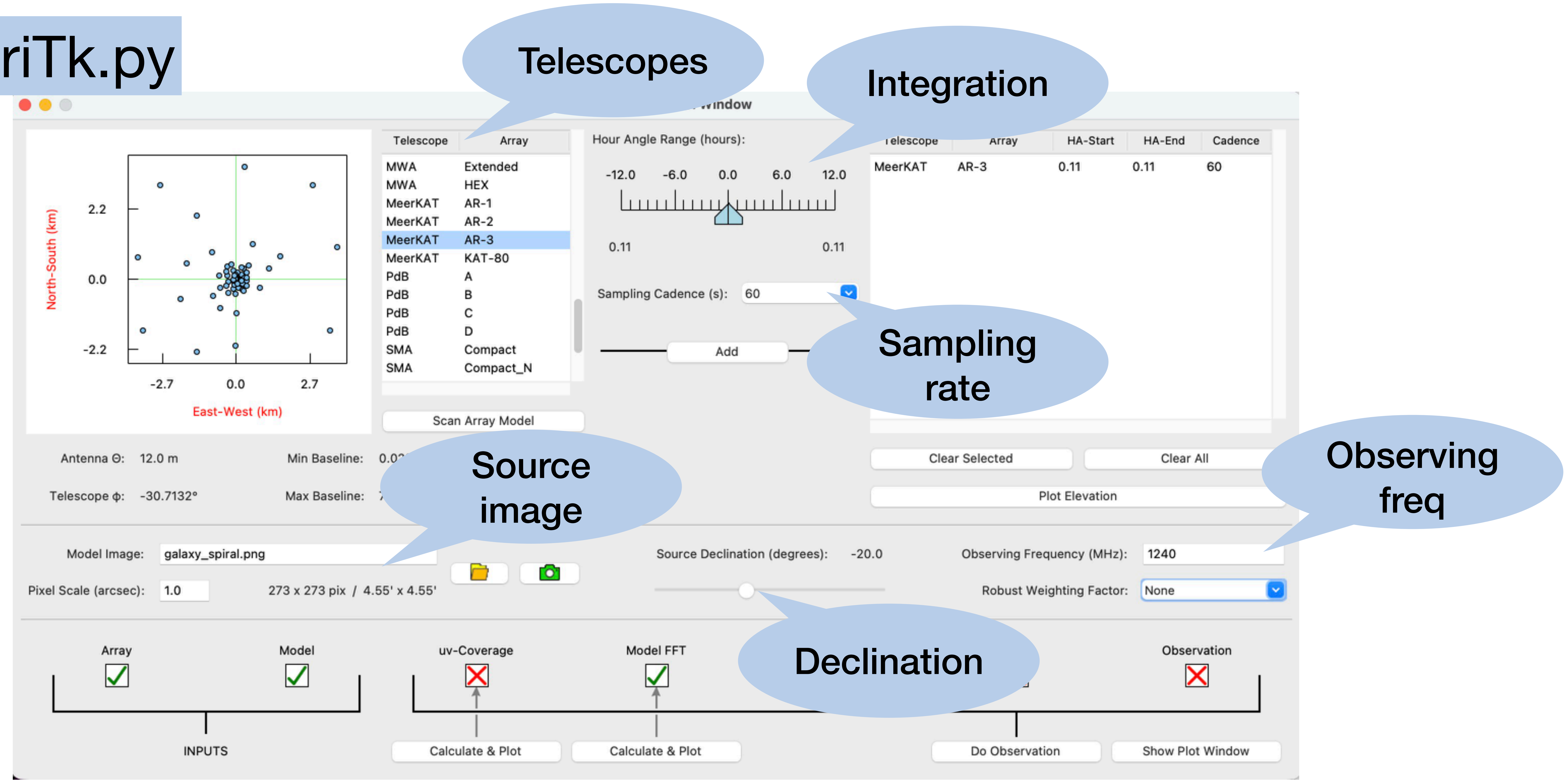
Preparing for the hands-on Tuesday afternoon

