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The inverse phase-referencing method of reducing VERA data using AIPS POPS

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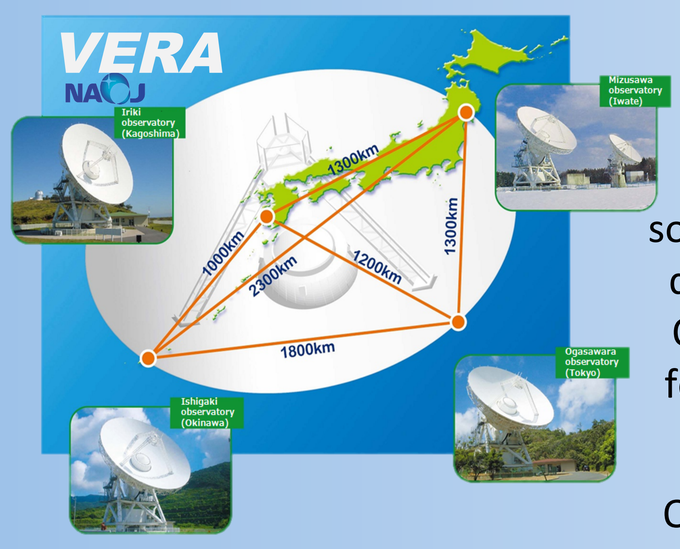
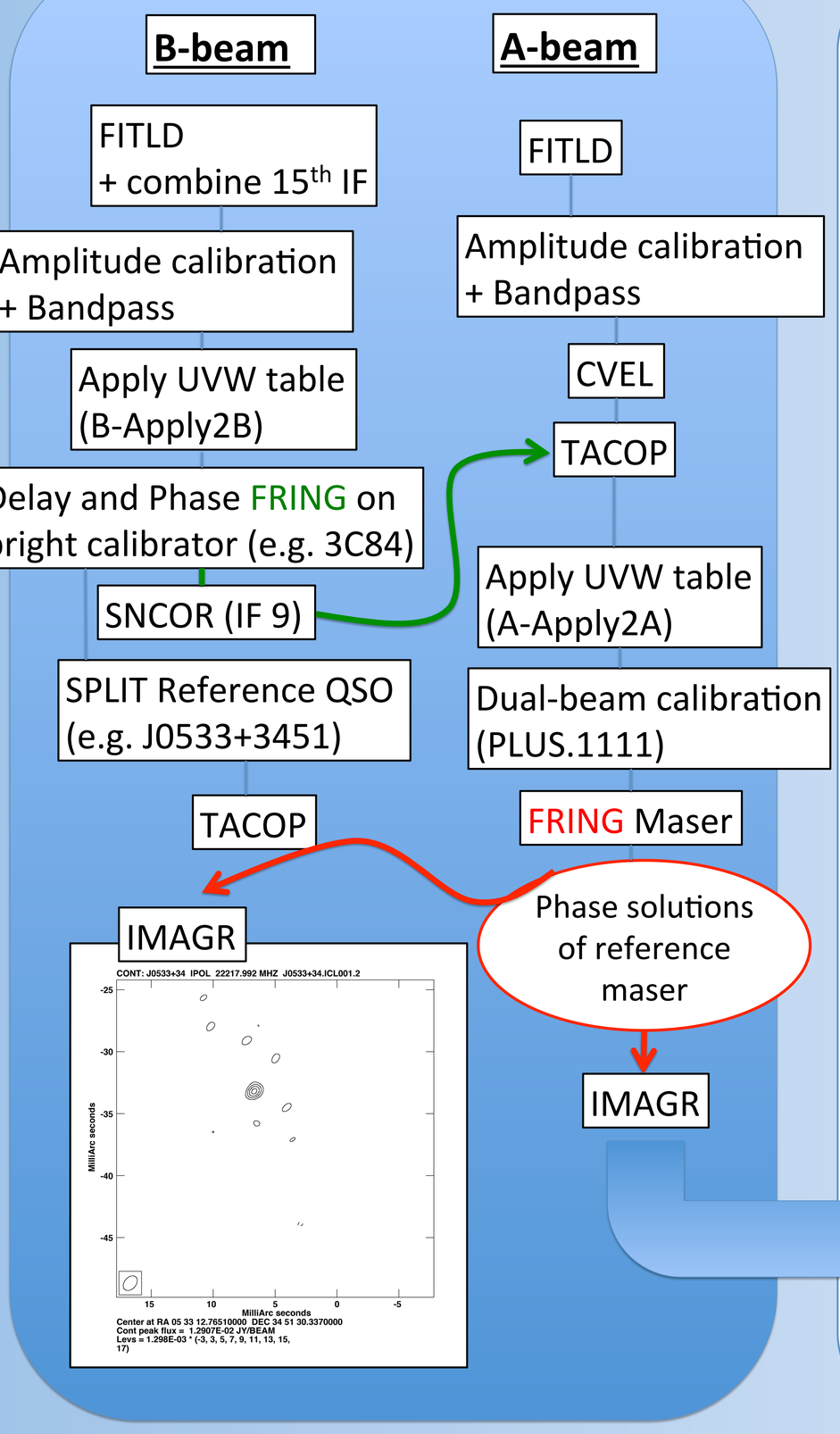
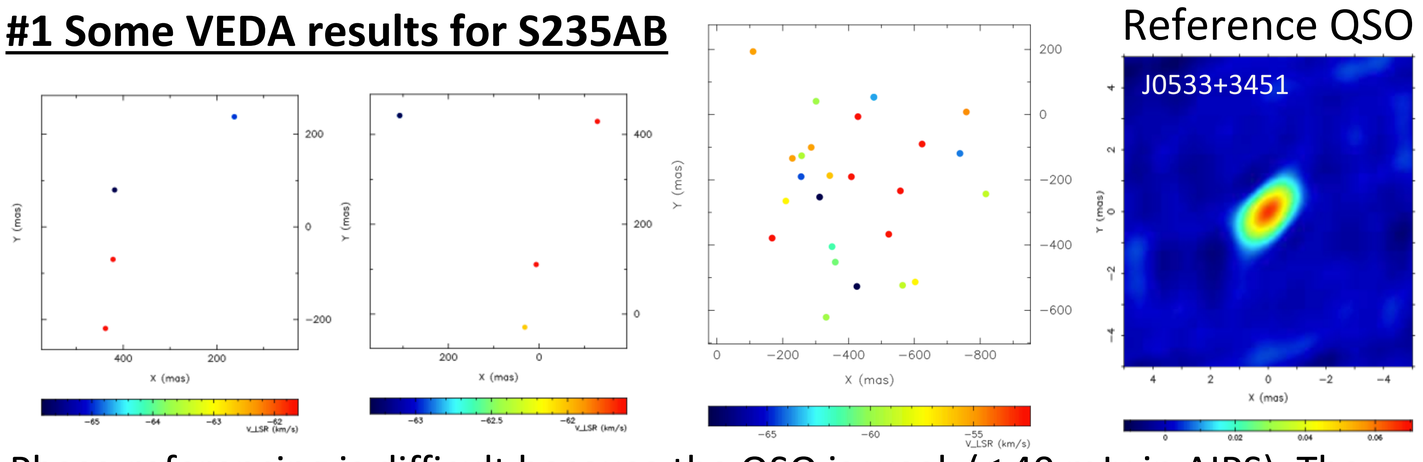


