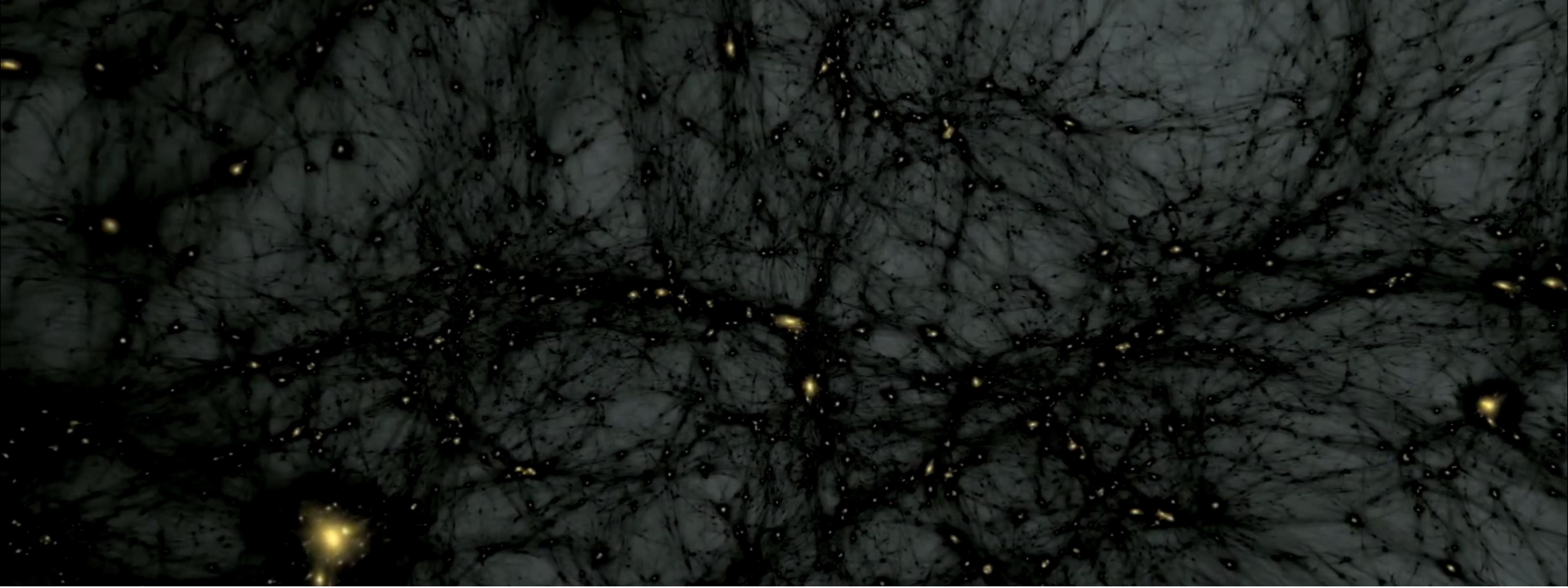

Virtual Research Presentation Conference

EPPUR SI MUOVE: DEFINING THE NEXT GENERATION OF COSMOLOGICAL MISSIONS

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Program: SURP

Assigned Presentation # RPC-006

Jet Propulsion Laboratory
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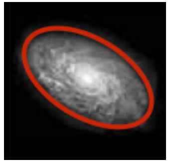
Gravitational Lensing

Mass in the foreground distorts images of background sources.

