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Testing emission models for Sagittarius A*

what closure phase measurements can tell us about source structure

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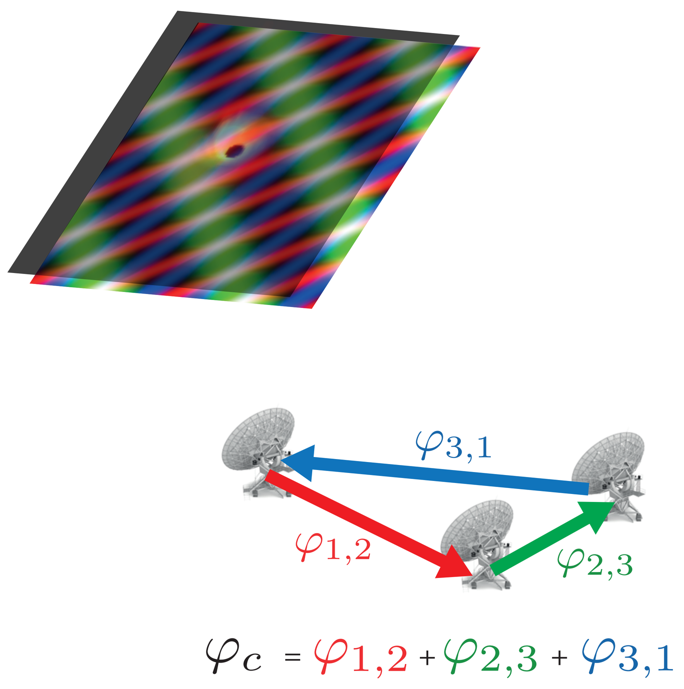
Direct imaging of the central supermassive black hole of our Galaxy at observing frequencies of 3.5mm and 1.3mm is notoriously difficult, due to issues of limited UV coverage and calibration. Closure phase measurements provide a robust tool for constraining the geometry of the accretion flow in this context. We have performed simulated observations of Sagittarius A* (Sgr A*) at both these frequencies for two different emission models. We present results that show the expected performance of a 3.5mm measurement and a 1.3mm measurement.

