



Consiglio Nazionale delle Ricerche



Istituto di Elettronica e di Ingegneria dell'Informazione e delle Telecomunicazioni

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[www.ieiit.cnr.it](http://www.ieiit.cnr.it)

# Dual-polarization Vivaldi Array Element for AA-Low

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INAF



CNR IEIT – Applied Electromagnetics Group

Scienza e Tecnologia di SKA,  
Rome, June 19-20 2012

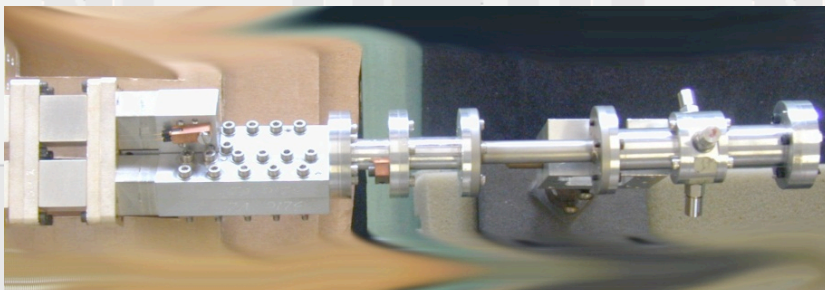
# IEIT-EA Group Activities (1)

Analysis and Design EM software

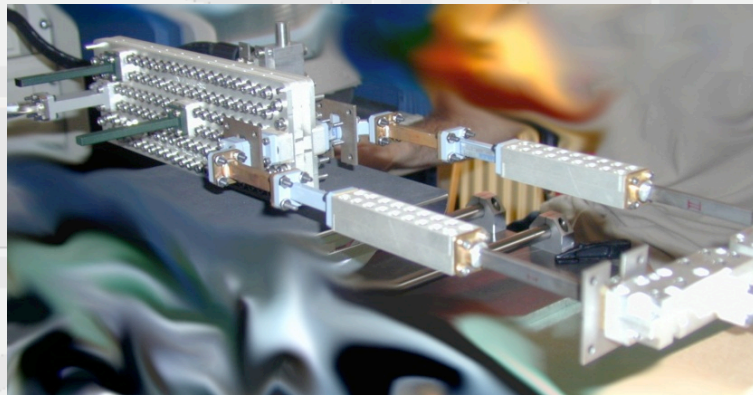
- Full-wave integral techniques
- Reduced Order Models
- Synthesis methods

Measurement techniques

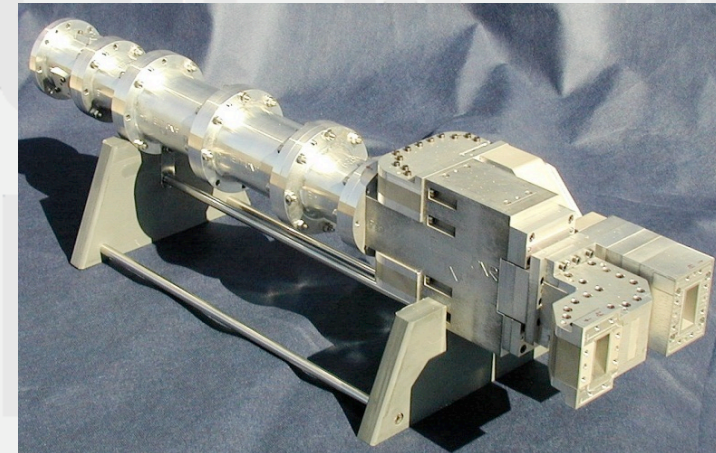
Ka-band dual polarization receiver



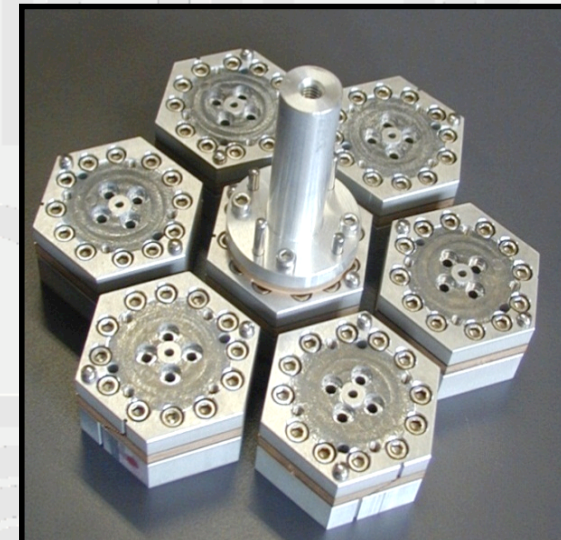
Ka-band analog correlation unit and filters



C-band dual polarization receiver (30% BW)



W-band OMT cluster (30% BW)



