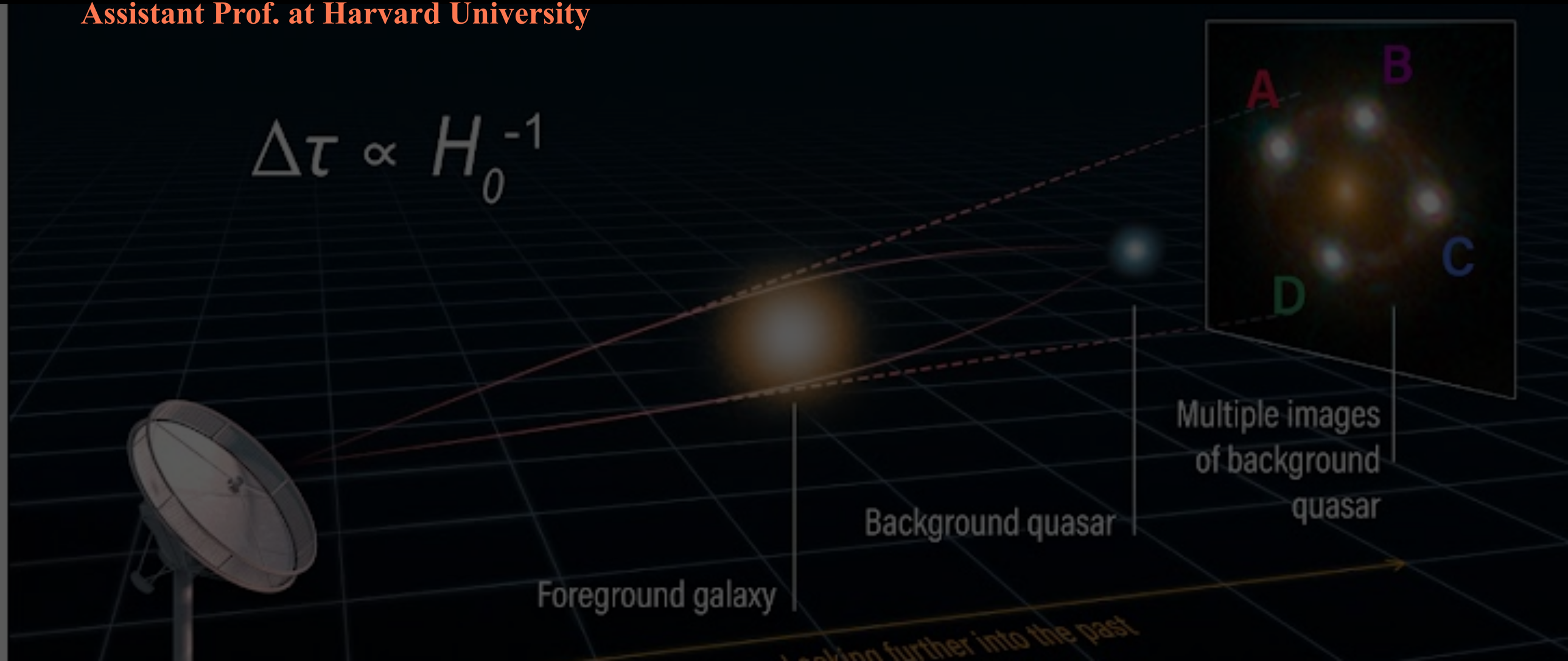
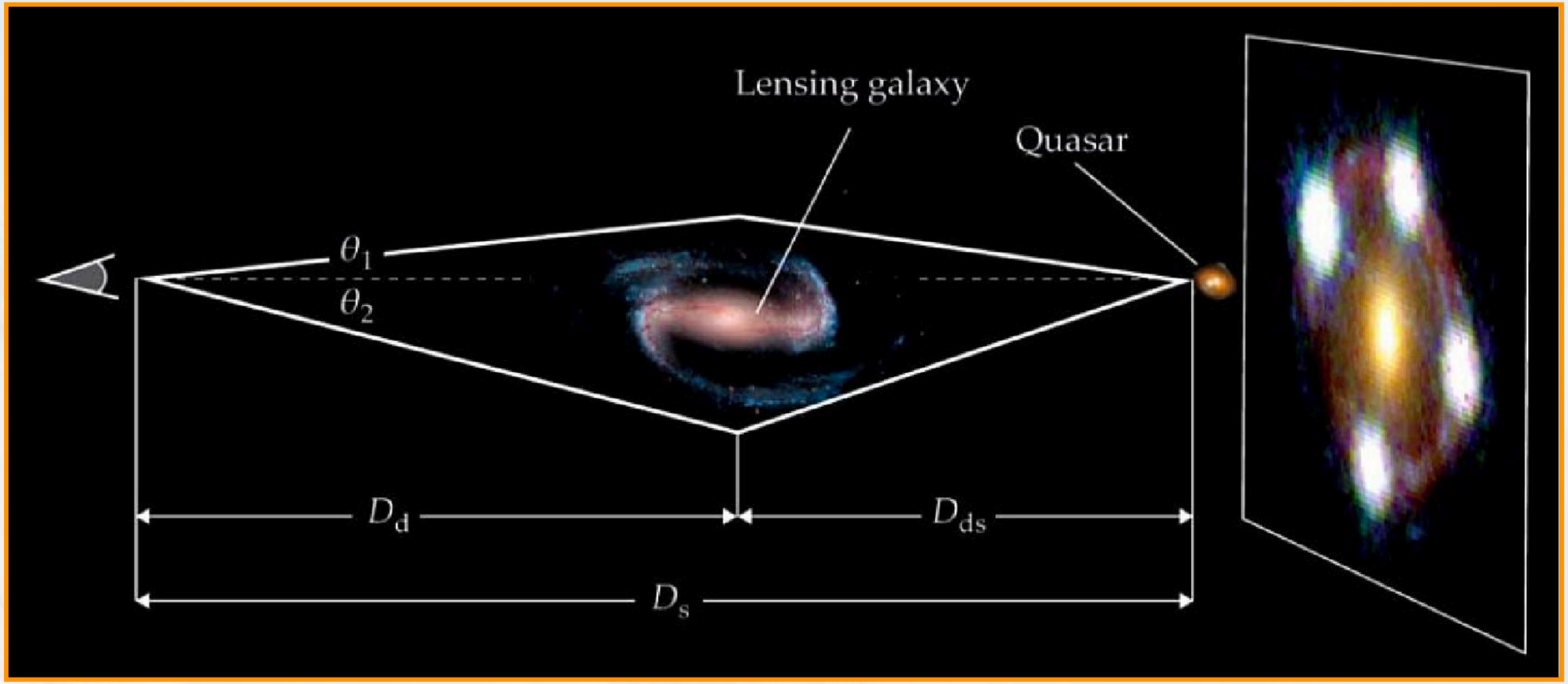
DSA-2000 & ngVLA synergies: strong lensing

