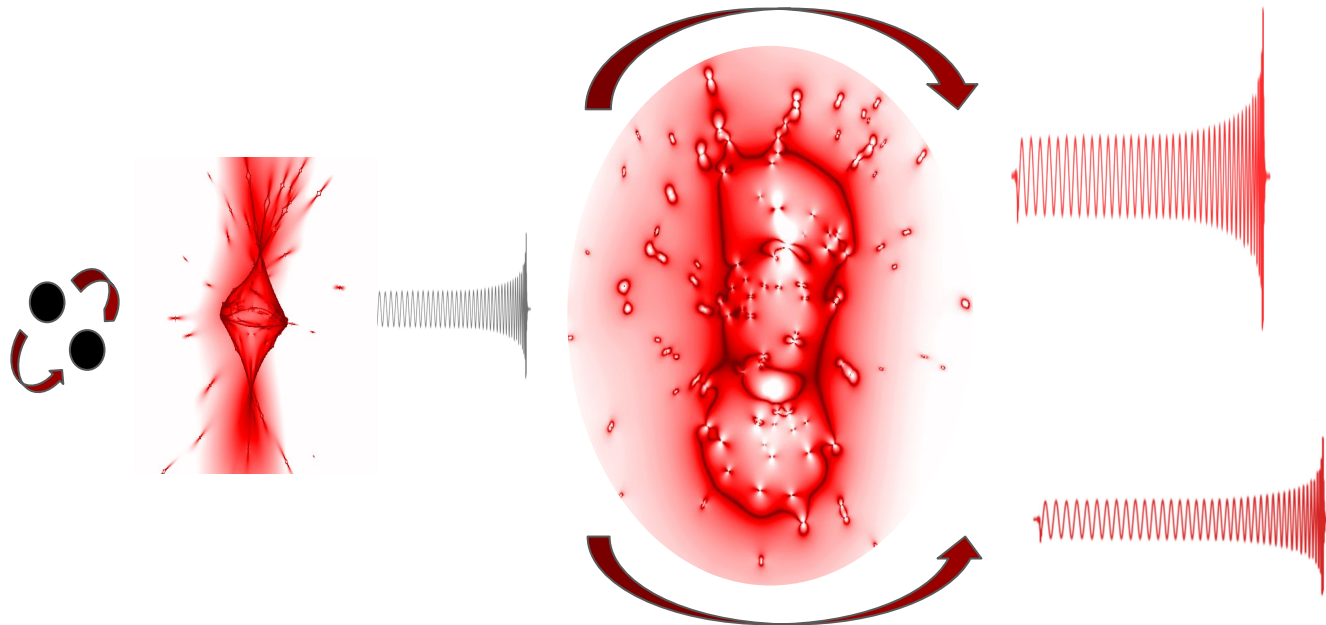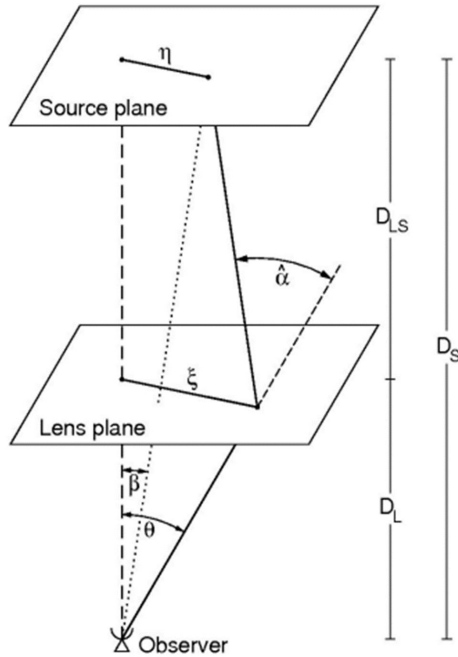# Gravitational Wave Lensing

