

# PHAROS

## *Phased Arrays for Reflector Observing Systems*

- ◆ Project outline
- ◆ Work packages and preliminary results
- ◆ Conclusion

The University of Manchester  
Jodrell Bank  
Observatory

INAF

mecsa

The logo for CSIRO, featuring a blue circle with white vertical bars and a white map of Australia in the center, with the text "CSIRO" in black below it.

THE UNIVERSITY  
OF BIRMINGHAM



# *FPA*s

- ◆ Focal Plane Array
  - ◆ Name in use for >25 years for multi feed (horn) arrays
- ◆ So: Phased Array Feed, PAF? APF?
- ◆ Or: Phased Focal Plane Array, FPPA?

Ref: Larry Daddario / Dave DeBoer

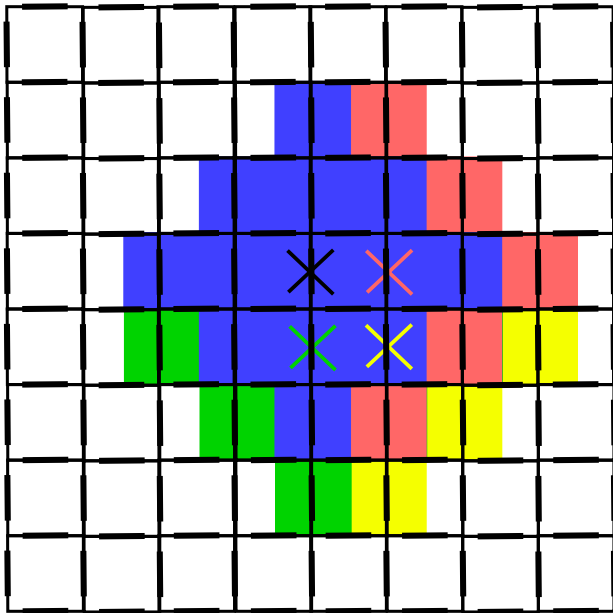
## *Project outline*

- ◆ FPA demonstrator *only*
- ◆ Analogue beamformer, 4 beams, 4-8GHz
  
- ◆ Cooled system: 20 Kelvin LNA temperature
- ◆ Wide bandwidth
- ◆ Tests at several Radio Telescopes in Europe and Australia
  - ◆ Easy replacement of existing feeds
- ◆ 2004-2007
- ◆ 1.6M€ + Matching

# Strawman concepts

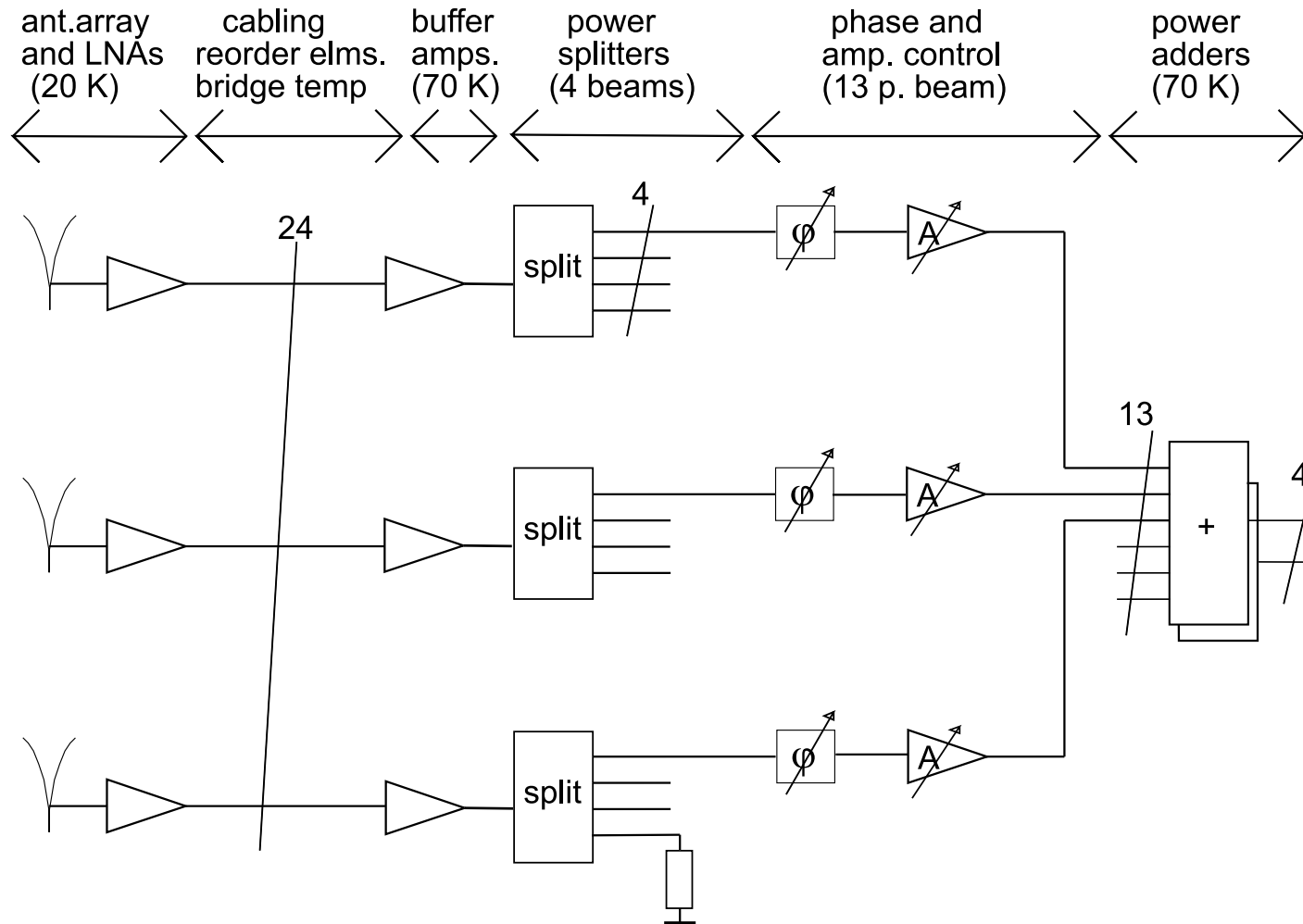
Group	tele- scope (m)	Freq (GHz)	BW GHz	F/D	Nr bms	Steer- able	Nr pol	Noise temp (K)	Application
<b>JBO</b>	Lovell (70)	4-8	2	0.3	3	yes	2 circ	30	EVN, JIVE
<b>JBO (2)</b>	Lovell (70)	4-8	2	0.3	9	no	2 circ	30	Merlin
<b>INAF</b>	SRT (64)	4-8	2	0.329	2	yes	2 circ	30	ph.ref.VLBI, var of weak, interf,suppr
<b>CSIRO</b>	PKS (70)	4-8	0.1	0.4	3 - 8 (64)	no	2	50	ph.ref.VLBI, dig.bm form
<b>CSIRO (2)</b>	xNTD (20x15)	0.8-1.7		0.4	20- 50	no	2	50	all sky surveys (transients)
<b>WSRT</b>	WSRT (14x25)	0.5-1.5	0.2	0.35	80	no	2		survey HI and pulsar
<b>TCfA</b>				3					