Liam Connor 15 January 2025

Assistant Prof. at Harvard University





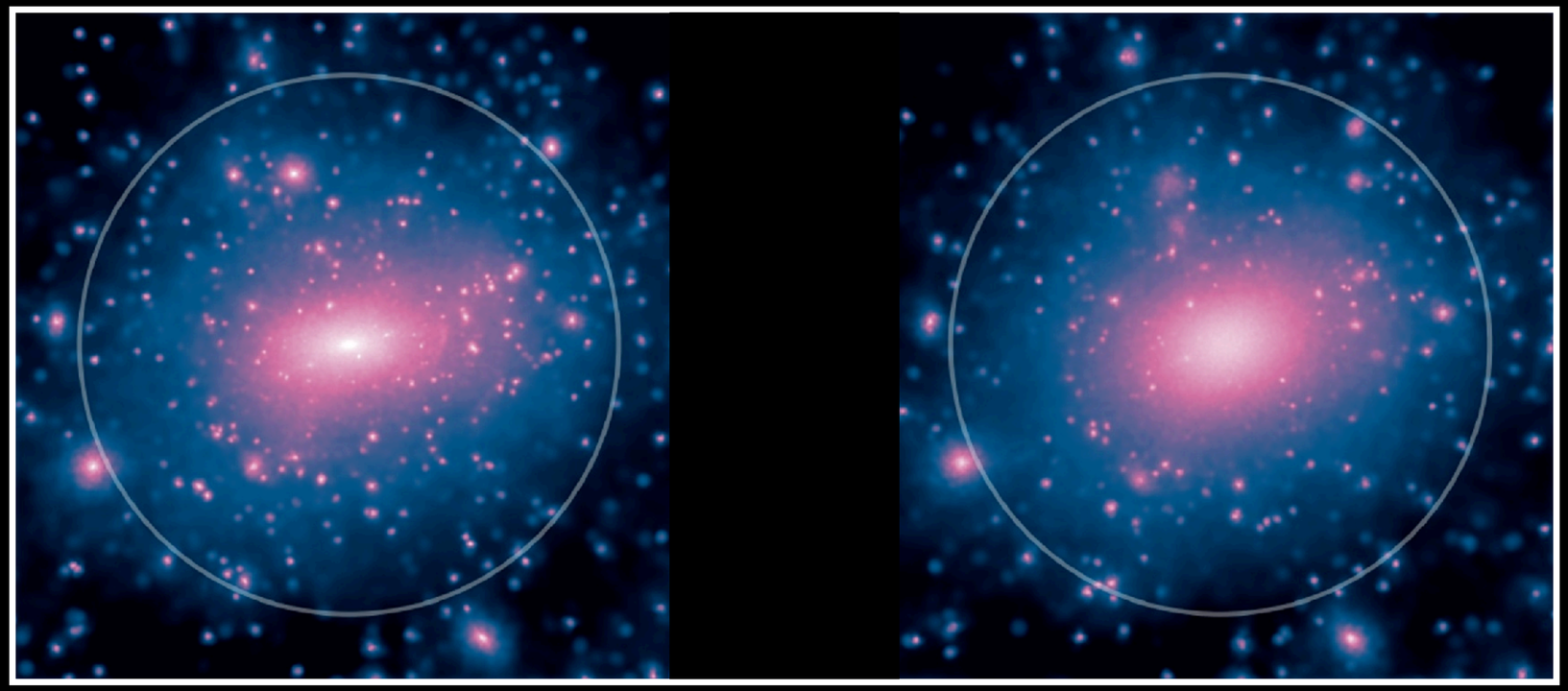
Total strong lenses today : ~10^3

Radio strong lenses today: ~10^2

DSA-2000 + ngVLA : ~10^5

Why do we need so many strong lenses?

- Dark matter halo distribution (radial profile, substructure, etc.)



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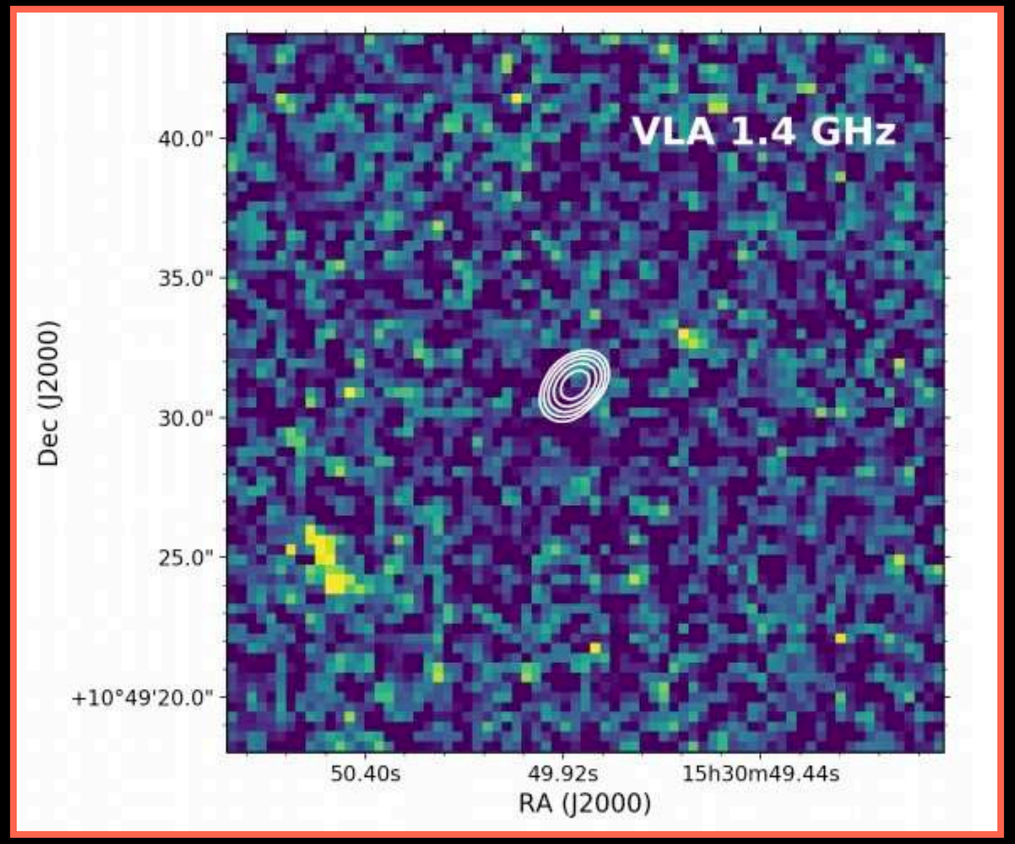
- **High-redshift sources via magnification**



