Another update on reviewer's comments on:

"The Effects of the Local Environment on a Compact Radio Interferometer I: Cross-coupling in the Tianlai Dish Pathfinder Array"

Peter Timbie, David Kwak

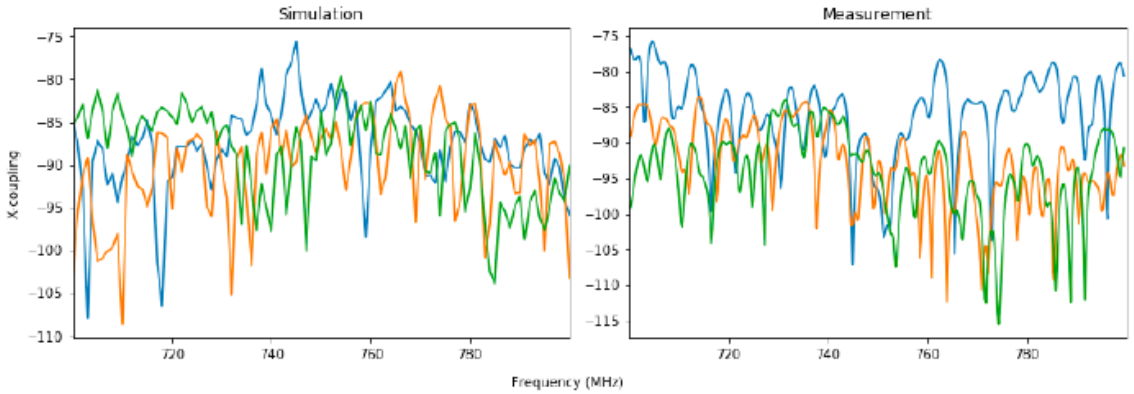
August 15, 2023

Reviewer's Comment: *"Please include some discussion on the data-reduction involved with producing the nightly mean plots (you can cite Wu 2021 but i think it'd be helpful for the reader to at least know the basic parameters of the calibration and observations). "*

Albert: : Please add a few sentences in Section 6.3.

Reviewer's Comment: "Please provide details about the sky map such as the specific source catalog, the model of diffuse emission, and the software used to perform the simulation."
Reza?

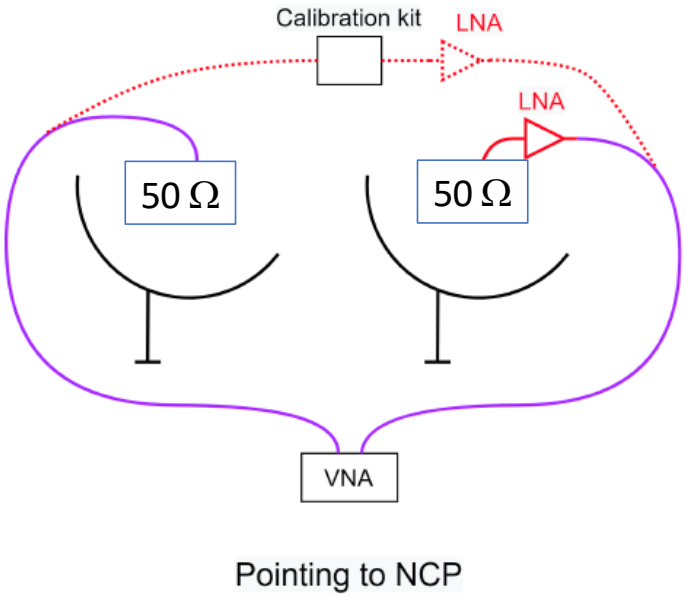
Reviewer comment: *"Fig 8: (Now Fig. 11.) the fine scale structures in the S21 parameters look like numerical noise, related to previous discussion, the authors should track down whether this is the case and try to mitigate it. (Peter: David is working on this.) Can the authors confirm that the ripples in the measurement panel are not sourced by cable reflections and uncalibrated spectral structure? Show a measurement where the measurements are terminated by 50 Ohms with nothing else changed so we can see where the systematics floors are. Peter: Fengquan has made such a measurement, showing that the noise floor is about – 107 dB. (Ask David to add a curve to the RH figure showing the noise floor measurement.) Fengquan: The ripple in the S21 parameter is indeed sourced by the uncalibrated spectral structure. The long measurement cable will significantly increase the residual calibration error.*

