

Mid Freq Aperture Array Technology

The MFAA Element

FP7: logos

In accordance with the Commission's guidelines on visual identity, all EU programmes must be identified **exclusively** by the EU emblem and the mention of the programme name.

The FP7 logo has been discontinued from 1 January 2014.

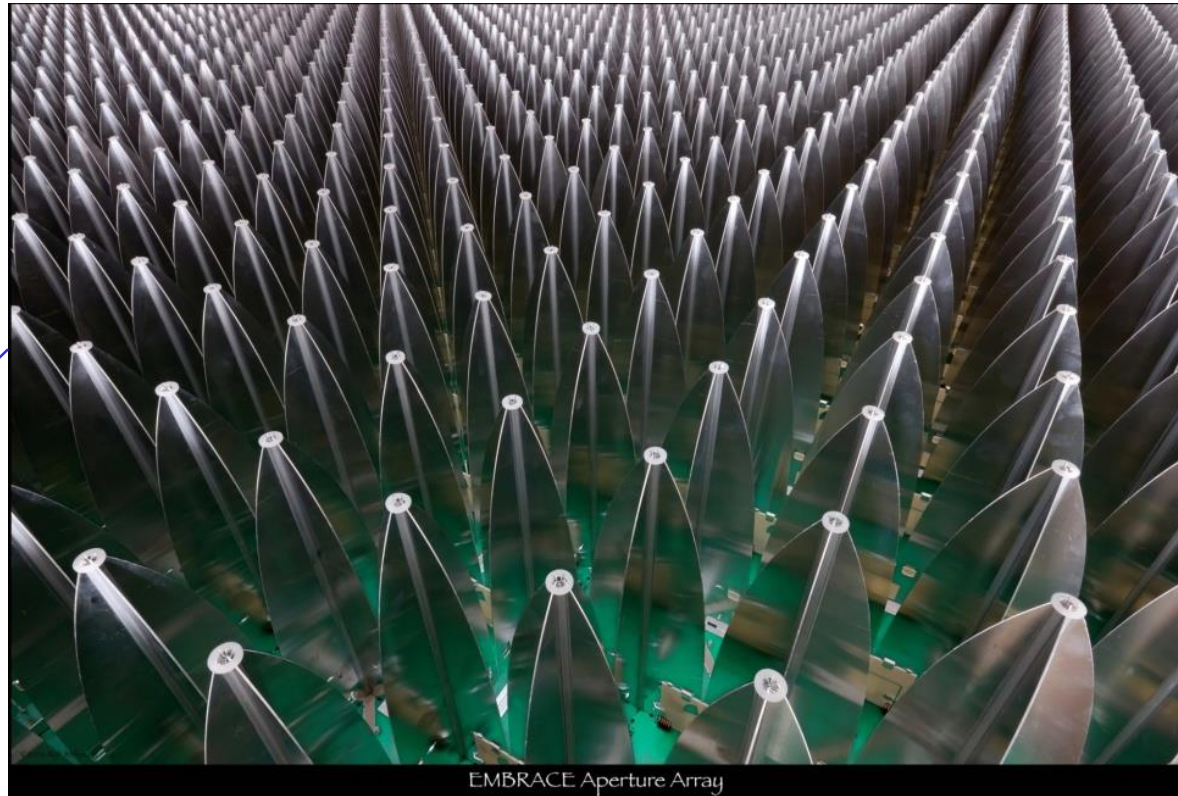
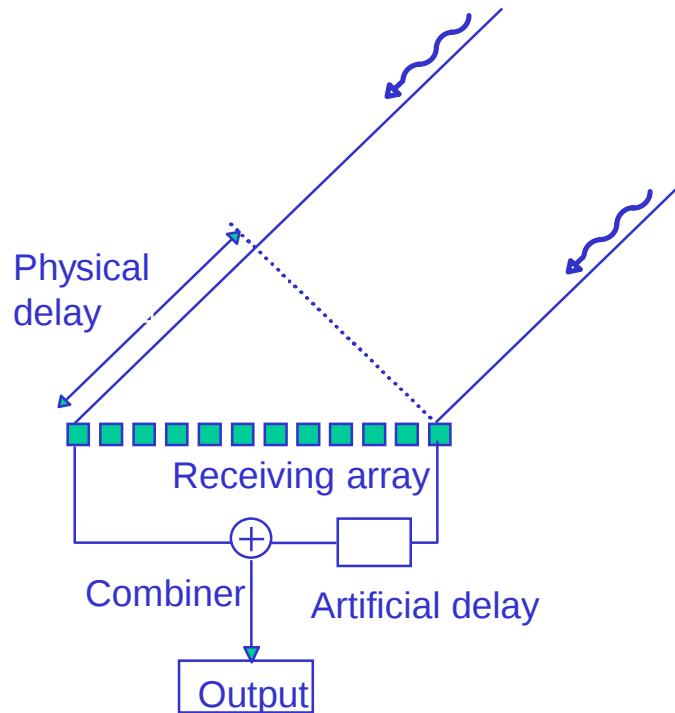
Jan Geralt Bij de Vaate



