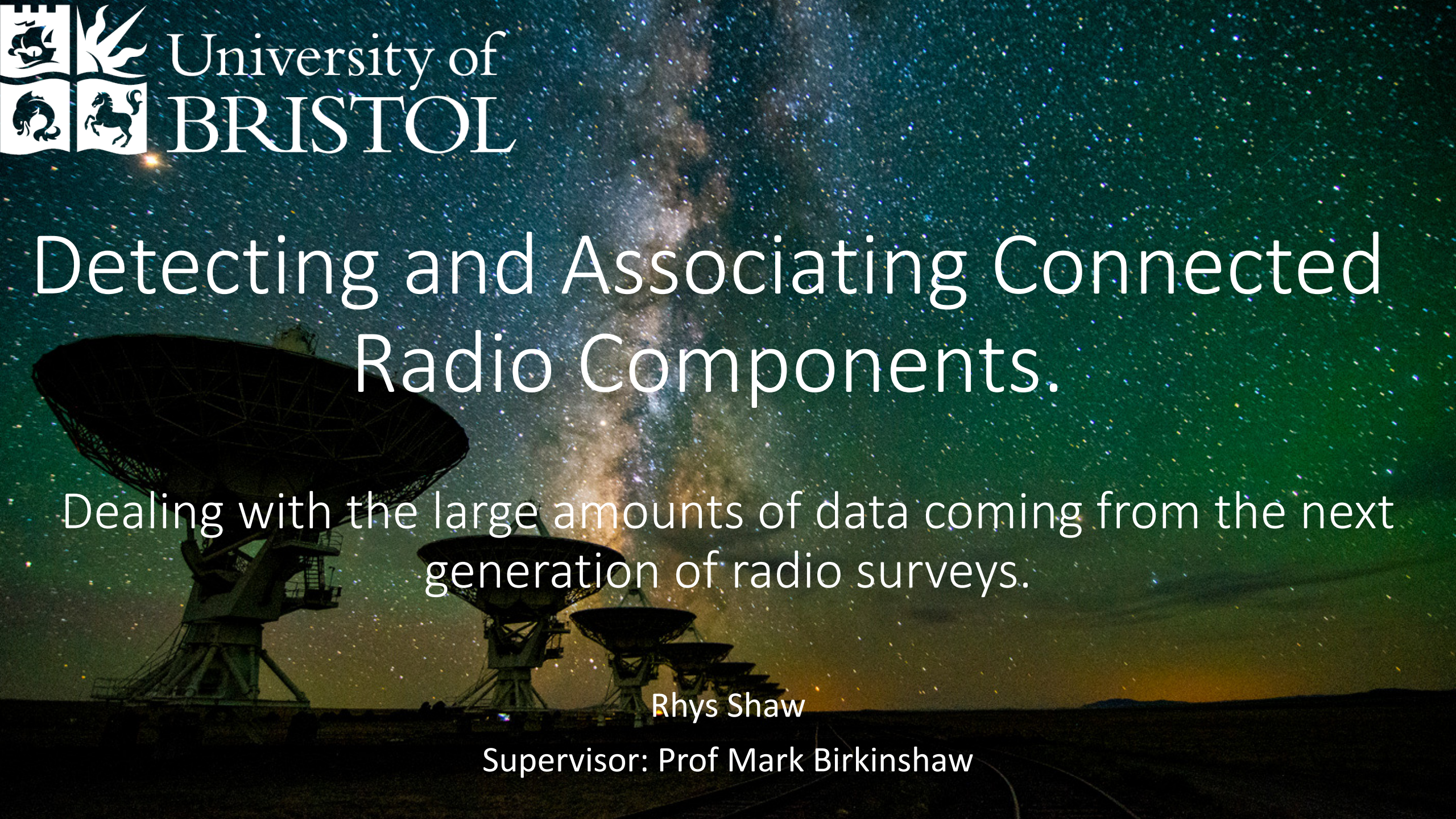


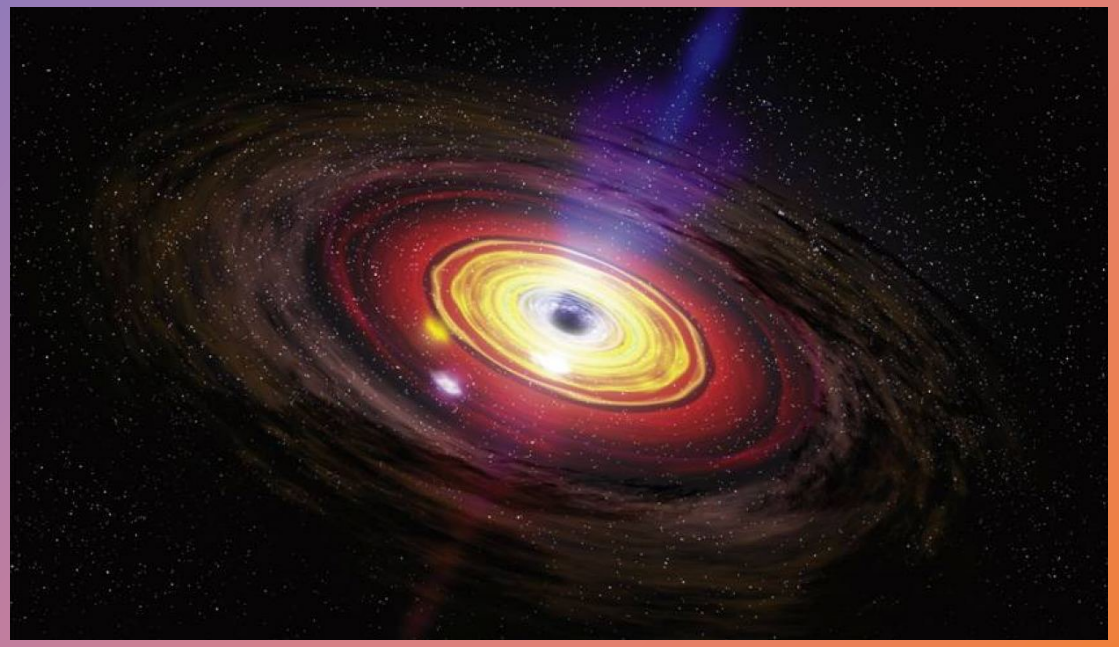
University of BRISTOL

Detecting and Associating Connected Radio Components.

Dealing with the large amounts of data coming from the next generation of radio surveys.

Rhys Shaw

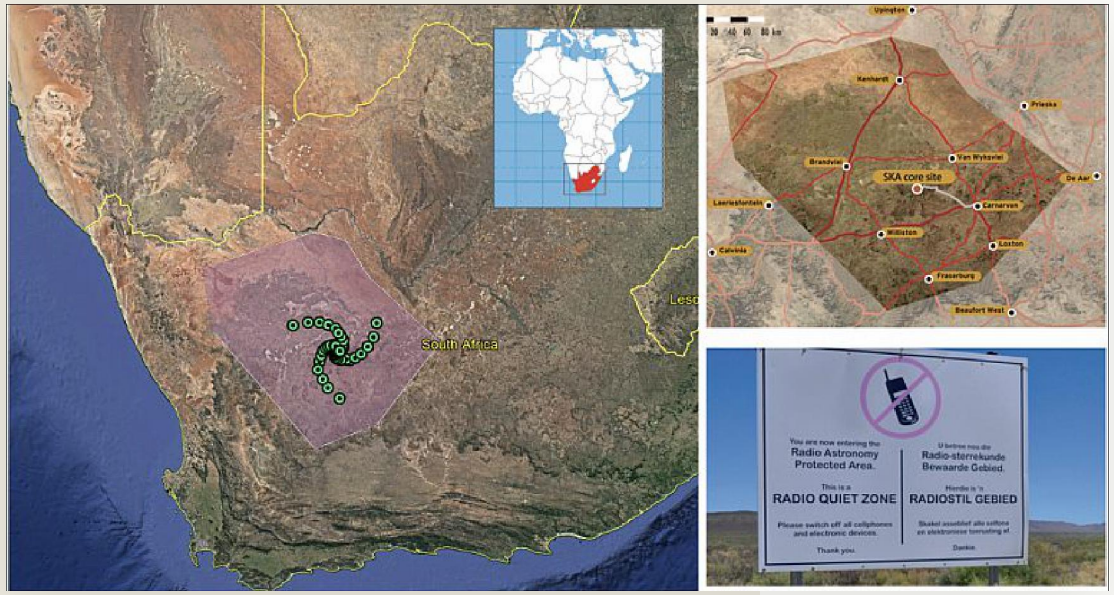
Supervisor: Prof Mark Birkinshaw



Sources of Radio Emission

- Radio emission coming from star forming galaxies, Active Galactic Nuclei (AGN)'s and even galaxy clusters.
- AGNs can be seen as having multiple components, extended sources, single point like sources both of which can be very bright.
- SFGs. Star forming galaxies bright and extended in shape.
- HI Neutral hydrogen [21cm line] (but not usually observed in radio surveys).
- Galaxy Clusters (boosted emission from the CMBR).
- Bluetooth, Wifi, Phone communication. (All on radio frequencies).
- A cell phone signal is a billion billion (10^{18}) times more powerful than the cosmic waves our telescopes detect.