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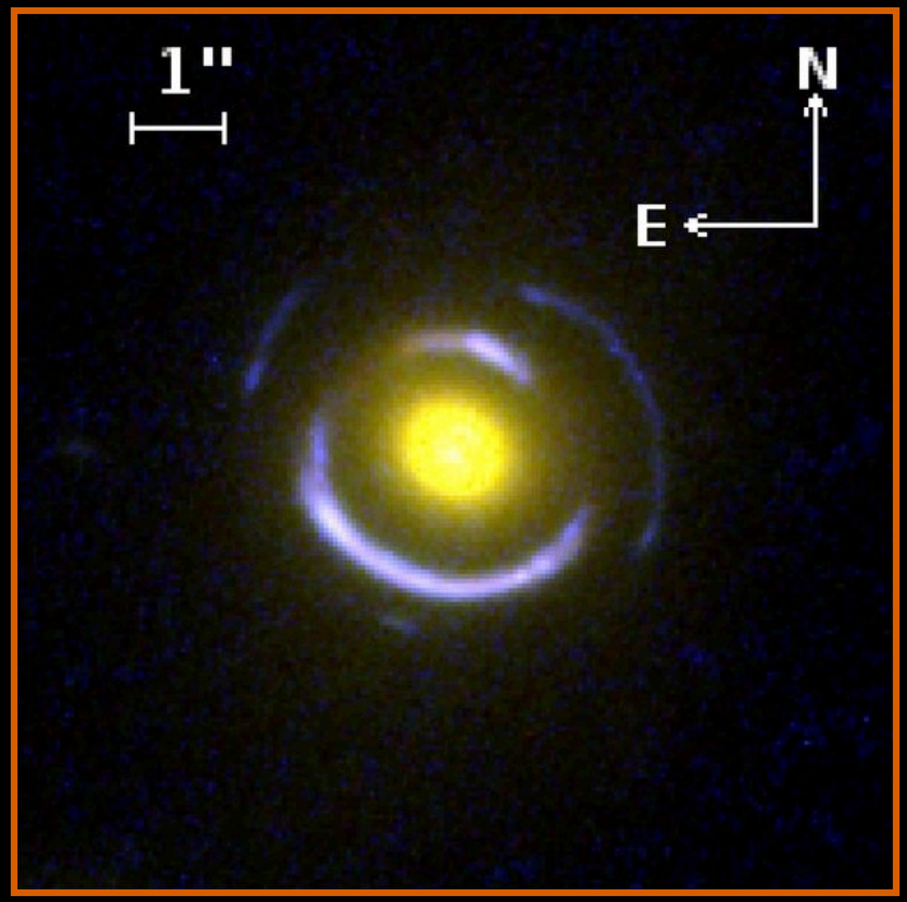
- **Discovery of “jackpot lenses” with double Einstein rings**



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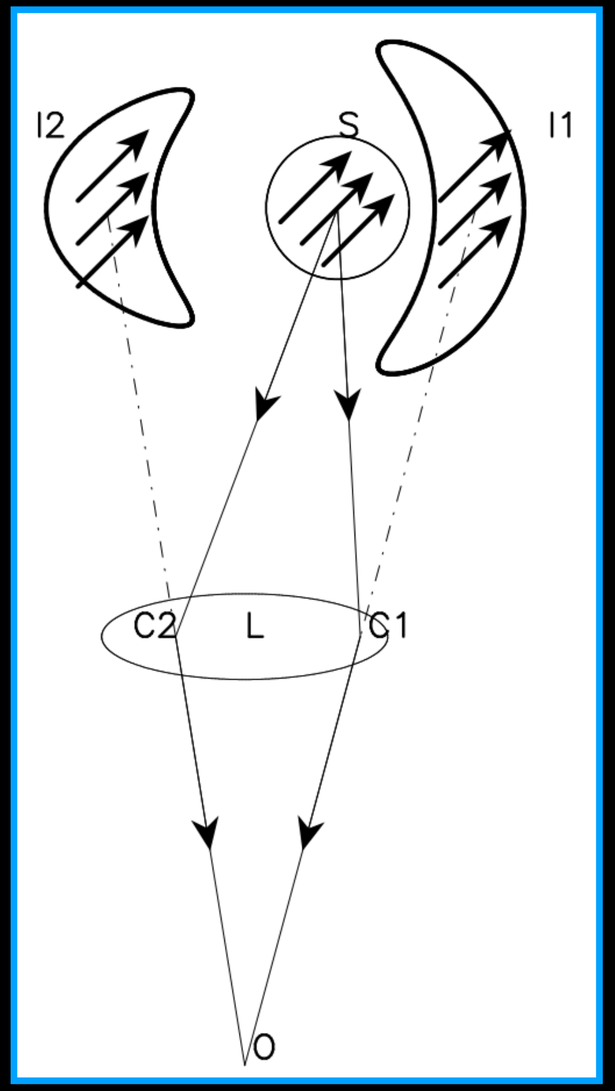
- **Polarization + lensing = magnetic field constraints**