Why MFAA?

- DRM 1.0, for SKA2, Survey Requirement
 - Speed $10^{10} \text{ m}^4\text{deg}^2/\text{K}^2$
 - Large FoV 100 deg^2
 - Freq $450(350)\text{-}1450 \text{ MHz}$
- Processing advantages
- DRM -> System requirements for SKA2 ?

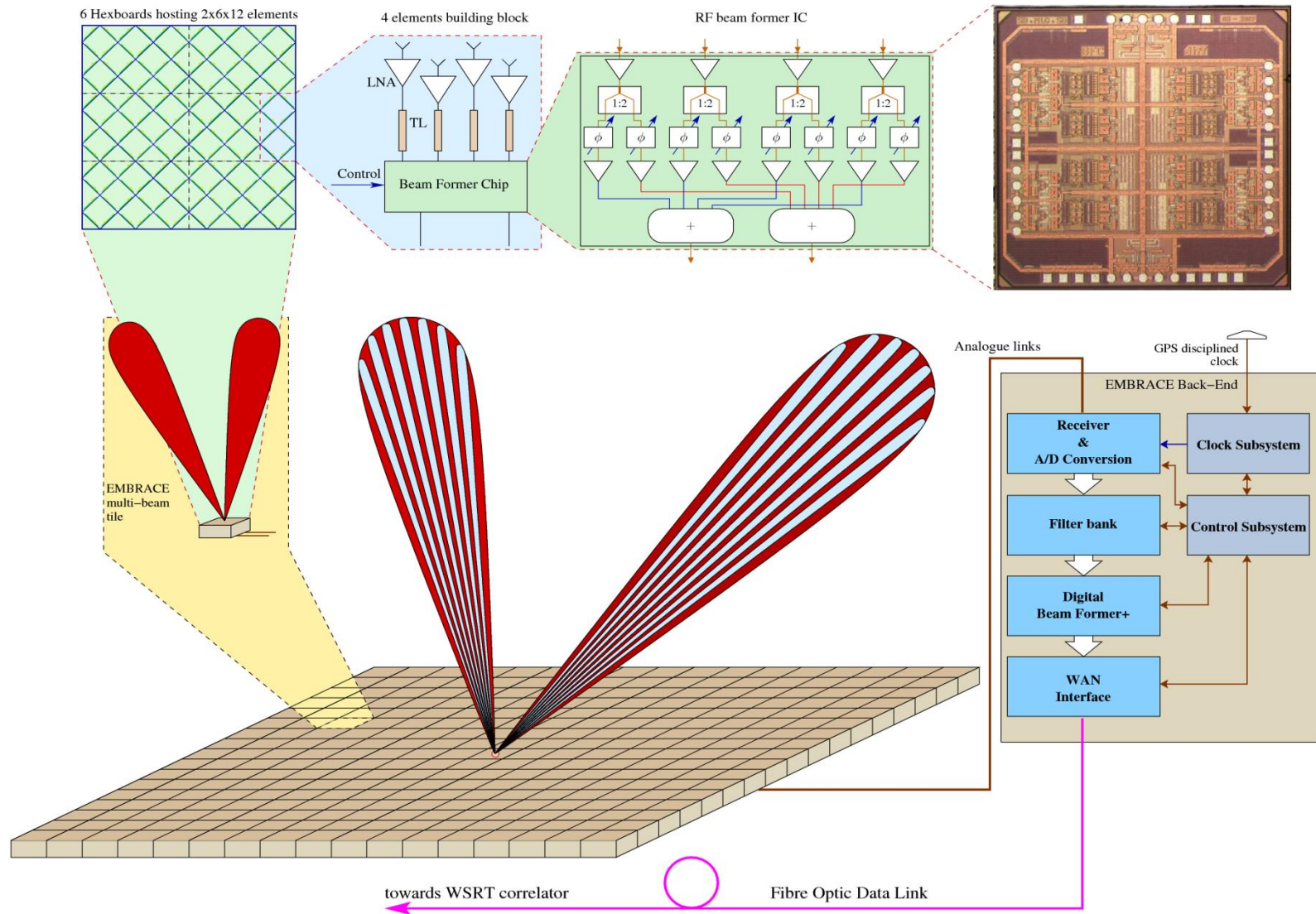
EMBRACE



EMBRACE design drivers

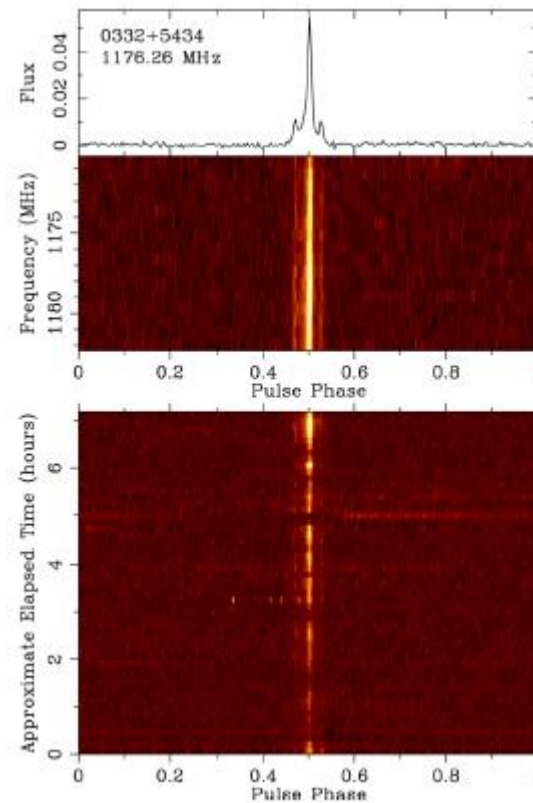
Frequency range	500-1500MHz
Area	150m ² WSRT 80m ² Nancay
Analogue beamforming	64 elements
Independent FoV	2
Digital beams	8