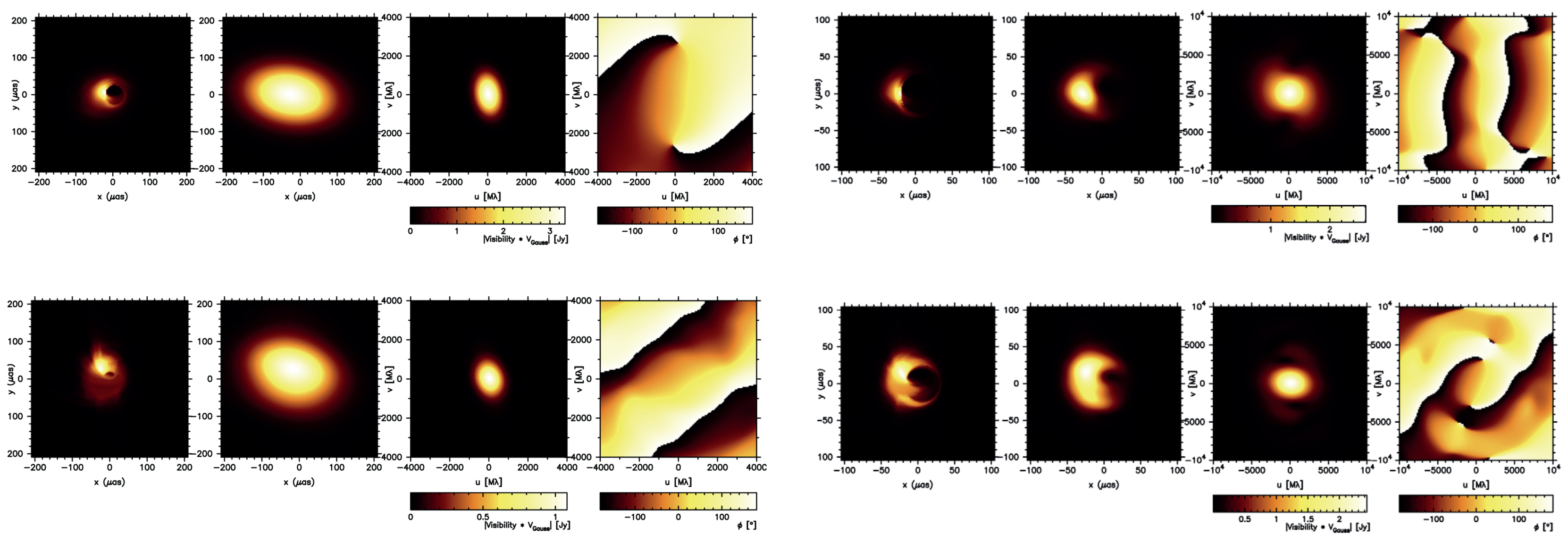
Closure phase



- Is calculated by adding visibility phases around a triangle of baselines
- Is unaffected by station-based phase errors
- Is indicative of asymmetric source brightness distribution
- Is nontrivial to interpret directly
- Is relatively unaffected by interstellar scattering (source image blurring)
- Allows for model fitting
- Can aid in phase calibration for imaging