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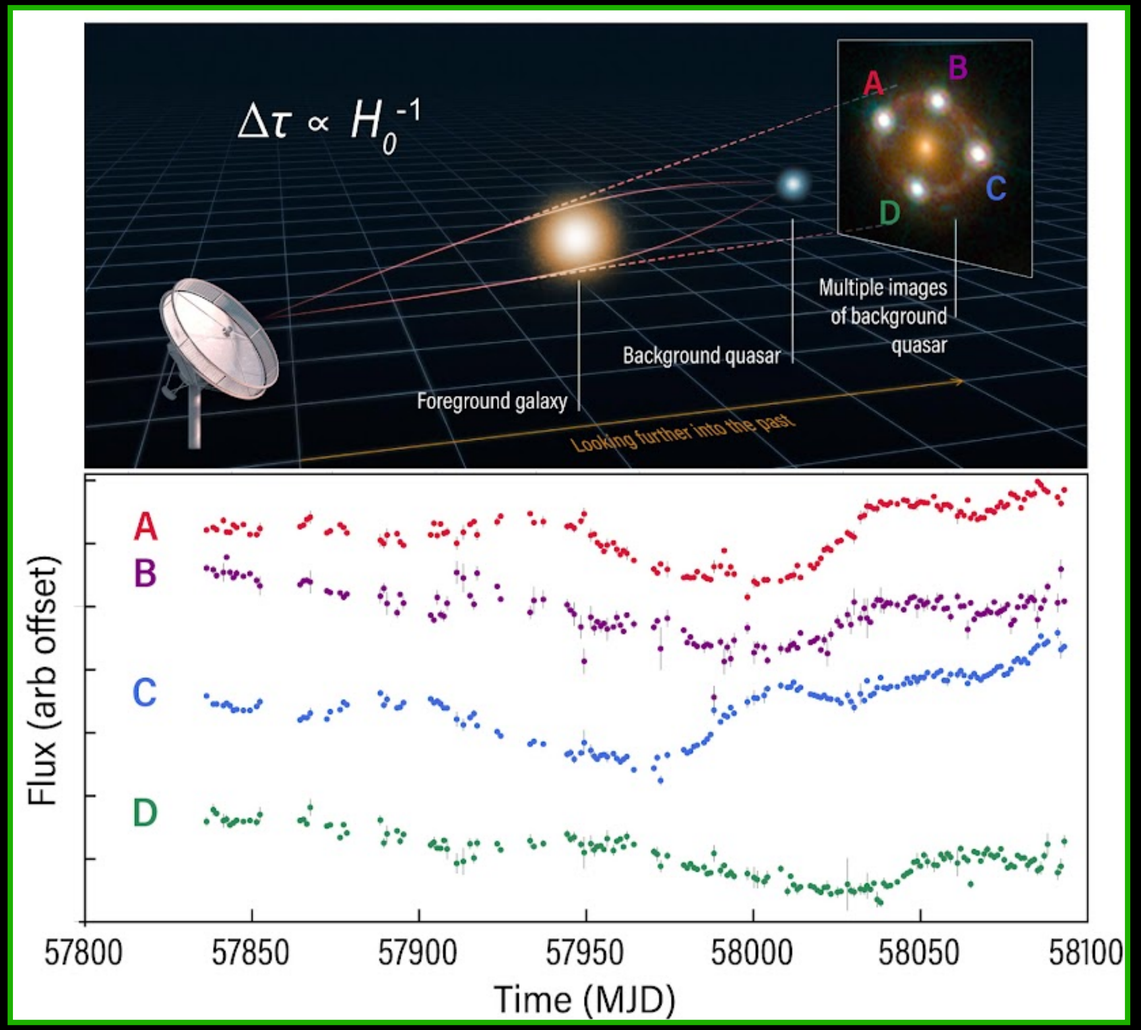
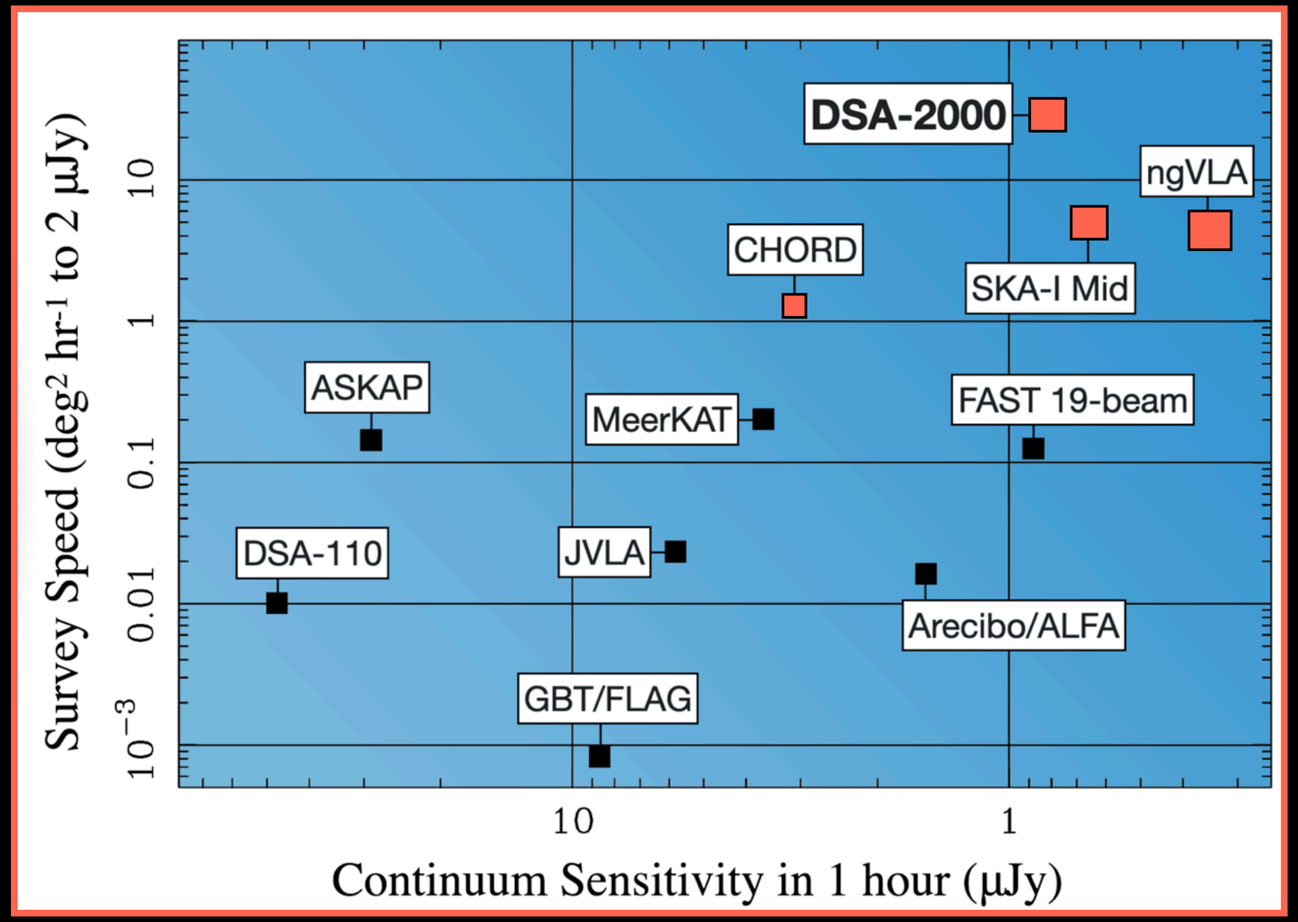
- **Gold sample for time-delay cosmography (<1% H0 measurement)**



