



Early Results and Development of APERTIF

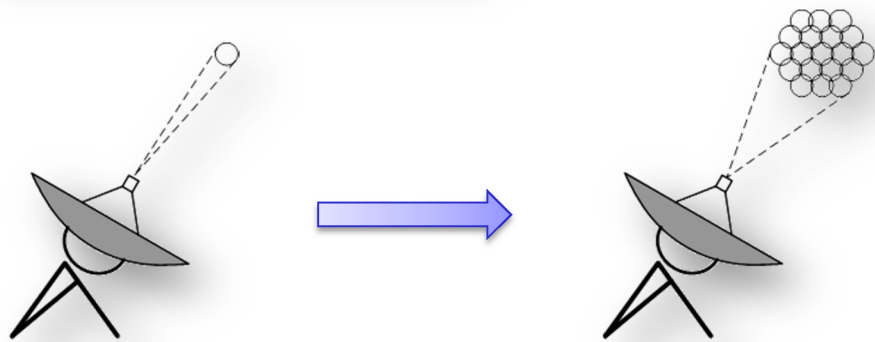
Wim van Cappellen
ASTRON



APERTIF: Phased Array Feeds for the WSRT

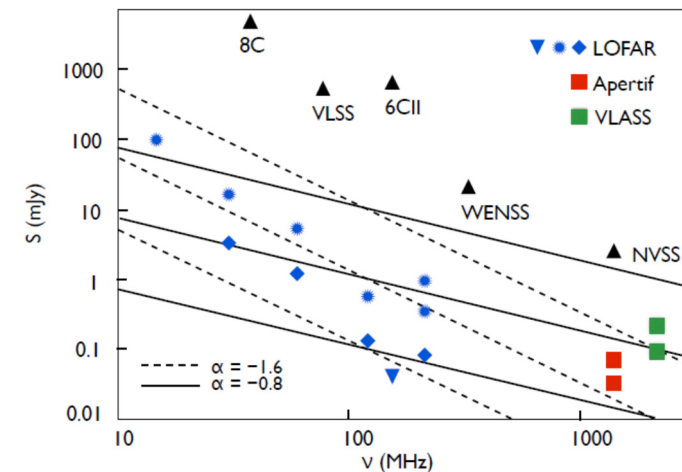


- Transform the WSRT into an efficient 21-cm survey facility
- 17x Survey speed increase
- SKA Pathfinder



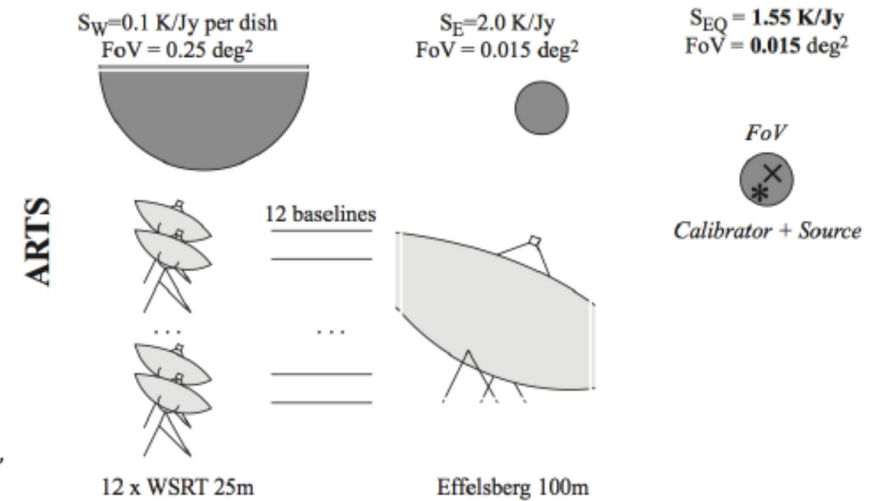
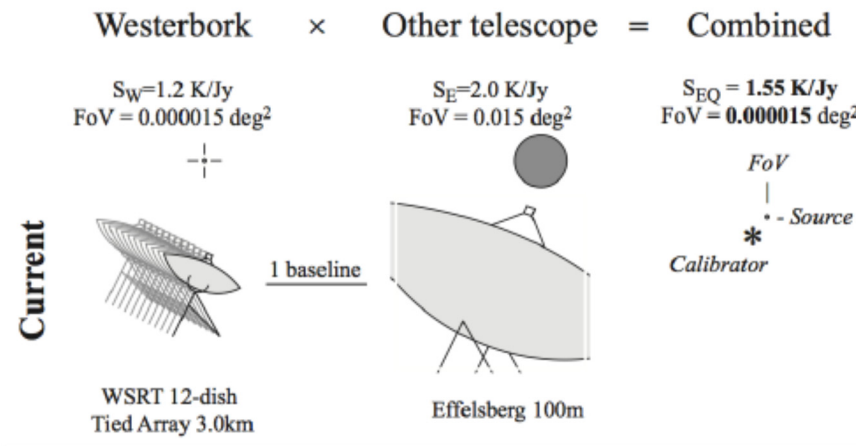
- Two main surveys
 - Large-area imaging survey (continuum & spectral line)
 - Large-area transient survey