Luka Vujeva, Jose Maria Ezquiaga, Rico Ka Lok Lo, Juno Chan
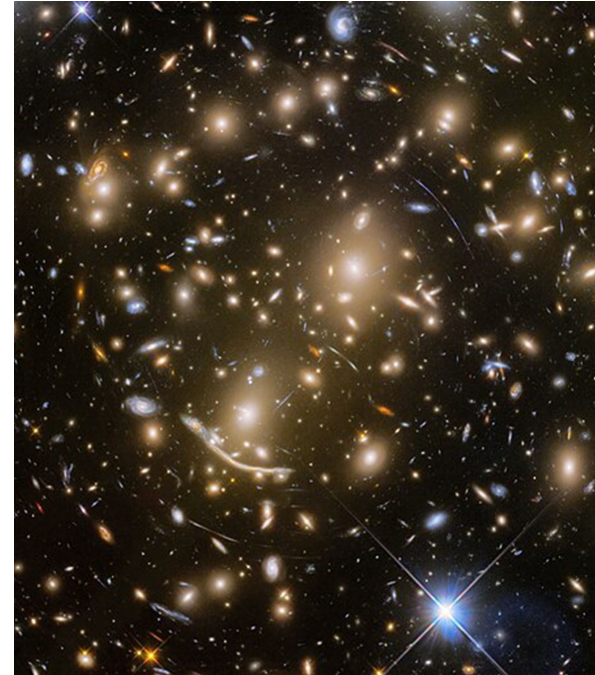
luka.vujeva@nbi.ku.dk

Crash Course in Lensing (1)

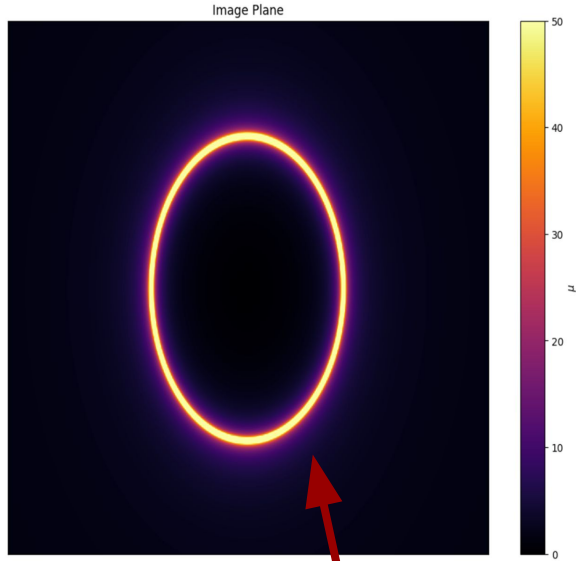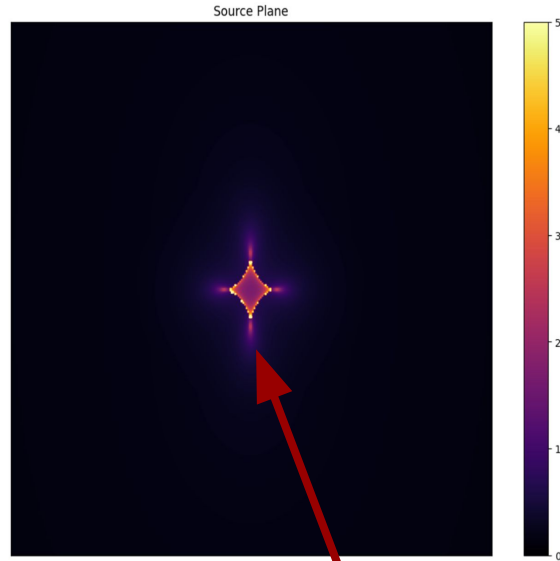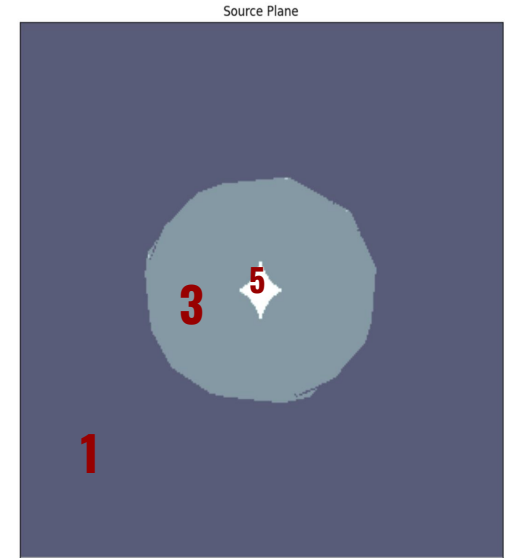**Typical Lensing Setup**