EMBRACE



Observations with Nancay EMBRACE

- Pulsar B0329+54
1175.6 MHz

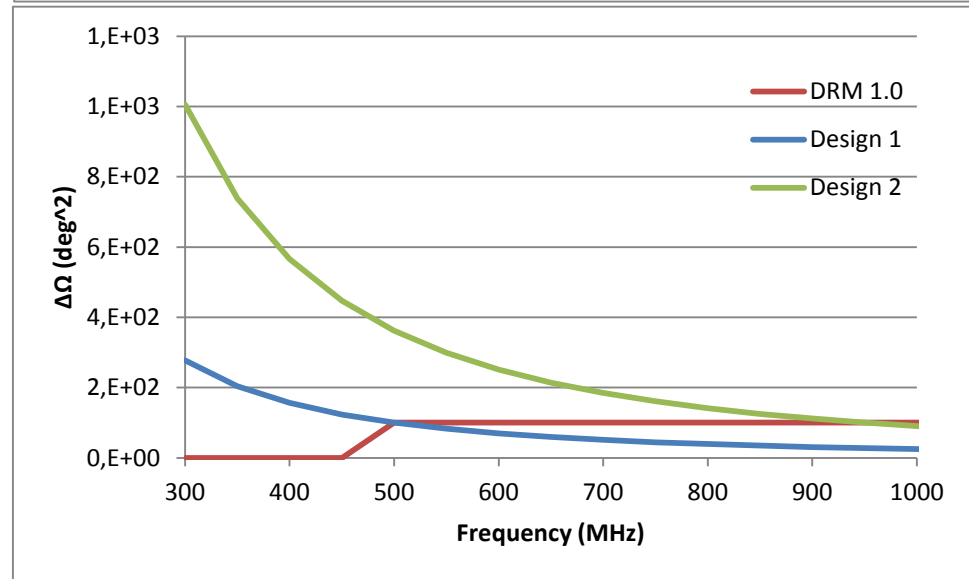
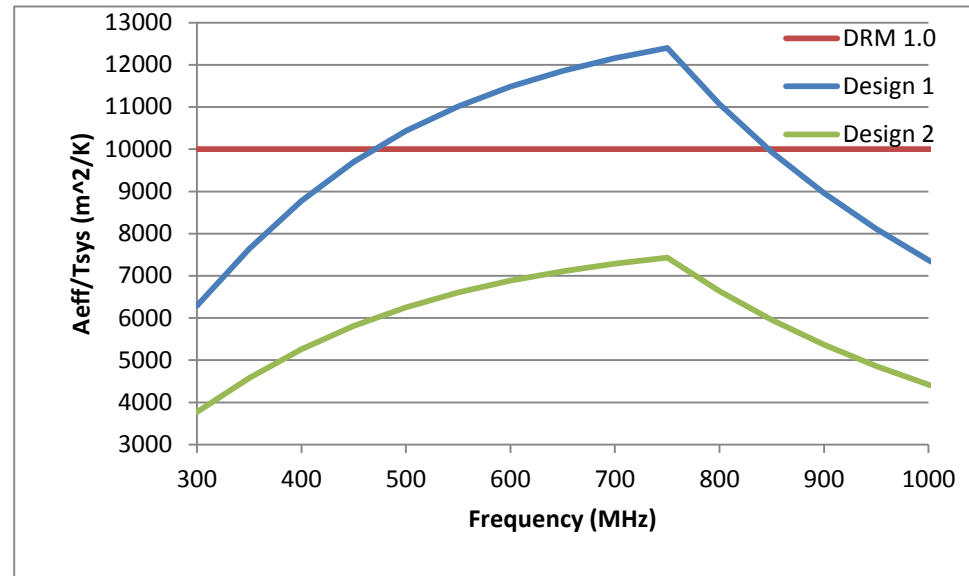


From EMBRACE to AERA³ to SKA2

- Issues to be resolved;
 - Power consumption
 - Cost: 3000 -> €1000/m²
 - Performance, calibratability, T_{sys}

