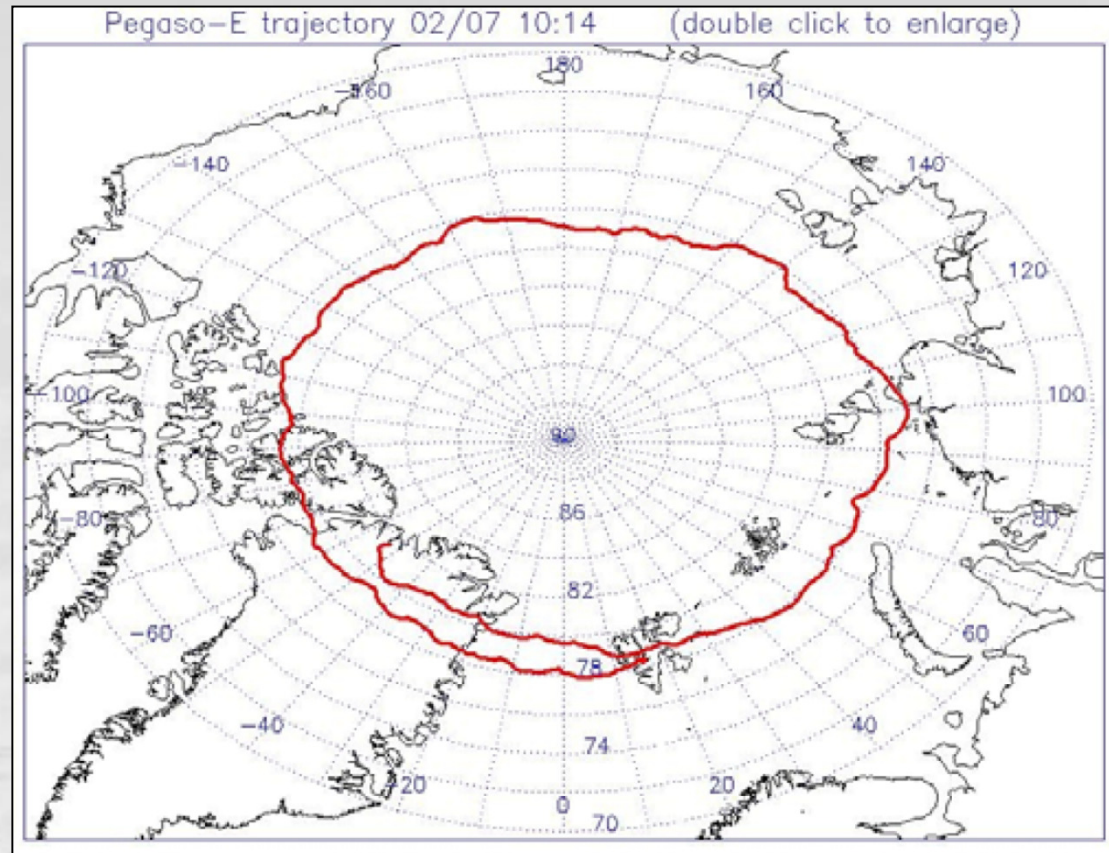


- ❑ Measuring the CMB polarization at large angular scales
- ❑ Produce wide maps of foreground polarization in our galaxy
 - ❑ Map of galactic magnetic fields from *synchrotron emission*
 - ❑ Study the properties of *ionized gas* and of *diffuse interstellar dust*

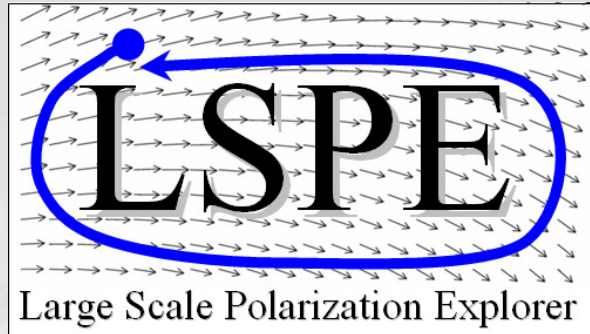
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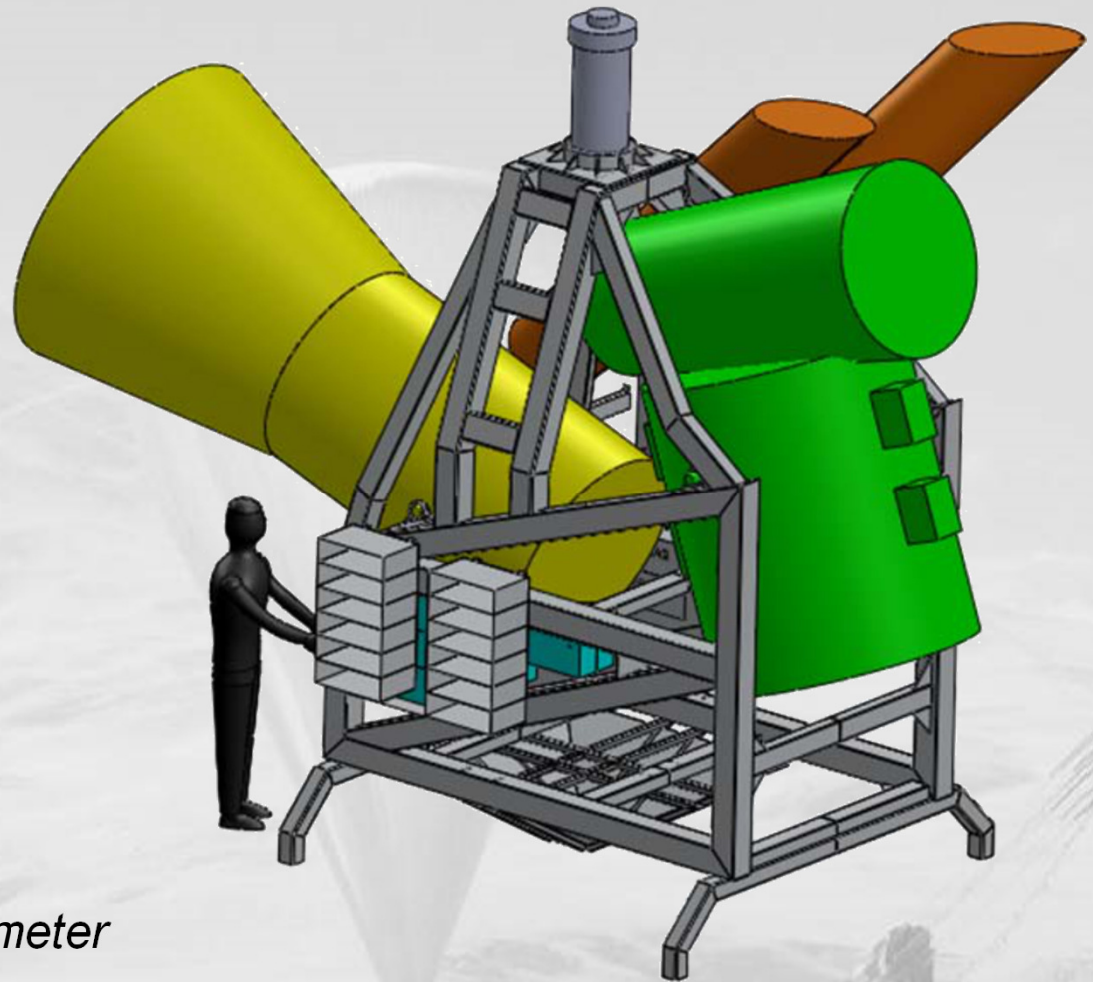
- ❑ **Balloon borne** mission from **Svalbard (Norway)**
- ❑ **13 days** observation
- ❑ **~20% sky coverage**
- ❑ **STR**atospheric **I**talian **P**olarimeter
- ❑ **S**hort **W**avelength **I**nstrument for the **P**olarization **E**xplorer