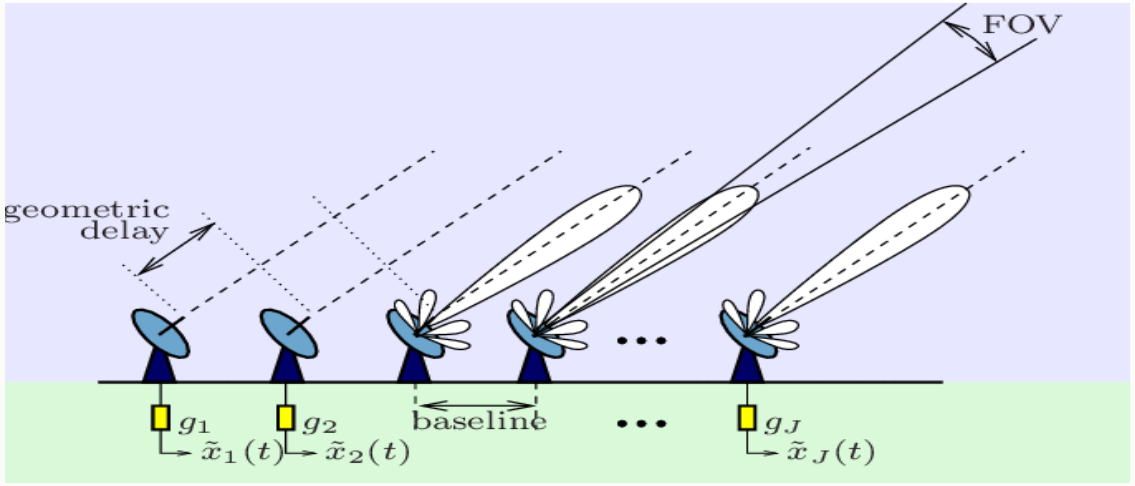
How do we observe the Radio Universe?



Planned SKA Mid South Africa. (image credit: SKAO)

VLA Observatory New Mexico, USA (image credit: NRAO)

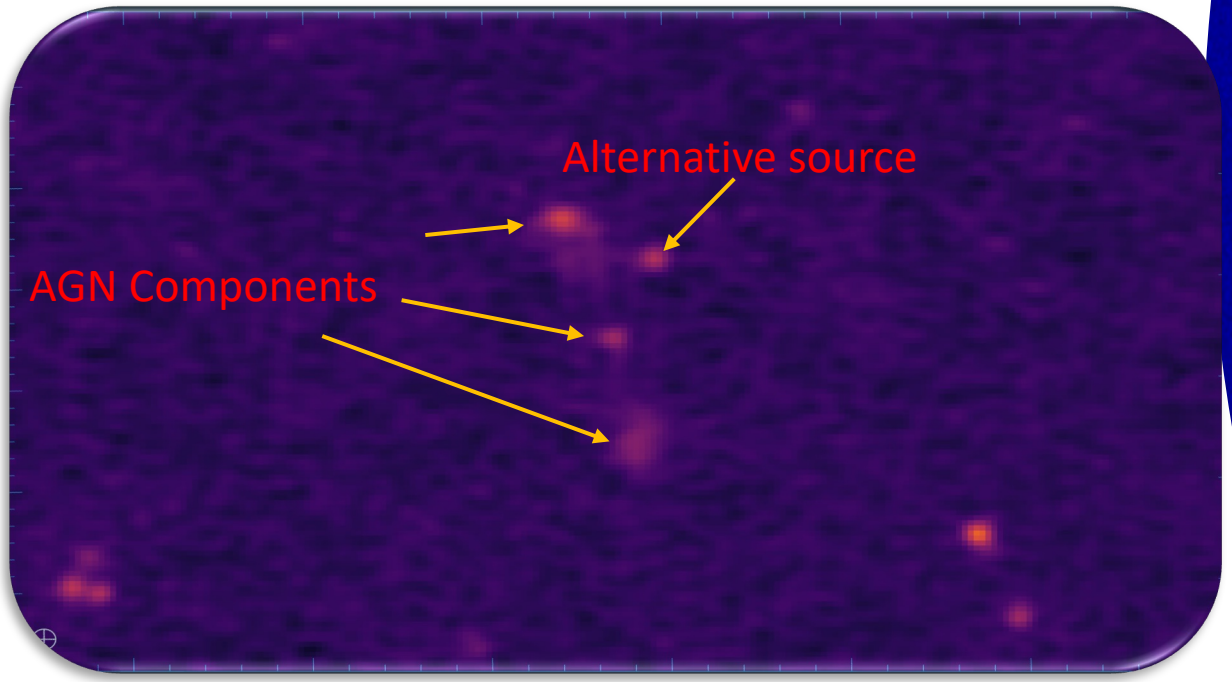
- Large groups of radio antennas with reflective dishes are used to get the highest levels of resolution when observing the radio sky.
- These separate telescopes will have there signals combined and used to construct a detailed radio map.
- This process introduces significant aritfacting, but make it possible to increase the telescopes longer baseline without a single dish at the same size as the largest baseline in the observatory.