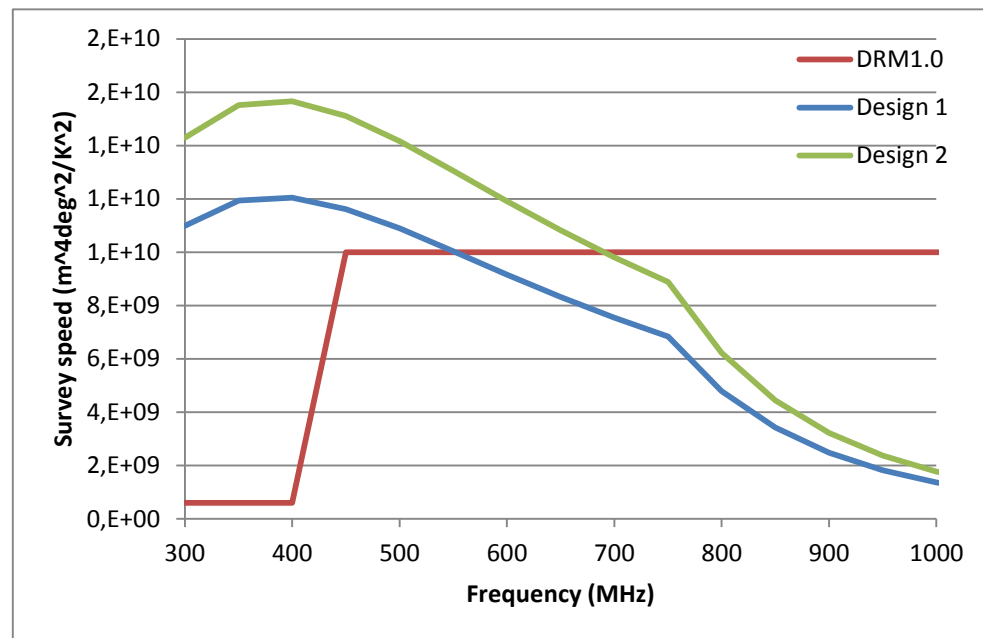
SKA System

- Two options for AA-mid realization:
 - 1: Large Aeff
 - 2: Large processing backend
- Design1: 30/70%
 - Front-end / Backend
 - 2012 technology

