

## SWG Chairs Telecon 20-July-2021

Participants: SWGs: J. Hessels, D. Oberoi, N. Hurley-Walker, V. Vacca, G. Heald, B. Catinella, S. Buitink, P. Woudt, A. Datta, P. Serra, F. Camilo, F. Combes, J. Forbrich, L. Wolz, A. Mesinger

Apologies: L. Verdes-Montenegro, A. Karastergiou, S. Camera, L. Lamy, S. Muller, M., Sargent, S. Nissanke

SKAO: Robert Braun, Jeff Wagg (Notes), Anna Bonaldi, Tyler Bourke, P. Hartley

### *Construction progress*

RB: - construction is finally underway

- Successful kickoff to start of activities (see slide)

### *Topic: ToR for SWGs*

RB: - ToRs continue to evolve to reflect changing focus of SWG role over time. We want your continued advice on how SKA can best enable your science. The ToR from 2018 is still in good shape

- Just to remind you that these groups are open to any prospective members, and we encourage diversity in all forms

GH: we want SWGs to be inclusive, but we are also looking for ways to be actively inclusive. Can we approach this cohesively across the groups.

Maybe a group brainstorm?

RB: We are working on an electronic portal to make it easier for prospective members to apply for membership. The old website is in the process of being updated and we are waiting for this to be in place. The group brainstorm is a good idea. We will organise and come back with further ideas in future.

### *Topic: SKA LOW station layouts*

RB: - currently we are using pseudo-random layouts, but there are issues with close proximity of antennas that are leading to effects, resonances at  $\sim 55$  and  $\sim 77$  MHz (see plot). 78 MHz is a concern for Cosmic Dawn studies

- Curves shown in slide show the diversity of embedded element patterns, depending on proximity to nearest neighbours, particularly an issue below 100 MHz (below transition from sparse to dense aperture sampling regime)
- There have been extensive studies on station layout which led to pseudo-random layout, but you can see overlap of EM footprint of closely packed antennas with this layout.
- An alternative is Vogel pattern (shown in slide) which follows a "sunflower" layout defined by uniform areal density and maximal azimuthal diversity.

- Next slide shows the minimum separation between antennas for pseudo-random and Vogel patterns, where the Vogel or Vogel\* shows a more peaked distribution with larger median antenna spacings
- What is important is the station beam properties, and in the next plots you can see the beams for the different layouts, and one sees that Vogel has superior cross-correlation beams with lower sidelobe levels at all frequencies 50 - 350 MHz
- Final slide shows histograms of the occurrence of sidelobe power
- Pietro Bolli is running EM simulations to assess presence of resonances in Vogel layout and early indications are encouraging

SB: Air shower detection could be useful to detect this effect

RB: An interesting thought as you can't beat real data.

DO: The mutual coupling for one polarization shows a more prominent effect?

NHW: These plots all show the Y pol, X is not shown.

RB: Indeed, both polarisations show similar effects, so only one was shown here to highlight the problem.

NHW: What about the ability to walk between antennas for maintenance?

RB: All layouts start with this risk and typically need to be tweaked to ensure that there is always an access route. Our Italian colleagues have code to test the access and tweak positions to enable access.

NHW: In the worst-case scenario, if you cannot access the central antennas, would you reduce the number of antennas or increase the station size?

RB: That should not be a problem in practise. There is scope for tweaks to create access routes. We anticipate that the problem is easier from the Vogel starting point, since the initial antenna separations are systematically larger.

NHW: Will you try and minimize the distinct number of different layouts with Vogel?

RB: This is still an open question for all station layout varieties, but the assumption has previously been that 10 different layouts might suffice. However, the improvement in the sidelobes continues all the way out to 512 different layouts. There may be computational overheads with an increasing number of layouts, so this needs more study before a decision is taken. Since rotational diversity has been shown to be sufficient, this diversity may not come with an excessive computational overhead.

NHW: Since there will likely be a non-negligible antenna failure rate, it may always be necessary to treat each station as different even if the layouts are nominally the same.

AD: How stable are the bandpass fluctuations with time? For EoR, rapid changes will be an issue

RB: Simulations are being used to investigate this, but indeed that is a real concern.

AM: I wanted to highlight the importance of mutual coupling as this is currently a showstopper for HERA as it is a close-packed array and the systematic errors are causing a bottleneck.

RB: Understood.

*Topic: AOB*

FC: Could you share (next time) the thoughts on the access model?

RB: Absolutely, we are doing a lot of work on this and I will prepare slides for next meeting

AM: What is the timeline for new website with the new SWG membership portal?

RB: It's hard to pin down, so if we find that it is taking too long, we may simply roll out an interim solution for the SWG membership portal.

PS: Regarding the current Science Data Challenge we think it would be a good idea to have a small meeting with the groups involved. Should we take the lead on this or are you planning to do this?

PH: We have not yet planned one but that is a brilliant suggestion and September sounds like a good timescale. There is also a paper in preparation. We want to highlight how far teams have gone down the reproducibility track.

RB: Next meeting will be in the normal slot in September as so many of us based in the Northern hemisphere will not be available for the August meeting slot.