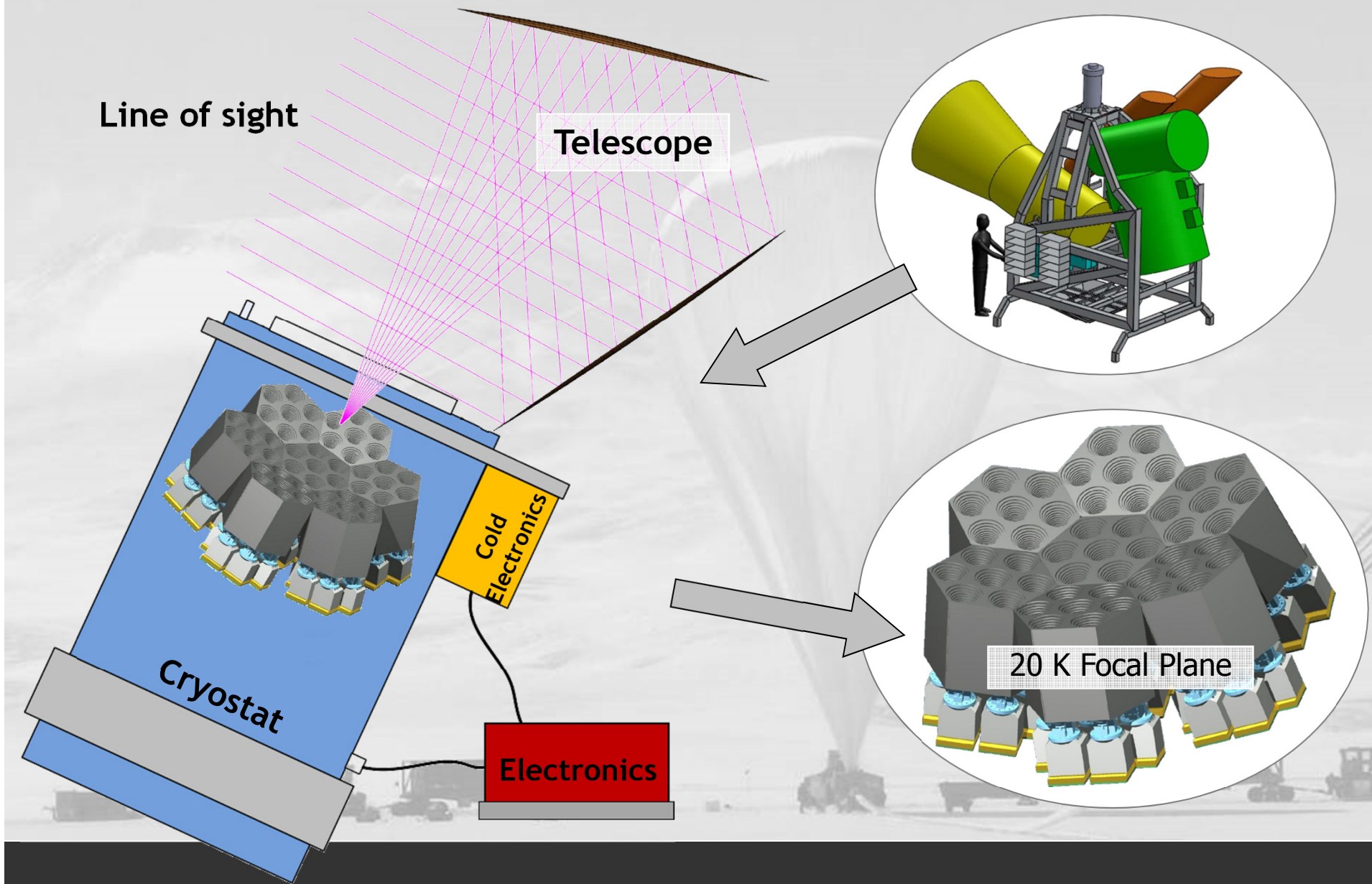
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THE STRATOSPHERIC ITALIAN POLARIMETER



ACTIVITIES AT UNIMI

- ❑ **Design & realization of STRIP focal plane**
 - ❑ Platelet technique engineered feed-horn array
 - ❑ 7-elements modules
 - ❑ Focal plane frame

- ❑ **Development of a fully automatized anechoic chamber for testing**
 - ❑ Electromagnetic design
 - ❑ Structure design and realization
 - ❑ Control software design and implementation

- ❑ **Beam pattern measurements**

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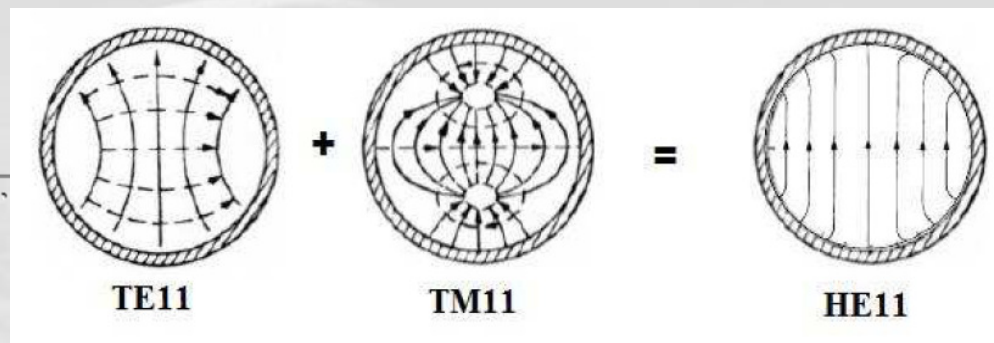
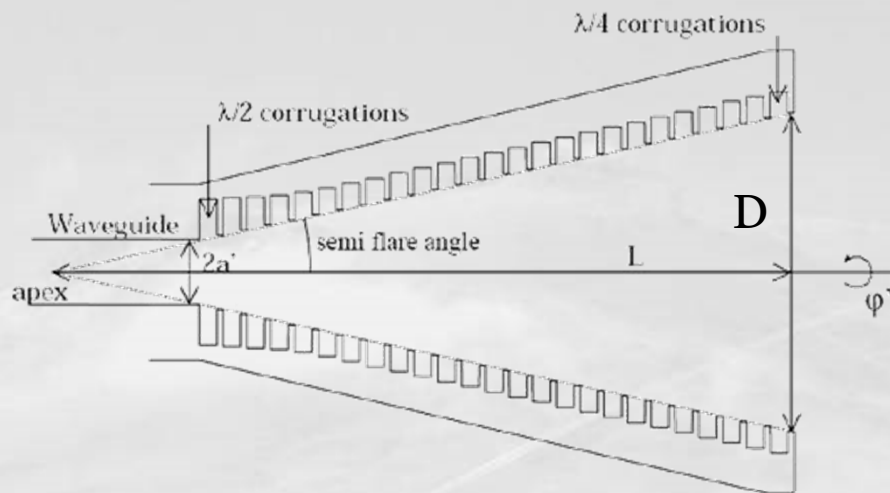
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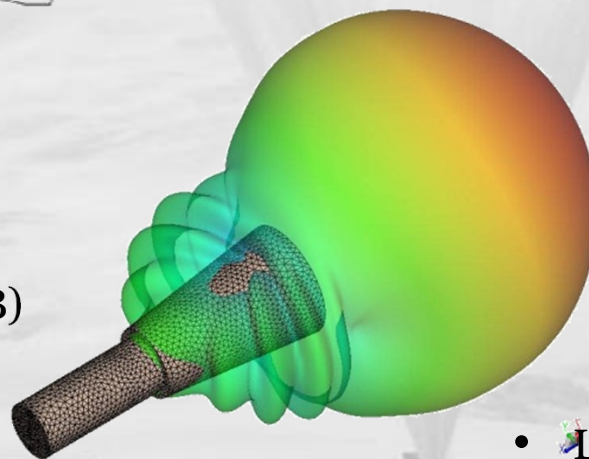
DESIGN AND REALIZATION OF FEED-HORN ARRAYS

Design & realization of feed-horn arrays



BEAM PATTERN (angular response)

- ✓ Symmetric
- ✓ Low cross-pol (<-30 dB)
- ✓ Wide band (20%)
- ✓ High directivity
- ✓ Low level of "side lobes" (<-30 dB)



- Low Insertion Loss (>-0.1 dB)
- Low Return Loss (<-30 dB)

DESIGN AND REALIZATION OF FEED-HORN ARRAYS

Design & realization of feed-horn arrays

Platelet Array

Tipologia Feed Horn

Nr. Frequenze: Frequenza Singola

Profilo Horn: Non profilato

Controlli

Genera E.M. Genera Inventor Opzioni

Genera Mecc. Genera SRSR Chiudi

Parametri E.M. (Freq. 1) Parametri E.M. (Freq. 2) Parametri Meccanici

Input

Frequenza (GHz): 100

FWHM (deg): 18.5

Angolo di Semi-flare (deg): 6

Nr. Corrugazioni Transizione: 10

Spessore Corrugazione (mm): 1

Rapporto Dente/Gola: 0.7

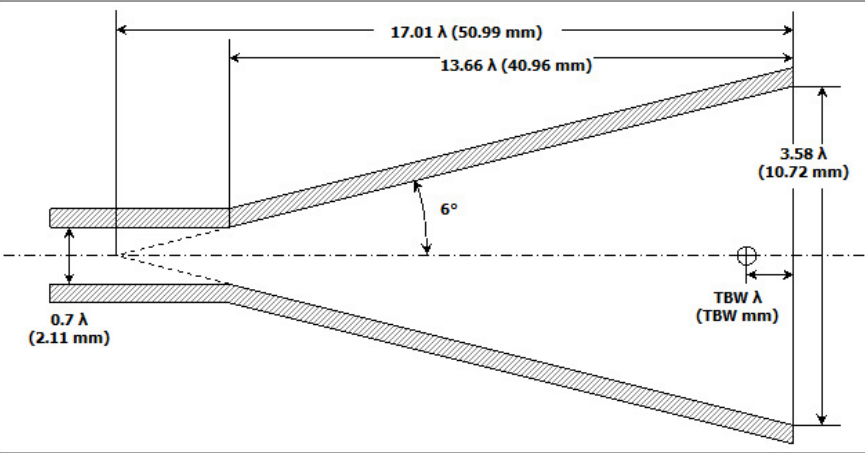
Output

Lambda (mm): 2.998

D apertura horn (mm): 10.718

D guida circolare TE11 (mm): 2.108

Nr. Lamine: 40



17.01 λ (50.99 mm)