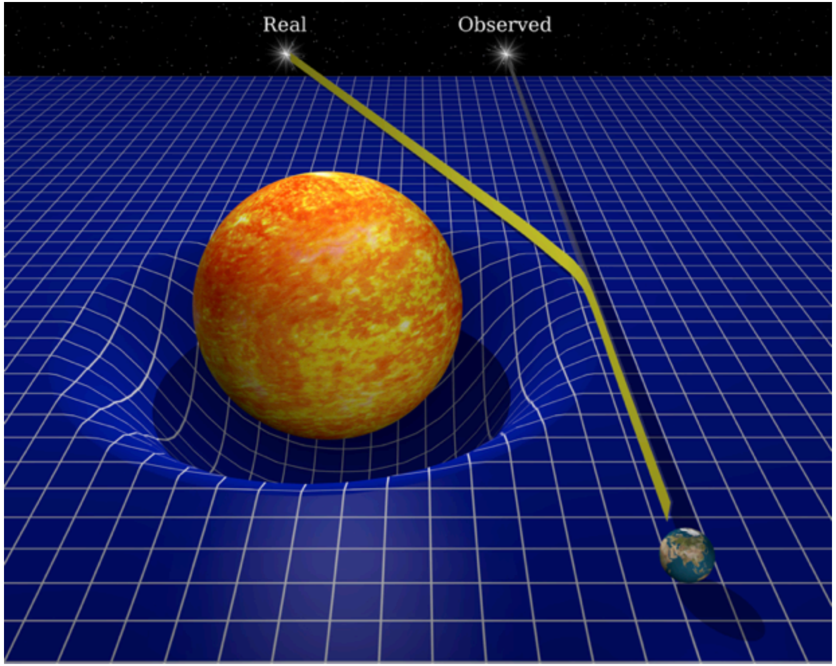
The primary effect is to distort the ellipticities of distant galaxies.



We measure the ellipticities. Each is random, but the average is distorted by the shear.

We can use these distortions to make inferences about the foreground mass.

This is the **only** direct way to map dark matter.



Gravitational Lensing

The lensing signal from real cosmic structures is tiny – it distorts galaxies by less than 1%.

By comparison, the random variations in galaxy images are 1-2 orders of magnitude larger.

Lensing surveys (incl. Roman) must average over millions of noisy galaxies to get their signal.

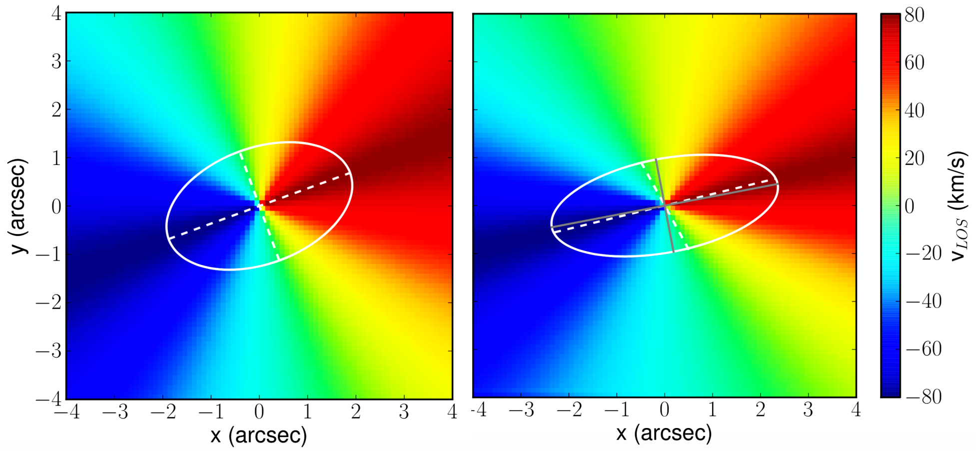
Kinematic Lensing

Disk galaxies have a coherent pattern of rotation.

Lensing distorts that pattern.

If we can make maps of disk galaxy velocities, it is possible to measure the lensing shear for individual galaxies.

Quantitatively, this could **reduce the noise in weak lensing measurements by an order of magnitude.**