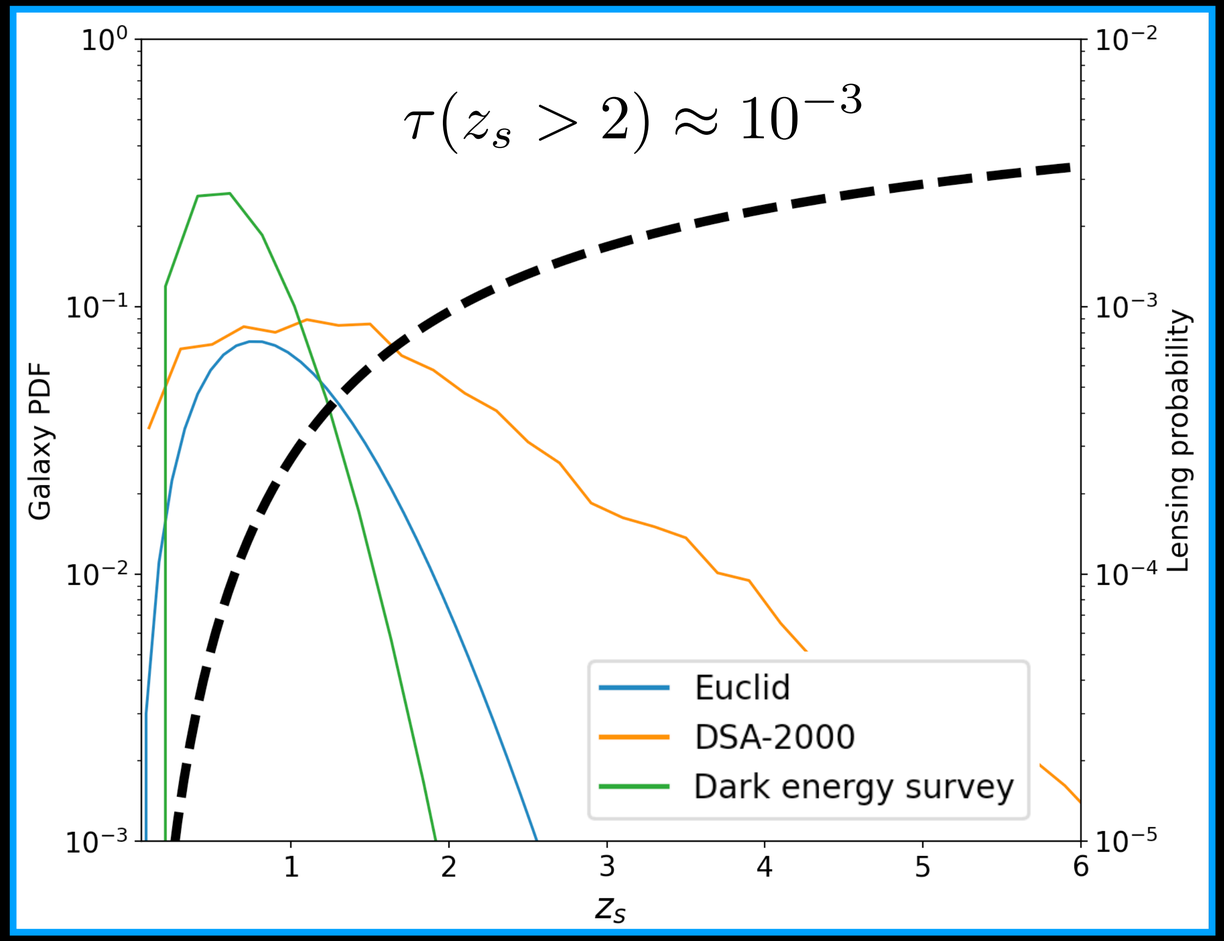
Strong lens discovery

1. Large number of sources (high survey speed)



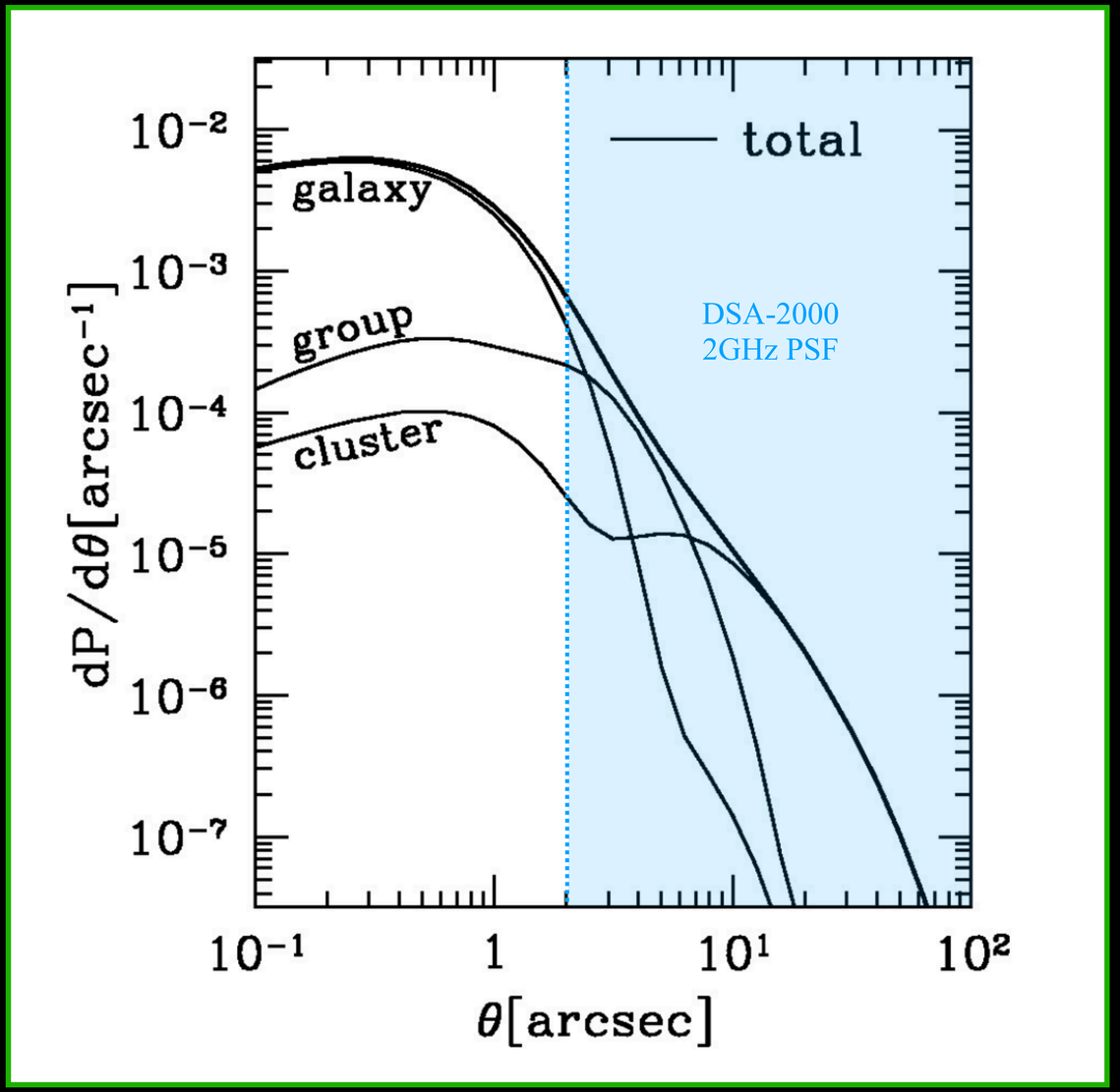
Strong lens discovery

1. Large number of sources (high survey speed)
2. Deep redshift distribution