Abell 370
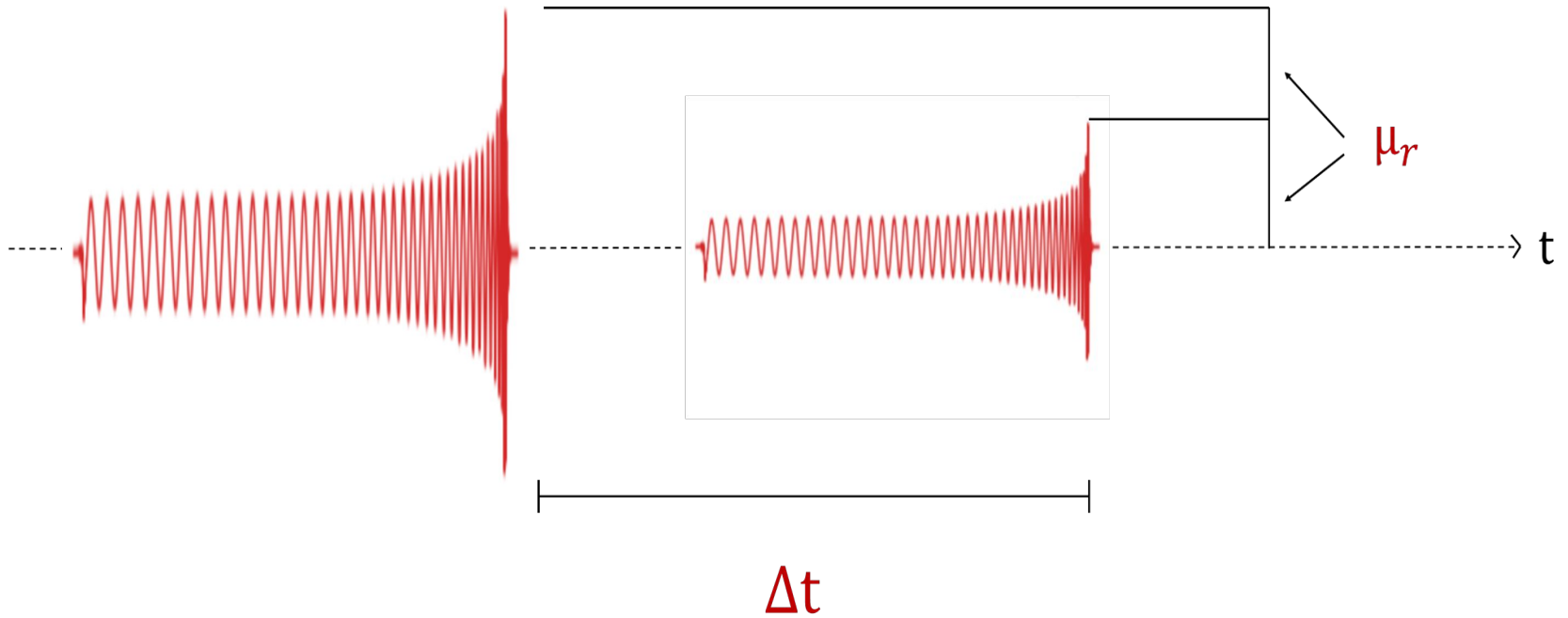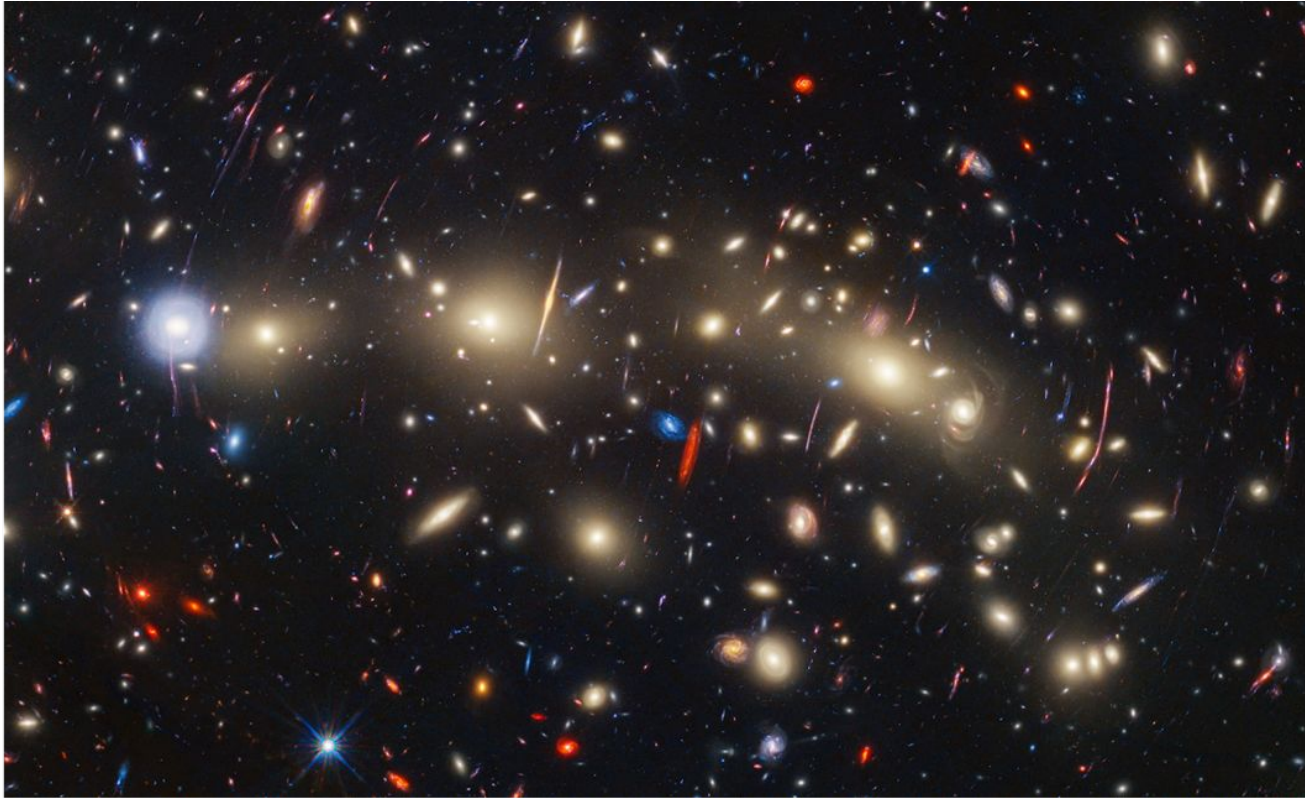