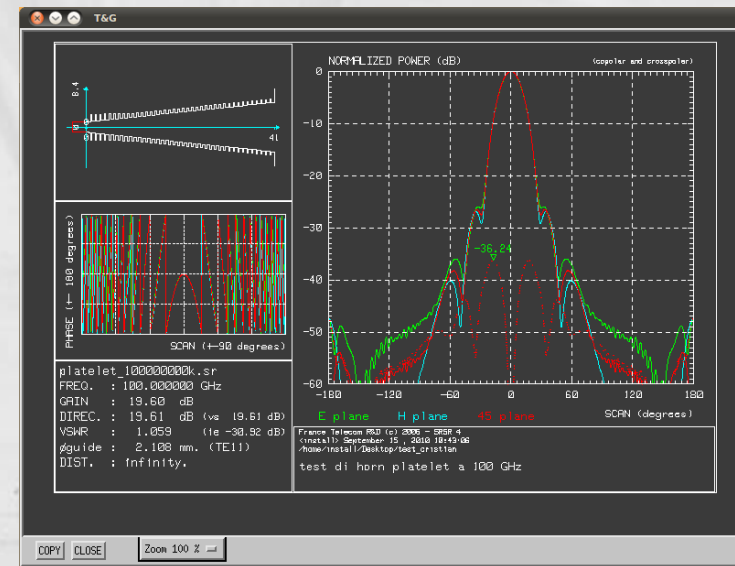
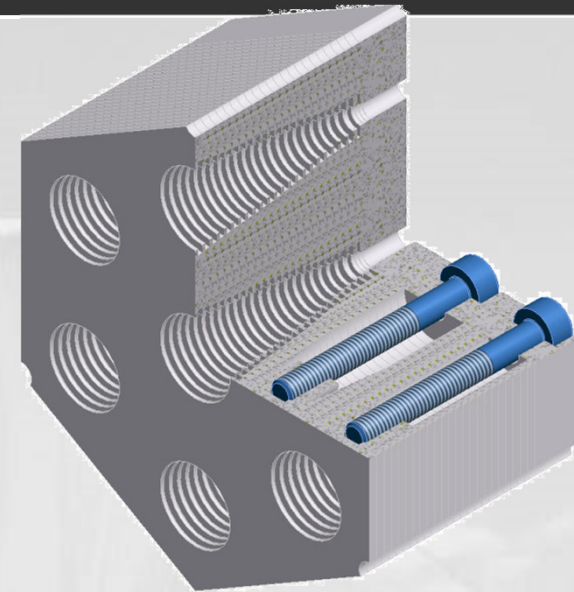
13.66 λ (40.96 mm)

3.58 λ (10.72 mm)

6°

0.7 λ (2.11 mm)

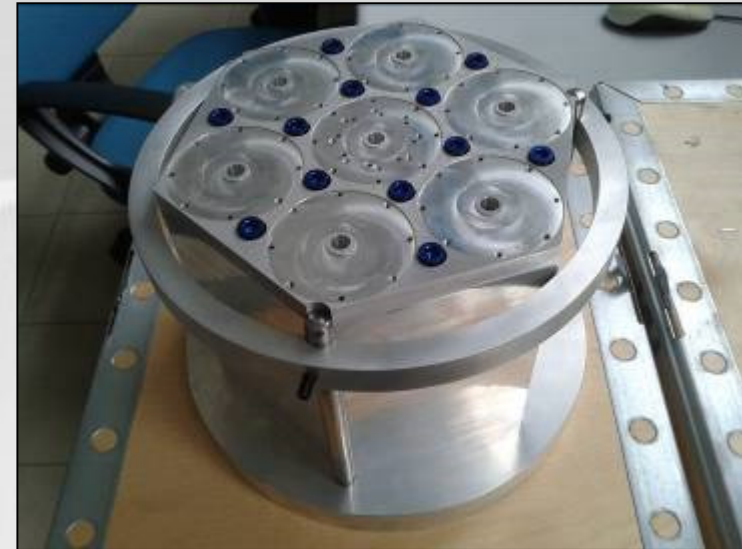
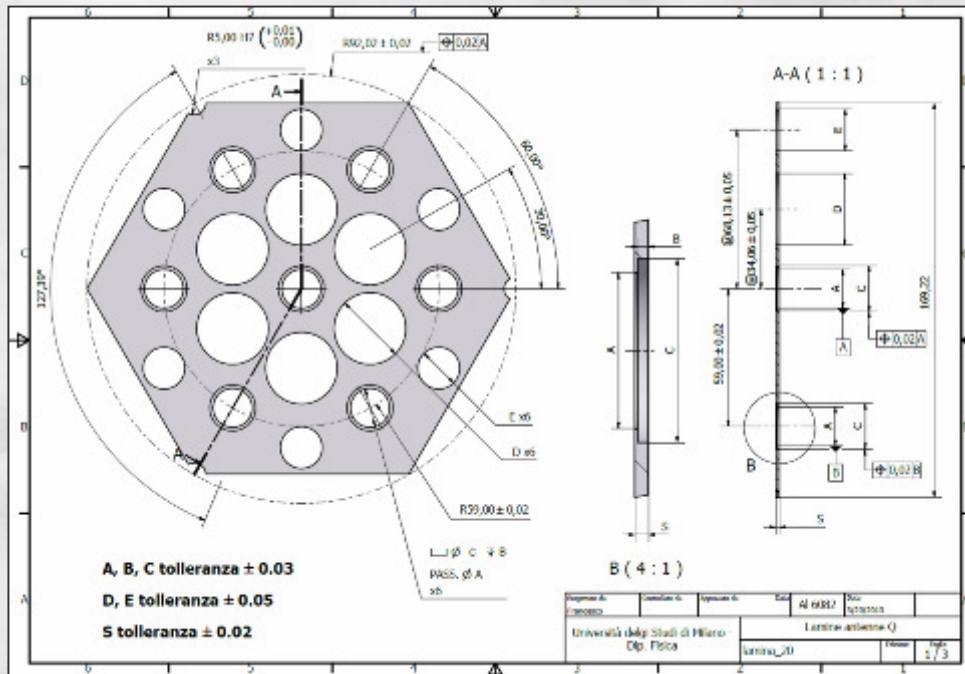
TBW λ (TBW mm)



DESIGN AND REALIZATION OF FEED-HORN ARRAYS

Design & realization of feed-horn arrays

□ Platelet technique engineering



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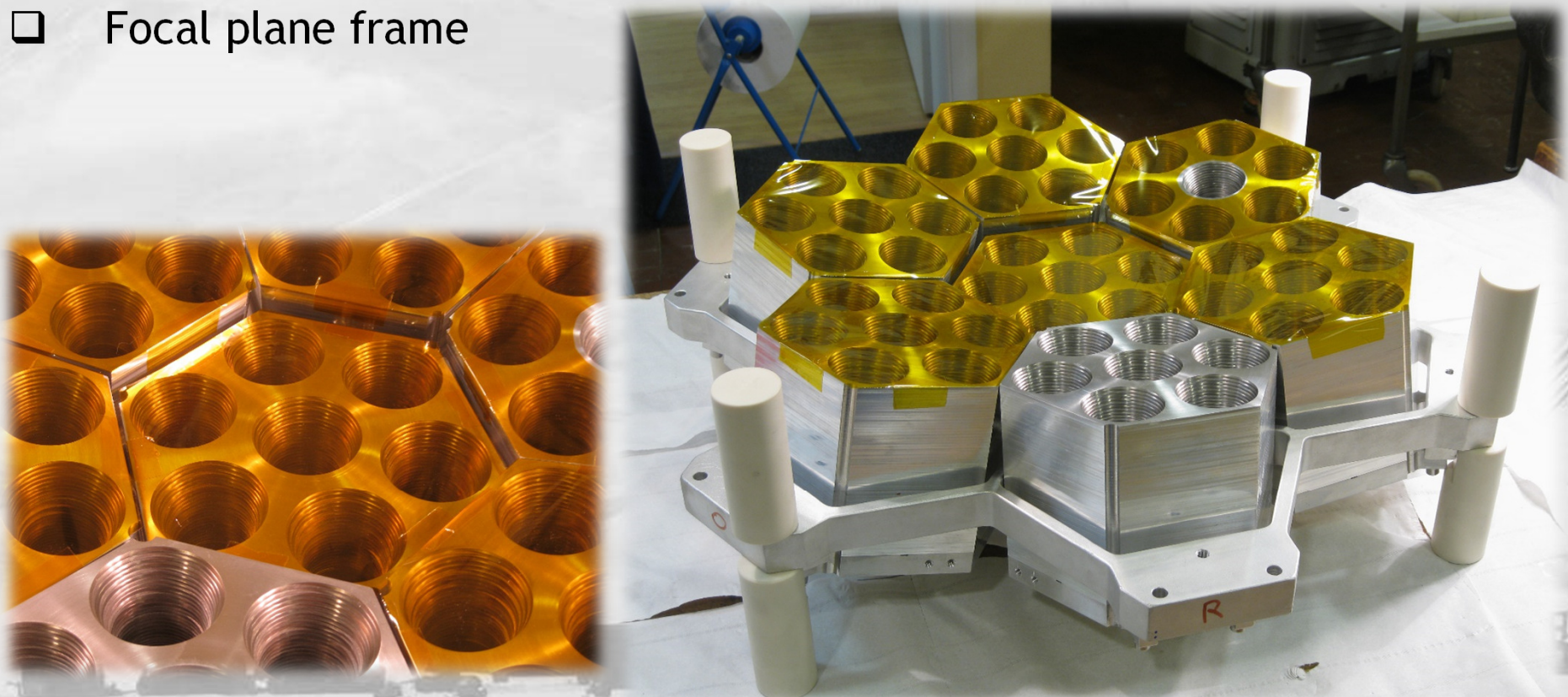
- ❑ Platelet technique engineering
- ❑ Realization of 7-elements modules



DESIGN AND REALIZATION OF FEED-HORN ARRAYS

Design & realization of feed-horn arrays

- ❑ Platelet technique engineering
- ❑ Realization of 7-elements modules
- ❑ Focal plane frame