# IEIT-EA Group Activities (2)

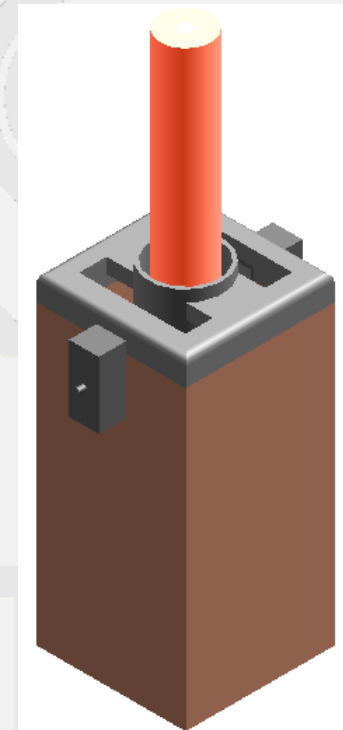
Antenna Radomes



Sundial - DBS - Antenna



Sensors for Industrial Applications



High performance corrugated horns

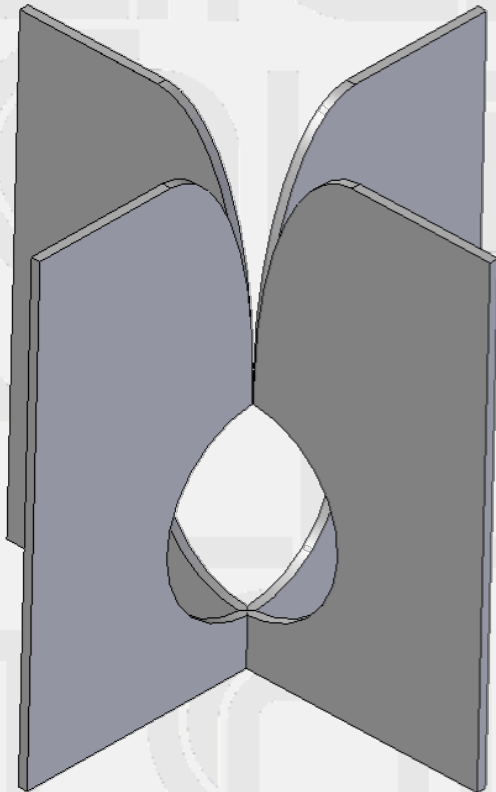


<http://www.to.ieiit.cnr.it/ea/>

# SKA AA-low main specs

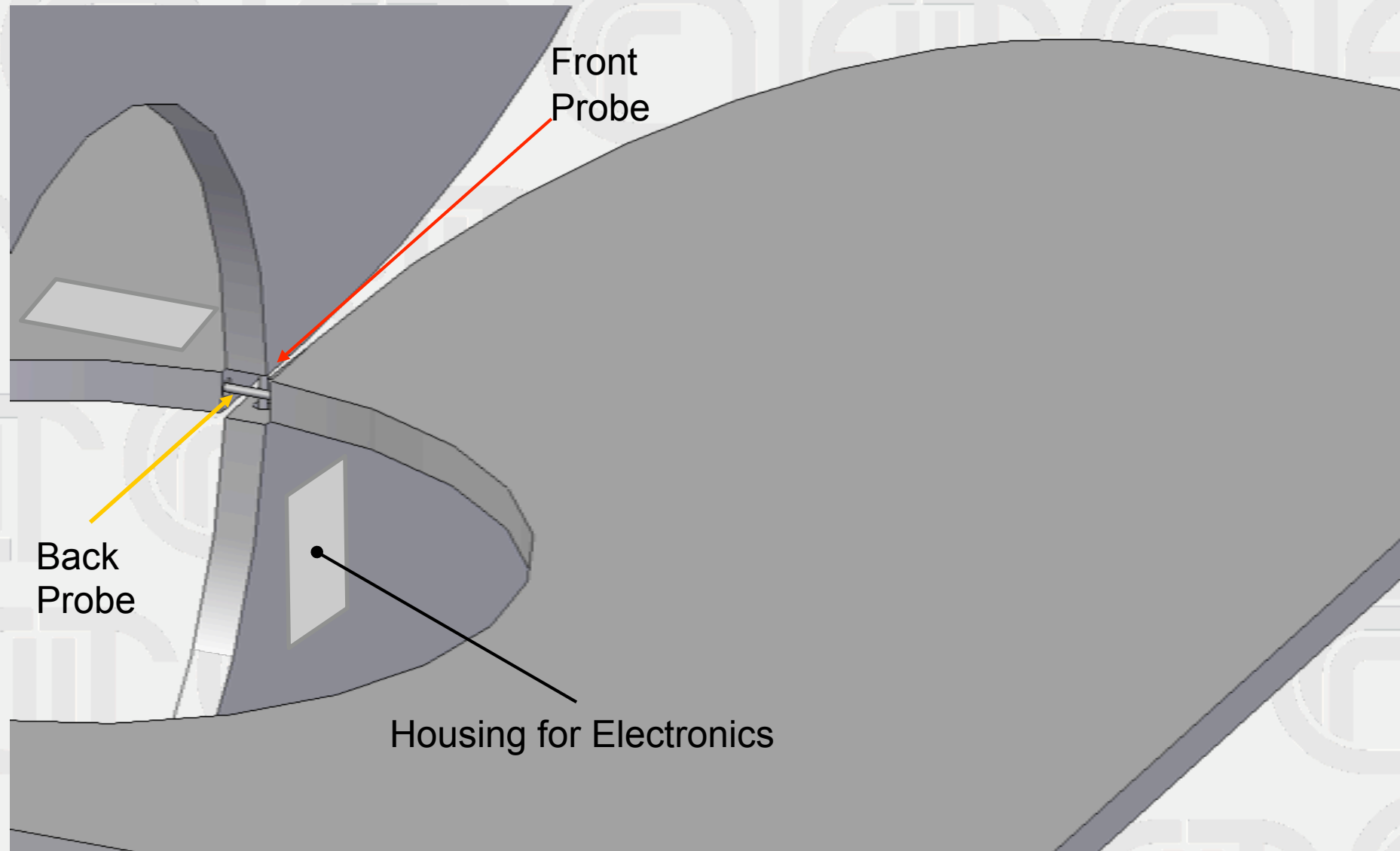
- Single element for 70-450 MHz to reduce cost and complexity
  - Sparse-array
  - +/- 45 Deg Sky Coverage
  - Dual-polarization
- 
- Such a bandwidth is not achievable with a low-gain element

# Dual-pol Vivaldi 50 Ohm ver1



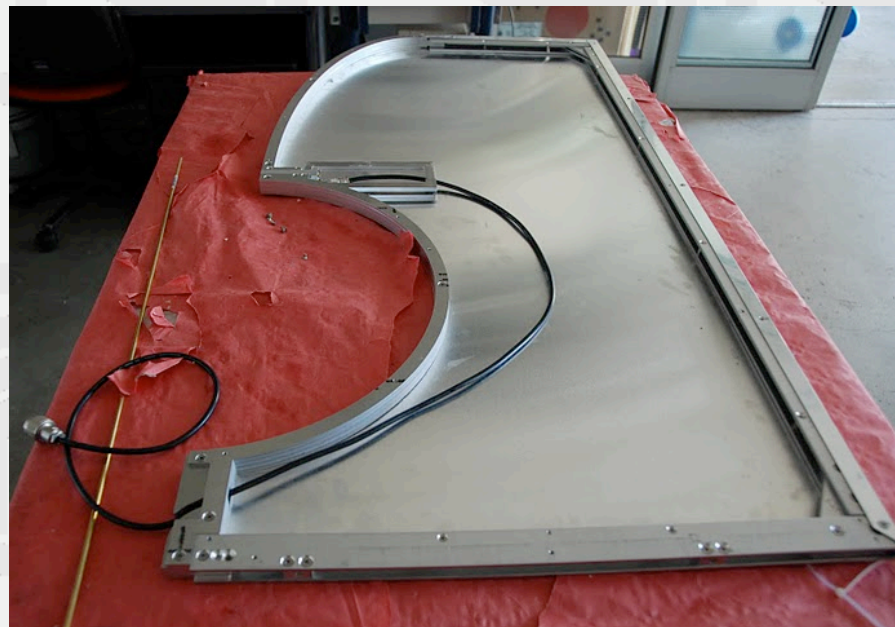
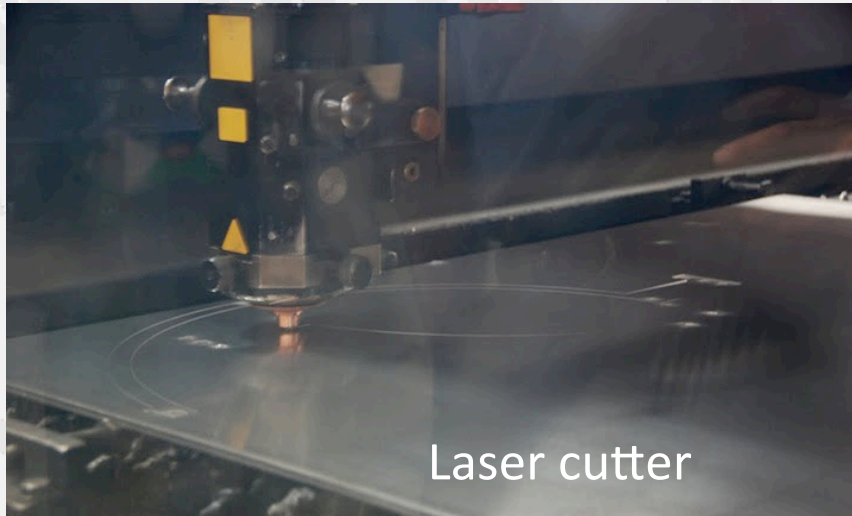
- Maximum size 1.1 m
- Metal-only
- 50 Ohm unbal impedance
- No additional ground plane
- Very Low Cross-Pol