# Beamforming

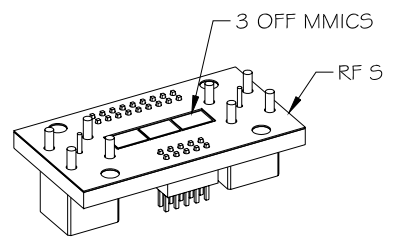
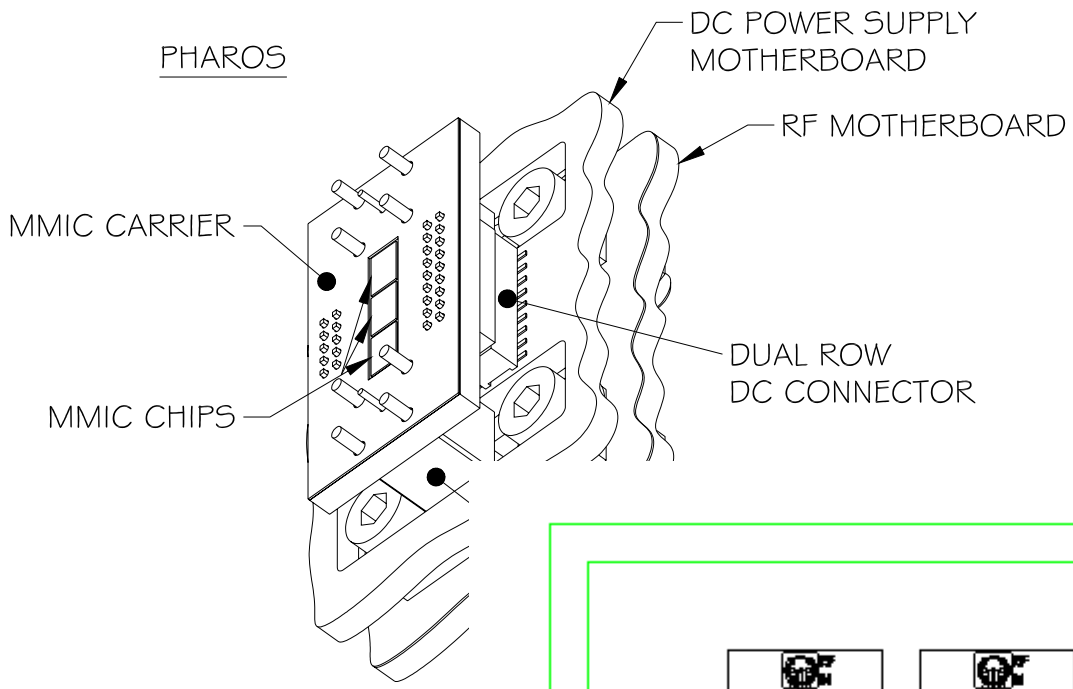