Crash Course in Lensing (2)
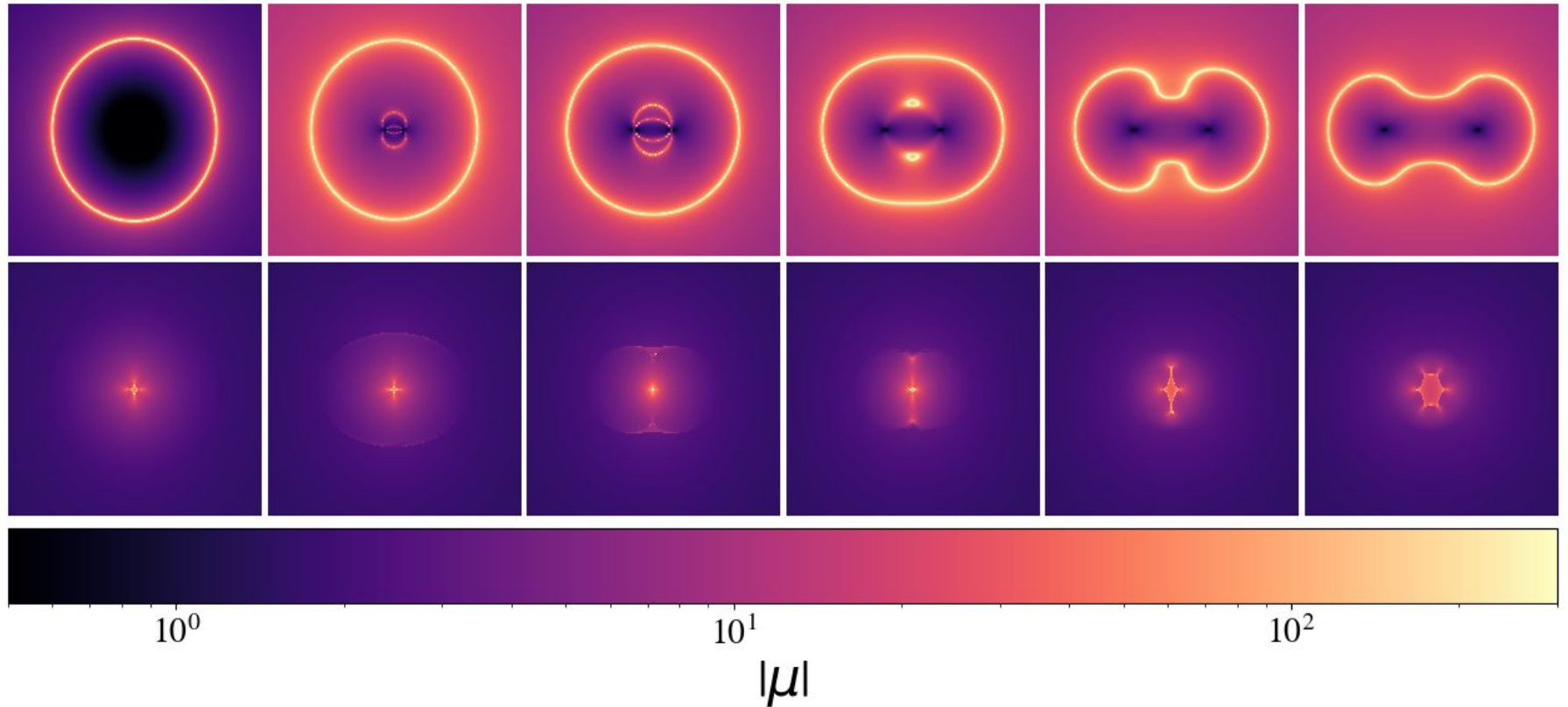