- Make sure you have conda
- git clone https://github.com/crpurcell/friendlyVRI.git
- go to the downloaded directory
- conda env create -f environment.yml
- conda activate vri
- pip install notebook
- git clone a python notebook https://github.com/cherryng/teaching/blob/main/PulsarSearchTutorial-ForStudents.ipynb
- Python notebook solution https://github.com/cherryng/teaching/blob/main/PulsarSearchTutorial-ForStudents-Solution.ipynb

Exercise 1: Playing with interferometer

Pick a source image, play with these settings and see which one gives you the best observations.

python vriTk.py



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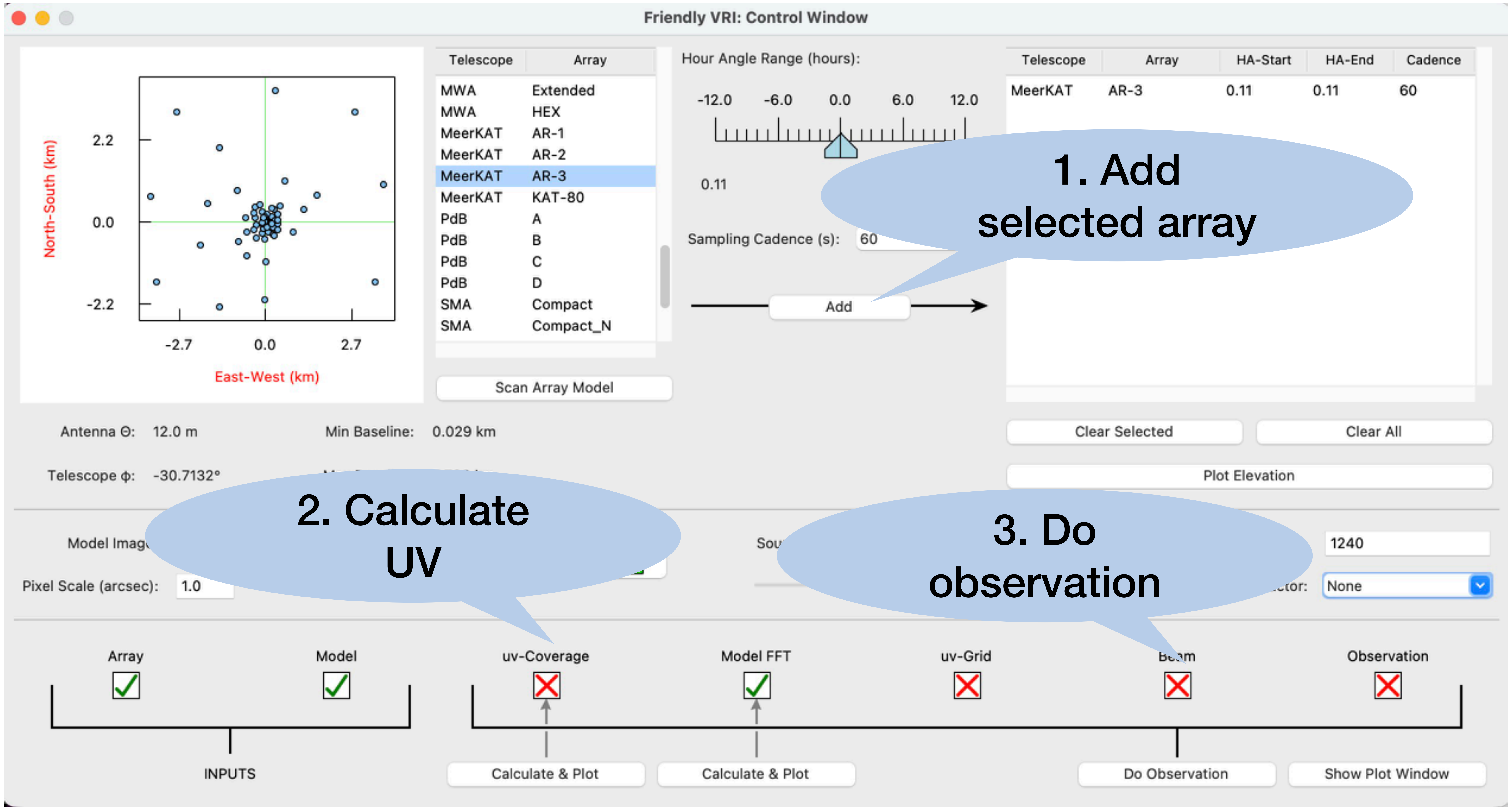
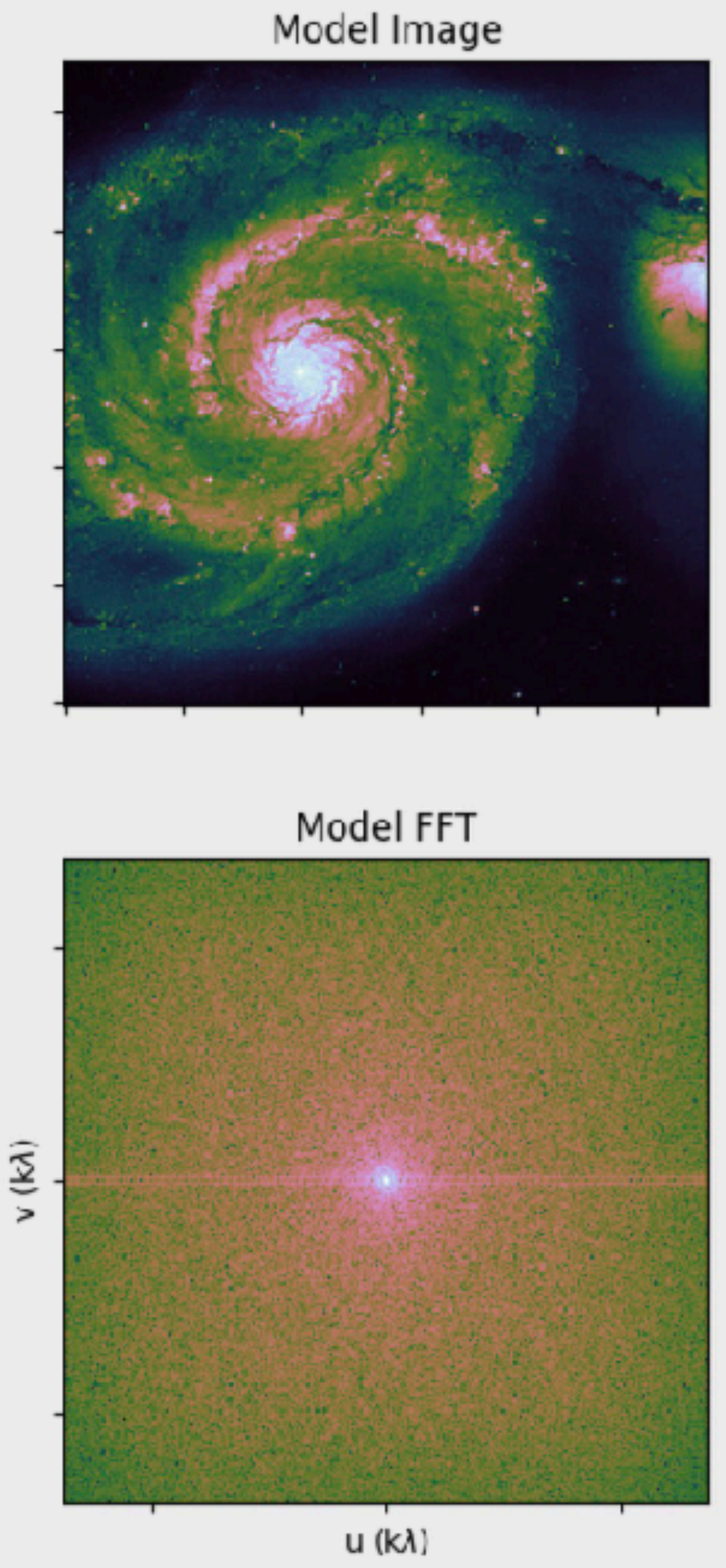