			1	2			
		1	1 2 3	1 2 4	2		
	1	1 2 3	1 2 3 4	1 2 3 4	1 2 4	2	
	3	1 3 4	1 2 3 4	1 2 3 4	2 3 4	4	
		3	1 3 4	2 3 4	4		
			3	4			

# Beamforming

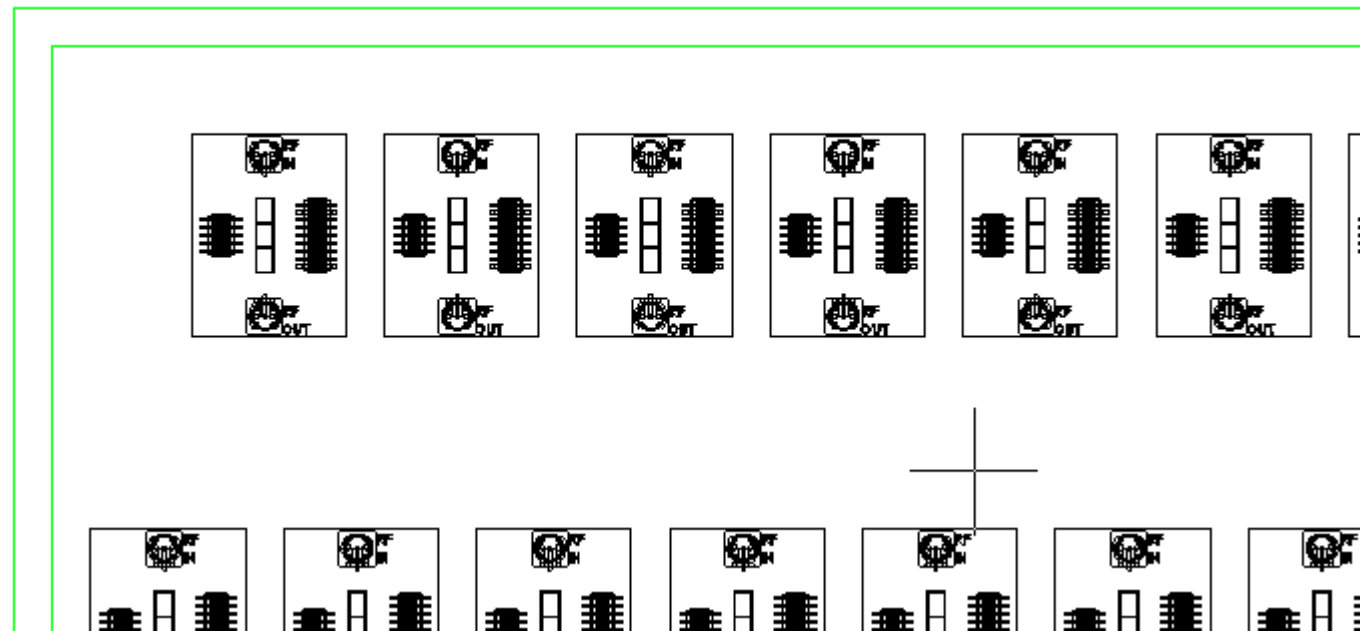


# Beamforming

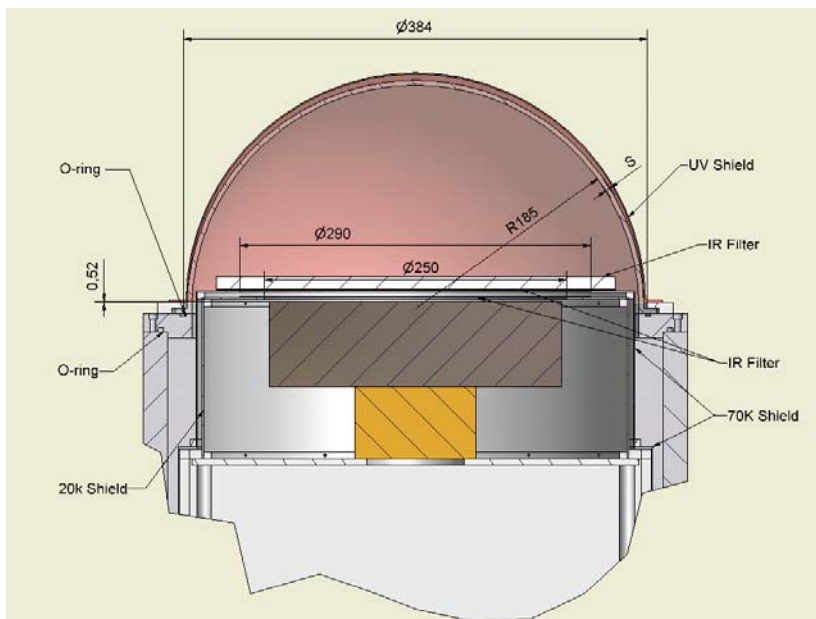


2 OFF TENS C  
SMP P603 CONNEC

RF INPUT



