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Seeing the full picture: measuring AGN feedback with next-generation radio jet models

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Active Galactic Nuclei (AGN) jets are the brightest objects in the radio sky. Their feedback is an essential ingredient in all galaxy formation models. Tens of millions of AGN jets have been discovered over the past decade with more promised by the SKA. Measuring the energy output of these jets is a notoriously challenging, requiring either analytical or numerical jet models. In this work, for the first time, we fully utilise the information contained in images of radio AGN at multiple frequencies –instead of just a single frequency measurement of size and luminosity.

I will present the first fast (millisecond run time) analytical model which generates synthetic radio images with comparable accuracy to full hydrodynamical simulations. We perform a novel MCMC parameter inversion which compares observed radio images at multiple frequencies to a large suite of analytic model predictions. This new method allows us to simultaneously recover both AGN energetics and environments into which the jets are expanding –another historically challenging task –using only radio observations. Application of this technique to large survey data sets will measure intrinsic properties of AGN jet populations, and their feedback, across cosmic time.

We are making this python code publicly available for use by the astronomy community for application to large radio surveys.

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