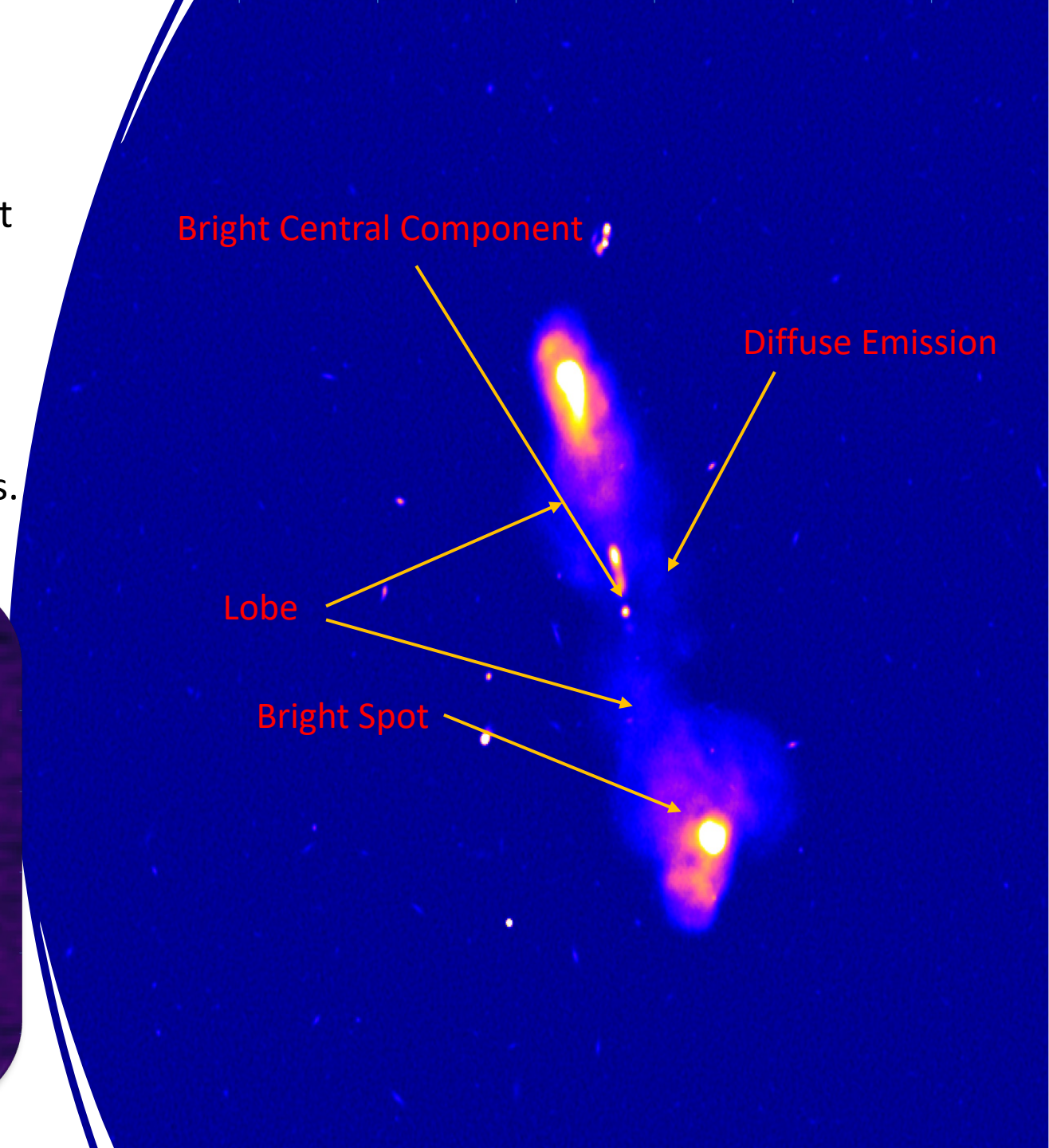


Radio Interferometry Schematic. (image credit: Veen, Alle-Jan & Wijnholds, Stefan. (2013))

What's the problem?