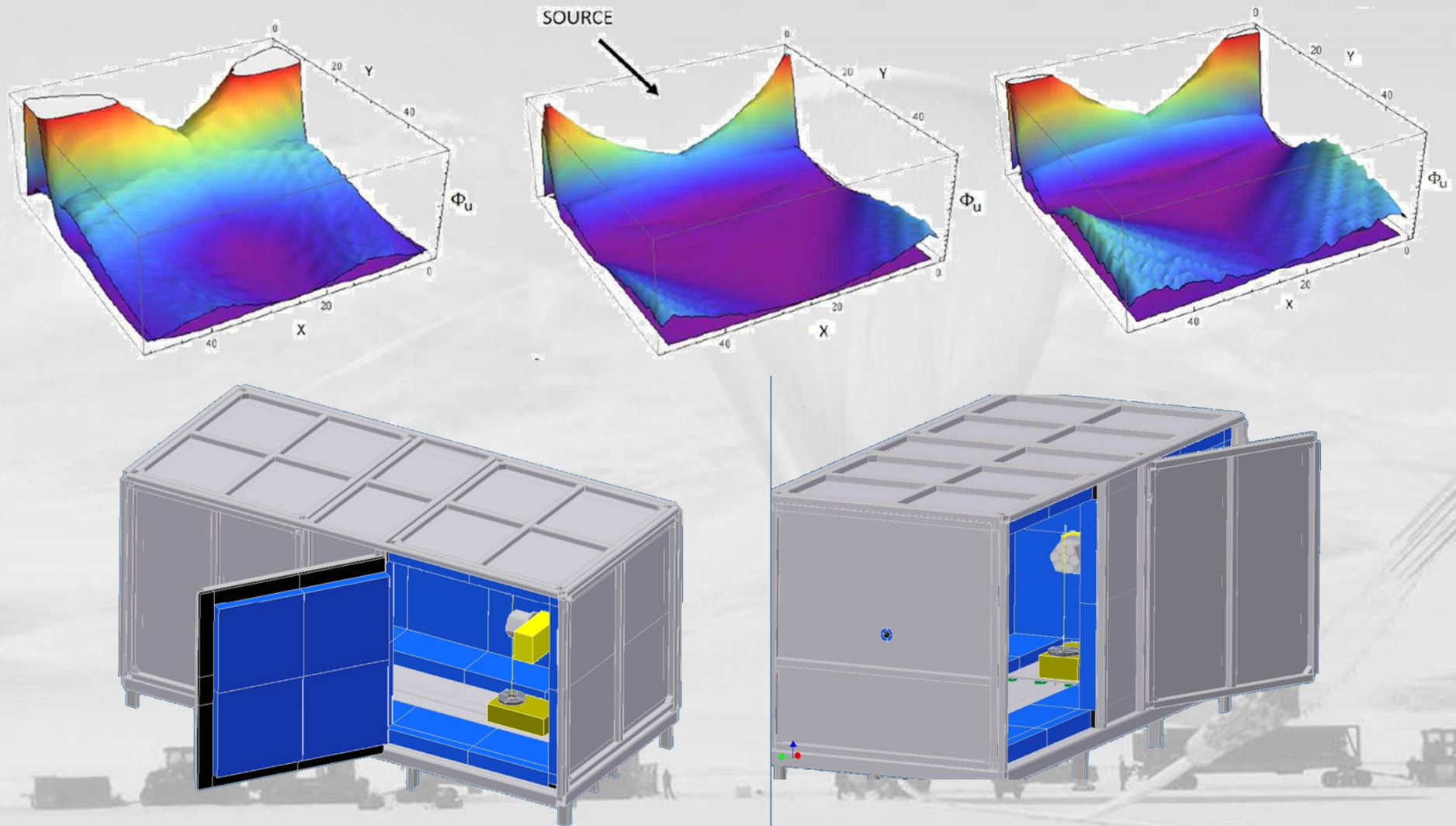
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DEVELOPMENT OF TESTING FACILITY

Electromagnetic & mechanical design



Collaboration with B. Paroli

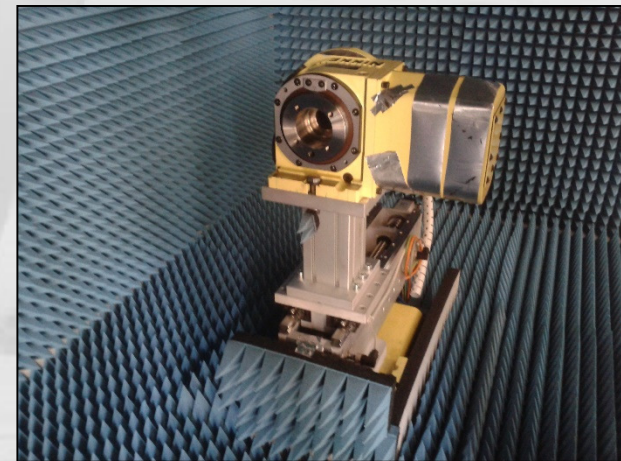
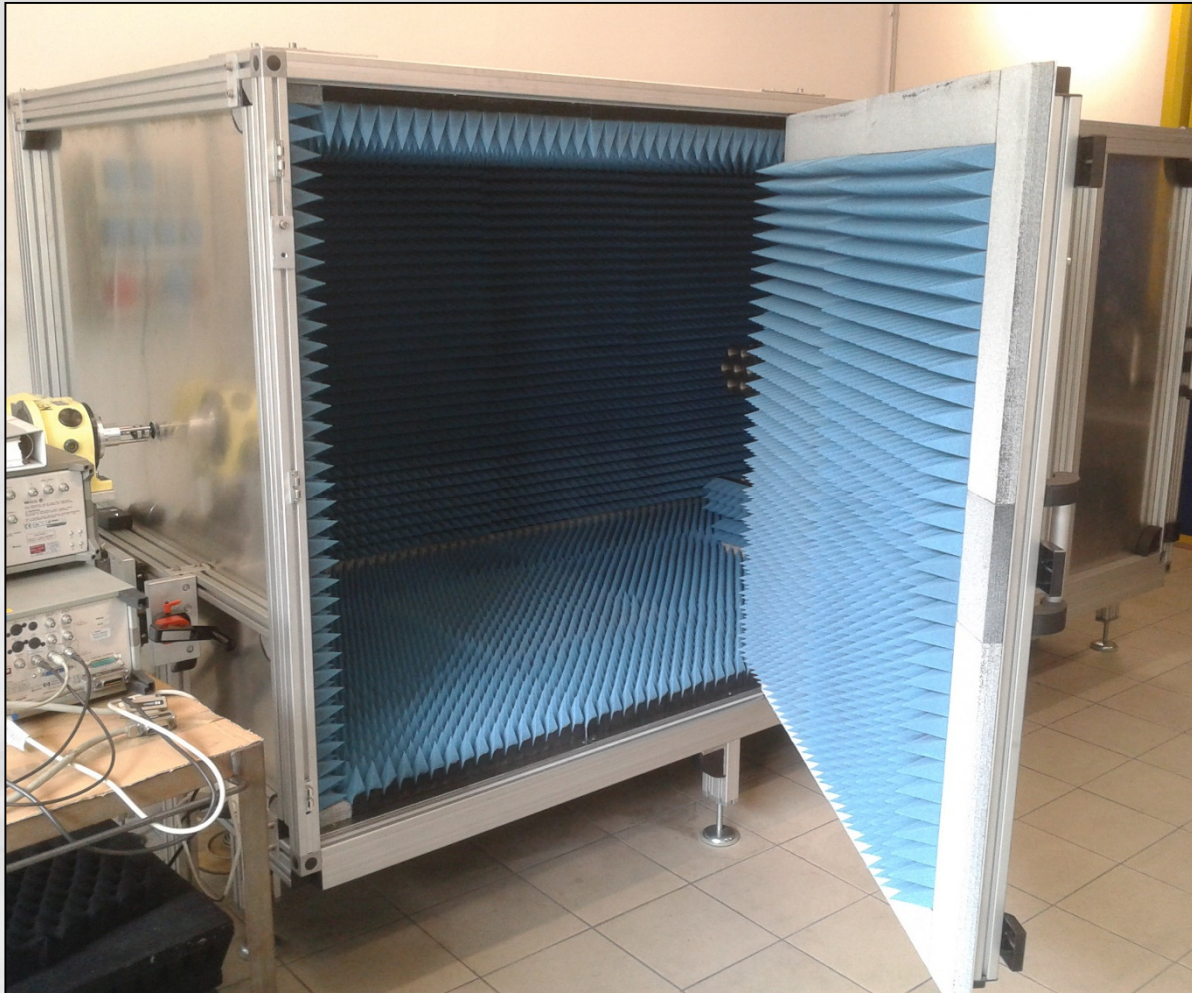
DEVELOPMENT OF TESTING FACILITY