# Feed Configuration and Labeling



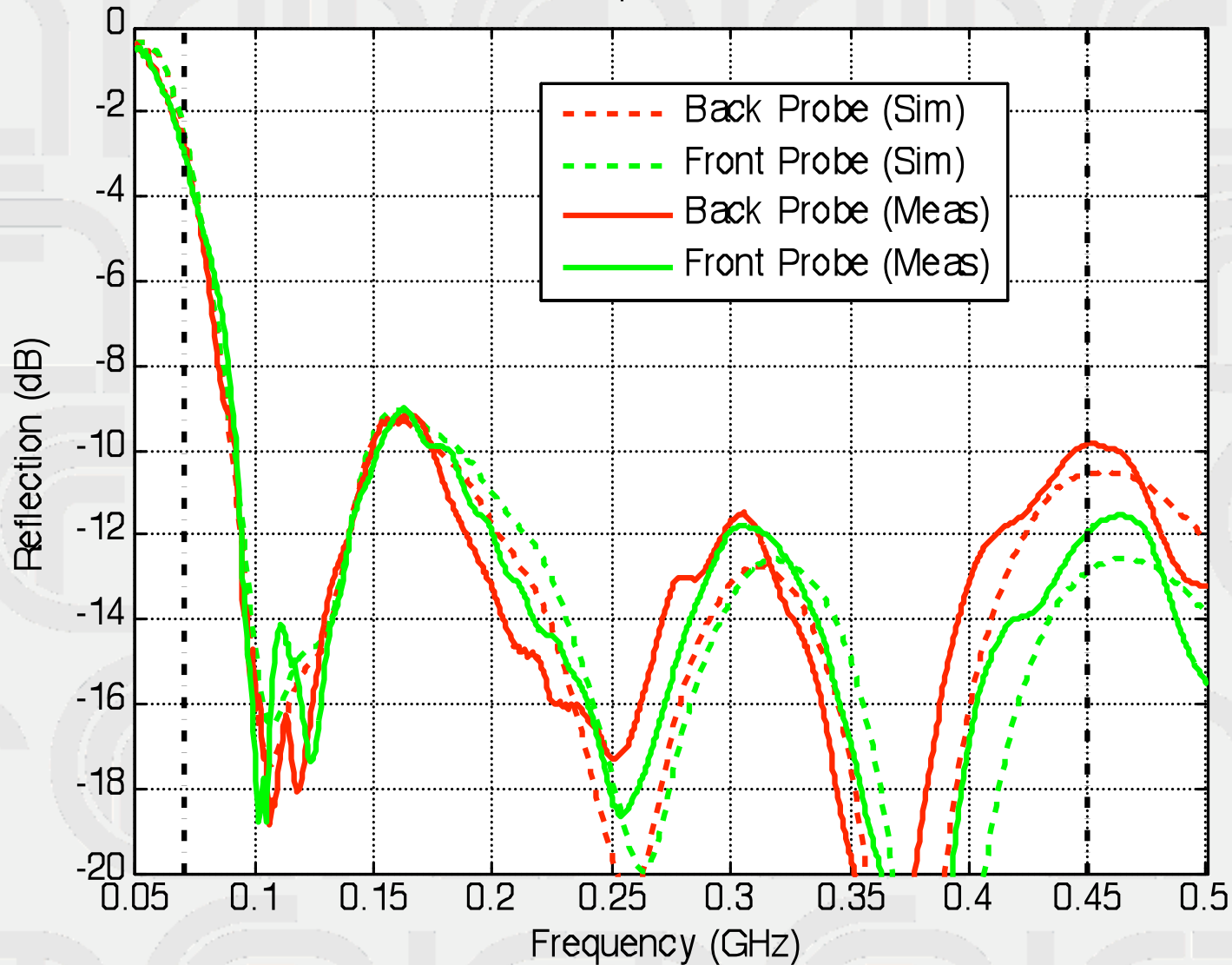
# Init. Manufacturing

- First Prototype
- Laser cutting machine
- Multi-layer aluminum prototype



# VNA Reflection Measurement

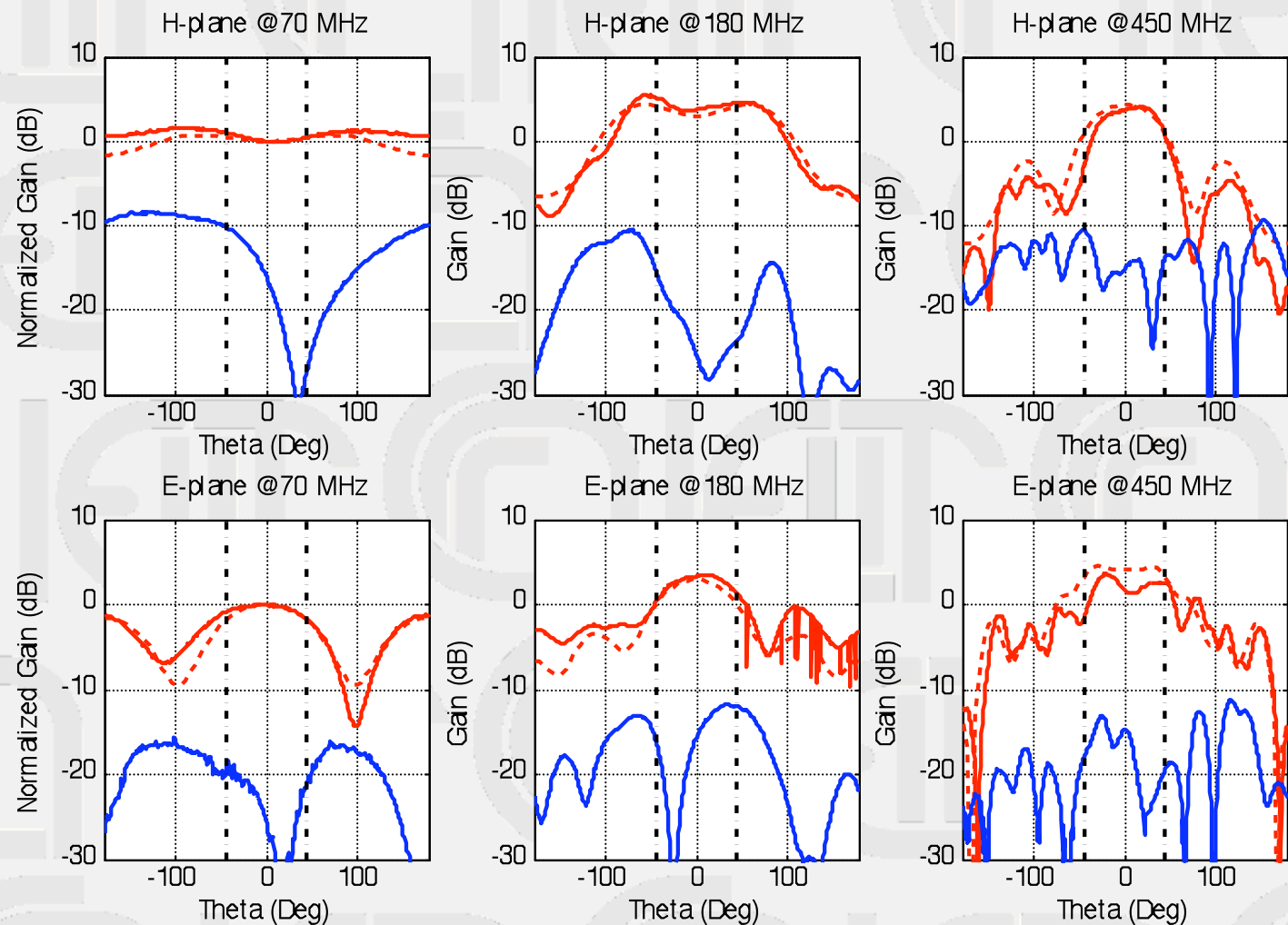