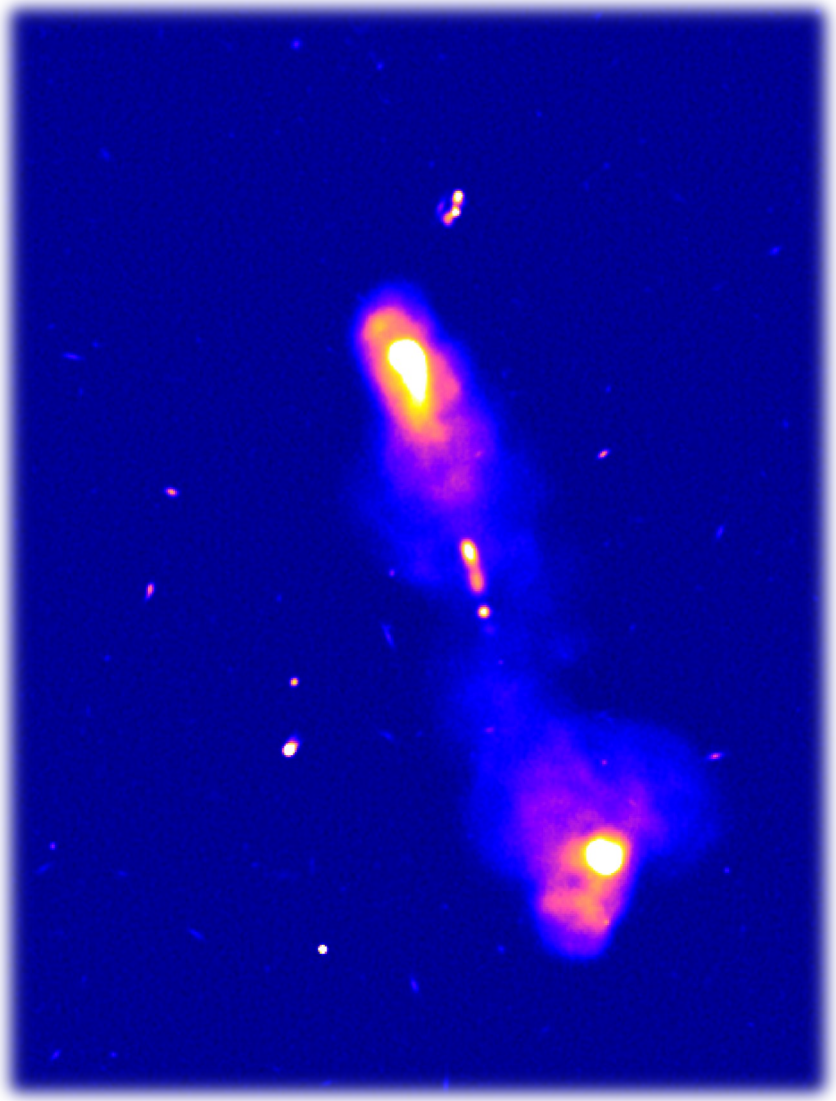
- AGN contain multiple components that have very different morphologies. Diffuse emission, lobes, bright spots.
- Current source detectors cannot group these components especially when they are faint. Currently Citizen science is used to deal with large datasets.
- This problem is made even worse with nearby sources.





My Data!