- Unique synergy with LOFAR:
 - Good match in continuum sensitivity and resolution
 - Detect radio burst with APERTIF, and wait for it to appear for LOFAR:
localisation!!!



VLBI

- Current FoV of WSRT for VLBI is tiny
- With APERTIF-ARTS: stream individual dishes
- Enable Wide FoV VLBI: FoV x 10,000 !!!!!

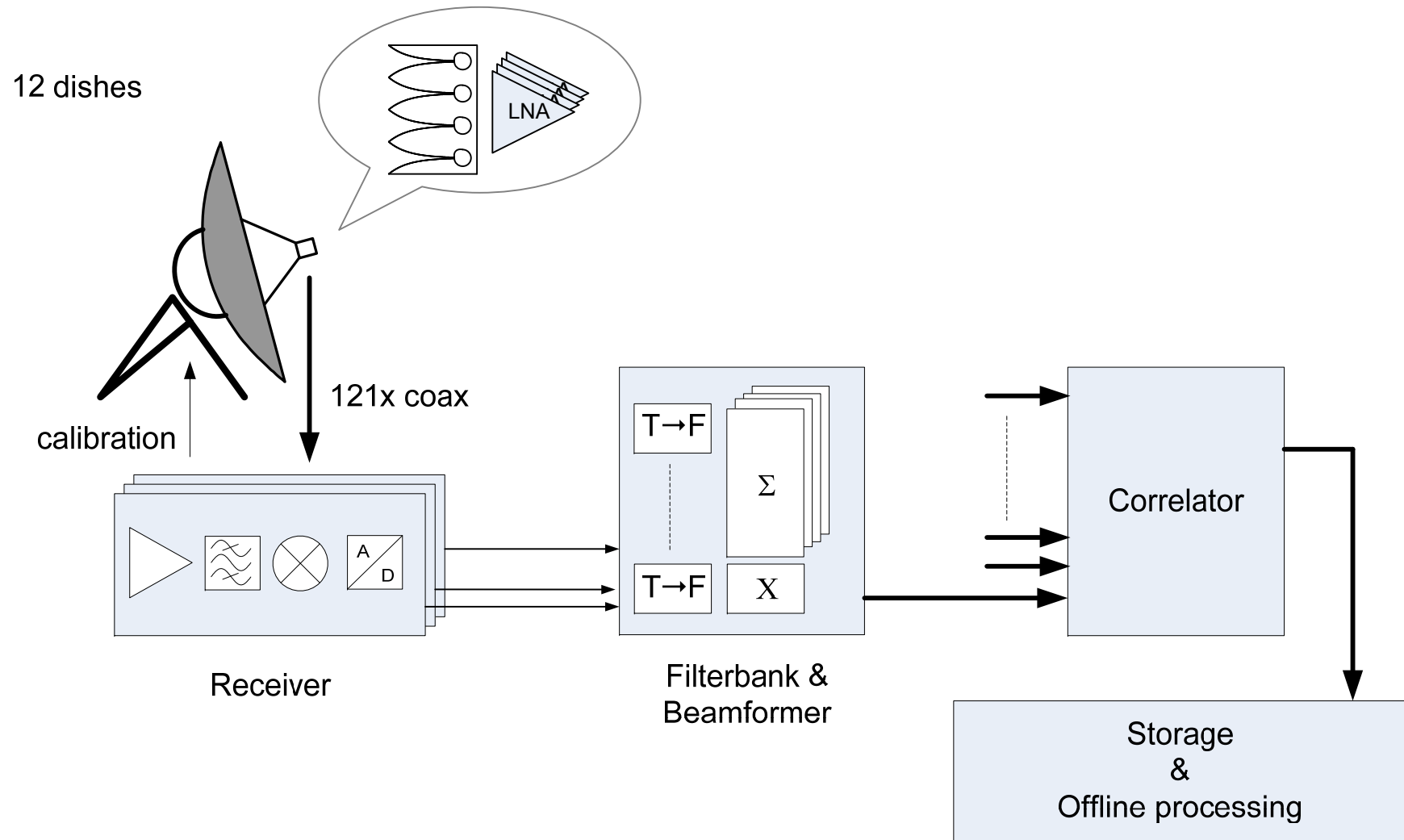