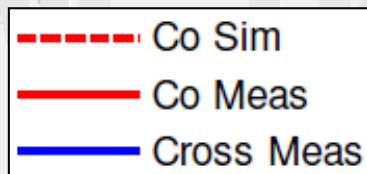
Reference Impedance = 50 Ohm



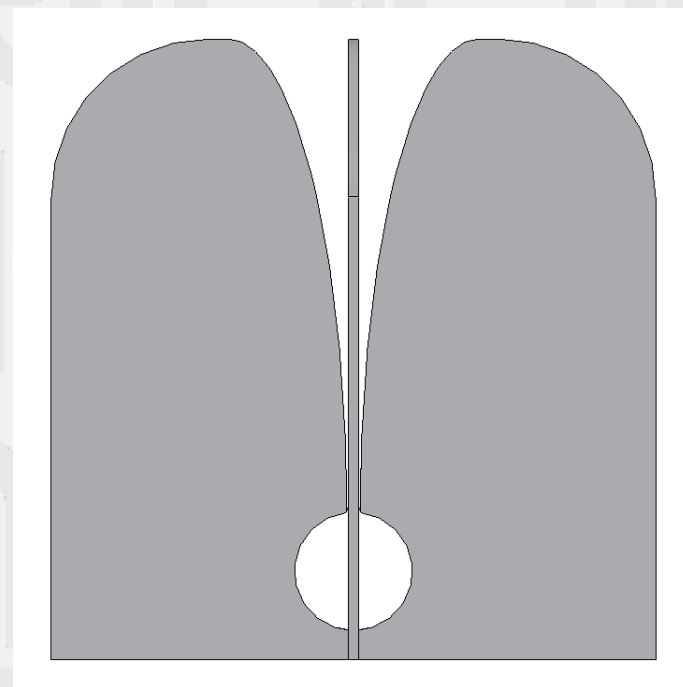
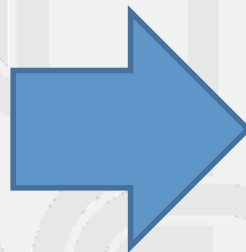
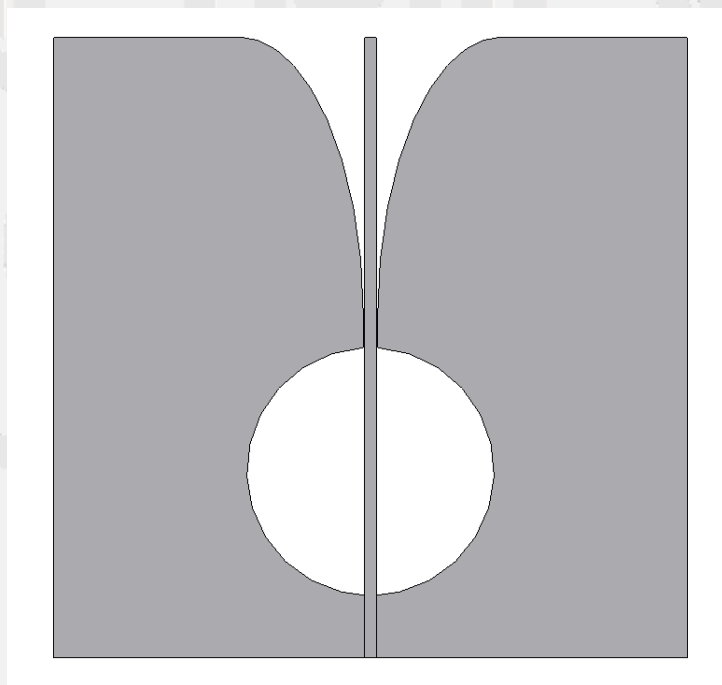