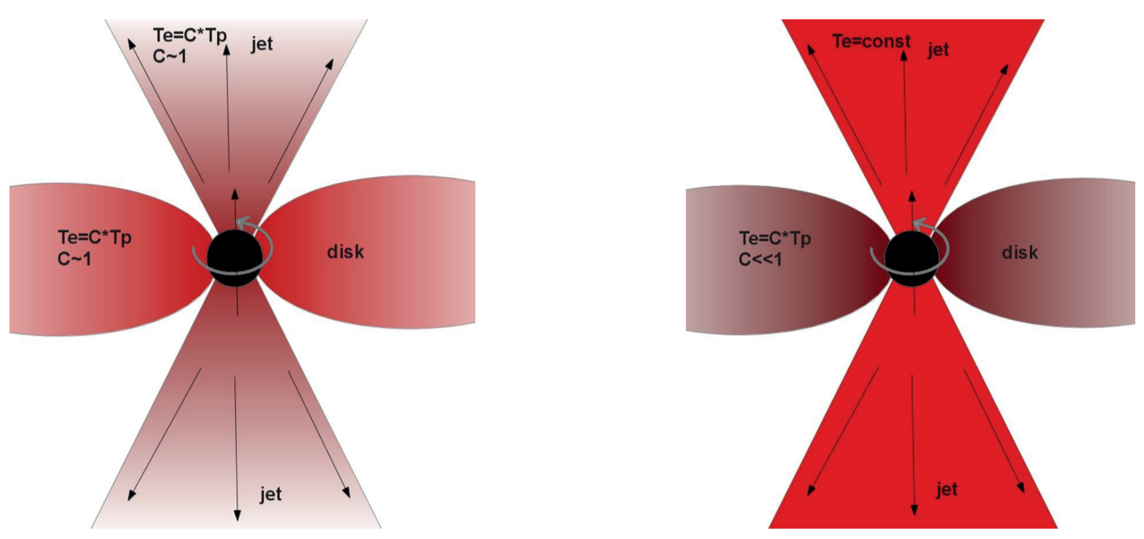
Our picture of Sagittarius A*

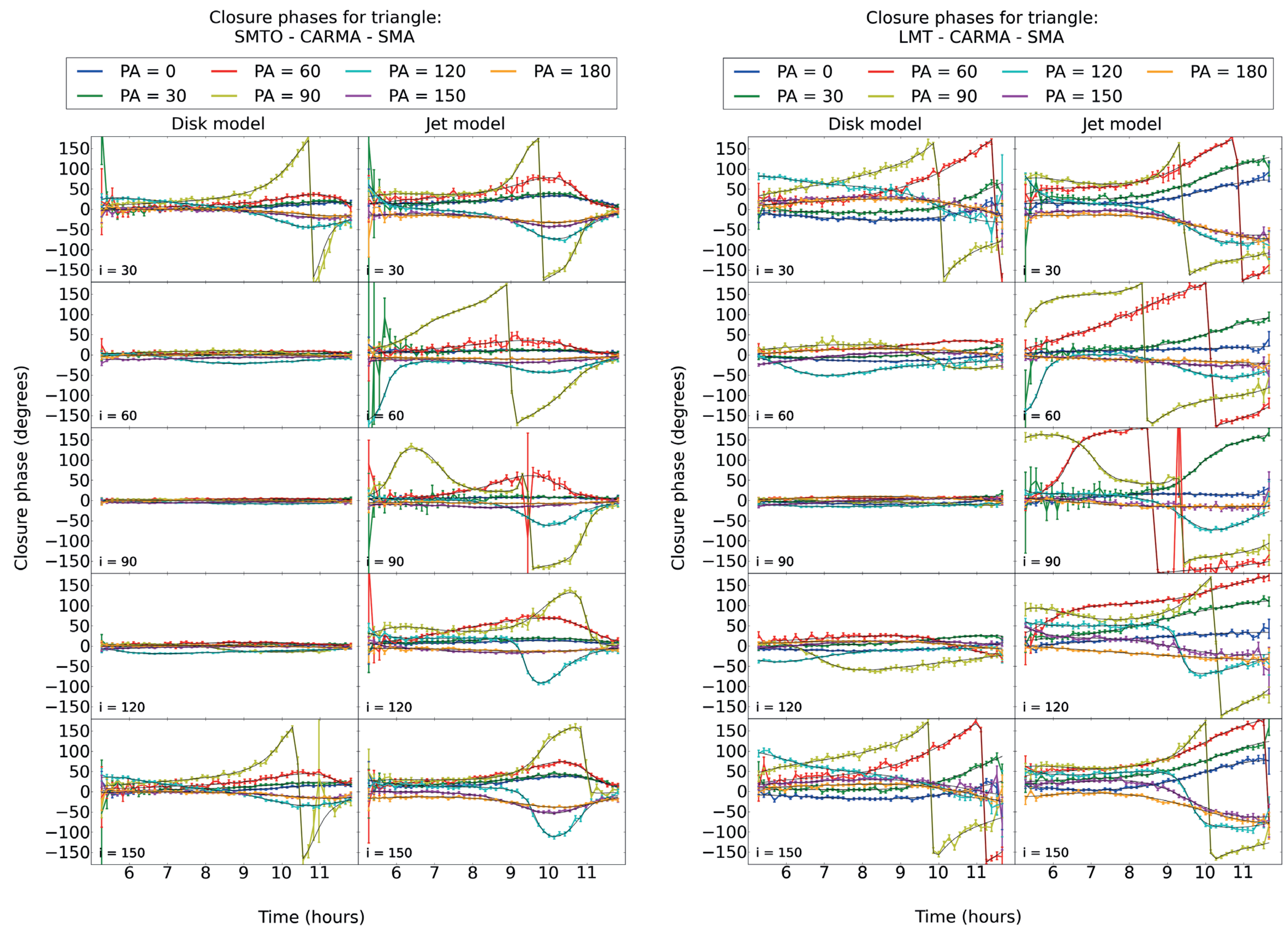
- Current models indicate low Eddington ratio (~10^{-8}) accretion, low density plasma
- Spectrum looks like synchrotron emission from electrons: optically thick flow in radio, switching to optically thin in submm regime
- Radio spectrum is compatible with compact jet but source is hitherto unresolved: open question
- Source is significantly blurred by interstellar scattering at frequencies over ~230 GHz
- Orientation of accretion torus on the sky is not well-constrained



Emission models

- Consist of electron temperature prescriptions applied to GRMHD simulation results, raytraced in Kerr metric
- 2 zones defined in simulation region: accretion torus (bound) and jet (unbound)
- 2 Models were used: one with $T_e = C * T_p$ everywhere ('cool jet'), the other with $T_e = C * T_p$ in the torus and T_e = const in the jet ('hot jet')
- Hot jet model is physically motivated: electron acceleration likely to take place in jet boundary region, keeps electron temperature up