APERTIF specifications

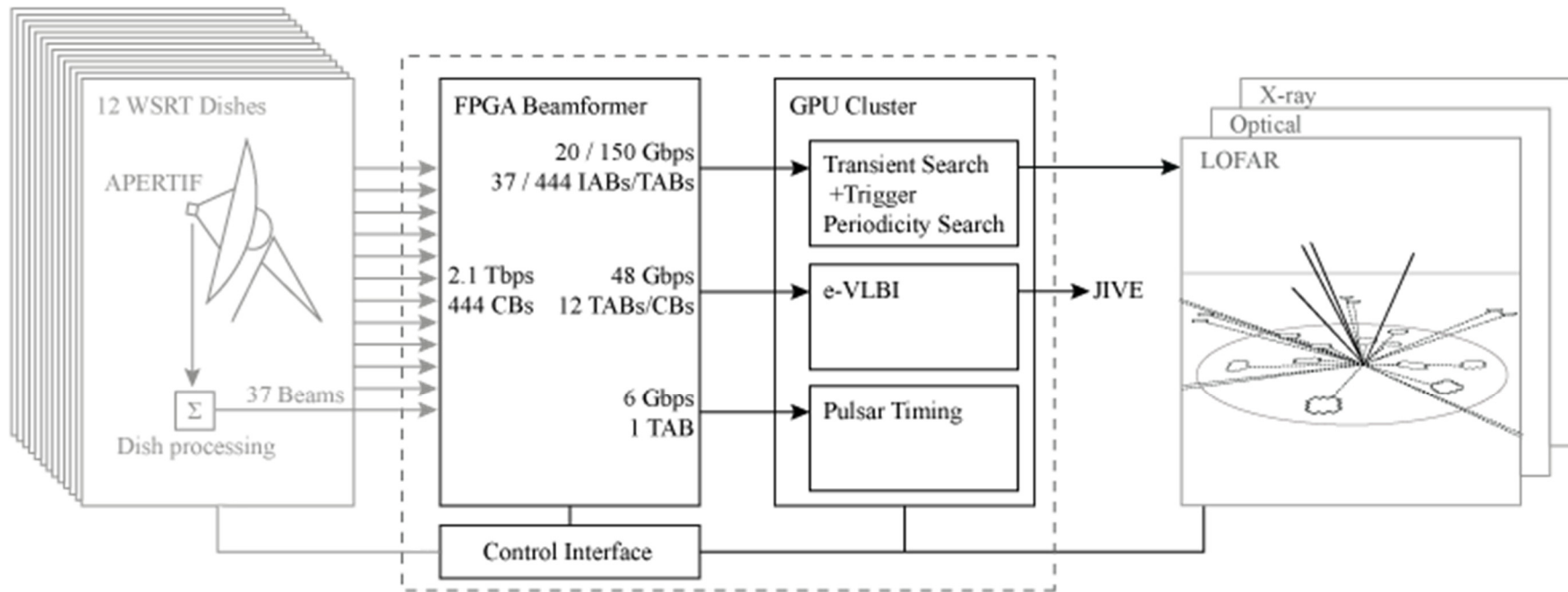
Frequency range	1130 – 1750 MHz
Instantaneous bandwidth	300 MHz
Channel bandwidth	18 kHz (16k channels)
Polarization	Dual linear
Reflectors	12 x 25m
Baselines	36 to 2412 m
System temperature	70 K
Aperture efficiency	75%
Simultaneous beams	37 dual pol
Field of view	8 deg ²
“Survey speed increase”	17x