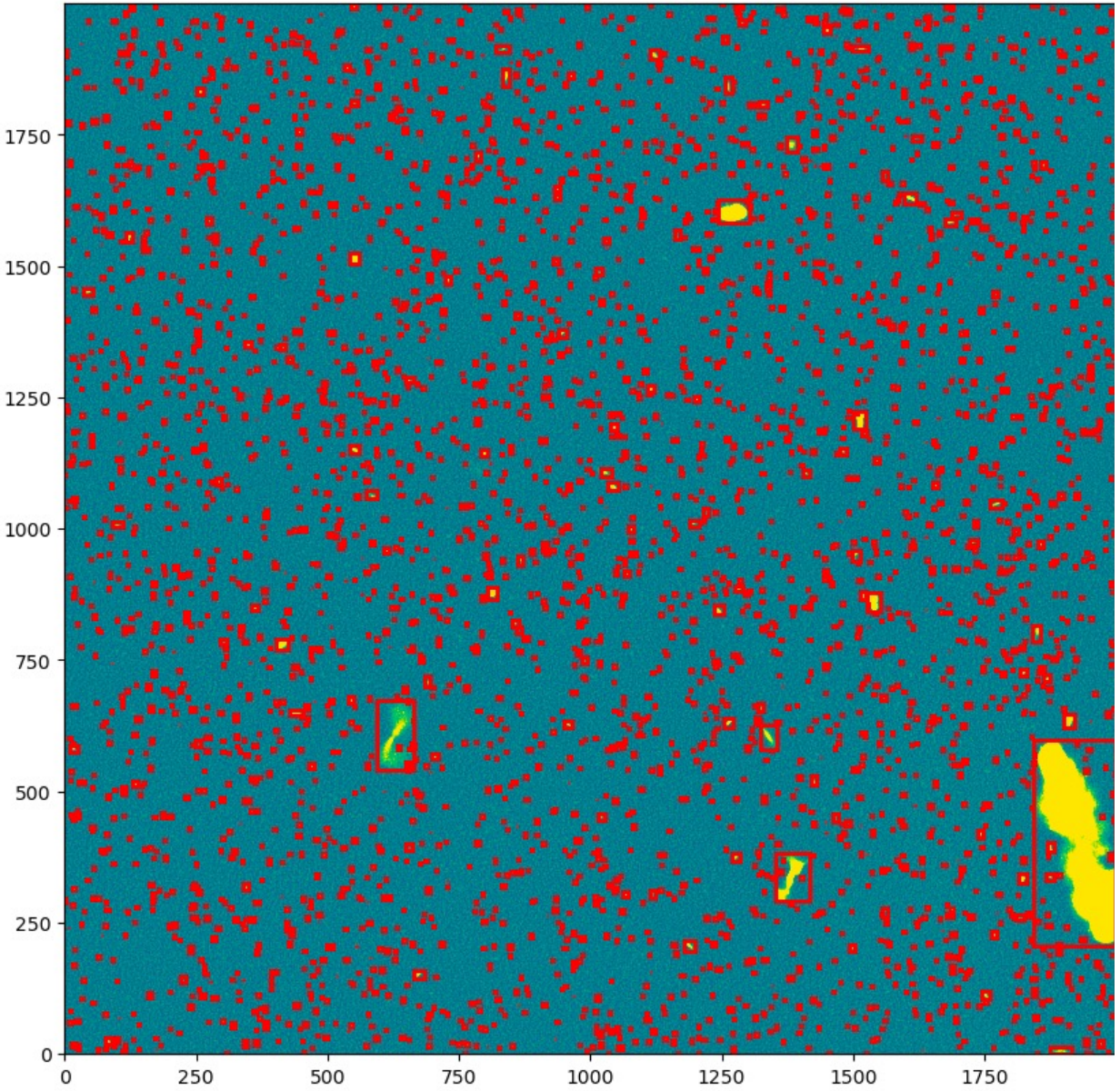
- Radio Maps for multiple frequencies (LoTSS [LoFAR], FIRST [VLA], SKA (simulated DC1 images).
- Radio Galaxy Zoo source catalogues, with correctly* Associated AGN components.
- Datasets of source cutouts from DR1 of the LoTSS survey.
- How can I present these. Radio Maps are quite easy to visualize – only challenge is providing an appropriate color mapping and annotations.
- Could display something about the source population in these catalogues.