Structure realization



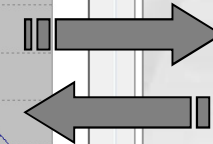
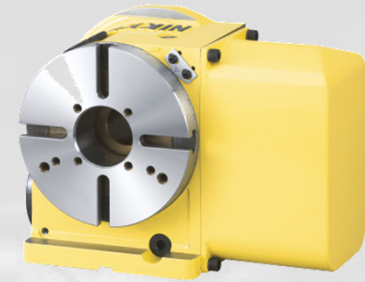
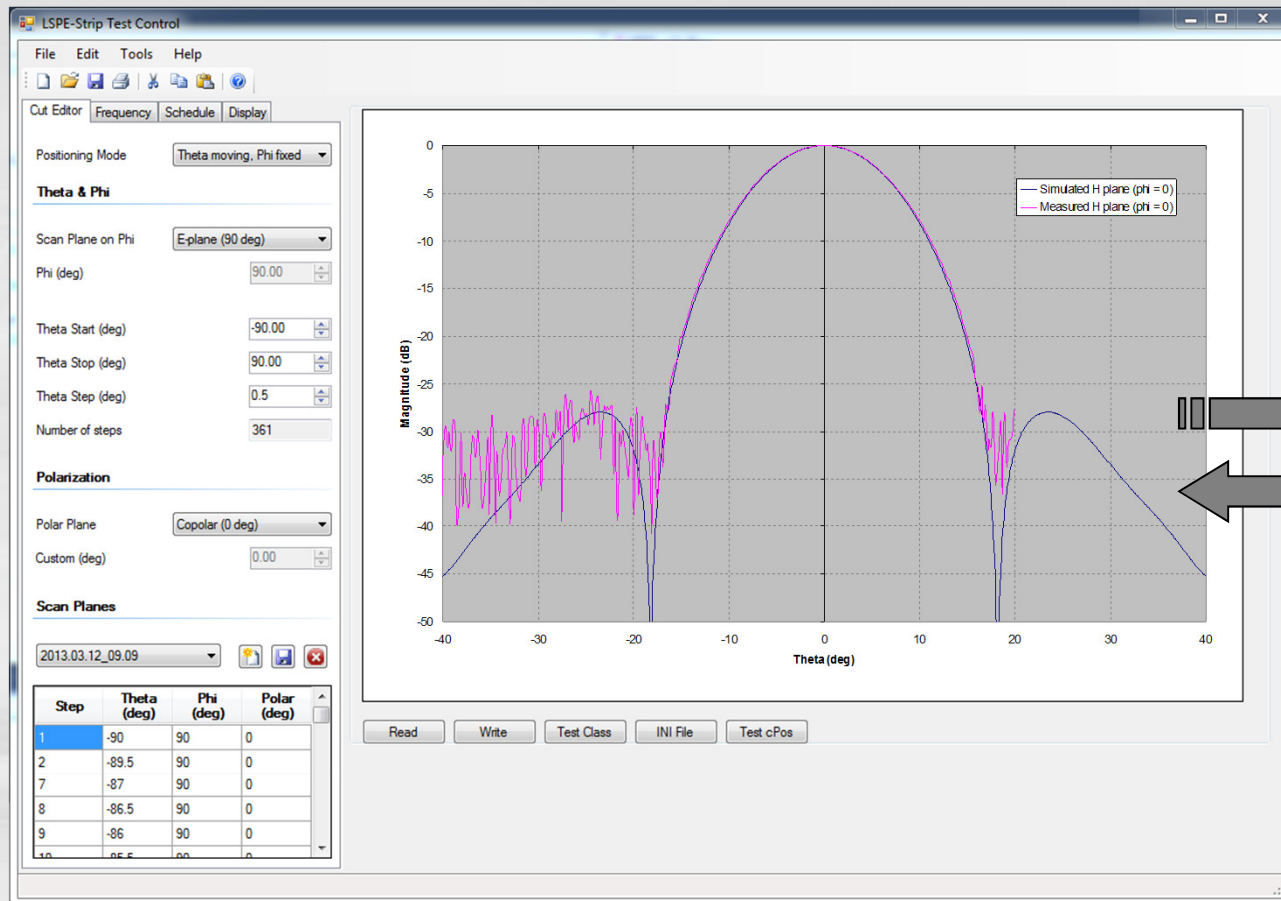
DEVELOPMENT OF TESTING FACILITY

Shielding, motion & cabling



DEVELOPMENT OF TESTING FACILITY

Control software



ACTIVITIES AT UNIMI

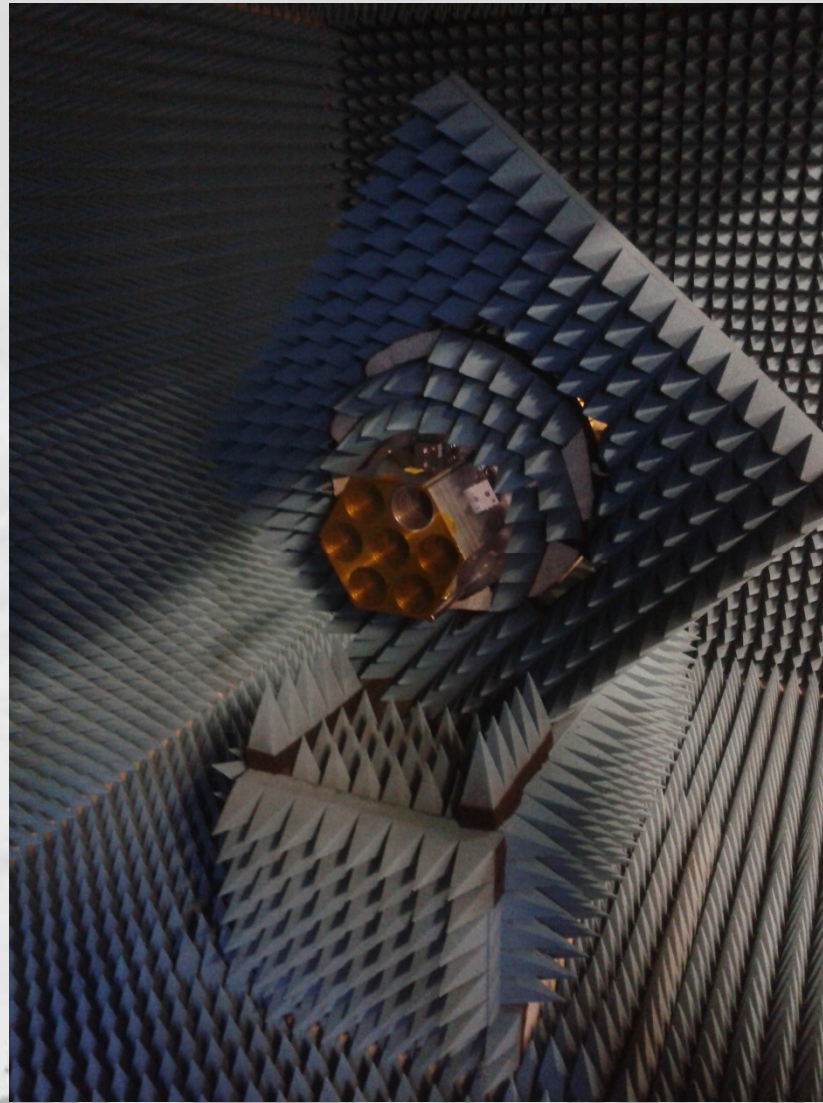
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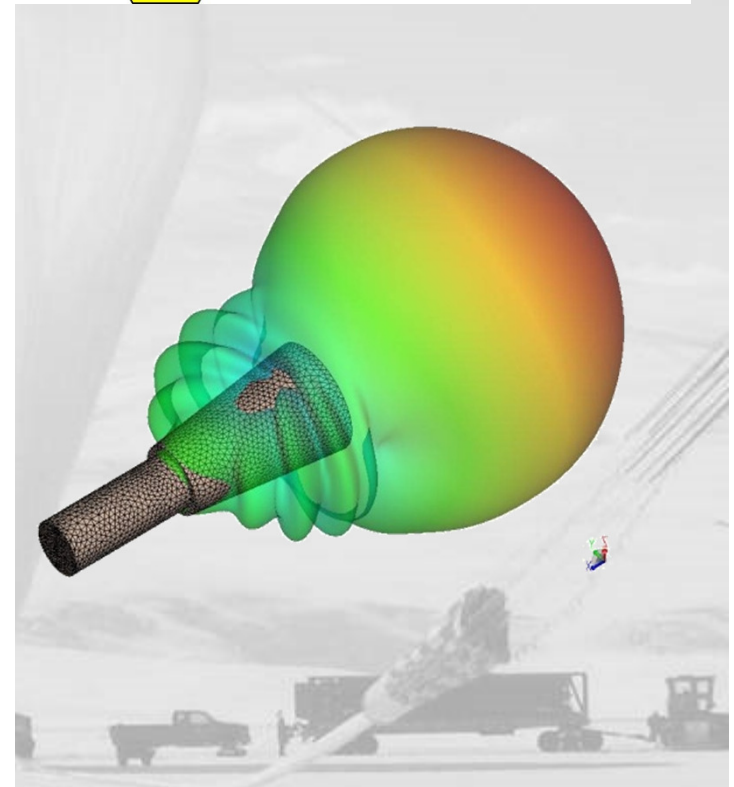
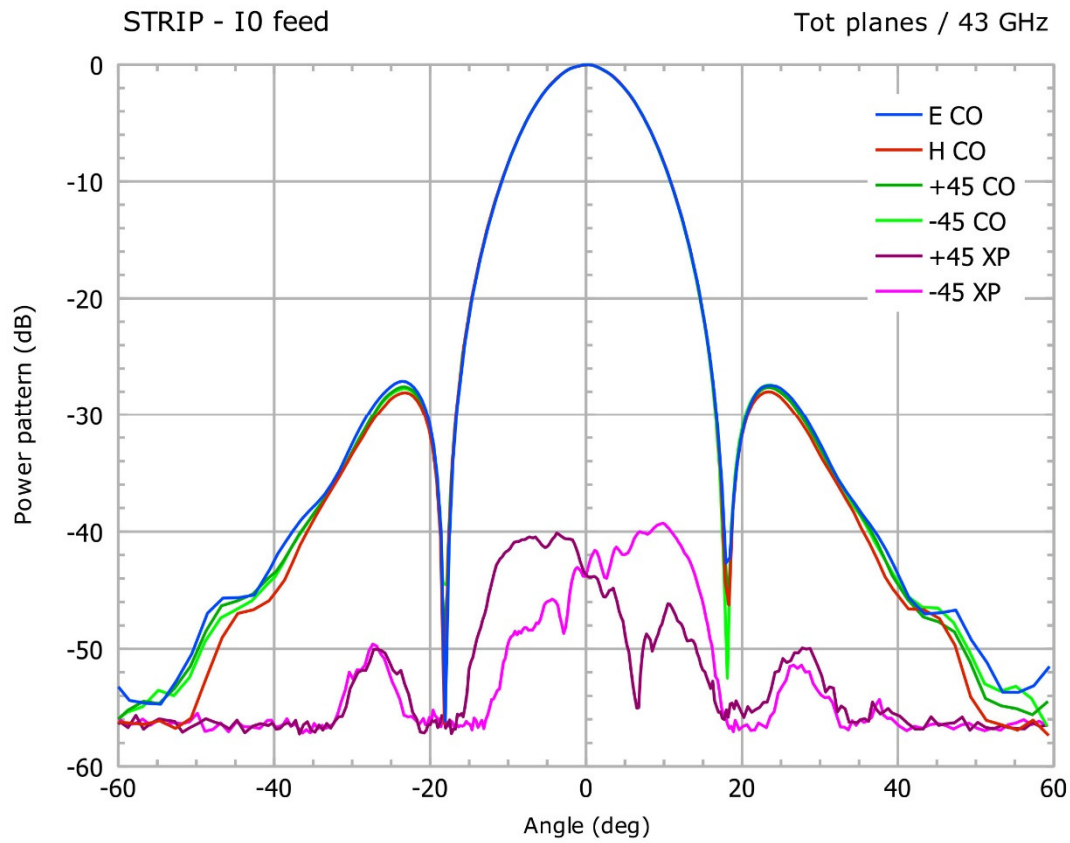
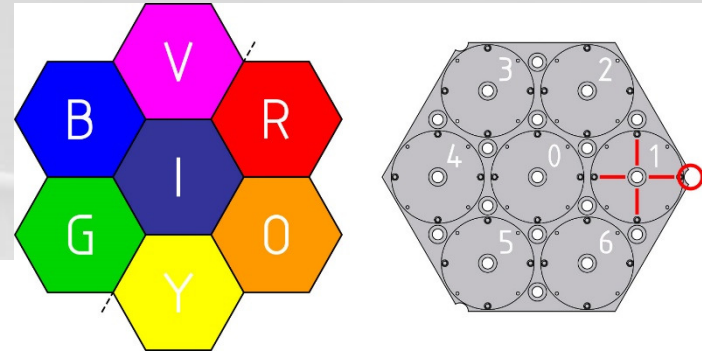
- ❑ **Beam pattern measurements**