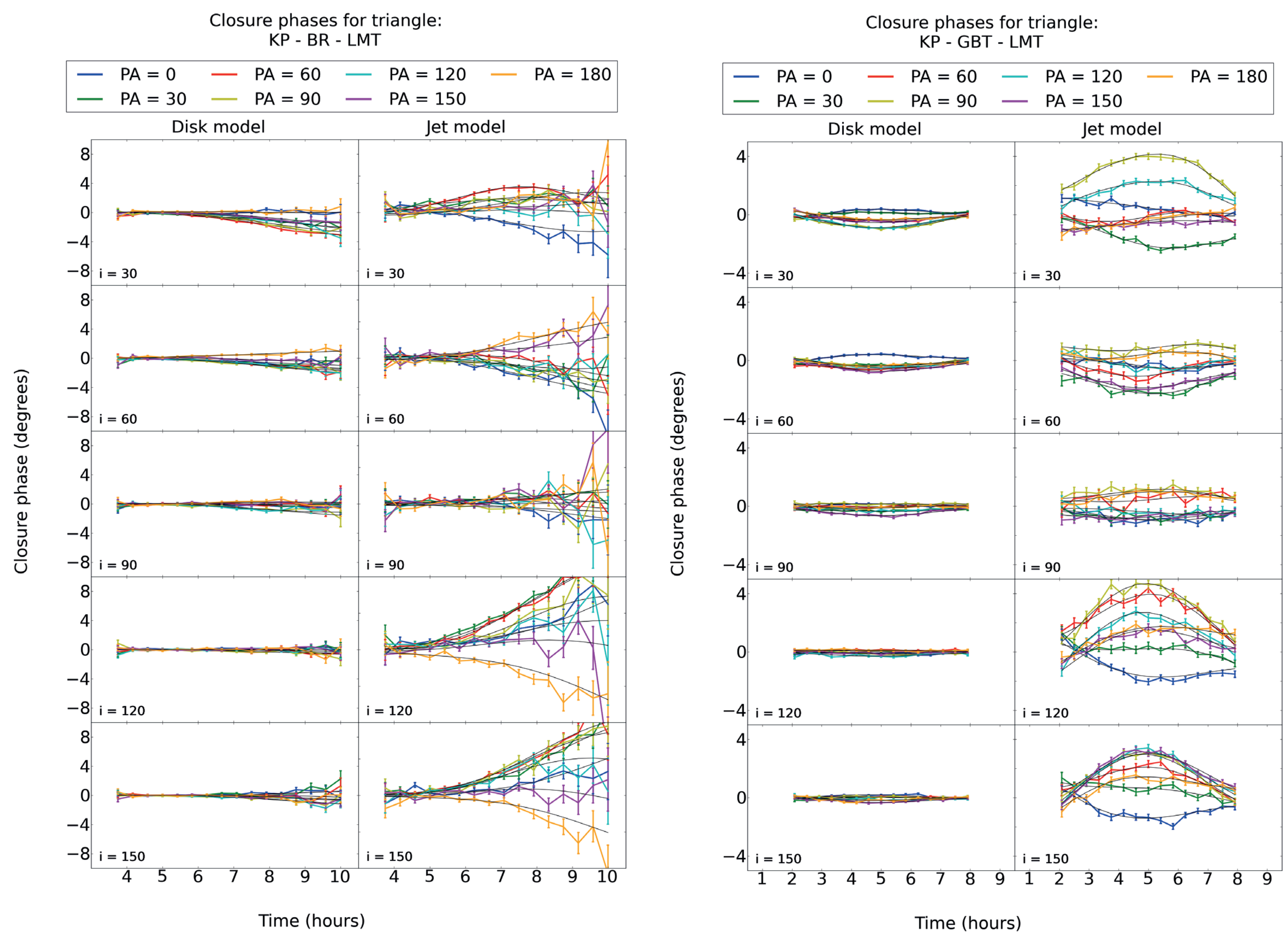


1.3mm: Nonzero closure phases for most modeled cases

At 1.3mm we predict much larger closure phase variations than in the 3.5mm case. Most position angles for the jet model yield closure phases on the SMTO-CARMA-SMA triangle that are in conflict with existing EHT measurements. Including the LMT in future EHT observations will allow us to make further constraints on the geometry of Sgr A* at 1.3mm.

3.5mm: small but detectable closure phases for hot jet

At 3.5mm the predicted closure phases are only a few degrees at most for either model, for any orientation on the sky. Using the VLBA by itself, noise levels would be so high as to preclude any measurement indicating the nonzero values of any closure phase measurements. Including the LMT and GBT enhance the sensitivity of the array such that these nonzero closure phases can be distinguished from a null result.



Acknowledgements

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