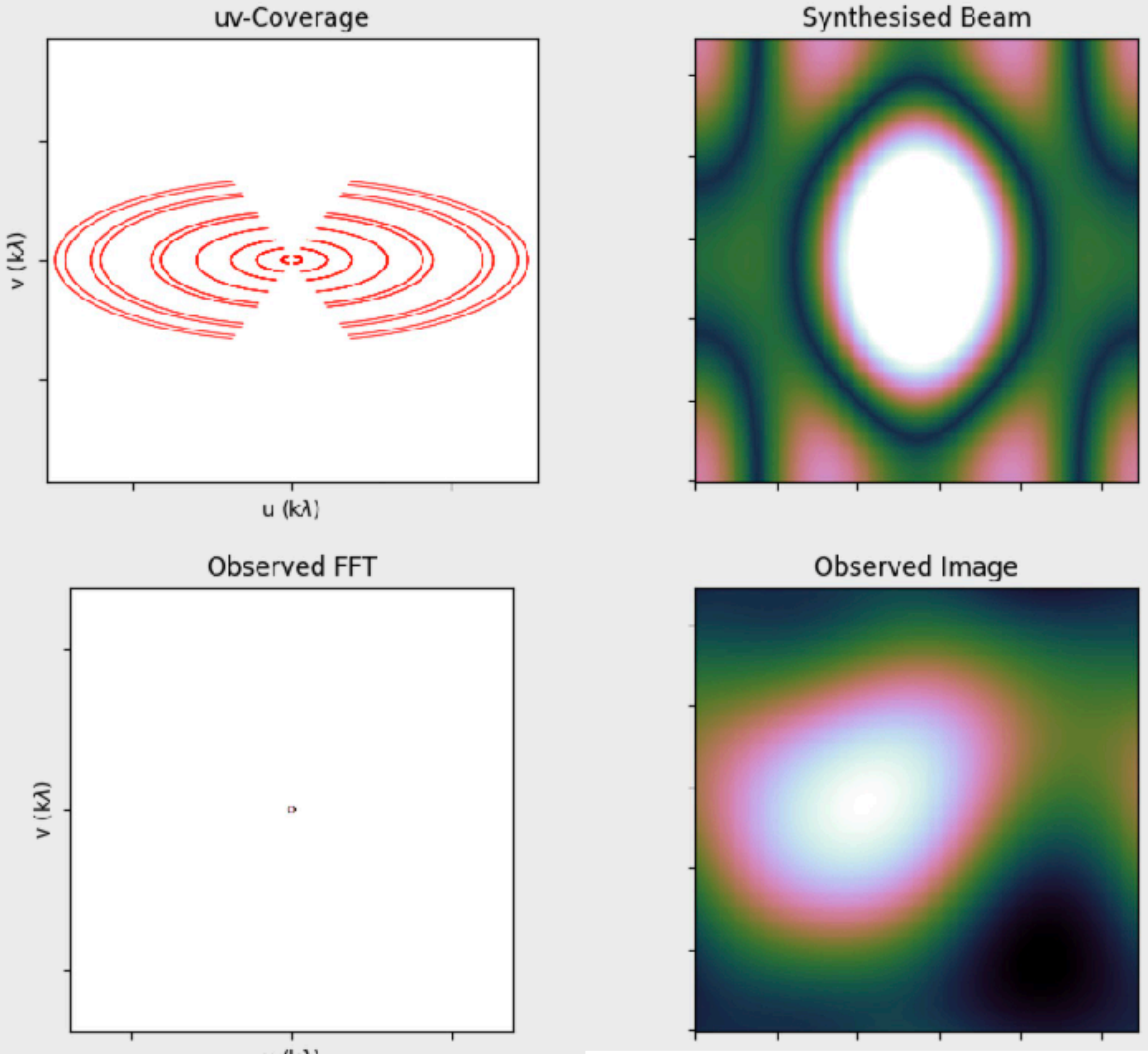
Exercise 2: Pulsar Searching and solving for binary