Strong lens discovery

1. Large number of sources (high survey speed)
2. Deep redshift distribution
3. Angular resolution



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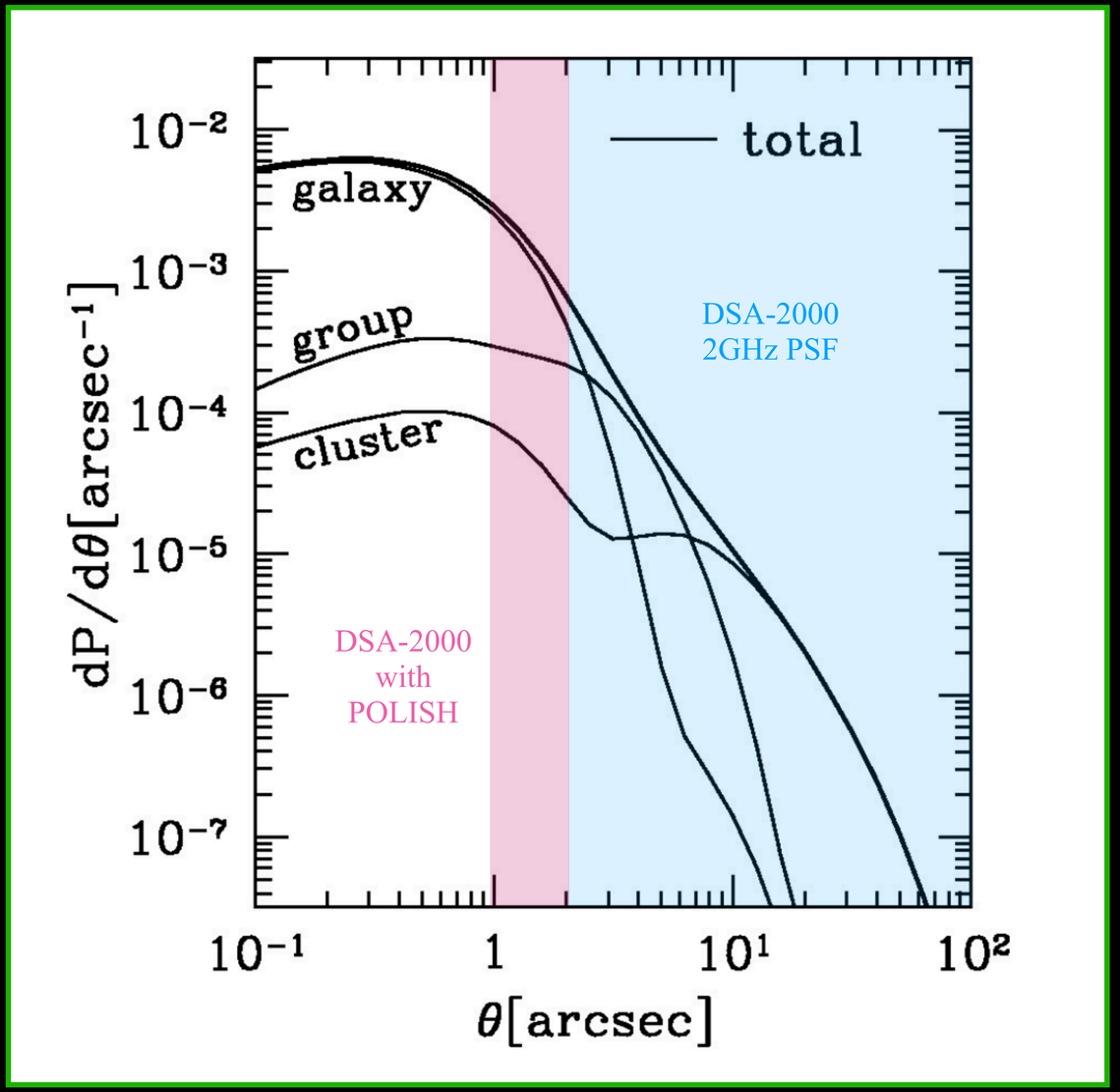
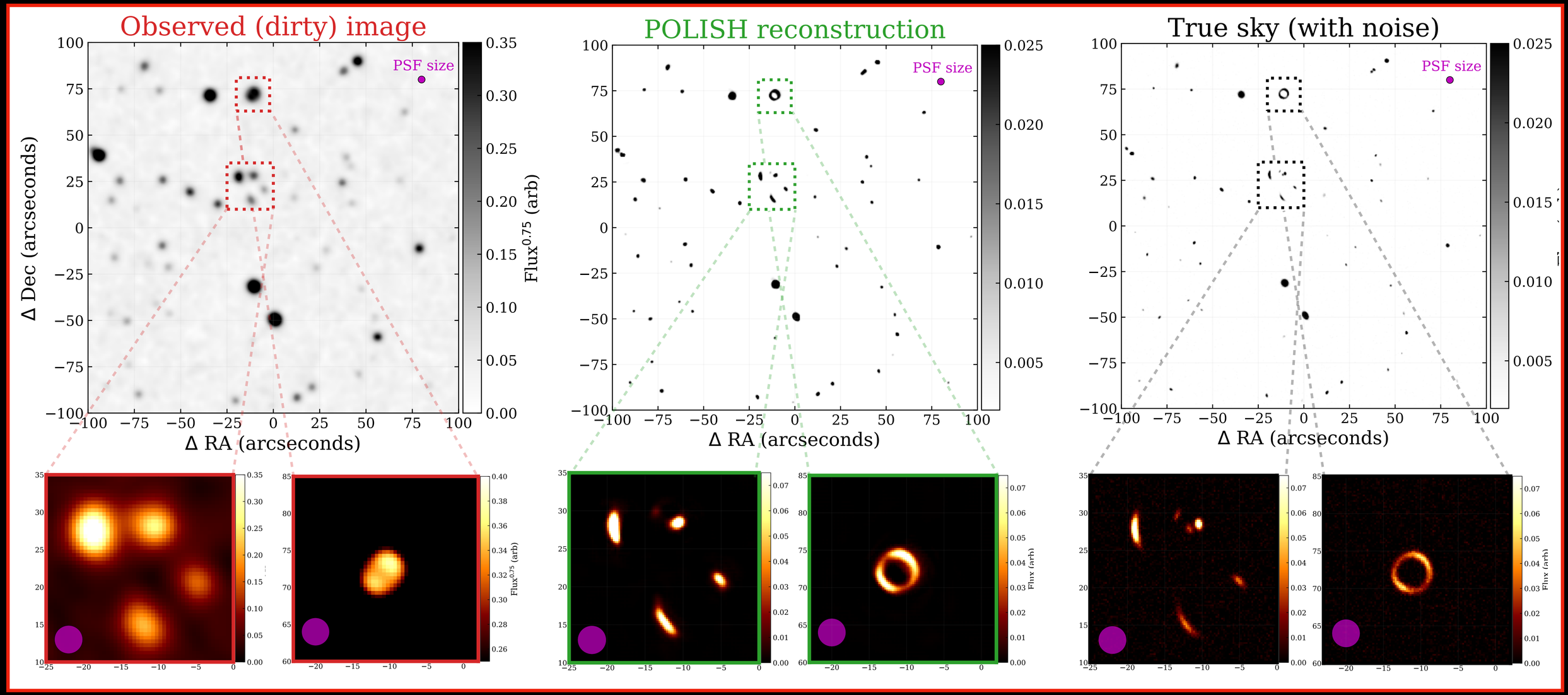