Top level block diagram, imaging



Transient + VLBI backend



Feed array



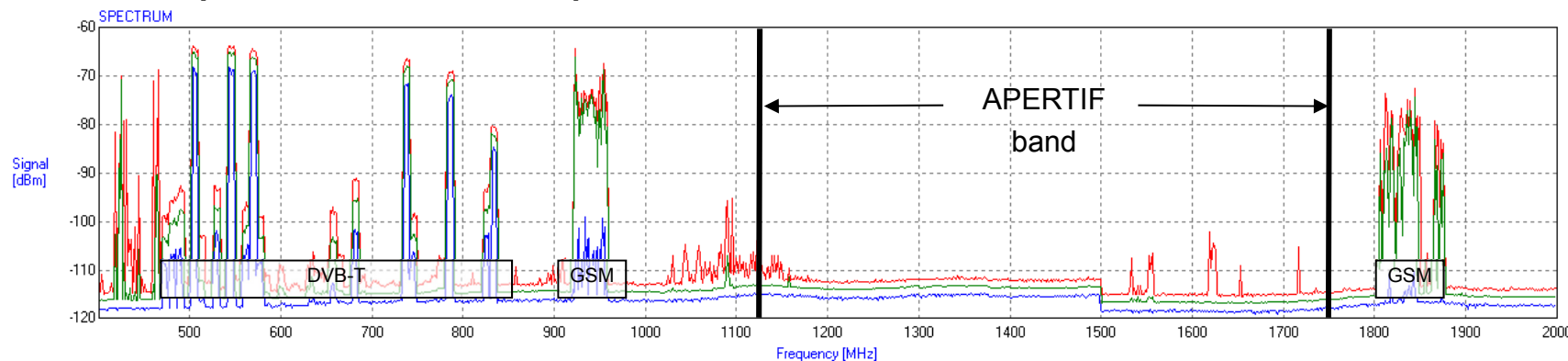
Gain ~ 40 dB

LNA $T_{\min} = 0.24$ dB

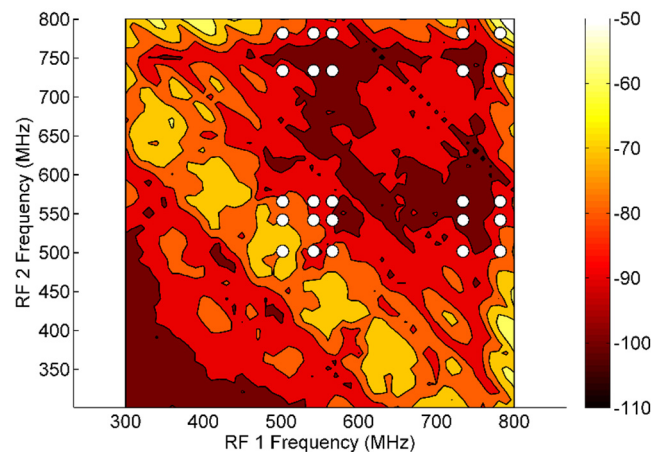
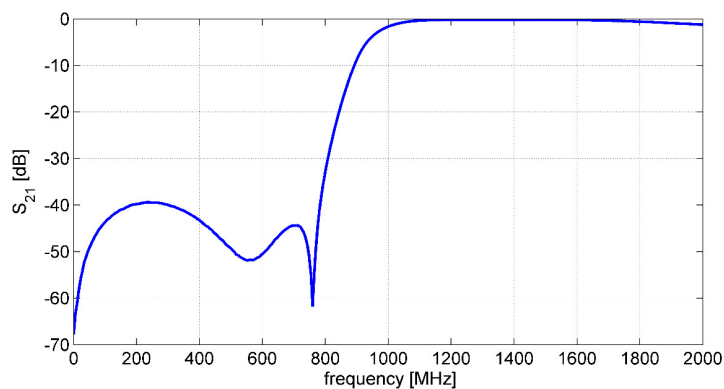