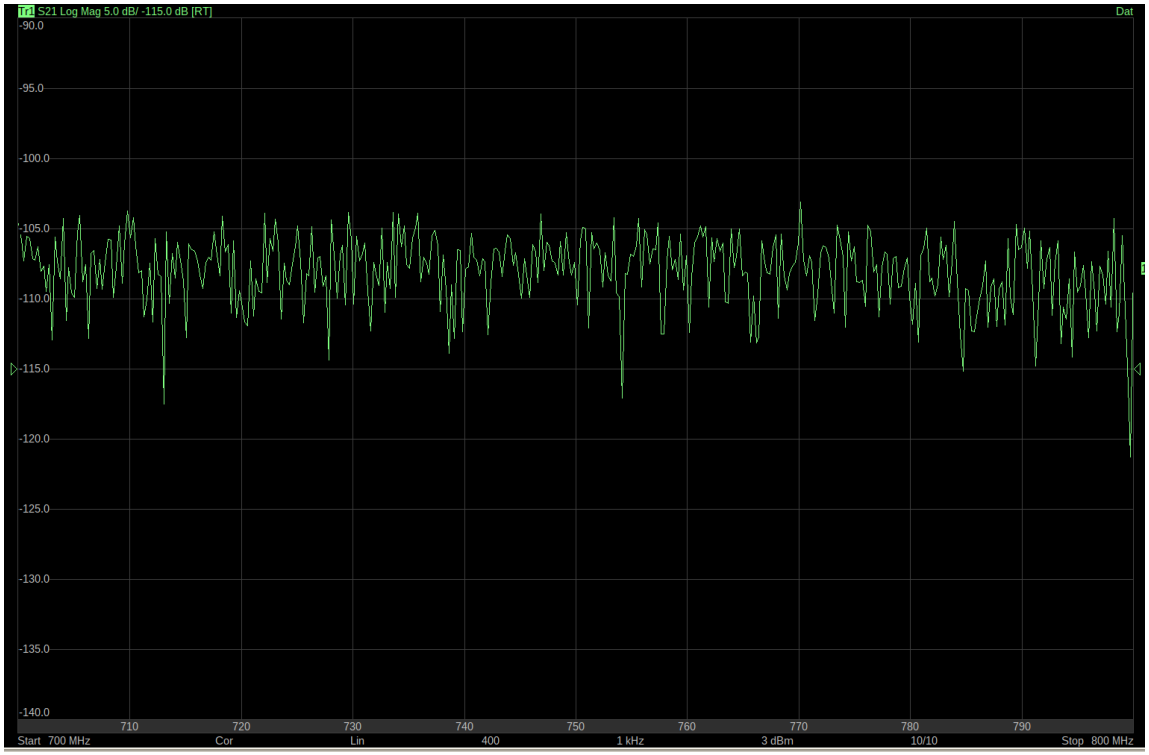


Should we try to filter out effects of standing waves in the cable?

