Some Thoughts on Pulsars with SKA-Low

Jason Hessels (ASTRON/UvA)
Pulsars with SKA-Low

• Lots of available non-EOR time?
• Useful commissioning using even one station.
• ~40 SKA-Low stations (each 35m and 289 elements) is equivalent to the full LOFAR core.
• The 650 SKA-Low stations within 1-km can be sub-arrayed to form 16 independent “LOFAR cores”.
• LOFAR COBALT correlator/beam-former: budget 200kEur, will do hundreds of tied-array beams from up to 80 stations.
• Doing a few tied-array beams from 16 sub-arrays of 40 stations each seems reasonable within a < 1MEur budget.
The LOFAR Core and Superterp

Using a single clock. Ionosphere not limiting.
Pulsars Detectable with LOFAR
Figure 2: Sky Noise Temperature vs frequency for low radio frequencies.

Figure 3: Cumulative collecting area as a function of core radius in the SKA1-low array.

Figure 4: The SKA1-low configuration in the core (35-m diameter stations).
Pulsars with SKA-Low

• Time SKA-Mid discoveries.
• Regular monitoring of at least hundreds of pulsars.
• Monitor flux, mode-switching, DM, scattering, RM.
• Targeted studies of profile evolution and spectra.
6 core stations $S_{\text{min}} = 5\text{mJy}$
1 intl. station $S_{\text{min}} = 15\text{mJy}$
1 rem. station $S_{\text{min}} = 30\text{mJy}$

DEC = -8 deg
DEC < -30 deg
LOFAR MSP Detections

(110-190MHz)

J0034-0534
J1810+1744
J2145-0750
The LOFAR Weather Report

Provide 1/10000 DMs at least once a month

Provided through the IPTA website???
Multi-Frequency Profiles

Blue is LOFAR 110-190MHz

Some profiles getting narrower?
LOFAR Tied-Array All-Sky Survey (LOTAAS)

- ~2x more sensitive than LOTAS (coh. pilot survey)
- ~2x more sensitive than LPPS (incoh. pilot survey)

24 LOFAR first detections now made in this way!!! (Maura Pilia)

Kondratiev & Hessels
Pulsar Spectra

Hassall
Mode-switching

LOFAR 150 MHz

Flux (normalised)

Time (h)

Phase

Sobey
Scattering

Kondratiev, using EPN Zagkouris & Karastergiou (110-190MHz)

Descattering J0034-0534

(110-190MHz)

Tscatt = 36 +/- 14us

Zagkouris & Karastergiou
Calibrating RM and DM

1 TECU = $10^{16}$ electrons/m$^2 = 3.2 \times 10^{-7}$ pc/cc

Maximum expected DM$_{ion}$ = $\sim 7 \times 10^{-6}$ pc/cc