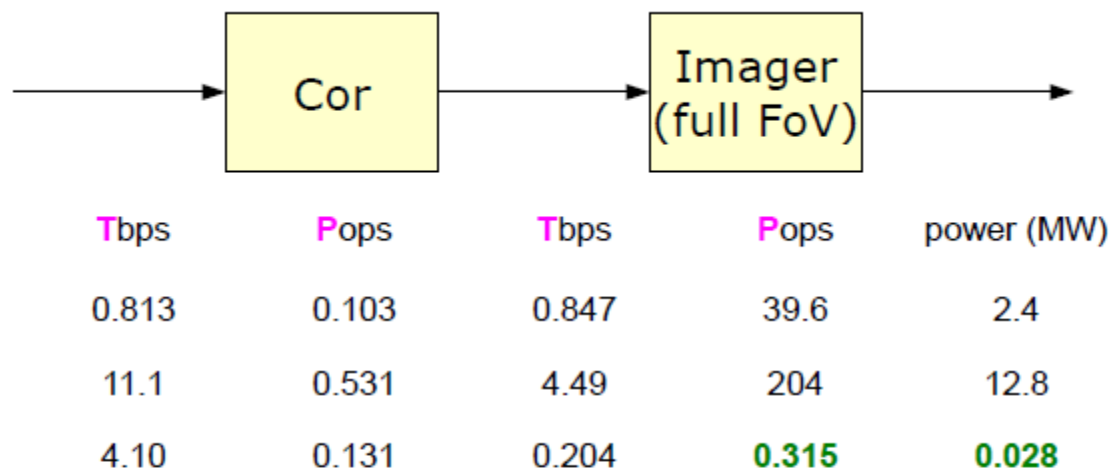


Performance

- Survey speed



Computing per 100MHz for full FoV



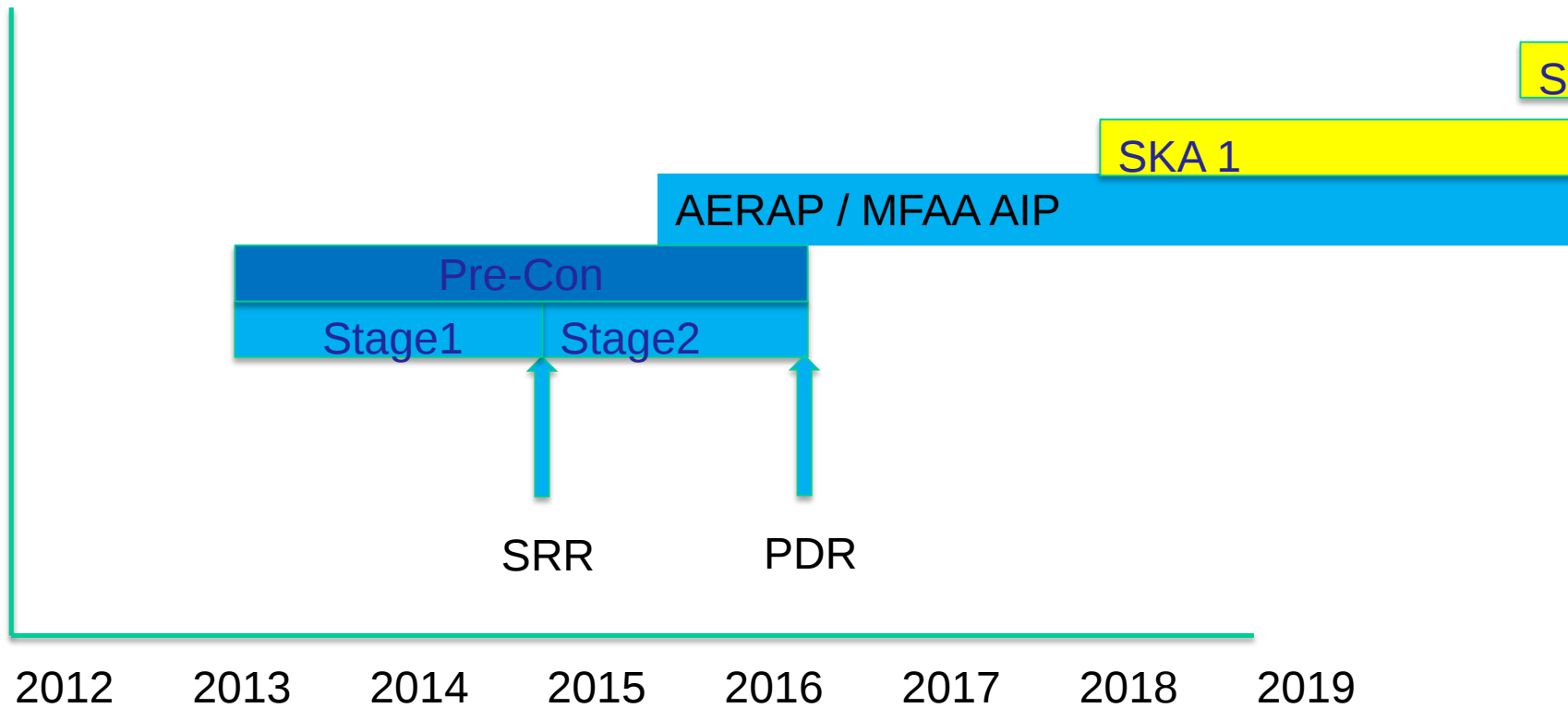
- power is for processing only assuming 16 Gflops/W
- **Reasonable balance correlator – imager only for AA-mid**
- **AA-mid could significantly reduces costs of imaging**

- Ref Stefan Wijnholds, SKA Oct Eng meeting

MFAA Consortium

- | | |
|--|--|
| 1. ASTRON | <i>Management, System, Prototyping</i> |
| 2. Observatoire d'Paris | <i>Front-end Chips</i> |
| 3. University of Bordeaux | <i>ADC</i> |
| 4. University of Cambridge | <i>System</i> |
| 5. University of Manchester | <i>ORA</i> |
| 6. KLAASA (China) | <i>Industrial design, Prototyping</i> |
|
7. Associate members: | |
| – Portugal, IT | <i>Renewable energy, RFoF</i> |
| – University of Malta | |
| – South Africa | <i>Site, array design</i> |
| • Stellenbosch University | |
| – Mauritius | <i>array demonstration</i> |
|
Focus on Front-end, LFAA will work on Digital Signal Processing | |

