

SKA Science with PAFs

Design Reference Mission for SKA Mid & SKA Low

- Many projects aim to observe large regions of the sky
(line, continuum, polarisation, transients)
⇒ SKA will have to have survey capability ⇒ large field of view (survey speed)
- A number of surveys plan to integrate 1000 hr per field
 - We build a telescope 100 x bigger AND observe >10 x longer.
Why? SKA is not big enough?
 - Different from how radio telescopes are used now
 - It is not realistic to assume that you can survey a large region in this way, unless the FoV of SKA is large

The case for large FoV

The best way of doing several deep, large-area surveys is with a telescope that has a large field of view

- Cosmic variance: at least 10 deg^2 at $z = 1$
not much less at $z > 1$ and much more for $z < 1$
- DRM lists several all-sky surveys
- Need (very) large FoV to survey the HI in all environments in the nearby Universe
High- z HI work will mainly give global HI properties.
This is not enough to understand the role of HI in galaxy evolution.
Need also deep observations of nearby galaxies and their surrounding IGM to understand galactic ecosystem (star formation \rightleftharpoons ISM, disk-halo interaction; accretion)
- With SKA we finally can image the HI in nearby galaxy with the same resolution as optical telescopes
- And detect the interface galaxies - IGM
- Synergy with E-ELT & ALMA
- Need (very) large FoV to survey the HI in all environments in the nearby Universe

Lessons from Apertif

- There is not enough observing time to do all the surveys you would like to do
- You can't do large projects in the way you would like to do them
- DRM adds up to more than 10 yr on-sky time. This amount of time will not be available. Large FoV is best way to satisfy ambitions of DRM
- Set priorities! But: decreases community support?
- Hard to predict what the top SKA science will be.
(a telescope 100 x bigger will always be interesting)
- Be flexible; What opens up parameter space?
- Commensal surveys is a *requirement*. This has impact on science & survey design (& instrument design)
- Large surveys should be done as legacy surveys. Has impact on survey design
- Consider what is planned/possible in other wave bands (multi-wavelength, selection of fields, topics) and consider the outcome of (other) pathfinders

The case for PAFs

- Offer large FoV & good survey speed. Intermediate between AA and WBSPF
- Go to higher frequencies than AA
Several survey projects from DRM target for frequencies up to 3 GHz
- Optimum performance over most of the sky,
performance can be optimised depending on science (e.g. polarisation)
- Results on prototypes encouraging, several telescopes have plans for PAFs
(Wim van Capellen - tomorrow - see Astron/Jive daily image of yesterday)