# Cryostat design INAF

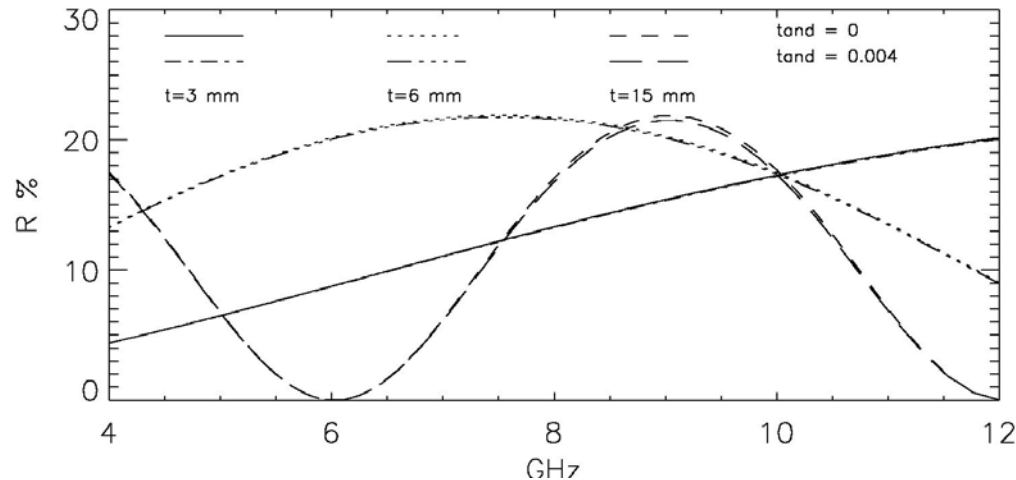
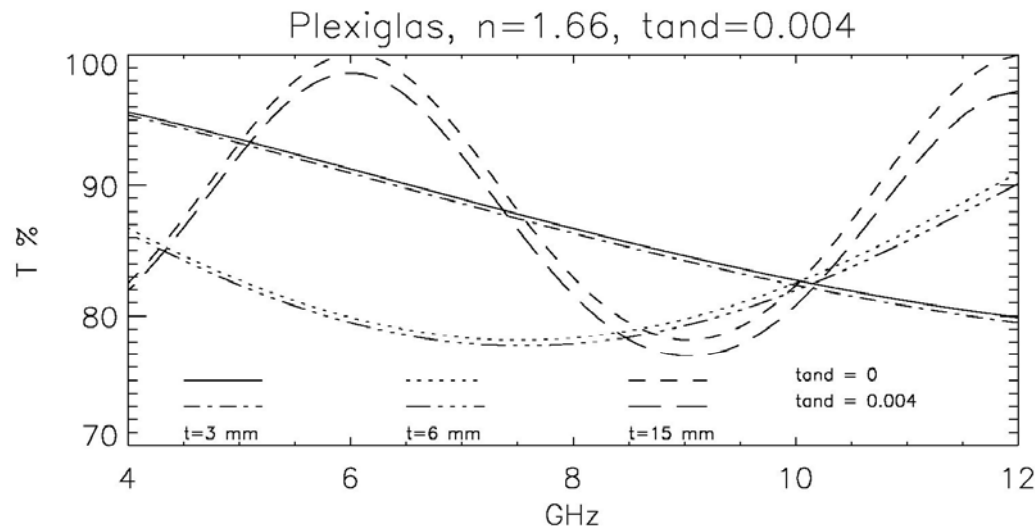


- ◆ *Complete antenna array cooled*
- ◆ *Dome shaped design*
- ◆ *Low blockage*
- ◆ *Low influence on antenna pattern*
- ◆ *Space for large array*
- ◆ *LNAs at 20K*
- ◆ *CTI 350C*