MFAA Schedule



Front-end proto typing

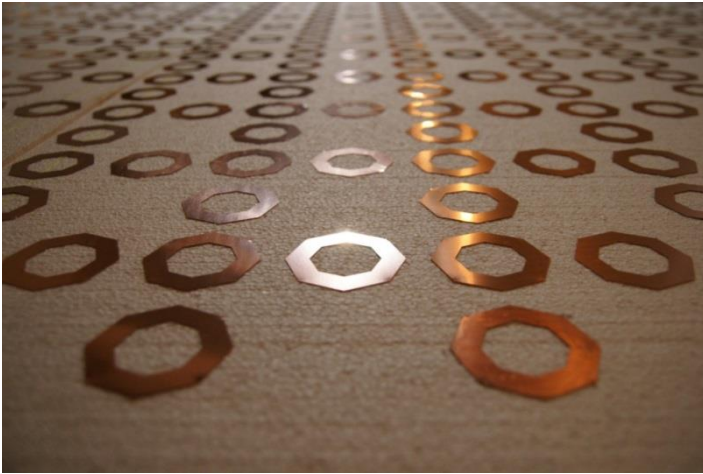


Front-end proto typing

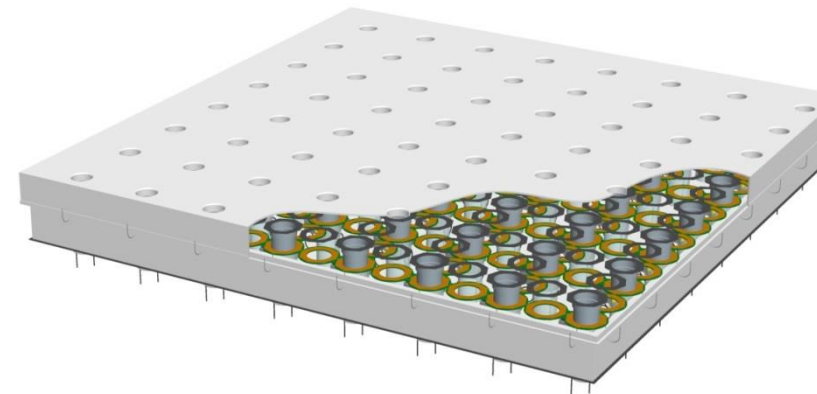




Octagonal Ring Antenna (ORA)



- Electromagnetic reception performance of basic ORA array has been verified
- Finite ORA array (1m² in area) integrated with LNAs has been measured with the lowest noise temperature of 39K