# Radiation Pattern Measurements

Outdoor Elevated Antenna Test Range (Turin, July 2011)



# From Version 1 to Version 2



Good matching in the 70-450 MHz band

Low directivity at  $45^\circ$  in E-plane

High back lobe

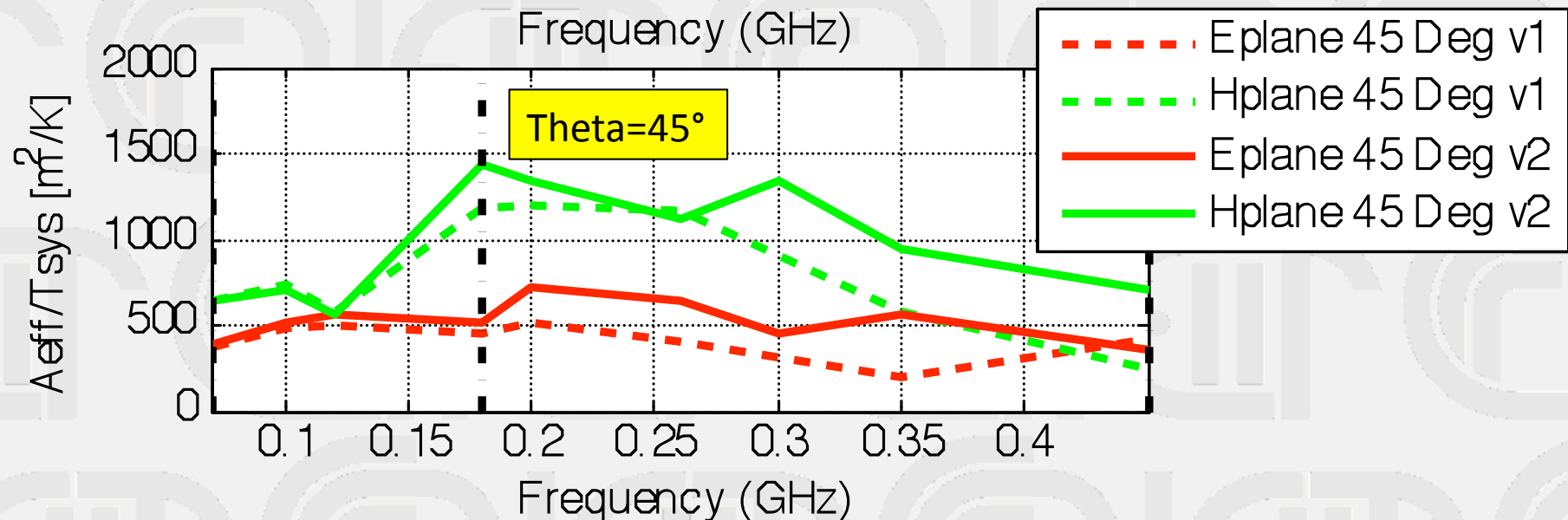
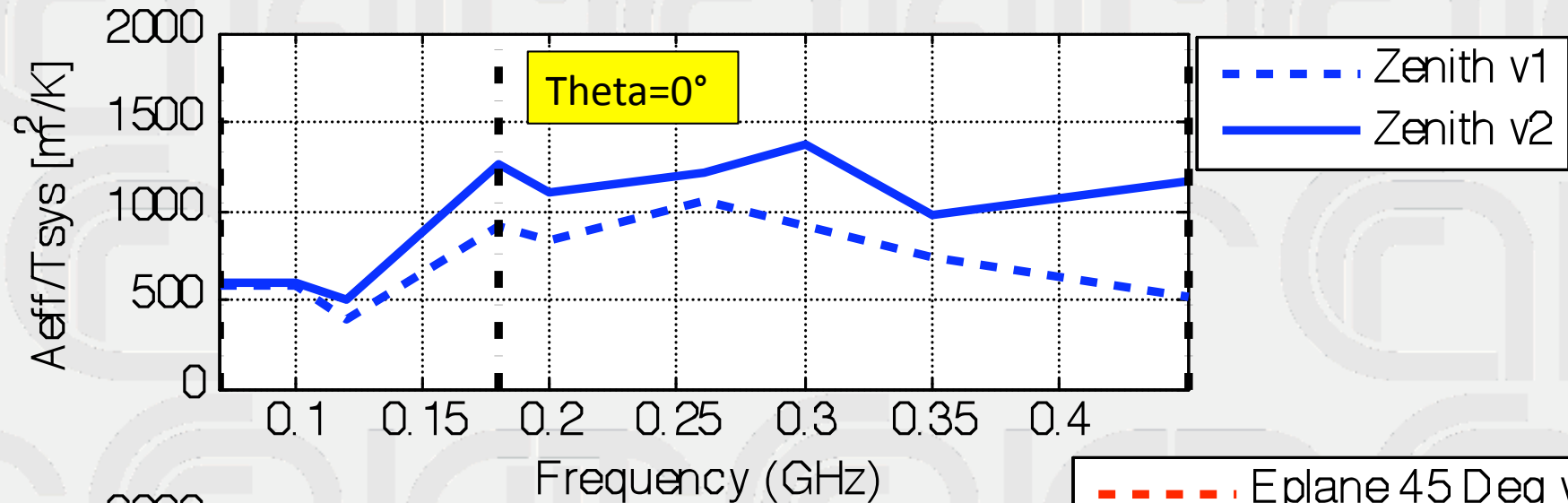
Acceptable matching in the 70-450 MHz band