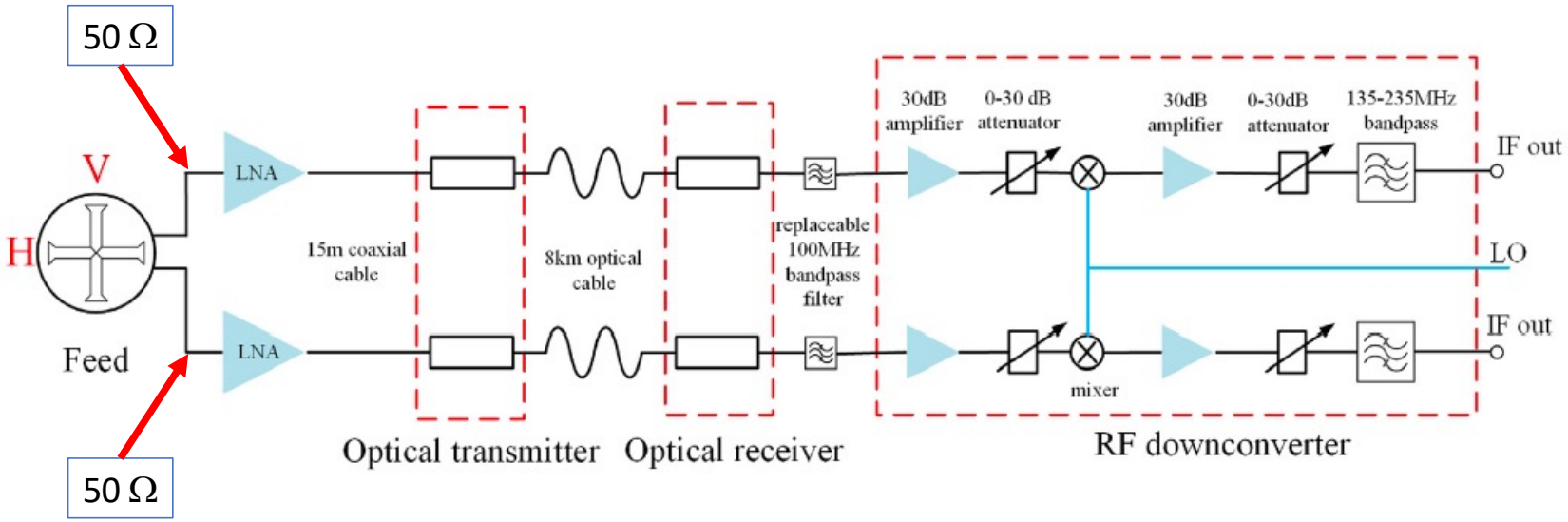
Fig. 11: **Left:** Peter: CST simulations of the cross-coupling of baselines 2V-10V (blue), 2V-15V (orange), and 2V-8V (green) when the full array is pointing at the NCP. The baseline lengths are ∼11.5 m, ∼20.3 m, and ∼30.5 m, respectively. **Right:** Peter: VNA measurement of cross-coupling (S_{21}) of 2V-10V (blue), 2V-15V (orange), and 2V-8V (green) Peter: with dishes pointed toward the NCP. The S_{21} measurements are described in Sec. 5.2. The noise floor of the VNA measurements is ∼ −107 dB. (Ask David to add this measurement to the RH figure.) Time averaging was performed only on the noise floor measurements. Although the simulations and VNA measurements do not match in detail, they are at about the same level. Peter: Are these simulations the average of S12 and S21? David will match scales on vertical axes.

Reviewer proposed this measurement, which Fengquan has done:





Proposed input termination test?



Reviewer comment:

"There is a lot of fine scale spectral structure in the averaged visibilities (nightly mean in current Fig. 15) that is not present in the averaged sky model. Can the authors comment about what the sources of these structures might be? For example, could they be uncalibrated cable reflections? Are they errors introduced by the calibration algorithm / processing?" Peter: We believe these structures are caused by coherent thermal emission from the ground and plan to discuss this model in a future publication. (However, a measurement of the visibilities for these three baselines with the LNA inputs terminated by 50 Ohm loads would allow us to check for cable reflections and for the possibility of cross-talk between cables.)