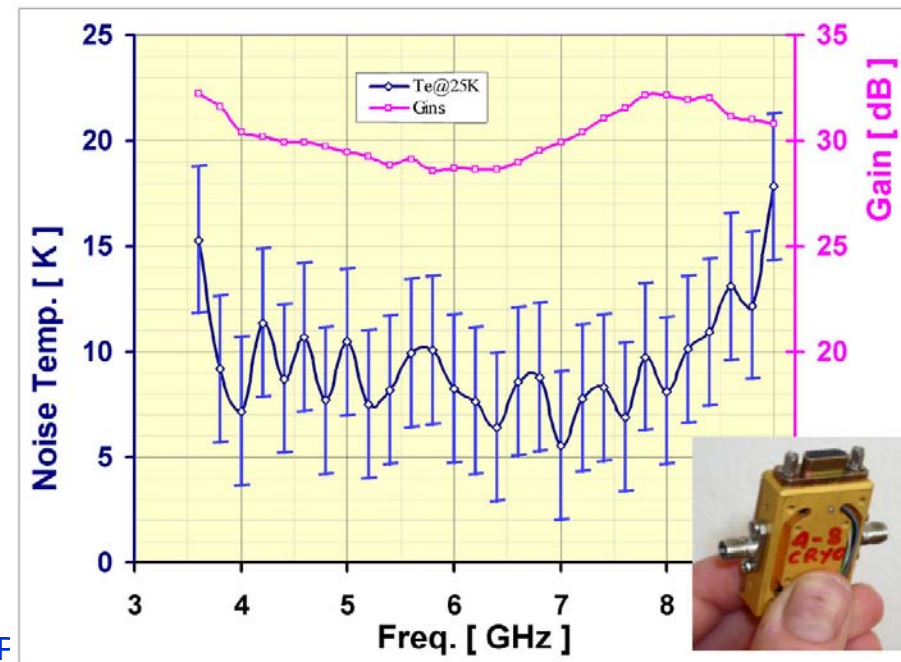
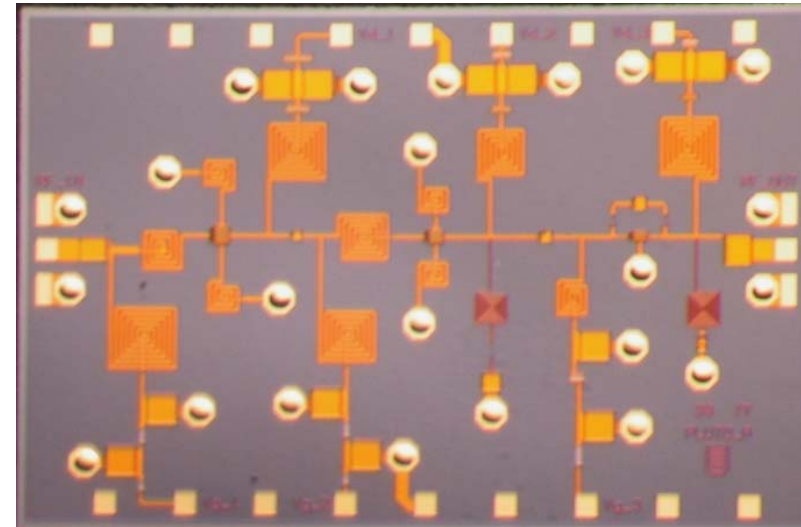
# Radome material

- ◆ Transmission and reflection losses
- ◆ High epsilon more significant than Tand



# MMIC designs

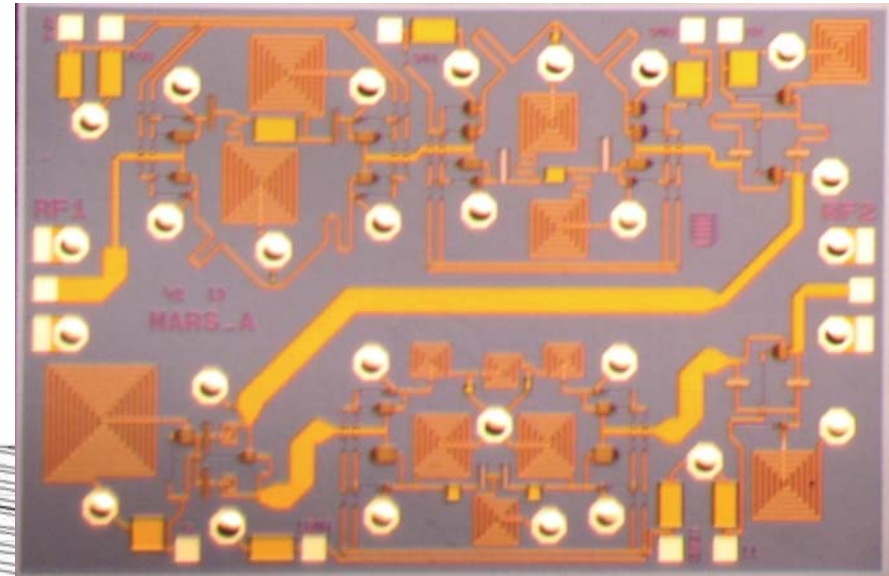
- ◆ LNA's; MECSA, JBO, ASTRON
- ◆ Phase-shifter; MECSA
- ◆ Attenuator; MECSA
  