Higher directivity in the  $\pm 45^\circ$  sky coverage

Lower back lobe

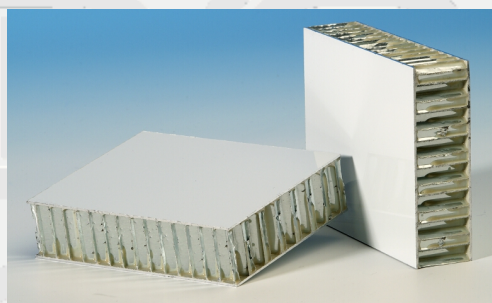
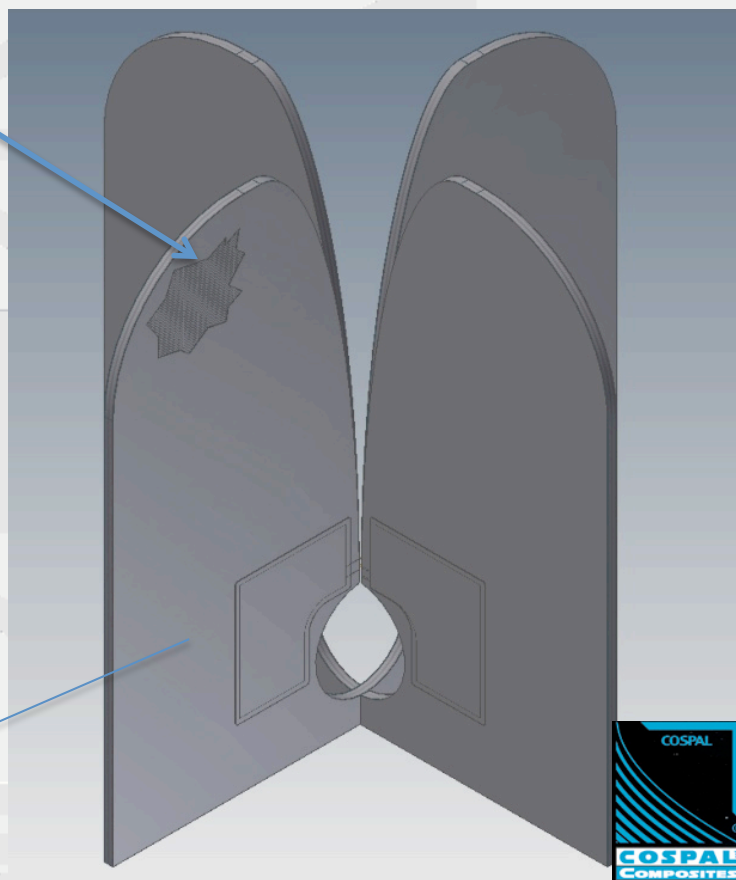
# Vivaldi $A_{\text{eff}}/T_{\text{sys}}$ for each polarization

Number of elements = 500000



# Low-cost Manufacturing

Based on honeycomb-filled aluminum panels

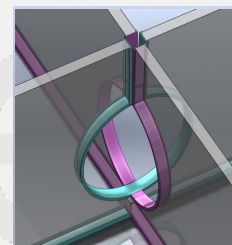


Target Cost  
200€ x antenna  
(AAVS1  
oriented)

COSPAL areas

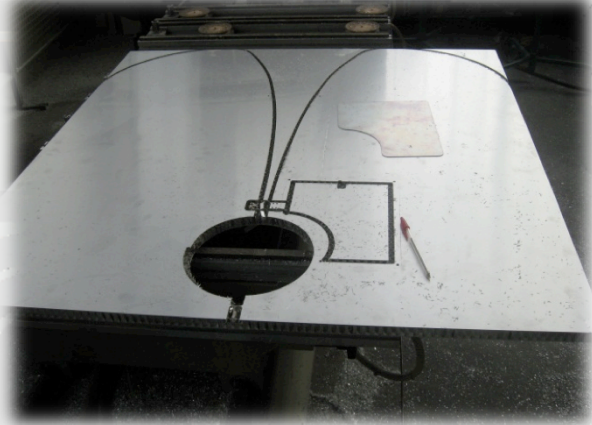


SGUINZI areas



# Manufacturing description

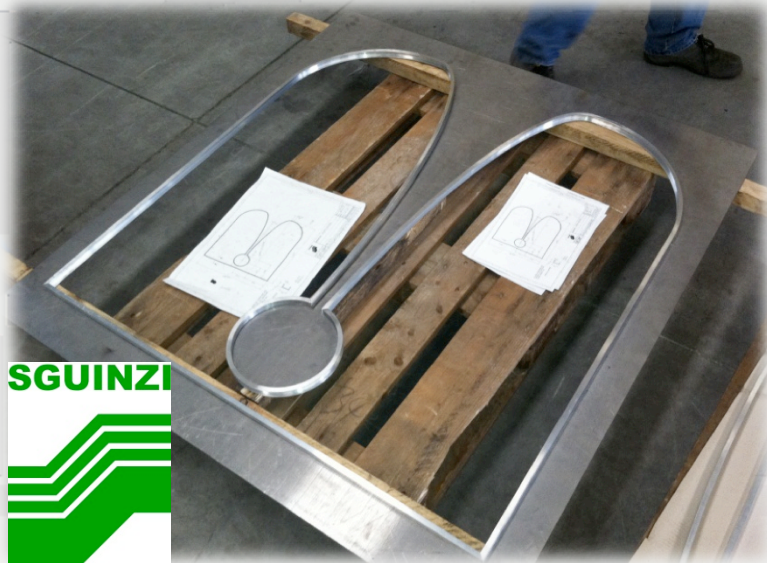
Aluminum Honeycomb sandwich panels



Feed block



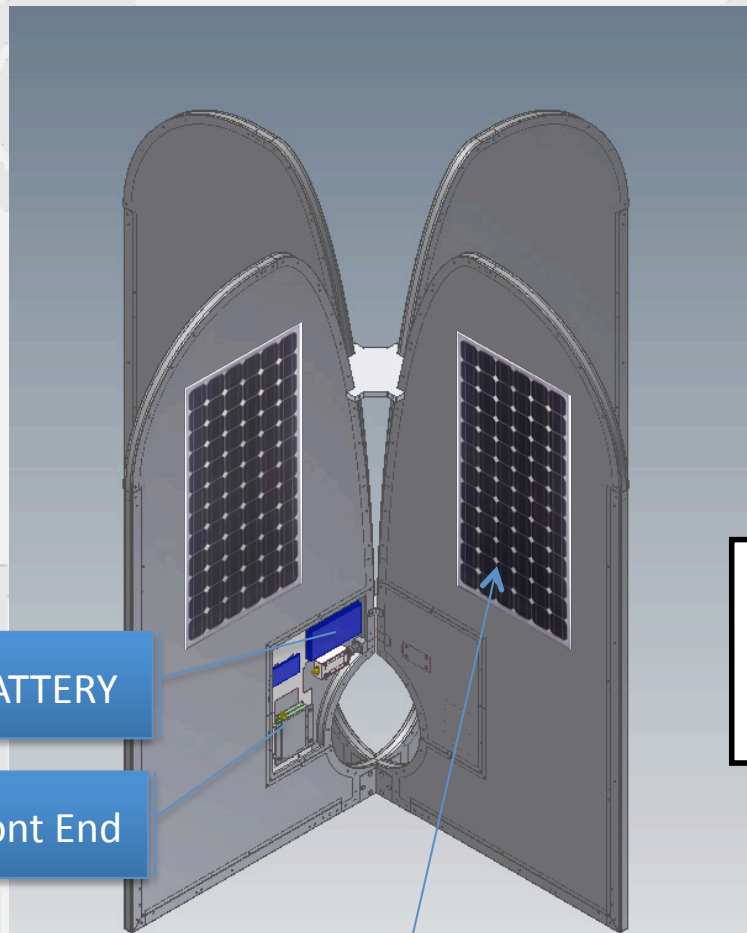
Aluminum C-shaped profile



50sec to assembly!!!