- The provided observational time series from LOFAR contains a pulsar:
  - jupyter notebook
  - Use FFT to detect the spin frequency of this pulsar
  - Check with literature to see if it matches
  - Plot the dynamic spectrum (time vs phase) by folding time series with the period
  - Solve the binary orbit
    - « By hand » take a few spin freq measurements at different epochs
    - Try to guess the orbit
    - Try to fit it with scipy.optimize.curve_fit

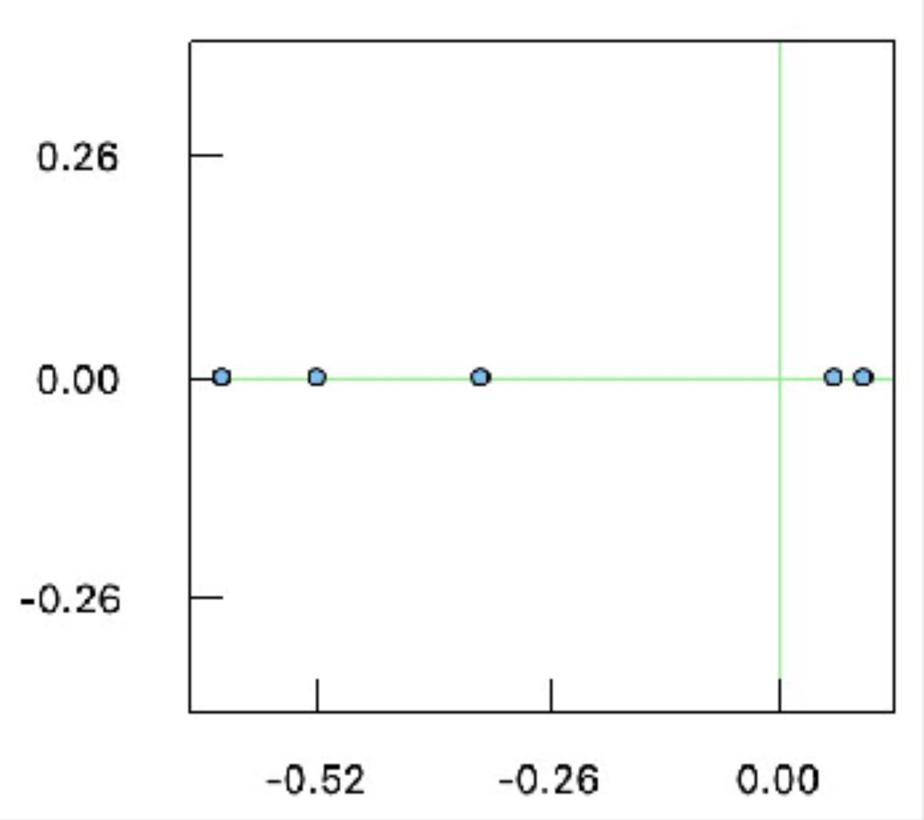
For circular orbit, timing (y(t)) is approx. a sinusoid with period equal to the orbital period (P_b) and amplitude (A) equal to the projected semi-major axis $y(t) = A\sin(2\pi\frac{t}{P_b} + \phi) + C$