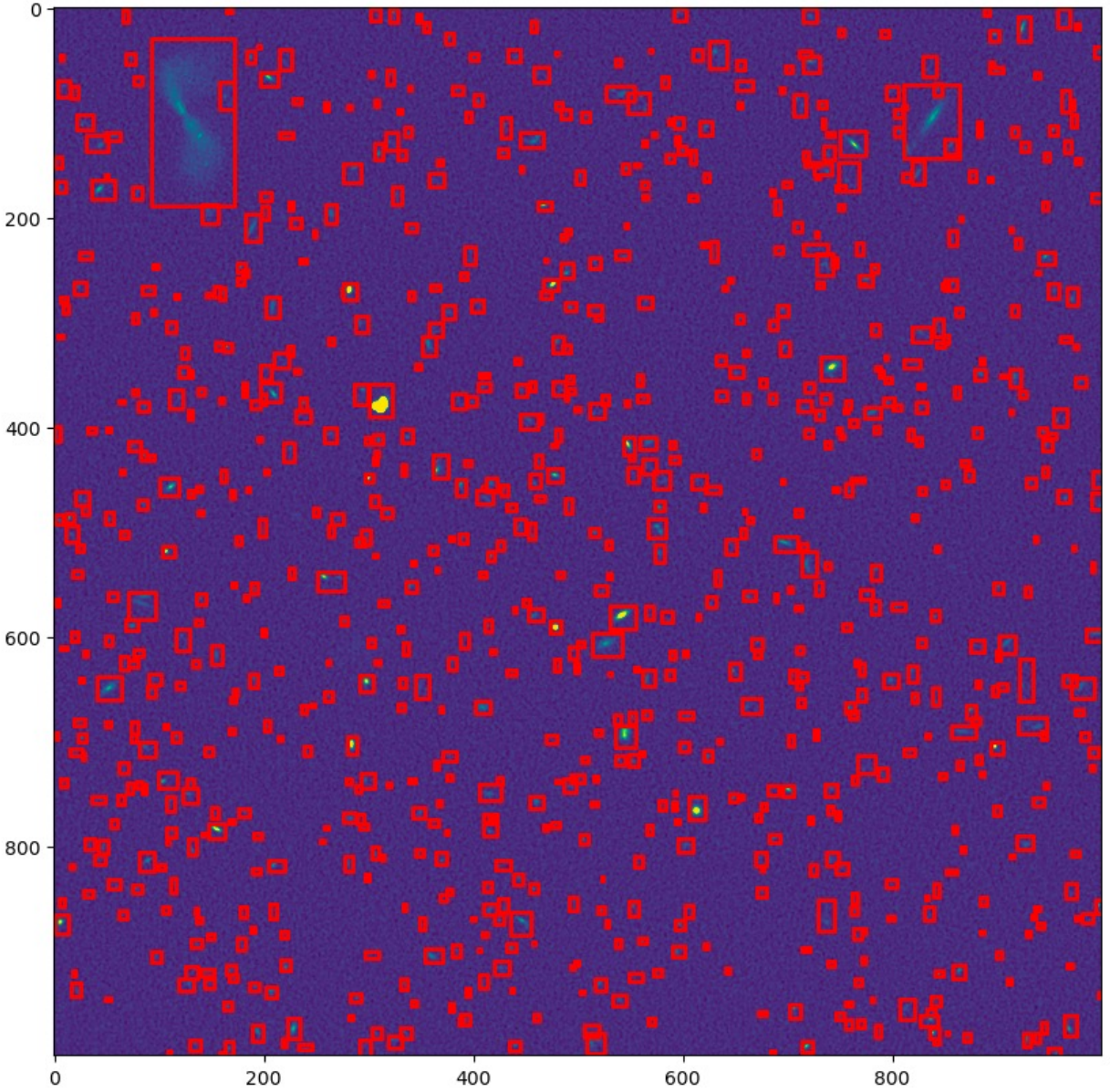


Simulated bright AGN from SKA DC1 radio maps

* Citizen science associations are thought to only have ~80% accuracy.

My source detection algorithm at present





Source Detection and Component Association in Radio Survey Maps

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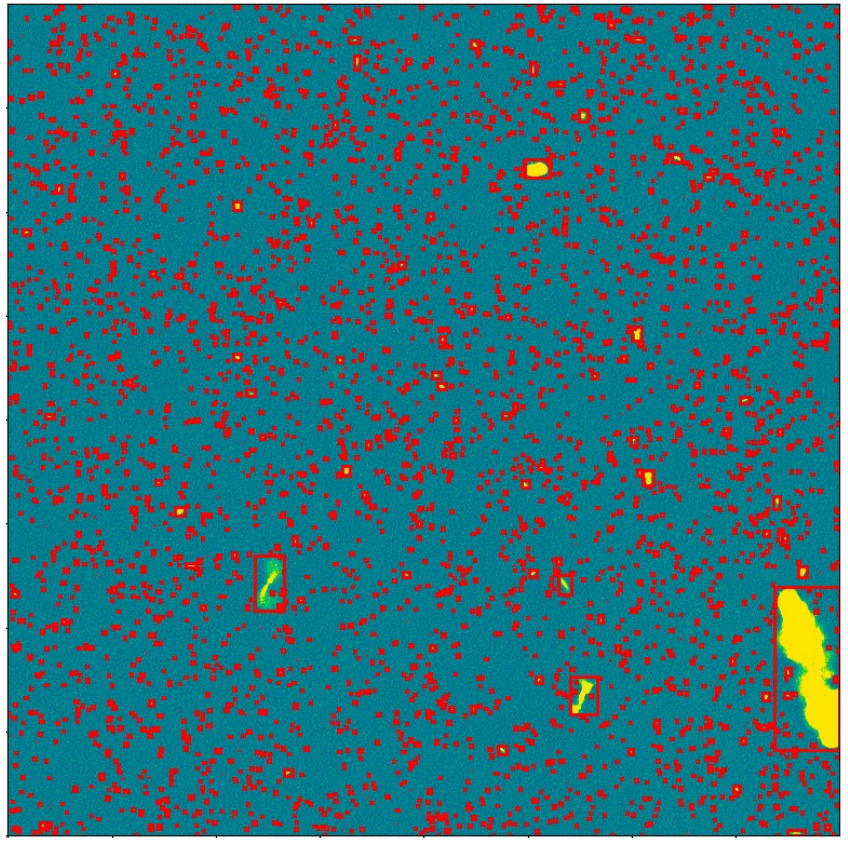
Abstract