# Optical Self-Powered Vivaldi



BATTERY

Front End

Thin film (amorphous silicon )

- Galvanic isolation between FE and DS
- more stable amplitude&phase Vs temperature
- RFI immunity (self-shielded)
- no Gain disequalization
- no Power Distribution → no DC power losses
- easy-deployable (no buried FO)



We have 0.15 m<sup>2</sup> maximum available area per arm.

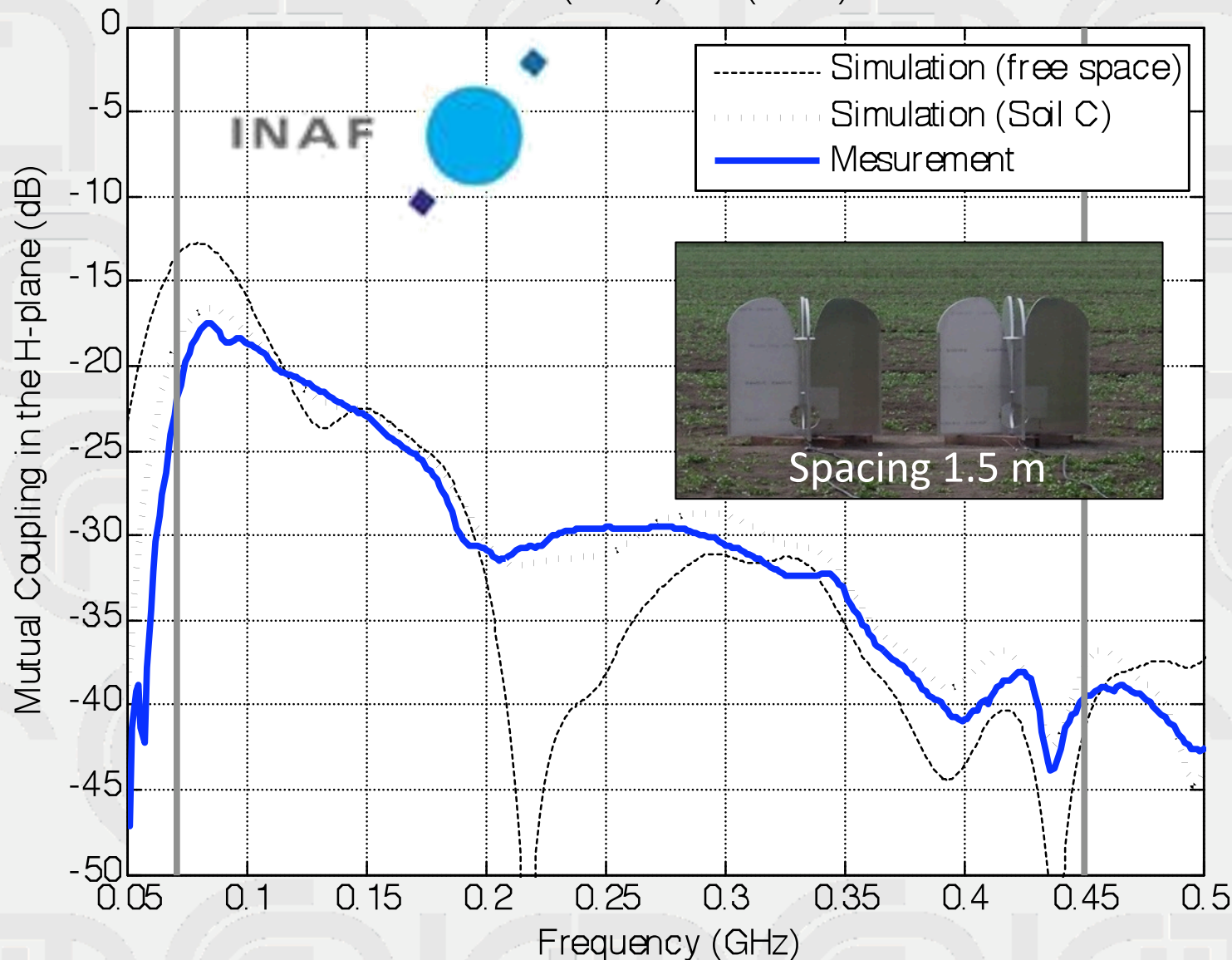


That area could be sufficient, but we need more investigation and tests on the field.