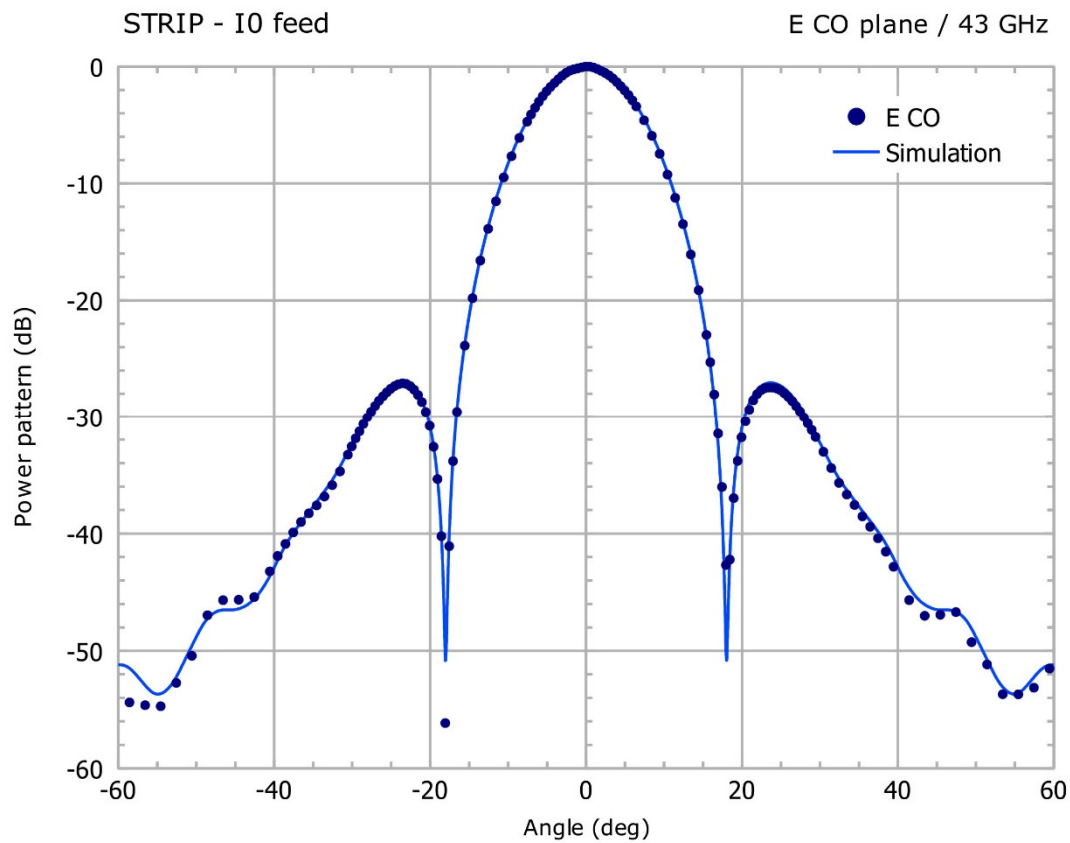
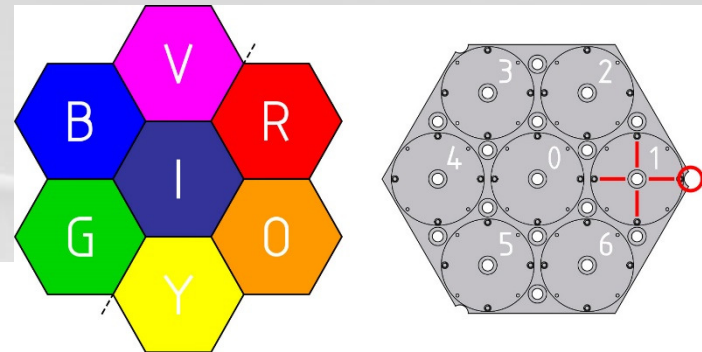
STRIP Q-BAND FEED-HORN BEAM PATTERN MEASUREMENTS