Critical Curve

Caustic

Basic Observables

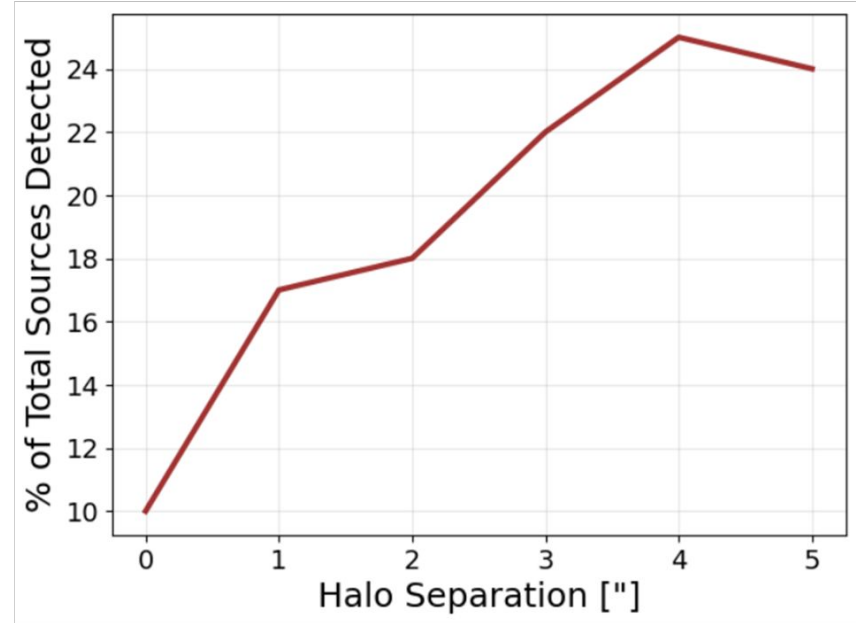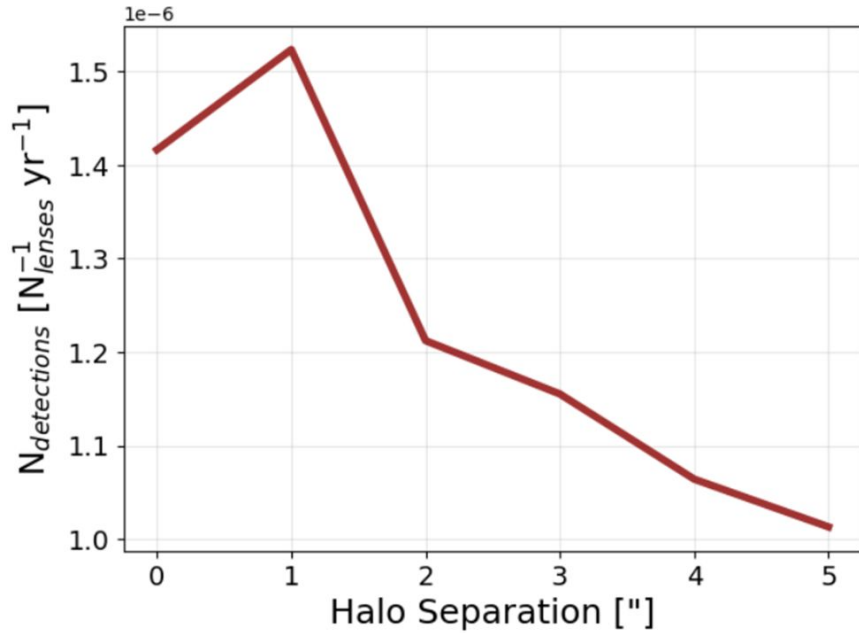# Galaxy Clusters are not (for the most part) Spheres

