The operational challenges of Apertif

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Outline

Apertif overview

Operational challenges

Science results
Apertif specifications

Frequency range 1130 – 1750 MHz
Instantaneous bandwidth 300 MHz
Channel bandwidth 12 kHz
Polarization Dual linear
Reflectors 12 x 25m
Baselines 36 to 2412 m

System temperature 70 K
Aperture efficiency 75%
Simultaneous beams 40 dual pol
Field of view 8 deg²
PAFs enable survey operations

1. Study of galaxy formation requires a large number of samples
   - Commensal transient detection

2. Lowering operational costs
   - A lot of quite similar observations
   - High level of automation
   - Limited flexibility
Top level block diagram, imaging
The dynamic, millisecond radio sky
Apertif high-speed brain ("ARTS")

- Hybrid FPGA-GPU supercomputer
  - FPGAs pre-process 3.2 Tbps of data
  - GPUs perform 2.0 PFLOPS of computing
ARTS, the Apertif Radio Transient System
August

Total time 744 hrs

Time-domain

- PSR-timing: 18.4%
- ARGO: 3.0%
- ABORTED: 7.1%
- SYSTEM: 20.5%
- IMG: 48.5%
Operational challenges

- Regular operations by 2 persons, no more engineers
- Beam weights
  - Measured on Cas A, 5 hours per full set.
  - Temporarily re-measuring weights every week
  - First results of the calibrator noise source are promising
- Correlator cannot yet deal with failing dishes during observation
- Lots of monitoring data, operators have difficulties to interpret
Monitoring

Central Building
(GPU CLUSTER)
Hardware status

LNAs status: attenuation delays, oscillating elements, low/high noise.

[Images of data and charts showing signal levels: high signal, low signal, Off, Nominal]
Inspection plots

Calibration & data quality
Science results
Imaging

![Graph showing imaging data with coordinates and scales.]
• Similar sensitivity and angular resolution
Spectral index images obtained with a cut at \(5\sigma\) (0.55 mJy/b) in the LOFAR image
Transient results

- FRB 121102 observations
- 29 observations between 2018/11/12 and 2018/11/29:
  - 50 hours
- Coherently dedispersed to DM=560.5 (Hessels et al. 2018)
- Searched with PRESTO + Apertif trigger analysis code (github.com/liamconnor/artsanalysis)
28 bursts detected

Oostrum, van Leeuwen et al. in prep 2019
The brightest

DM: 565.05 pc cm$^{-3}$
Width: 2.6 ms
Fluence: 22.6 Jy ms

DM: 560.5 pc cm$^{-3}$
Width: 8.8 ms
Fluence: 20.3 Jy ms
Summarising

• WSRT is doing science operations again

• Complementarity with LOFAR enables unique galaxy evolution studies

• Operational efficiency is being improved

• Thanks to Apertif, the 50-years old WSRT is again state-of-the-art!