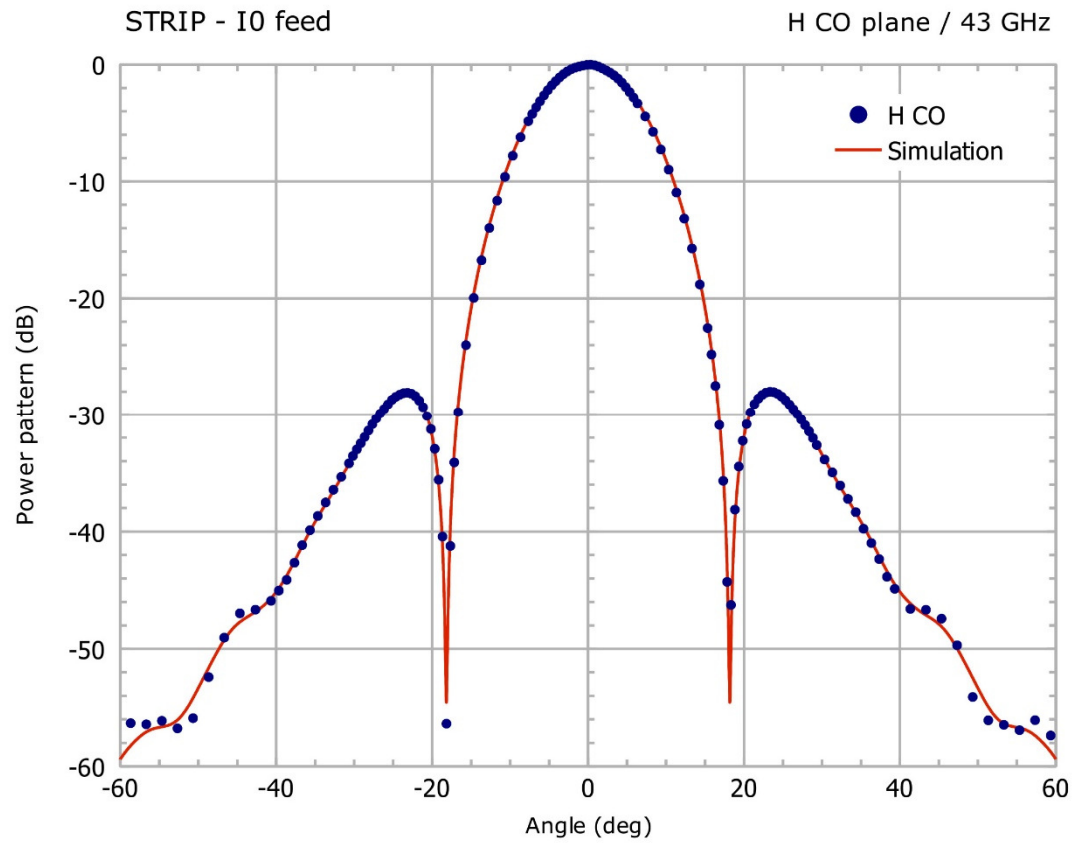
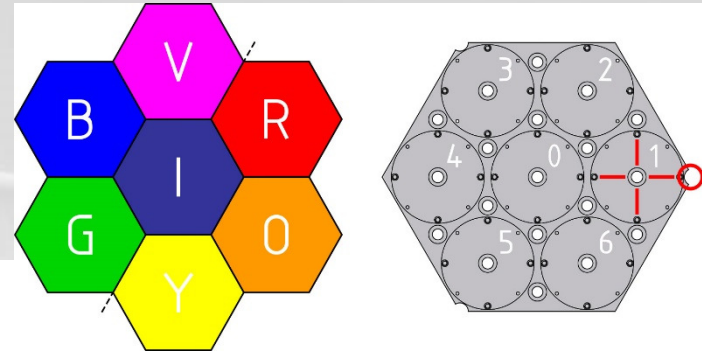
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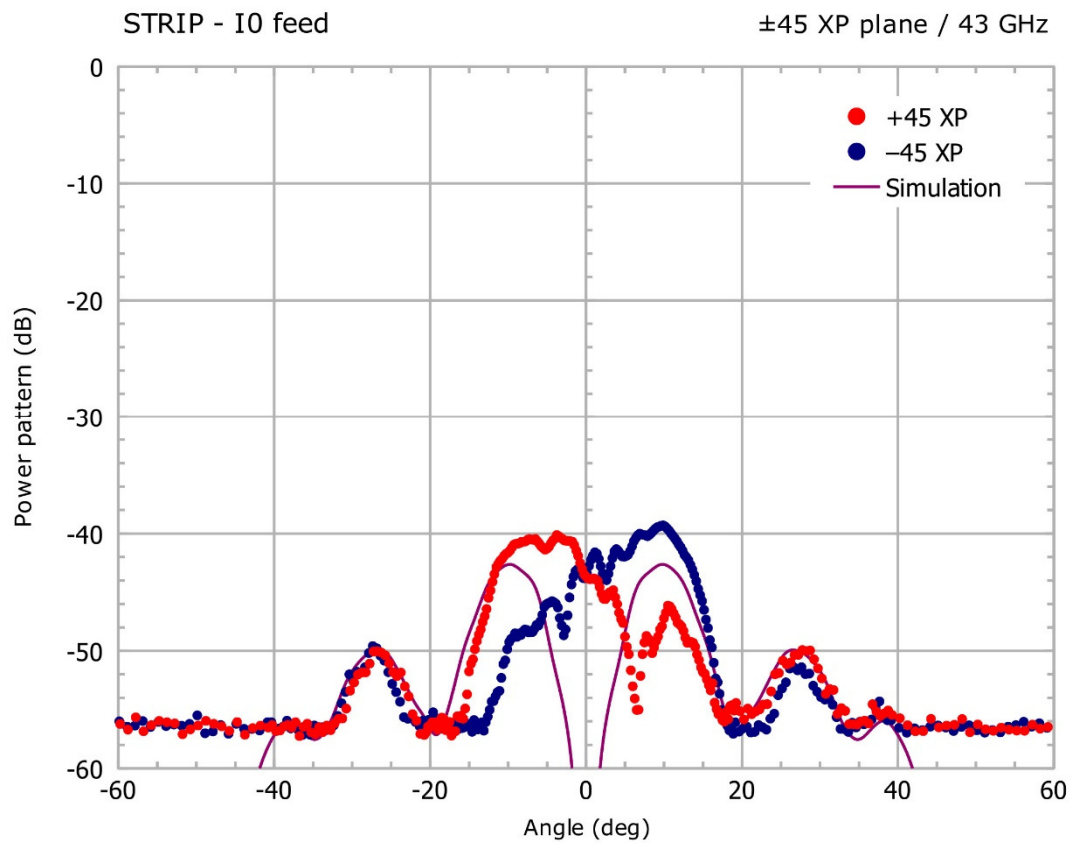
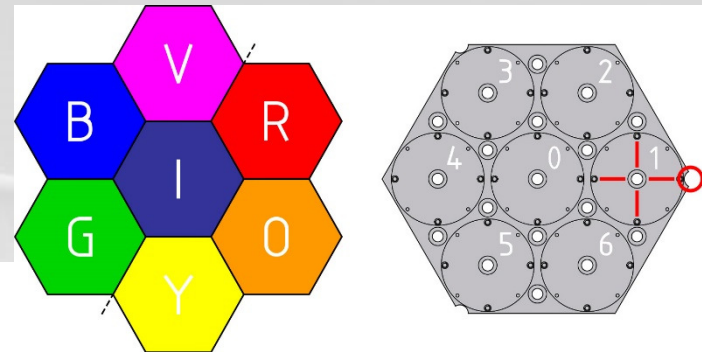
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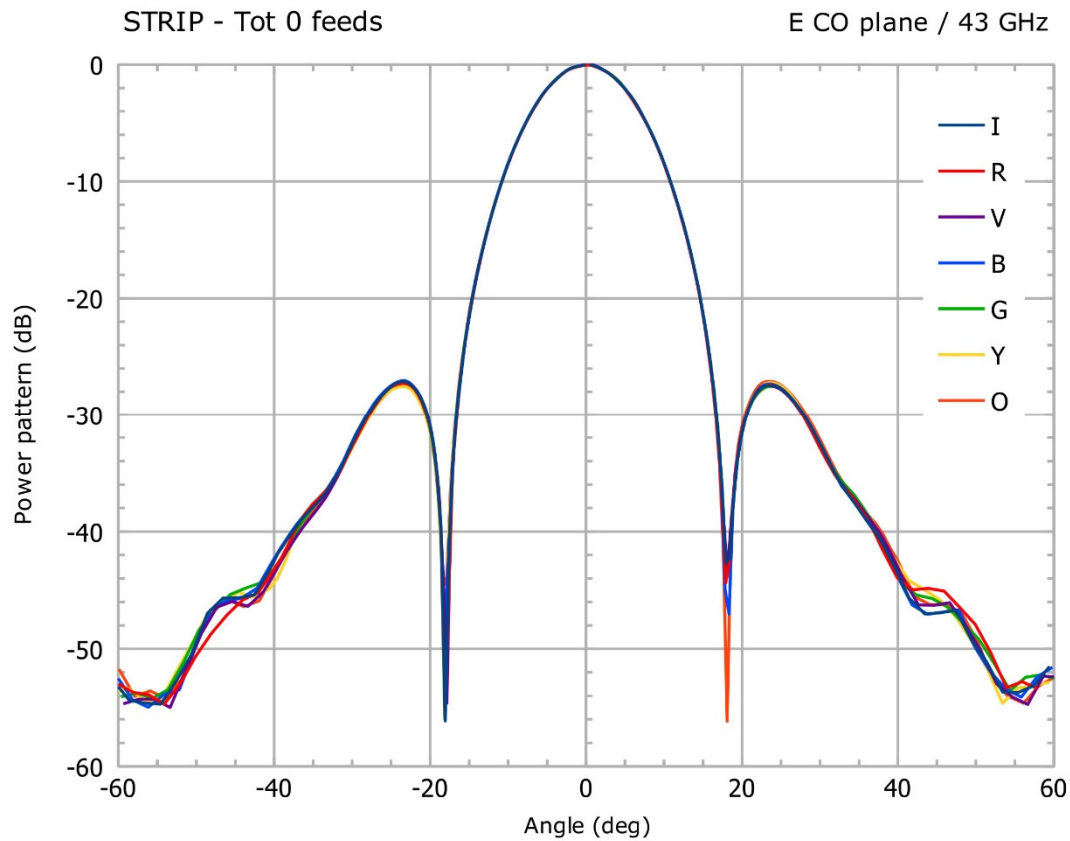
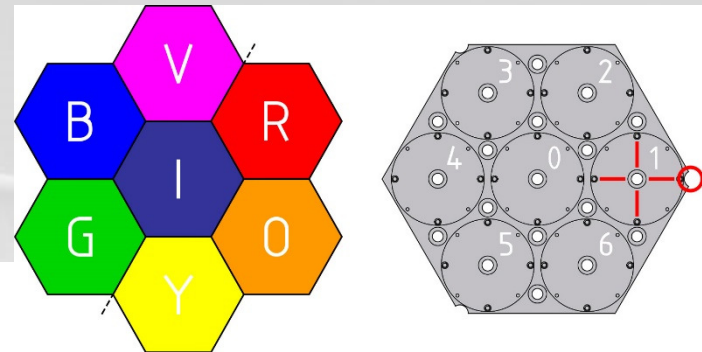
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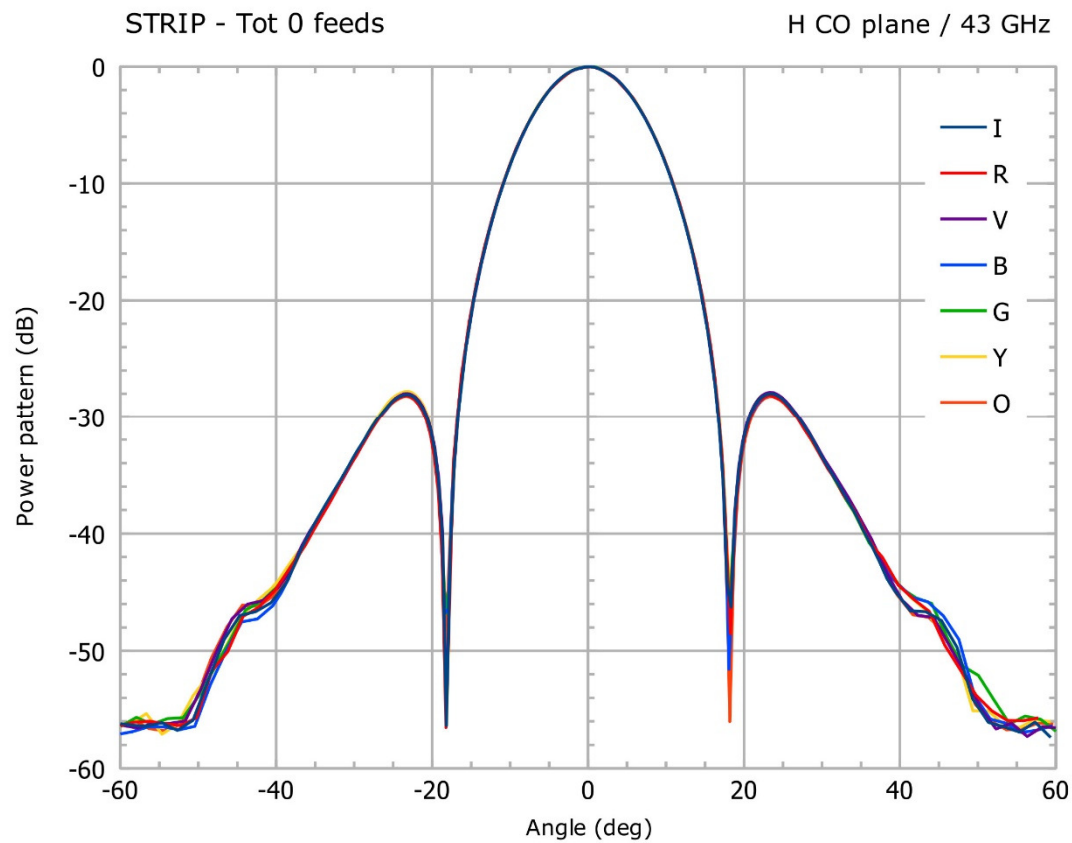
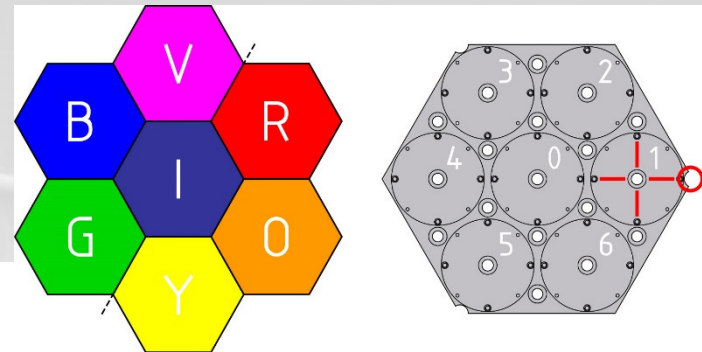