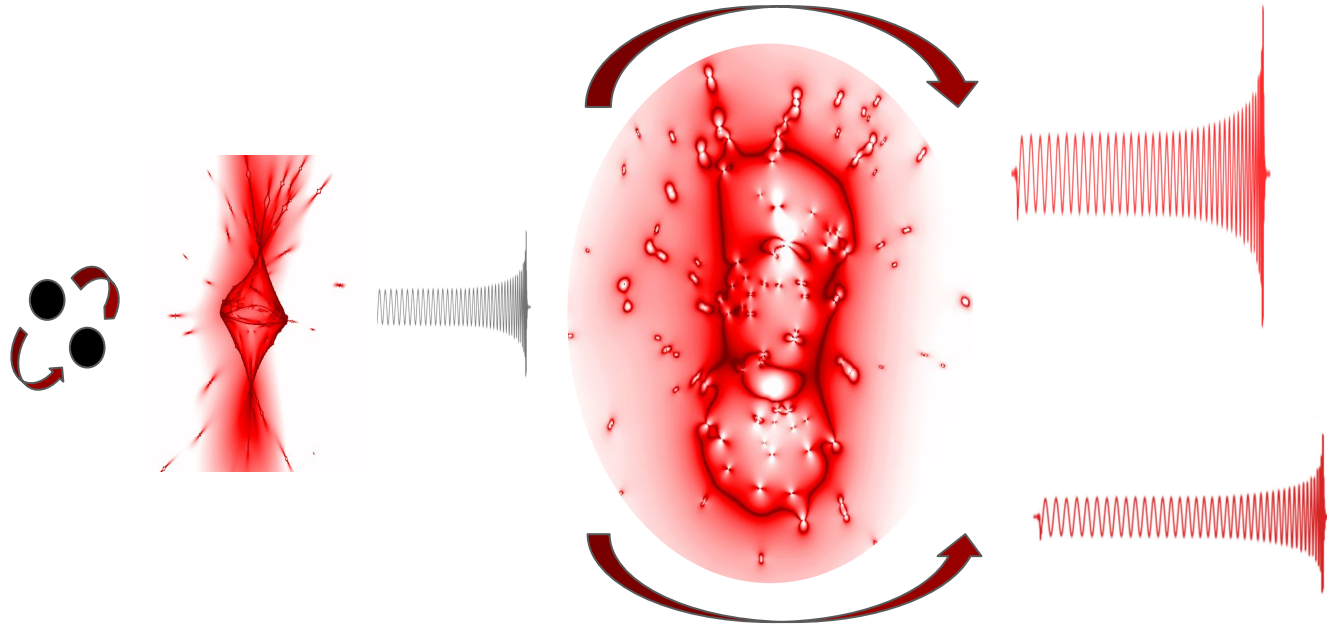MACS 0416 (Credit: JWST PEARLS (PI: Windhorst)

Including Basic Structure

Including Basic Structure

Towards More Realistic Models

Impact on Observables

- The distribution of time delays is heavily impacted by the presence of substructure

- Increasing the length of caustics significantly changes the number of highly magnified sources

- However, due to the low number of publicly available cluster lens models, putting constraints on rates is very challenging

Future Work

-   Would love to hear suggestions on how we can use GW lensing to learn more about dark matter (aside from how it forms in larger structures)

-   Do we stand a chance at lensing signals from the early universe?

-   Lensing in the strong field regime (i.e. EMRI or IMRI systems)