RFI immunity

- High-pass filter between the antenna and LNA
 - System temperature penalty ~ 15 K
 - Measured IP2 products now > 70 dB below system noise (well below RA.769)

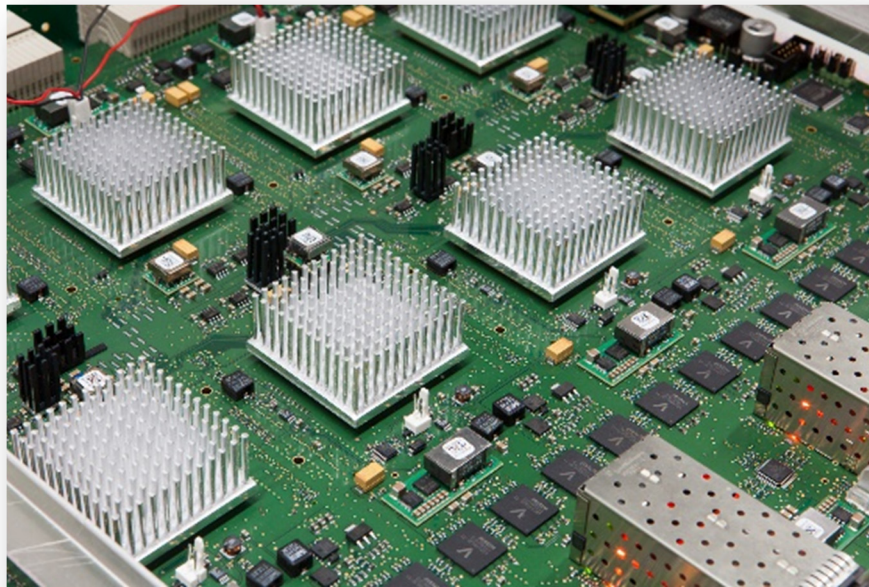


File: Wb20100303_001 ; Station: WSRT, ASTRON, The Netherlands ; BandWidth: 30 kHz