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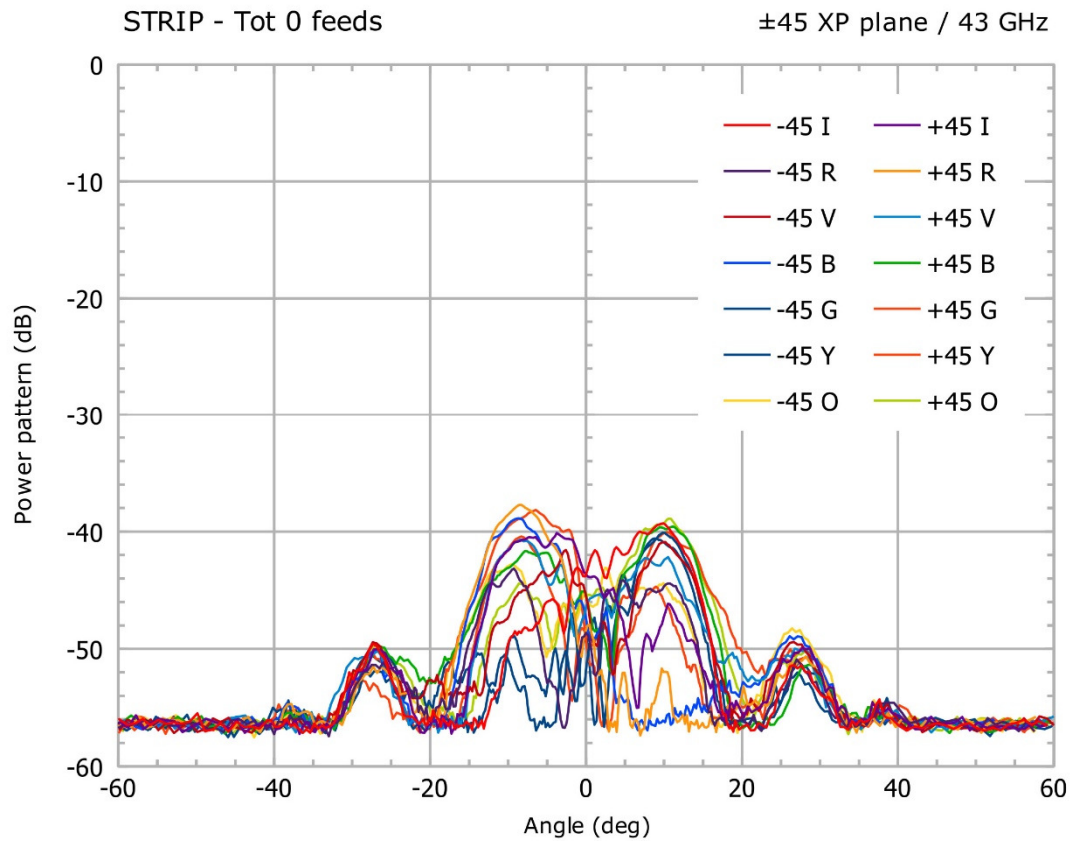
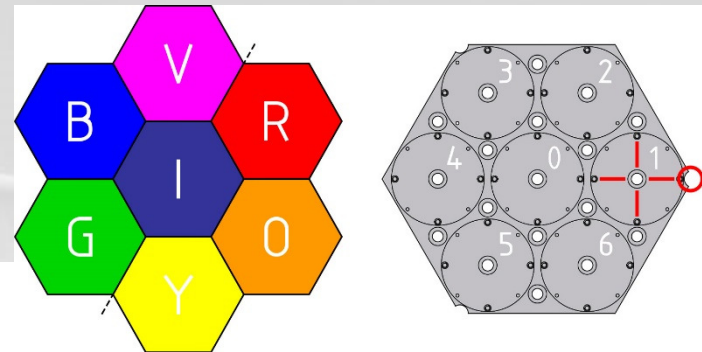
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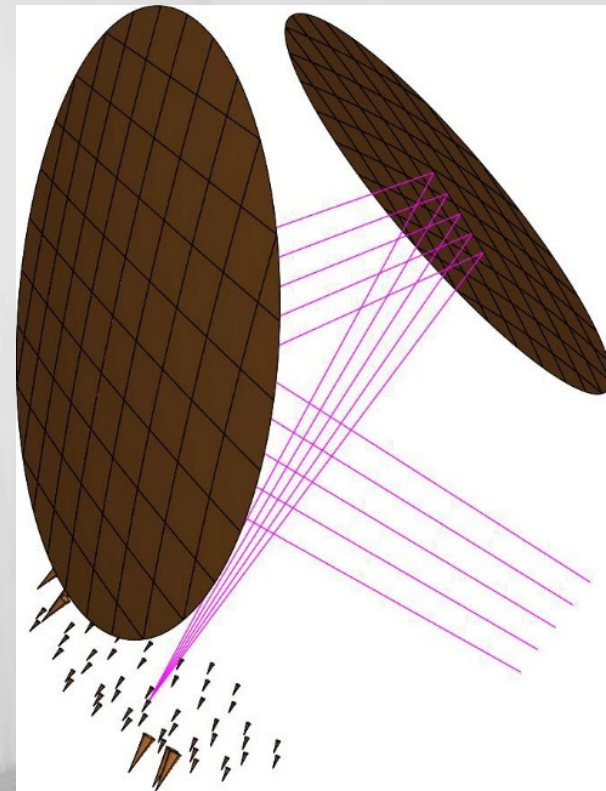
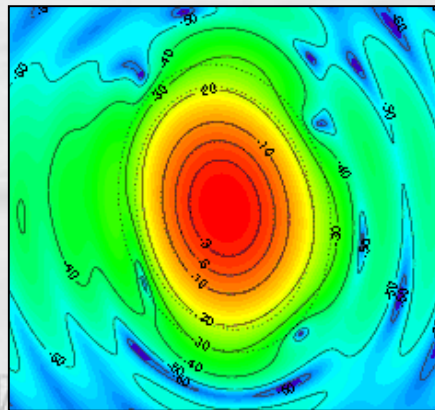


NEXT STEP

❑ Simulation of the STRIP optics response

using feed-horn measured data into GRASP®

- ❑ Main beam
- ❑ Side lobes
- ❑ Shields



SRT Q-BAND FEED-HORN BEAM PATTERN MEASUREMENTS