Most of VERA's data is reduced using the phase-referencing technique by using a continuum (QSO) source to solve for phase fluctuations in the sky – these solutions are used to 'phase-reference' the maser data. When there are no strong reference QSOs available within 2.2° we can only use a weak (≤ 40 mJy) QSO. In this case the phase solutions have a low signal to noise ratio (SNR). Low quality phase solutions for the QSO gives low quality maser maps – therefore we are limited by the available reference sources.

In this work I demonstrate the inverse-phase referencing reduction method which is sensitive to weak QSOs. Therefore, by using this method we are not so strongly limited in our choice of reference sources. I plan to provide a working POPS script, and I encourage other VERA users to practice this technique.

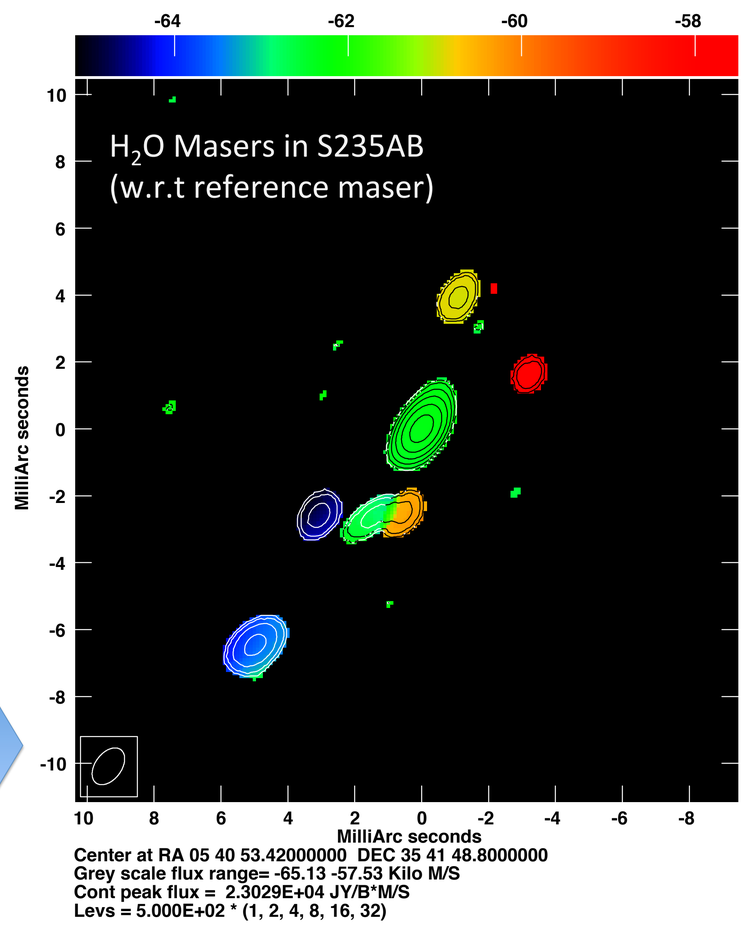


#1 Some VEDA results for S235AB



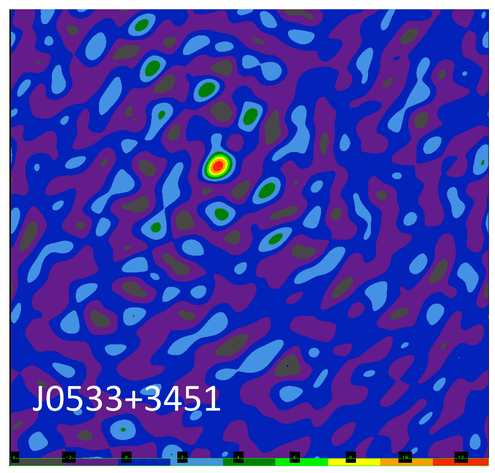
Phase-referencing is difficult because the QSO is weak (≤ 40 mJy in AIPS). The quality of the maser results are not good enough for measuring annual parallax.

#2 Results using inverse phase-referencing



We use the FRING solution of the bright maser to reference the QSO AND to make self-calibrated maser image. Therefore we can get the astrometric positions of ALL self-calibrated masers.

Self-calibrated => Phase-referenced



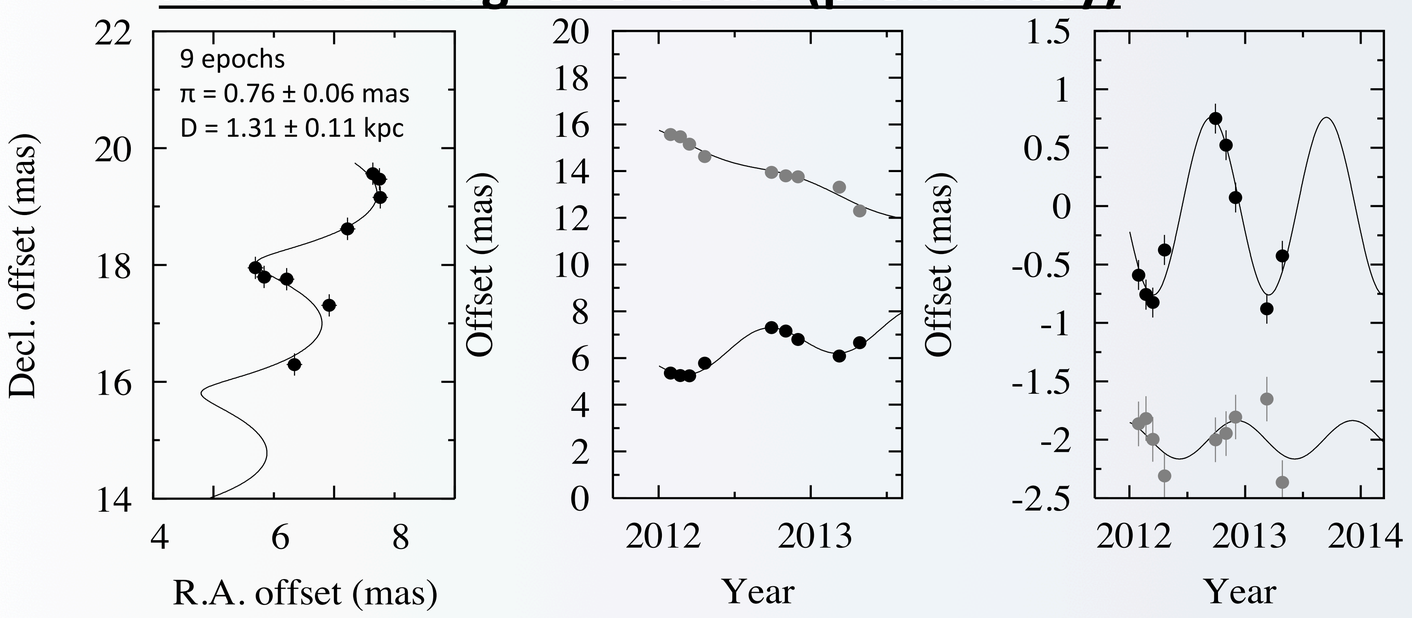
Typical referenced images of the QSO were of 15-20 mJy and SNR > 10