# AAVS0 Results – mutual coupling

Medicina, May 9<sup>th</sup> 2012

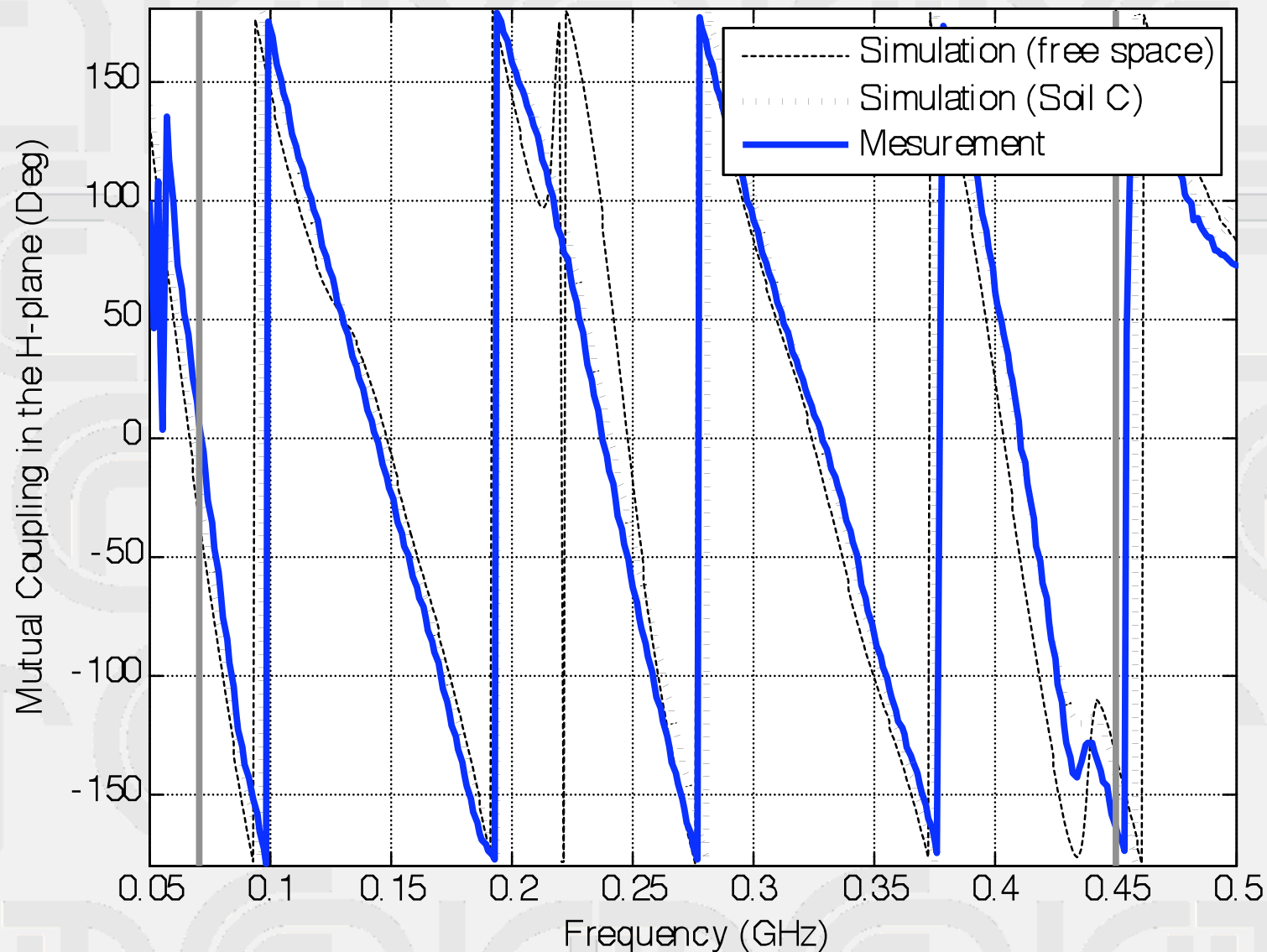
Ant1(Front) Ant2(Front)



# AAVS0 Results – mutual coupling

Medicina, May 9<sup>th</sup> 2012

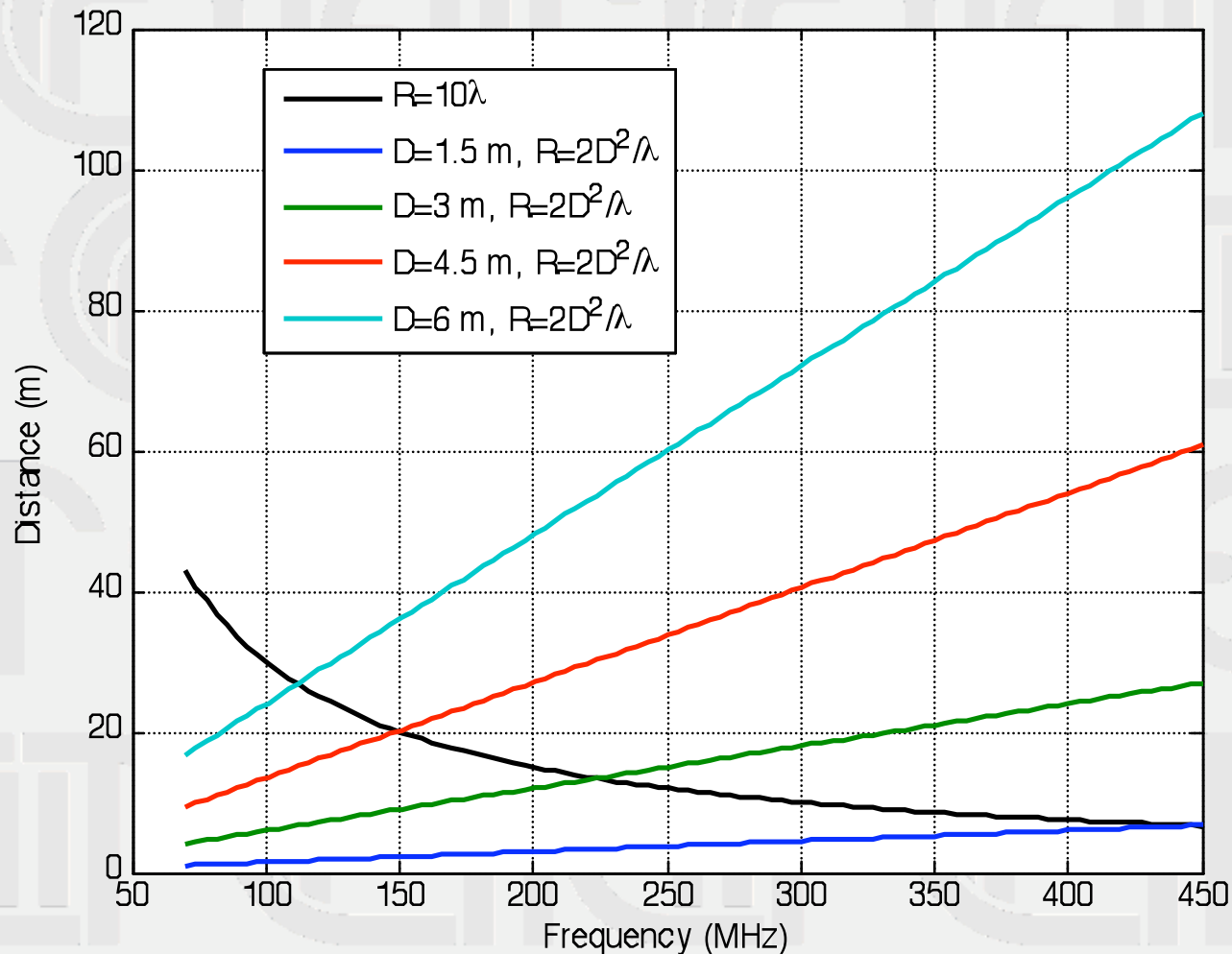
Ant1(Front) Ant2(Front)





# AAVS0 Far-field Measurements?

Embedded Element Pattern measurement in the operative conditions



See next presentation by M.Piras et al. DIATI, Politecnico di Torino

# Conclusion

- Experimental results confirmed the computed data of the Dual-Pol Vivaldi v1 and v2.
- Embedded element pattern measurements are in progress
- Performance of Vivaldi v2 is very close to the AA-low specs
- Industrialization process already meets the AAVS1 cost requirement
- Optical Self-powered element concept