- ◆ Samples tested with good performance



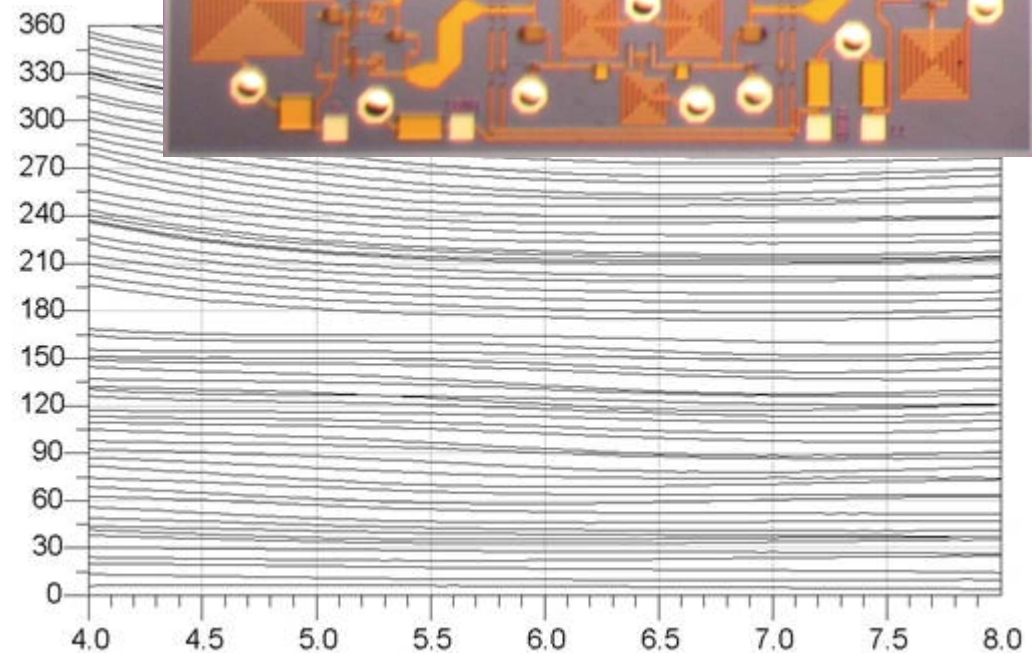
Vd1 / Id1	6	10	16	[mA]
1.5	10.1	10.1	10.4	[K]
2	8.3	8.3	8.7	
[V]				

# MMIC design

- ◆ 6 bit phase-shifter
- ◆ Attenuator with buffers designed as well

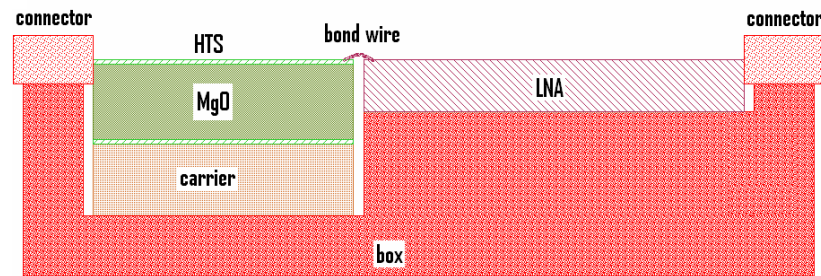
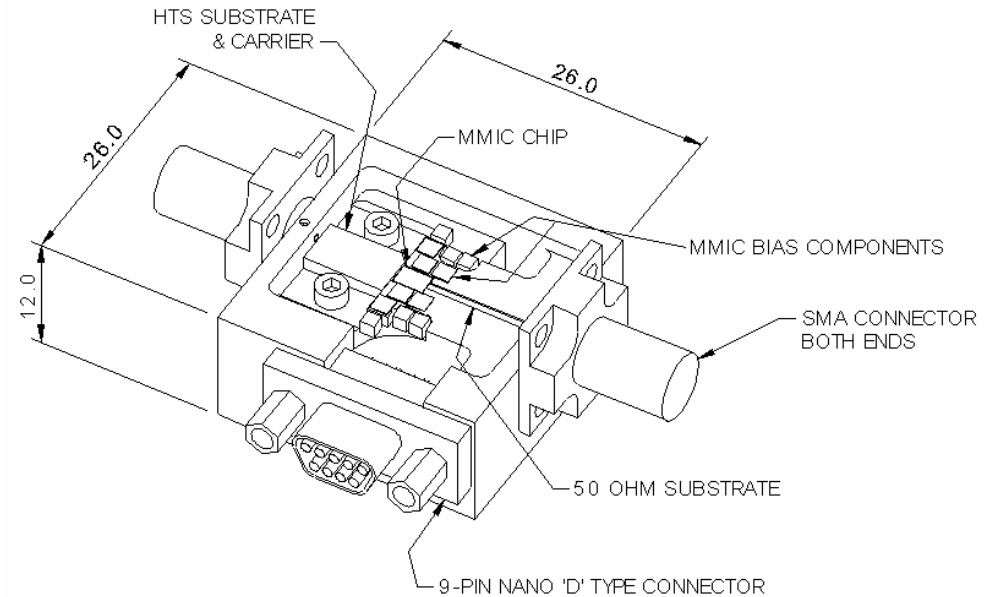
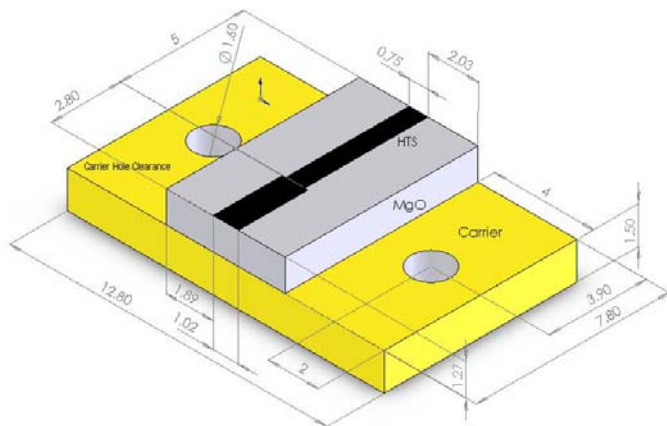