POLISH and superresolution imaging



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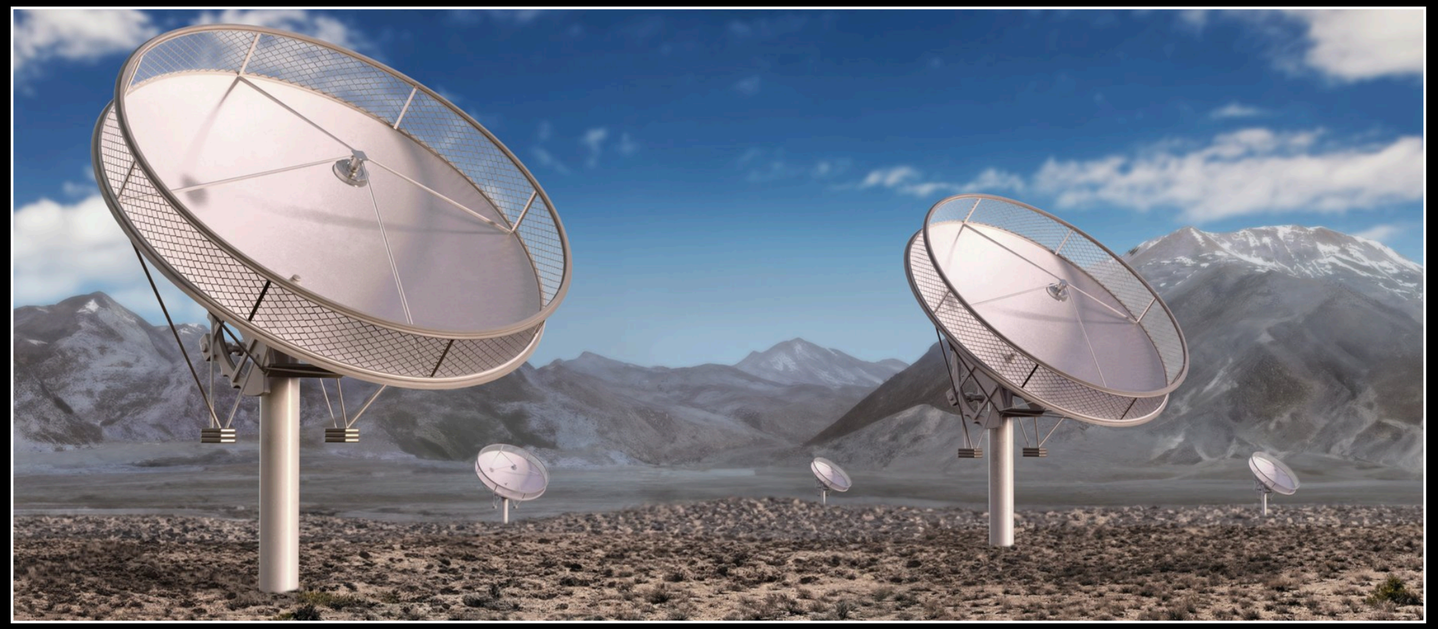
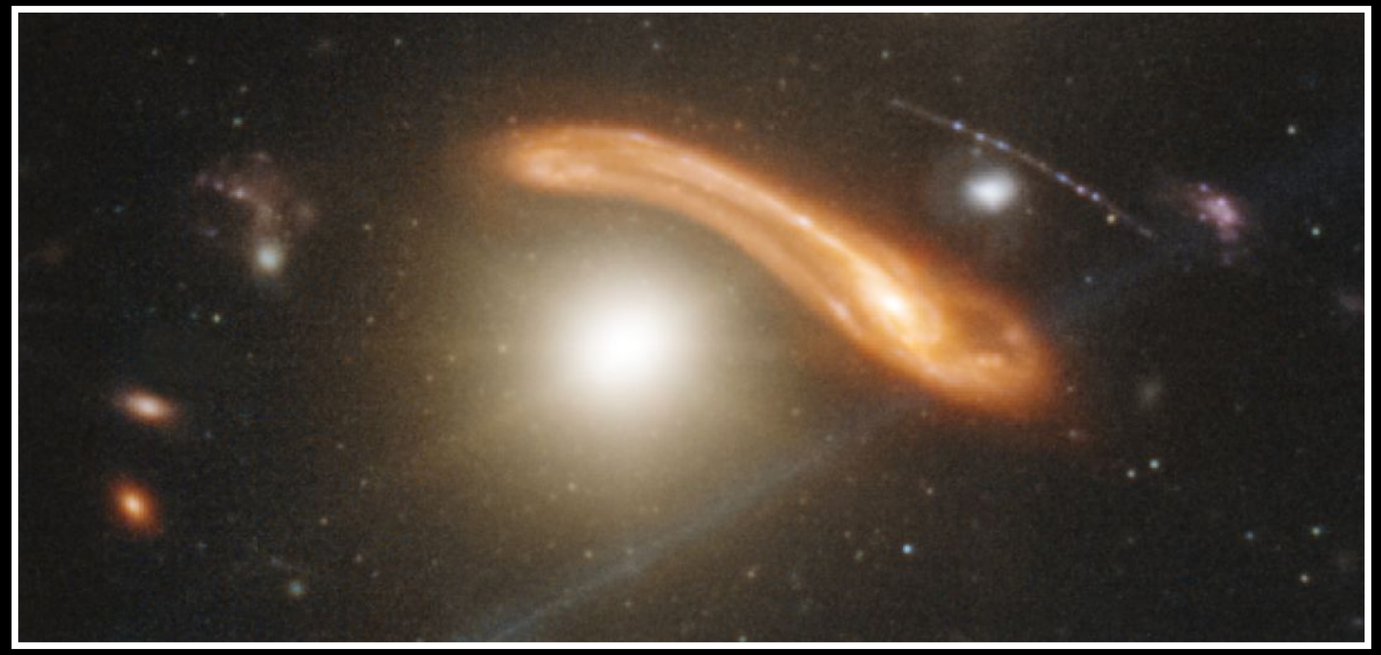
DSA-2000 could find:
50-100k strong lenses, many of which will be group and cluster lenses