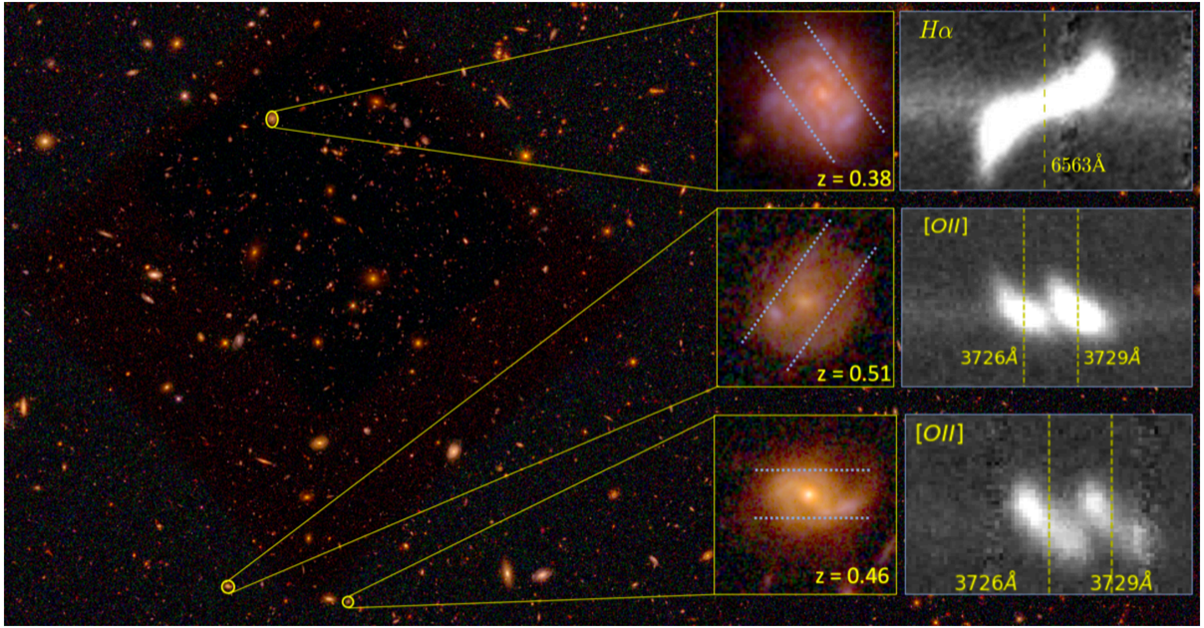


Galaxy Kinematics

To do this requires obtaining resolved spectroscopy of disks, much like the data shown on the right.

Data similar to that on the right exists, in large enough quantities to ensure a kinematic lensing detection.

We are first simulating these data, and ensuring that we can perform unbiased retrievals of the shear.

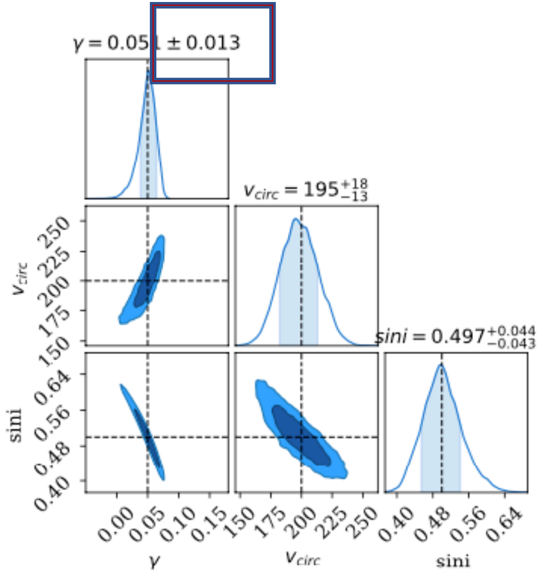


Kinematic Lensing

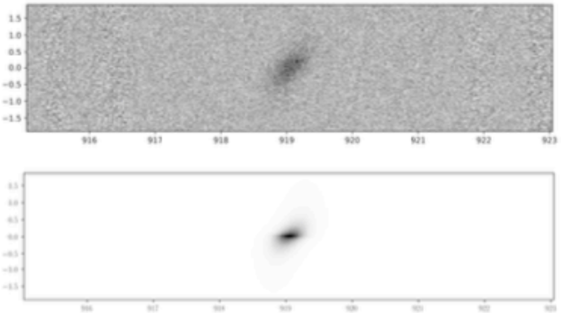
Our group has performed detailed simulations of kinematic observations.

We simulate a full retrieval of the lensing signal, with realistic observational complexities.

We find that we can typically recover shears with an error of 0.015 -- a **factor of 15** reduction in noise over traditional methods.



(a) Parameter constraints from forward-modeling a the simulated disk galaxy shown at right, at lower inclination. The recovered shear error is ± 0.01.



(b) **Top:** Simulated disk galaxy spectrum showing at lower inclination ($\sin i = 0.5$). Noisy vertical bands indicate position of simulated night sky emission lines after sky subtraction. **Bottom:** Best-fit model for the simulation shown above, with posterior constraints shown at left.

Results and Forecast

Results of our simulations suggest dramatic improvement in the signal available for cosmic weak lensing analyses.

This suggests that the science yield from a hyperspectral imaging survey would exceed that from **any** other planned lensing studies.

Our first measurement (forecast in the right panel) is forthcoming this fall.