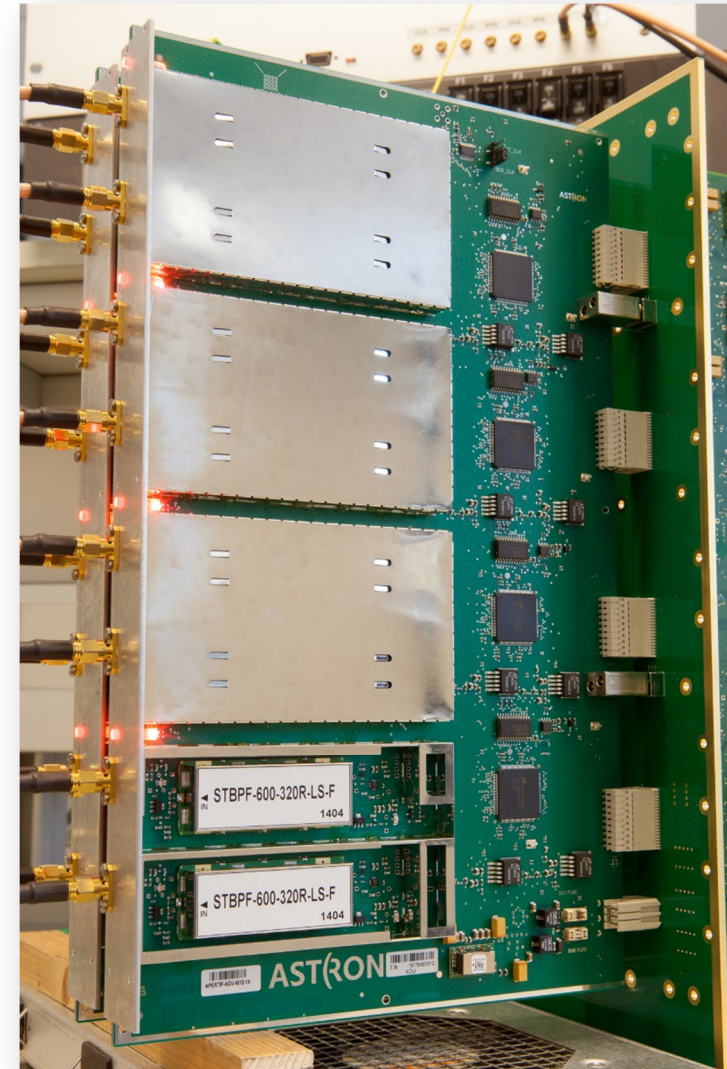


Massive digital processing

- 800 Msps, 8 bit ADC
- 9 Tbps of raw data
(12 dishes)