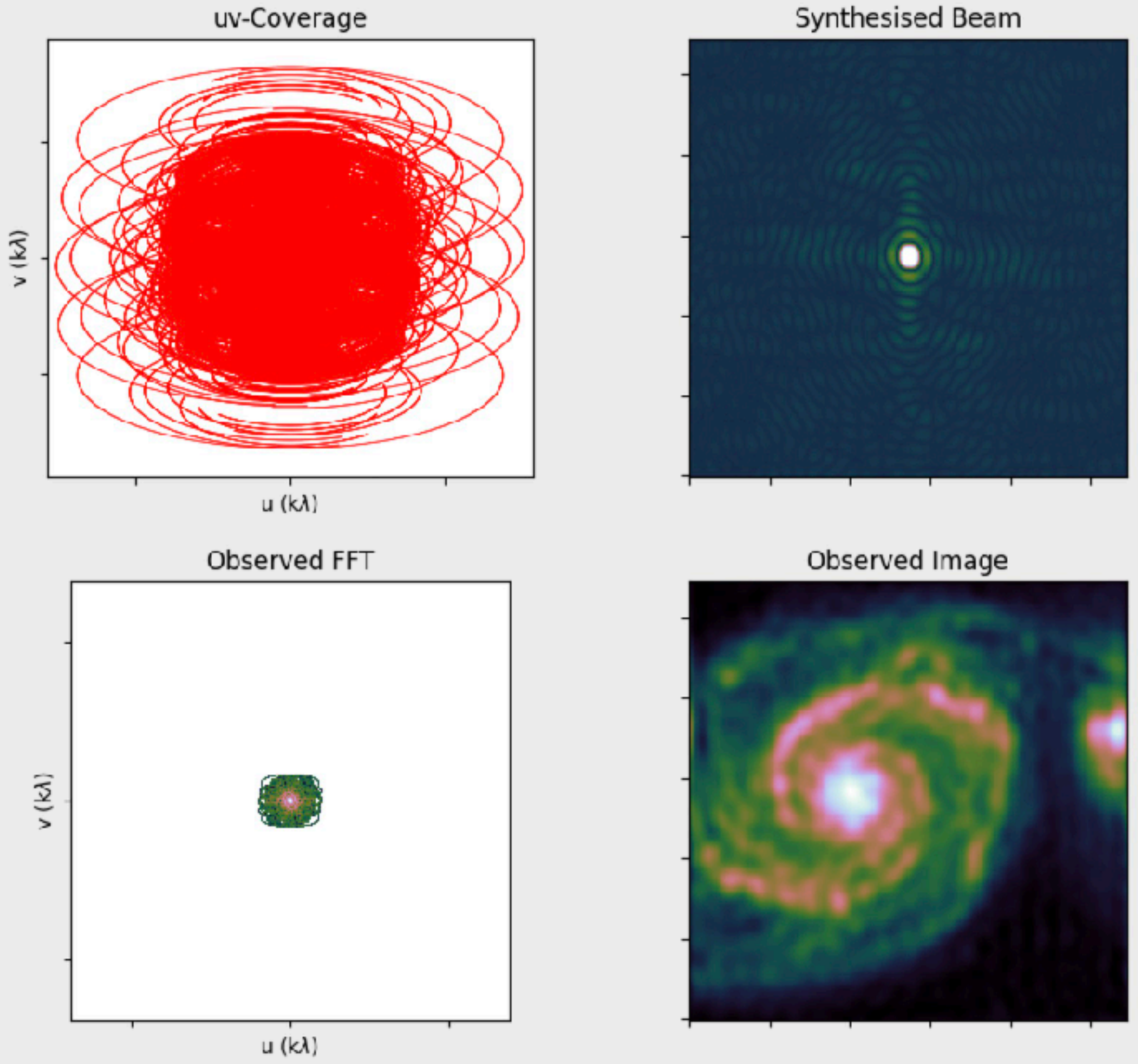
A = amp_guess
P_b = pb_guess
Phi = phase_guess
C = offset_guess