Phase steps



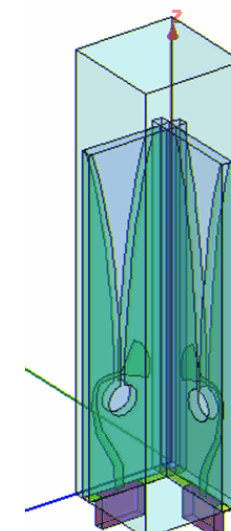
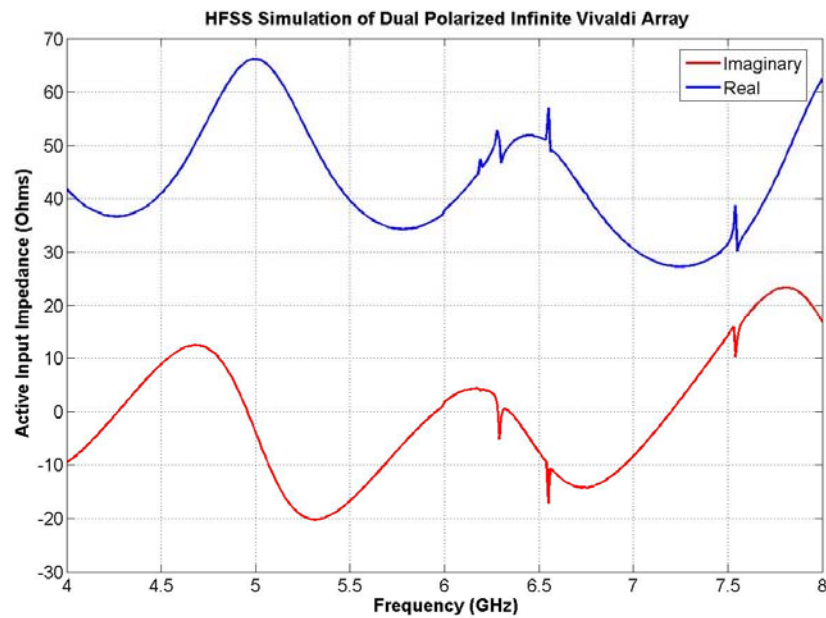
# MMIC design

- ◆ High Temperature Super Conductive material proposed for LNA input-match



# Antenna design

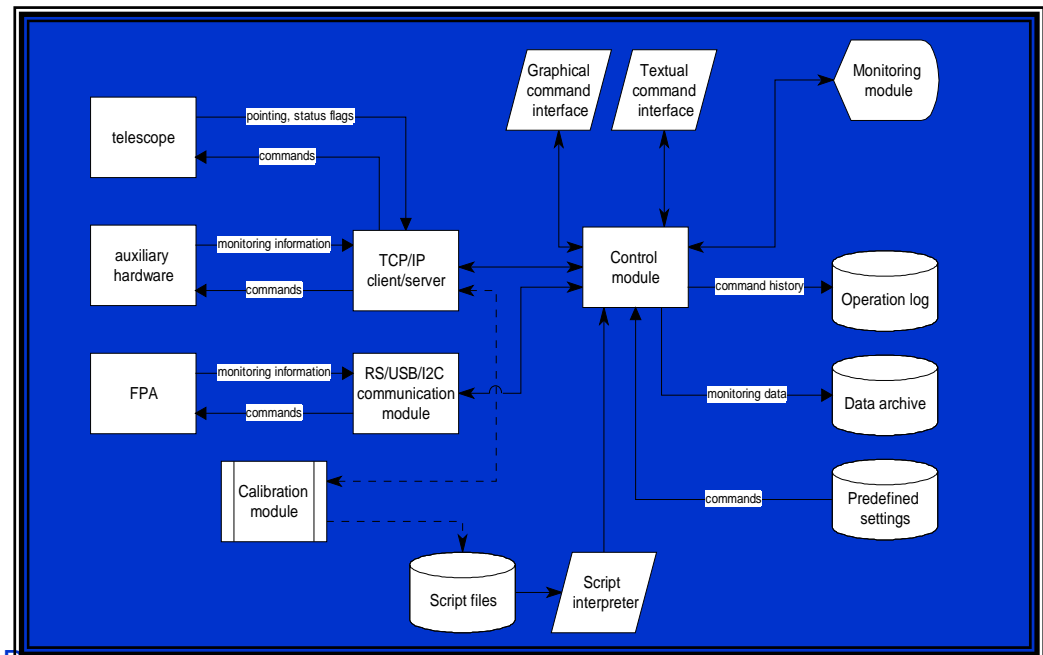
- ◆ HFSS and other codes
- ◆ Finite or infinite problem?