In the case of S235AB, the data reduction was not possible using the normal phase-referencing technique for most epochs because of the weak QSO. Also, the multi-epoch results from VEDA reductions are not consistent with eachother. It is not possible to measure the parallax of masers in S235AB using the normal data reduction procedures.

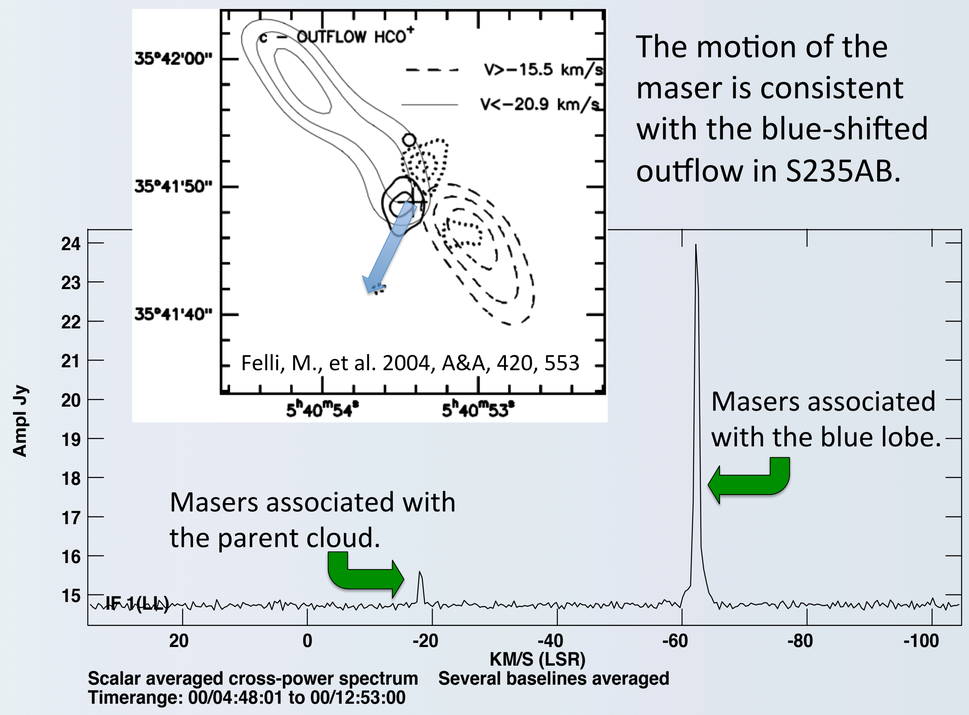
By using the inverse phase-referencing method I detected ≥7 maser features in each epoch. About 3 maser features were detected in **at least 6 epochs** and are suitable for parallax fitting. About 10 features are detected in more than 3 epochs and can be used to measure the absolute proper motion.

In total, about 50 phase-referenced maser spots were found in each epoch at SNR > 5, and the QSO was detected with a typical SNR of > 10.

Parallax fitting for S235AB (preliminary)



The results of parallax fitting for 1 maser feature in S235AB; *Left image* is the sky-plane motion of the maser, *middle image* shows the offset vs time in (grey) Dec. and (black) R.A., *right image* is the offsets in RA and Dec. after subtracting the proper motion component.



The motion of the maser is consistent with the blue-shifted outflow in S235AB.