Inverse problem

$y = \phi x + n$ where $\phi : x \mapsto y$

Information lost

ill posed

- Insufficient information to solve
- Degenerate solution space
- Unstable to inversion

Applied Math

$$x^{\text{map}} = \underset{x}{\text{argmin}} \Big[\overbrace{\underbrace{f(x)}_{log-likelihood}}^{Data-fidelity} + \overbrace{\underbrace{g(x)}_{log-prior}}^{Regulariser} \Big]$$

<u>Advantages</u>

- Low computational cost
- Highly scalable

<u>Disadvantages</u>

- Approximate inferences
- Restricted to log-concave posterior functions

Statistics

$$\underbrace{P(x|y,\phi,\mathcal{M})}_{Posterior} = \frac{\overbrace{P(y|x,\phi,\mathcal{M})}^{Likelihood} \overbrace{P(x)}^{Prior}}{\underbrace{P(y|\phi,\mathcal{M})}_{Evidence}}$$

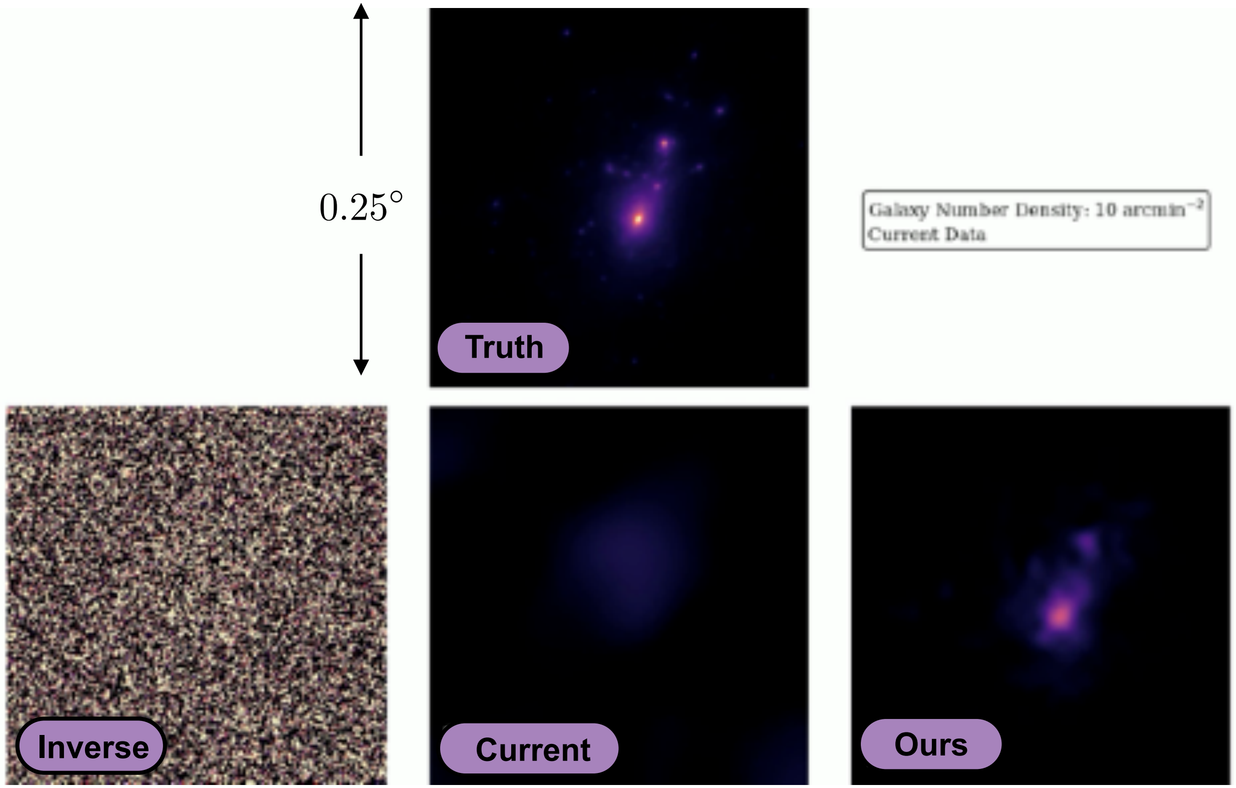
<u>Advantages</u>

- Asymptotically exact
- Any posterior

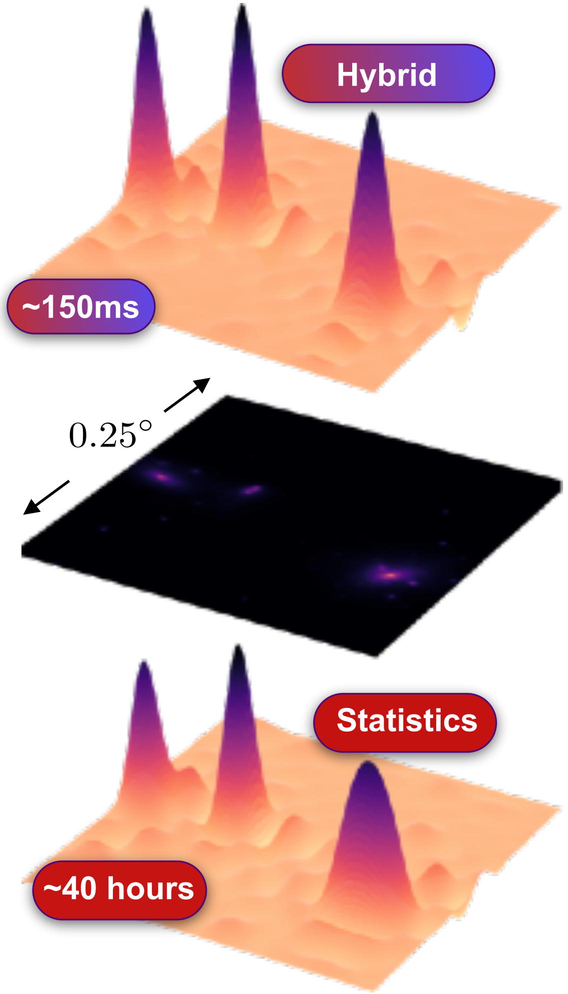
<u>Disadvantages</u>

- Computationally expensive
- Large memory overhead
- Not scalable

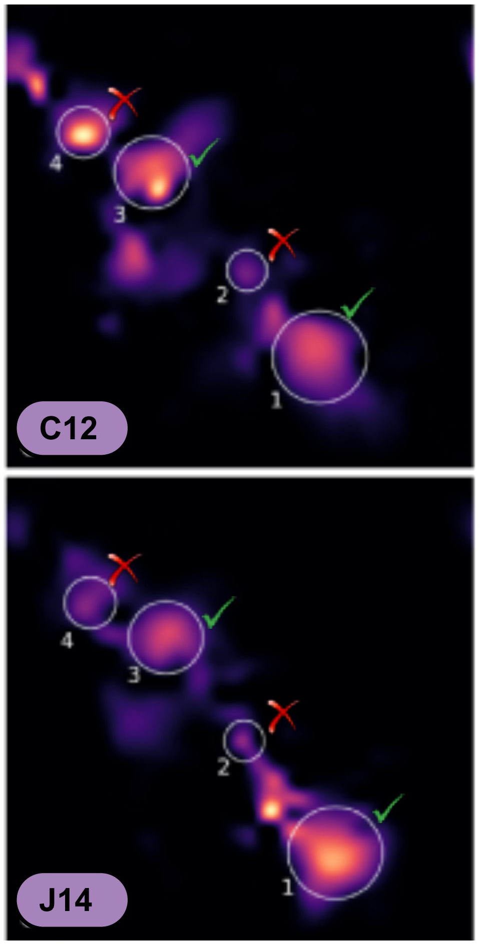
Planar Weak lensing



Super-resolution MAP estimation versus Kaiser-Squires for various settings [1]



Bayesian sampling versus optimisation [2,3]



Application to Abel 520 merging cluster observational data [1]