UniBoard



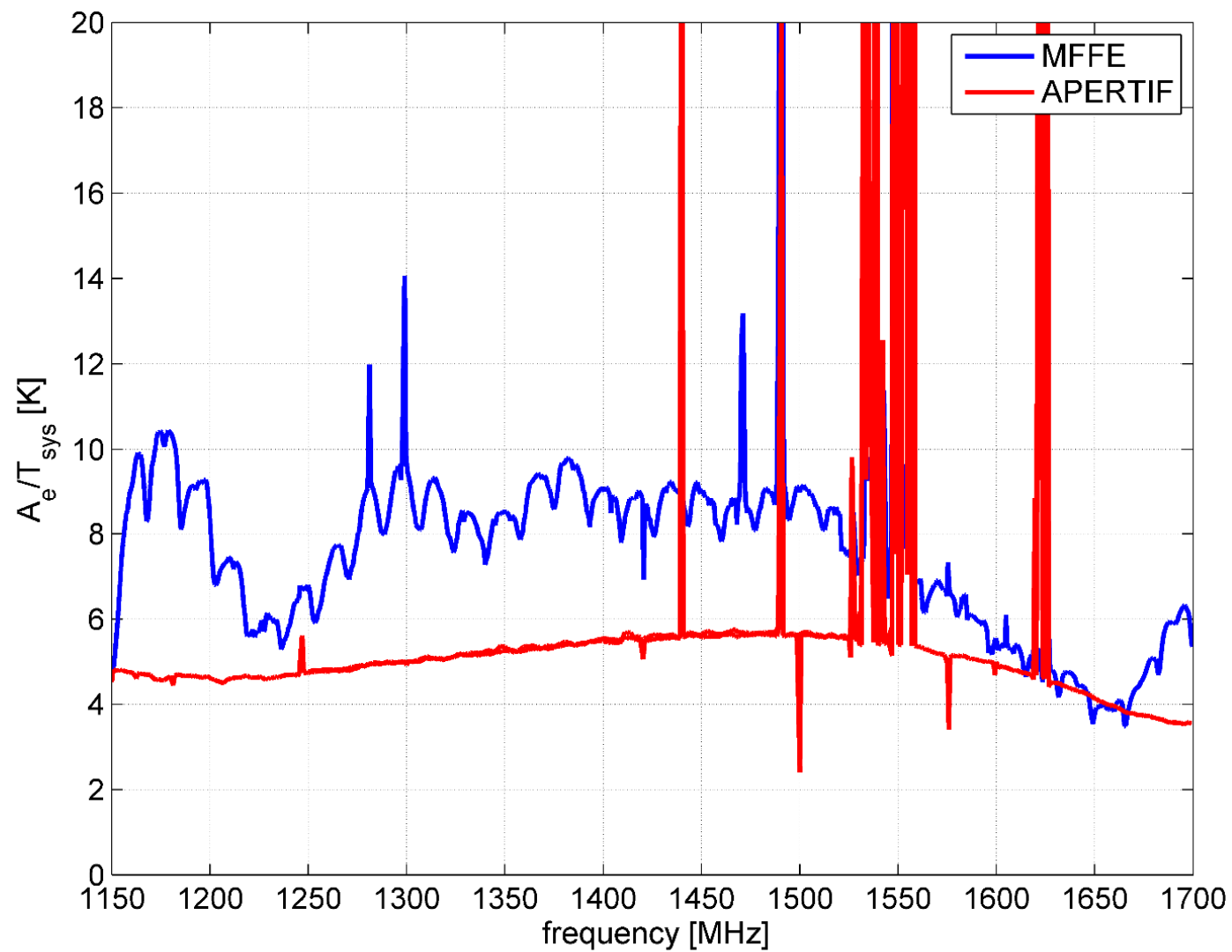
8-channel ADC board

Status

- CDR successfully passed in October 2014
- Now commissioning with 3-dish interferometer
- Upgrade of the first 6 dishes approved
- Hardware is in production
- Dishes are now being upgraded