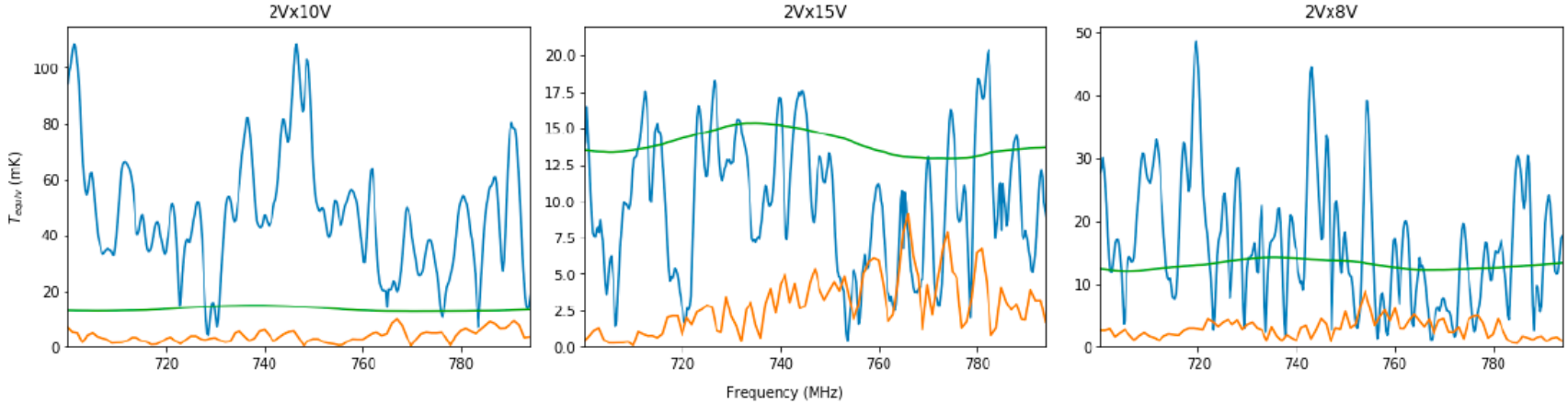
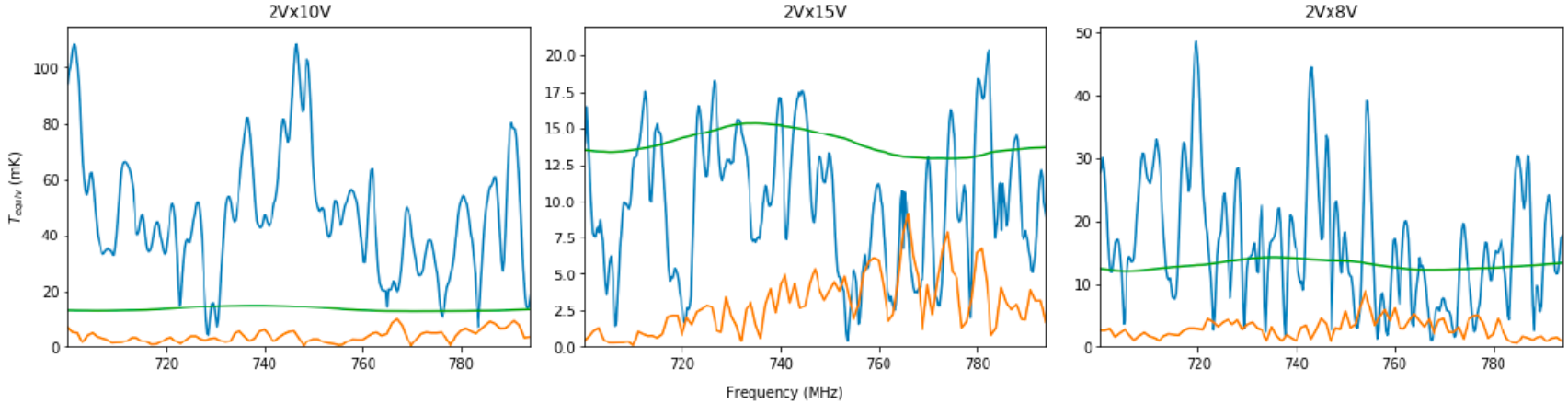


Fig. 15: Comparison of the observed nightly mean (blue), cross-coupling (orange), and simulated sky contribution to the visibilities (green).

Reviewer comment:

"It looks like both the averaged visibilities and the VNA noise measurements have significant 5 MHz ripples which correspond to roughly to round-trip travel times in 30 meter coax cables. Does the signal chain contain coaxial cables? What attempts were made to calibrate these structures out in both the VNA and visibility measurements?" Peter: This is a good question. We could calibrate it out of the VNA measurements with the 50 Ohm termination test suggested above. We could also measure the effect in the visibilities (nightly means) by terminating the inputs to the LNAs with 50 Ohms. But Albert suggests that calibrating the array on Cas A should remove the effects of cable reflections.



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