Introduction

Methods

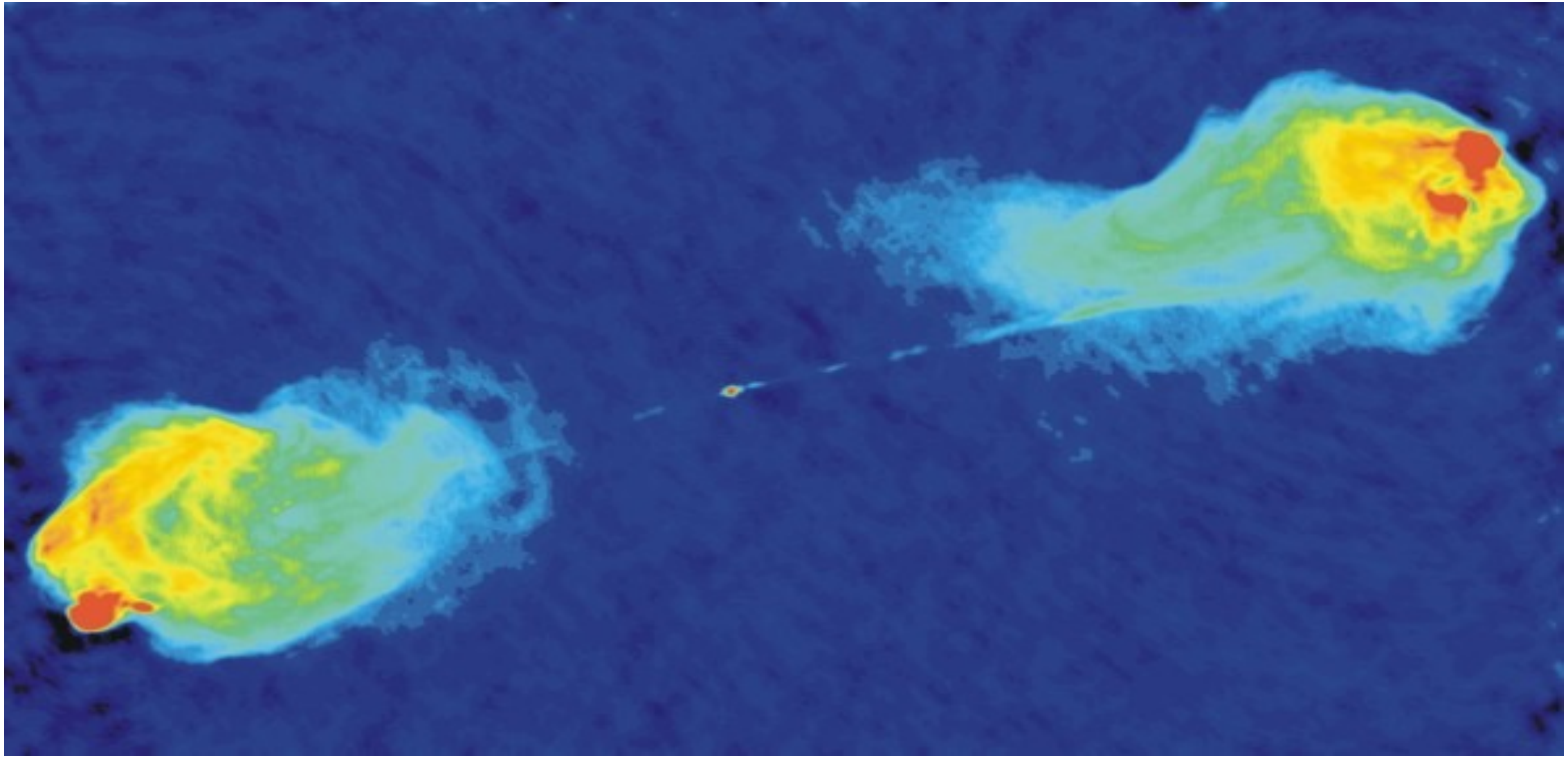
Persistence diagram



Future Work

References

Thanks for listening!!



Radio galaxy Cygnus A. **Credit**: Image courtesy of NRAO/AUI; R. Perley, C. Carilli & J. Dreher