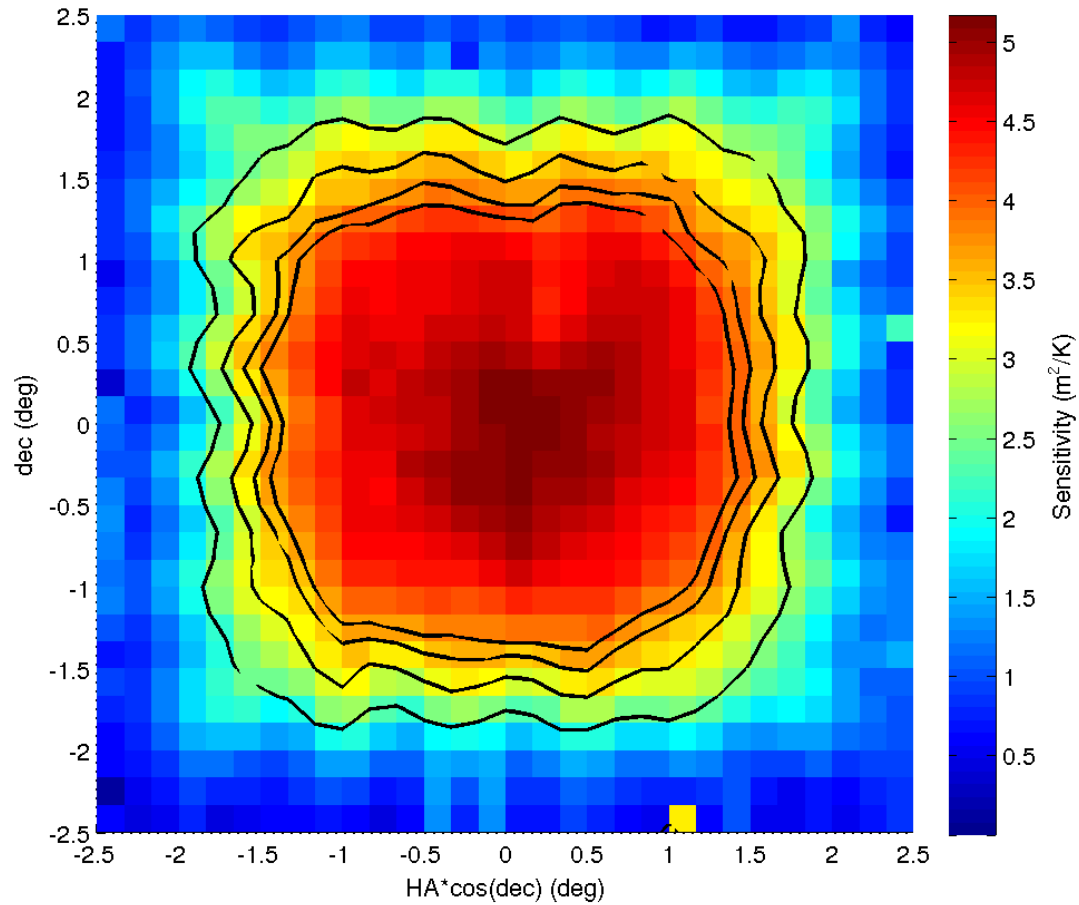


APERTIF vs MFFE sensitivity



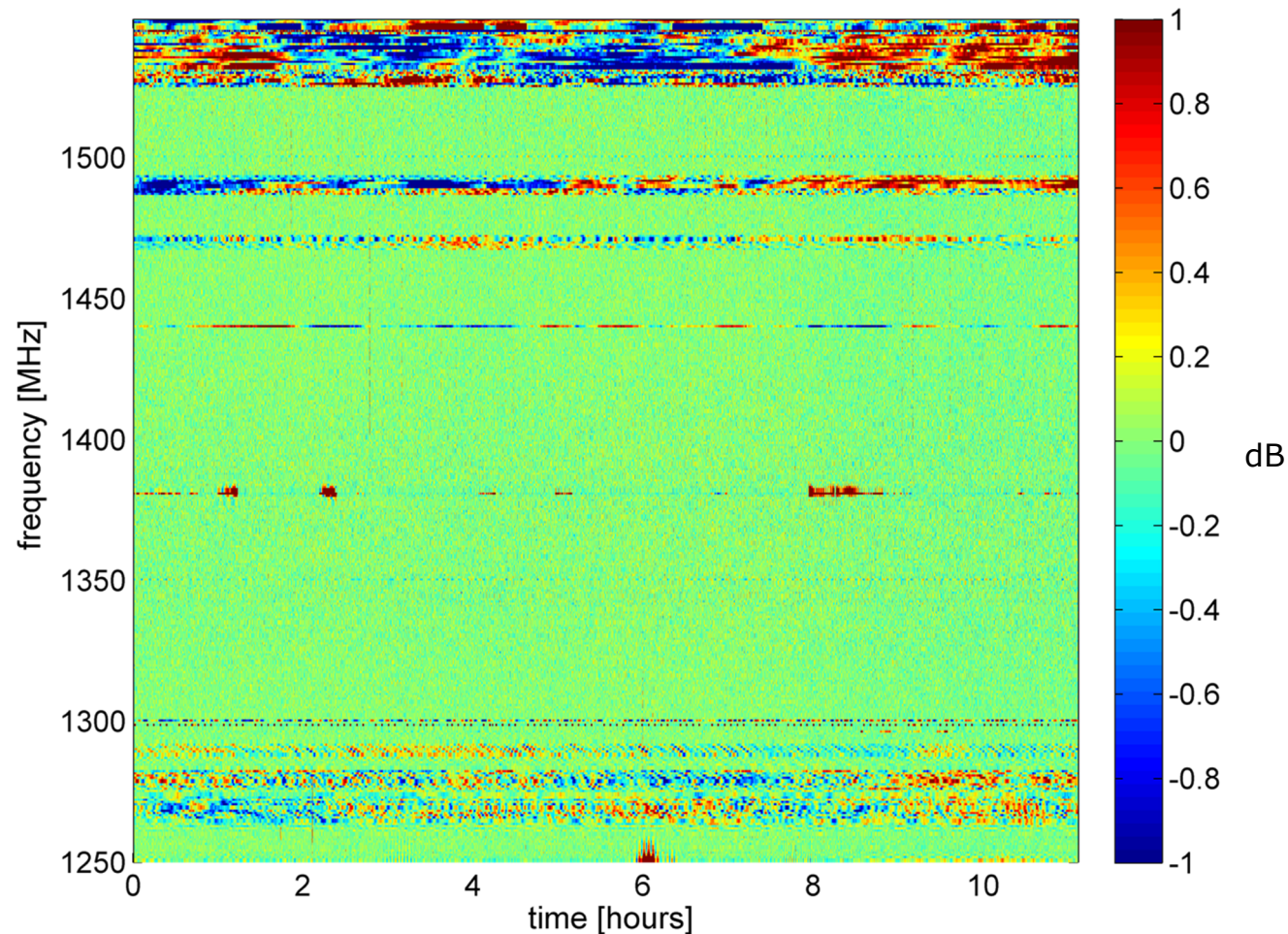
Sensitivity over Field of View

- 1420 MHz



ALPHA-3 results

- Normalized correlation coefficient, 3C147, 300 MHz, 12h
- Very good interferometer band-pass stability ($<1\%$)



Summary

- APERTIF is going strong!
- Rollout of the first 6 dishes is ongoing
- Commissioning results are good, no major issues