McCarty & Connor (2025)— arxiv:2412.01746



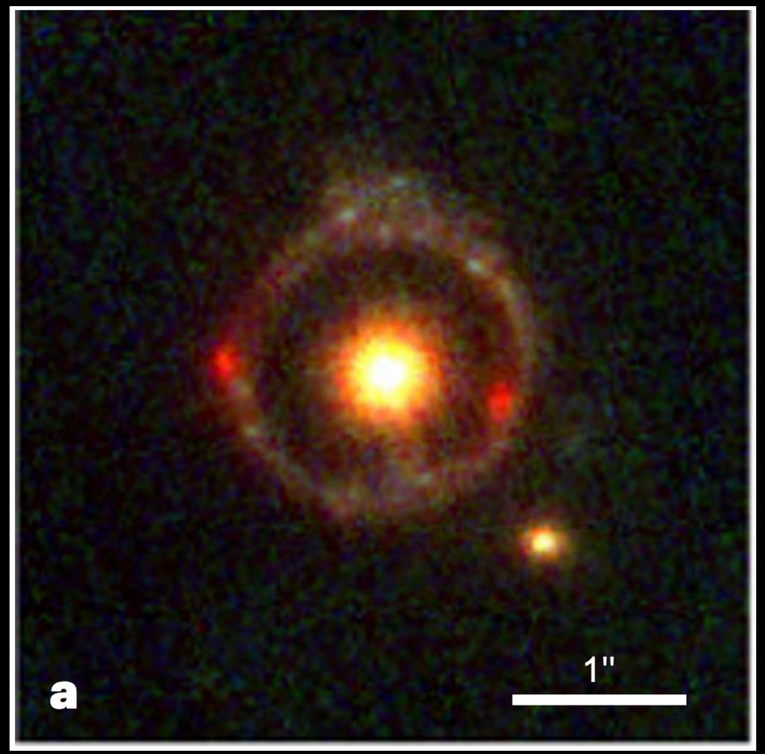
Samuel McCarty

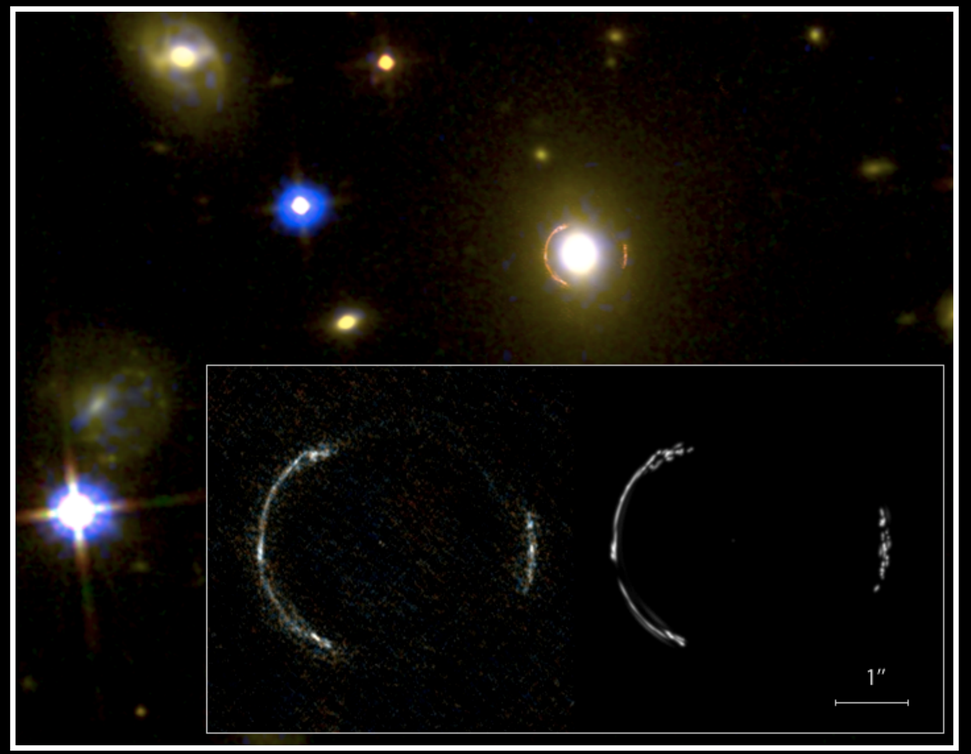


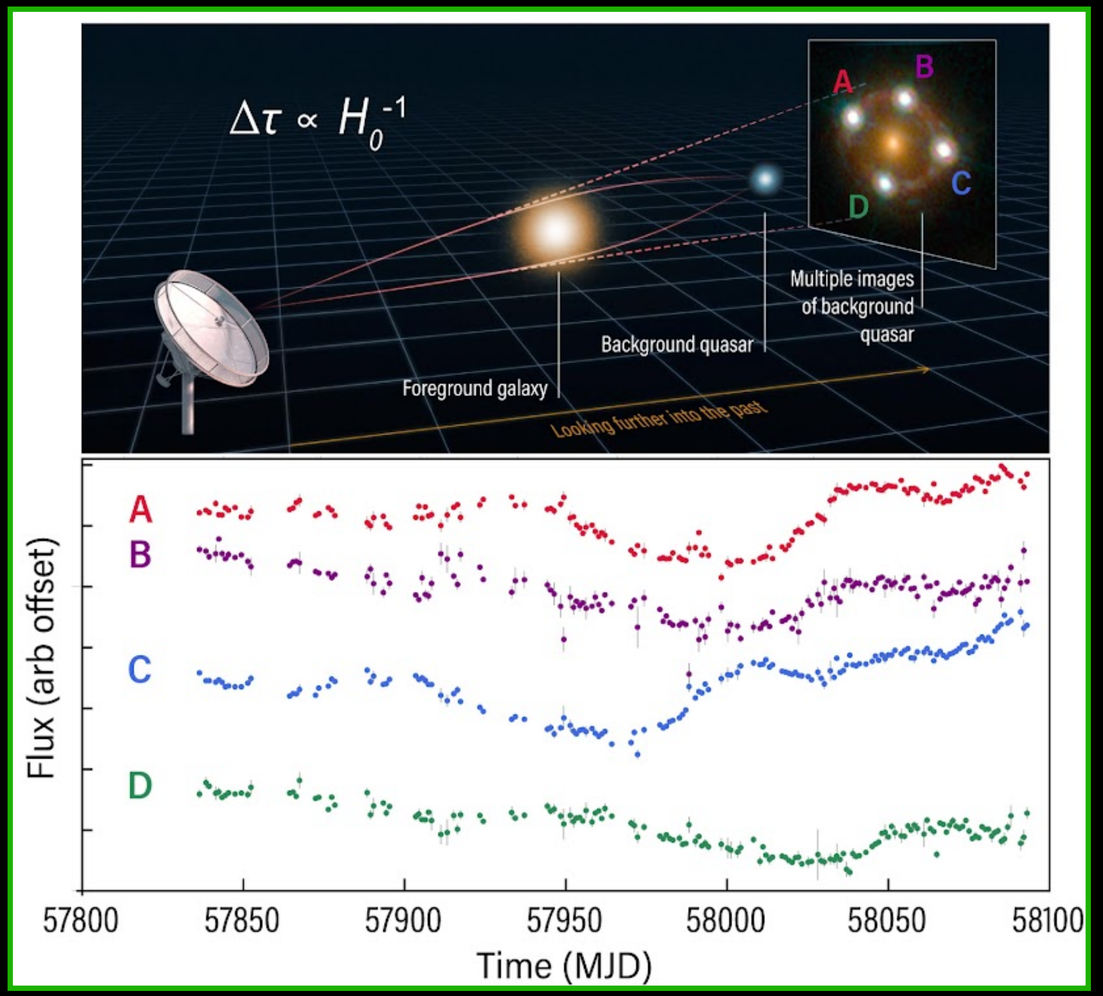
Lensing science

1. **Resolution!!**

2. Sensitivity







Time-delay cosmography

- Identify lensed FSRS with DSA-2000
- Mass modeling from + precise timing with ngVLA.
- Lens kinematics may break the mass-sheet degeneracy
- Decade long lensing time delays spanning the surveys

DSA-2000 & ngVLA synergies: strong lensing

- Radio lensing is unbiased by dust, offers full Stokes, fewer systematics in time-delays etc.
- DSA-2000 could find 50-100k strong lenses + extraordinary imaging from ngVLA
- H0 from time-delay measurements + mass modeling
- I’m a lensing dilettante: Plenty of low-hanging fruit in radio lensing on DSA + ngVLA left to be picked.