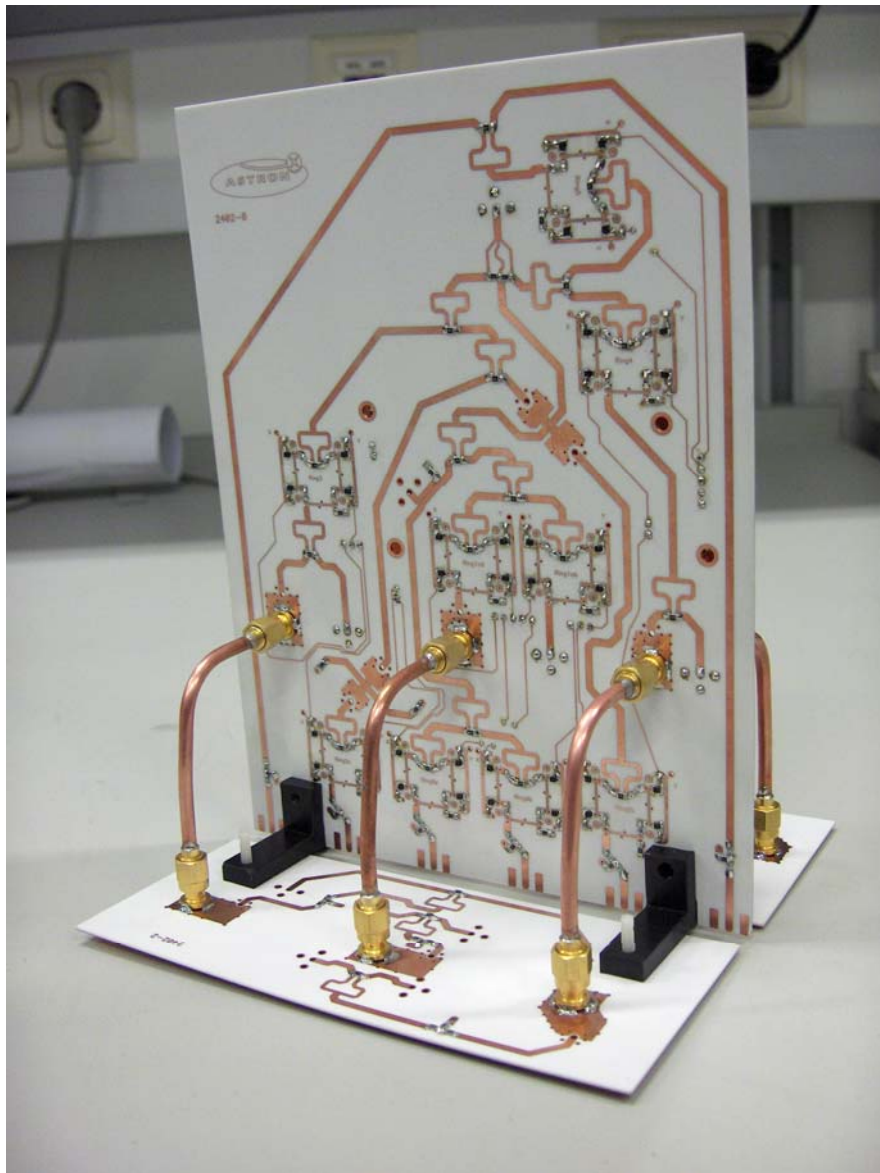
# Control

- ◆ Control software
- ◆ Calibration software + **hardware!**
  - ◆ Noise source e.g.

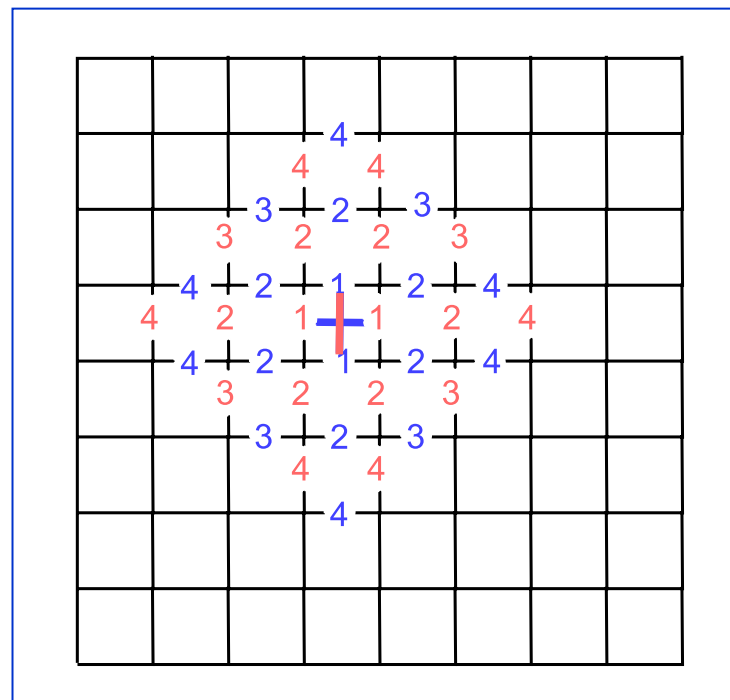


## *Conclusion*

- ◆ PHAROS: first Phased Array Feed with good noise figure
- ◆ Noise model of the Array: Maaskant
- ◆ Antenna & System: Ivashina



x-pol



y-pol