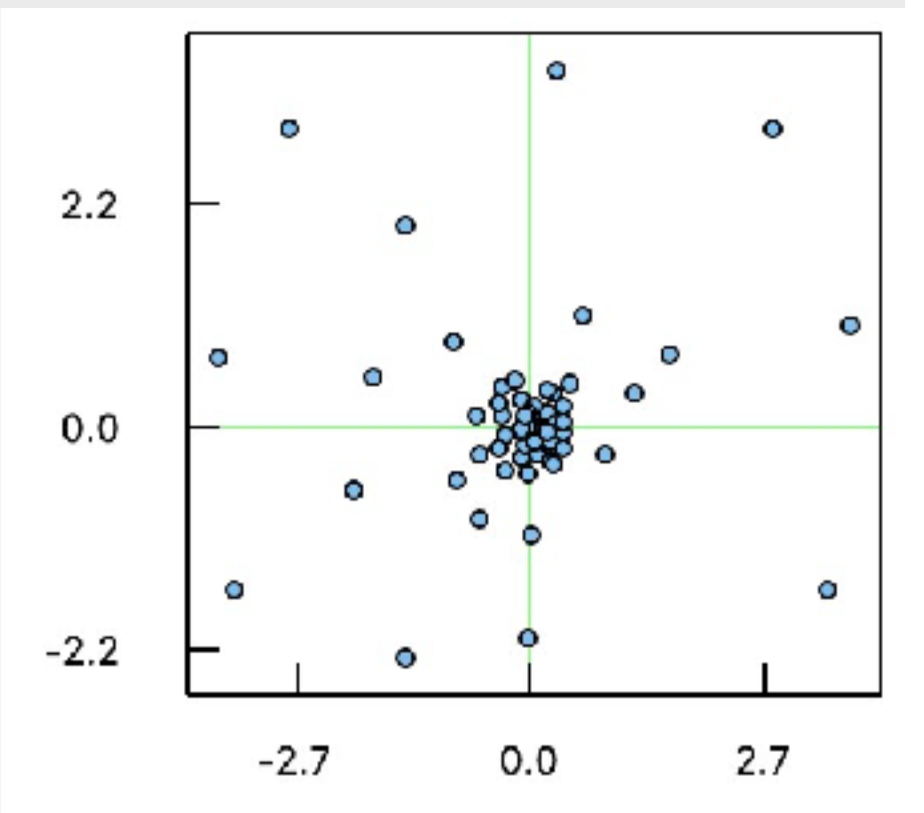


ATCA linear array
0.03 < baseline km
< 0.7



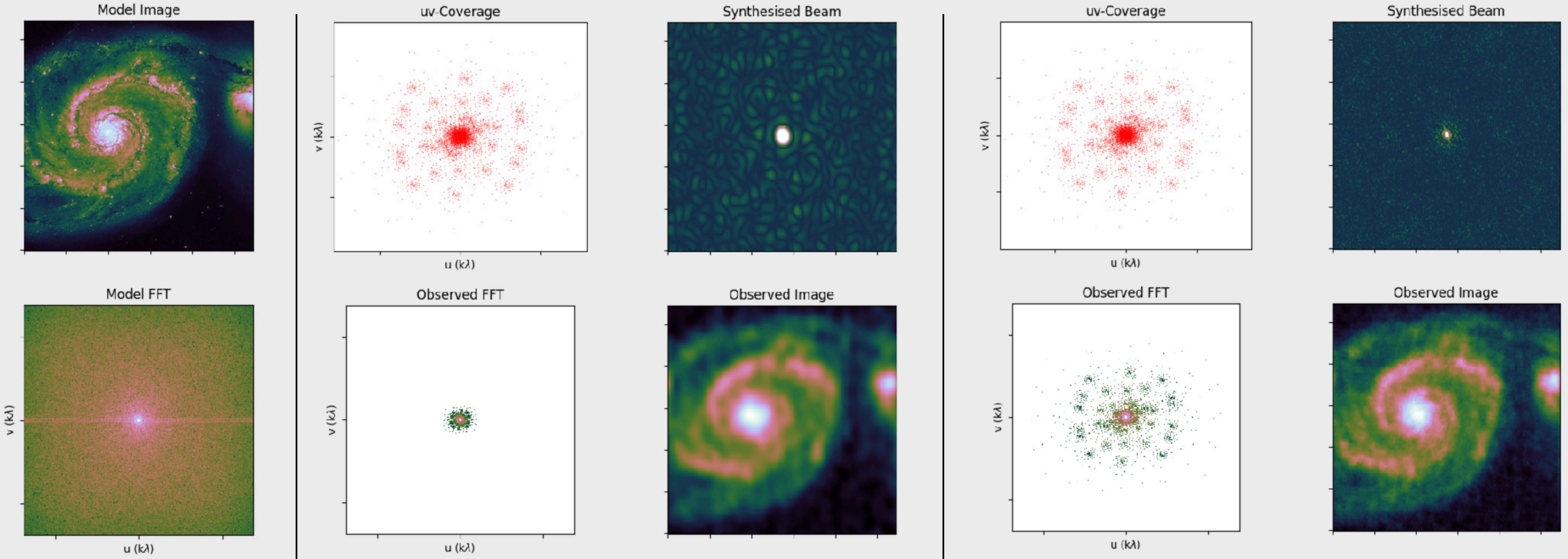


MeerKAT AR3
0.03 < baseline
km < 7.7



More baseline lengths —> better filled UV plane

MeerKAT AR3, || 0.03 km < baseline < 7.7 km || 13 min obs

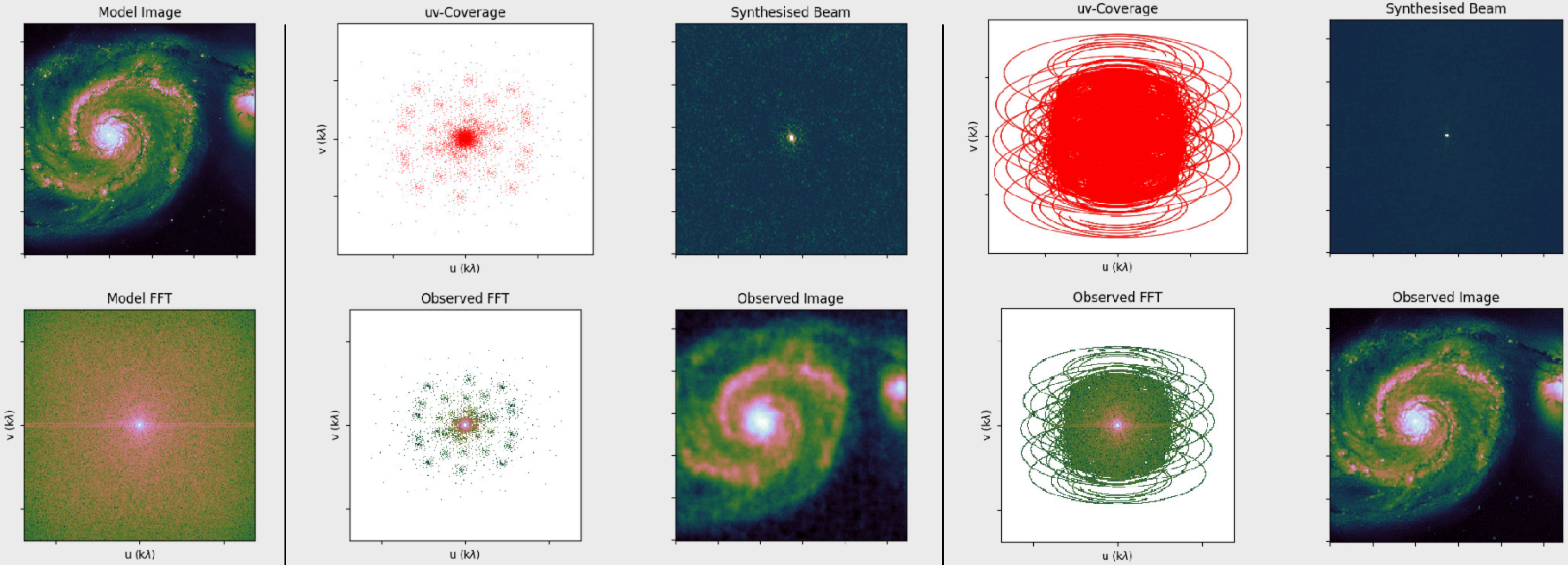


Observing freq @ 1.2 GHz

Observing freq @ 7GHz

Higher obs freq —> finer synthesized beam —> higher angular resolution

MeerKAT AR3, || 0.03 km < baseline < 7.7 km || Obs freq @7GHz



13 minute integration

10 hour integration

Longer obs —> Earth rotation fills UV plane —> less sideline —> high fidelity