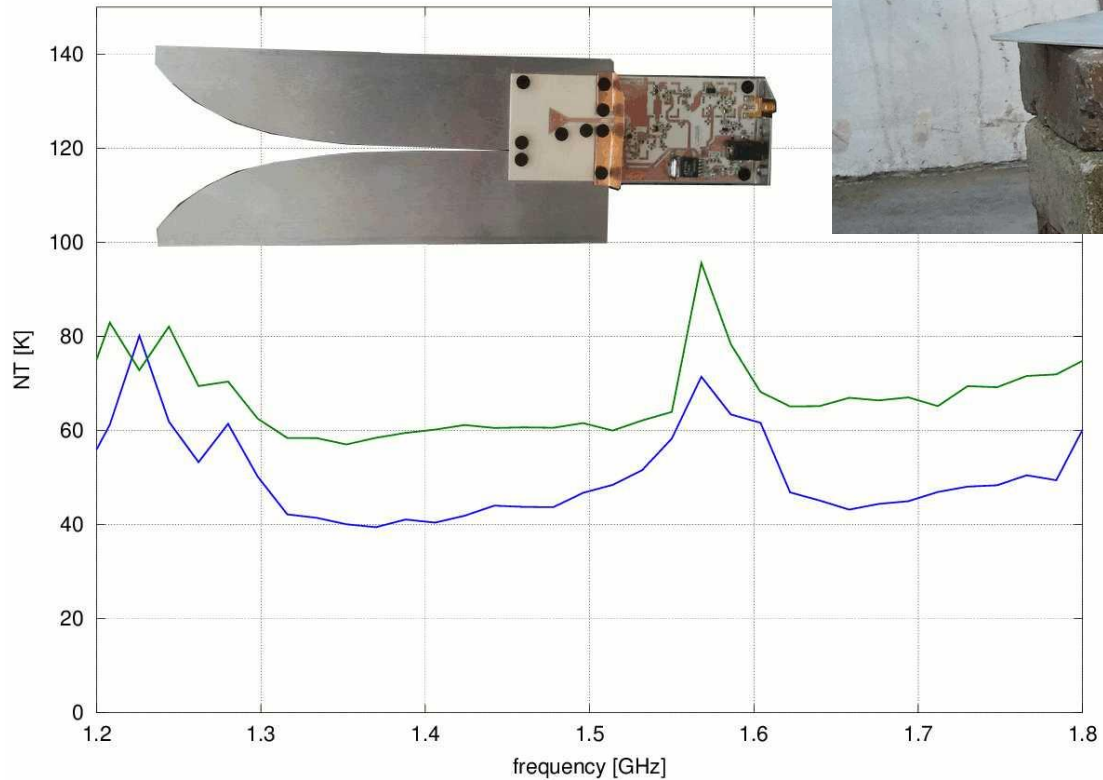


ORA with AVAGO MGA16116

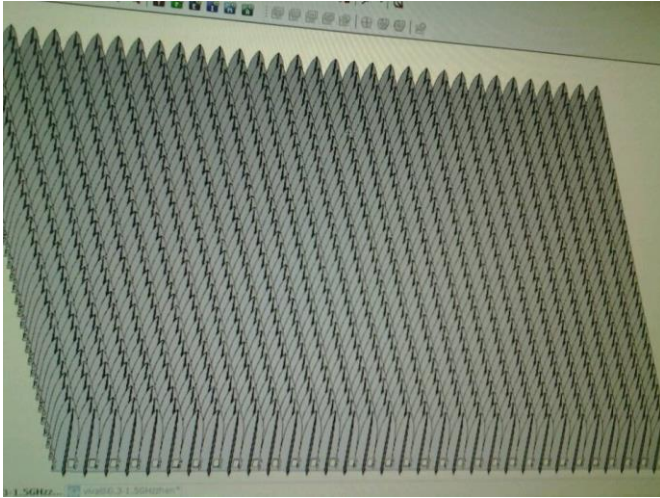
Noise temp AAs



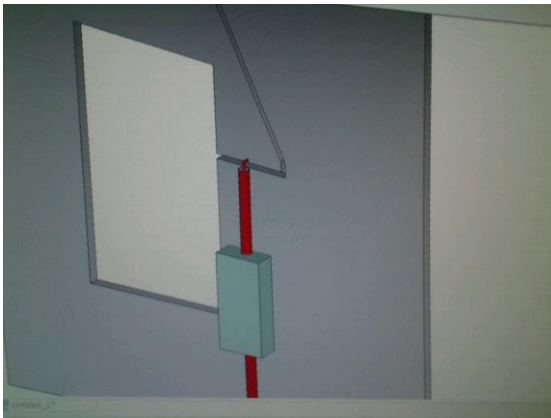
NT improvement of new LNT board compared to prev



KLAASA Front-end prototyping



- Performance and cost of the Vivaldi Antenna arrays comparison in a metal array and a dielectric-slab
- Finite Metal Vivaldi Antenna array (9m² in area) integrated with LNAs
- Material and manufacturing method with low cost will



Next steps

- AERAP / MIDPREP supported engineering work
 - Student exchange, MIDPREP, NWO-NRF exchange money
 - 3x3 m² arrays, Mauritius, Stellenbosch, Durban
 - New Tile evaluation, new array
 - Beamforming software
 - Calibration, Imaging