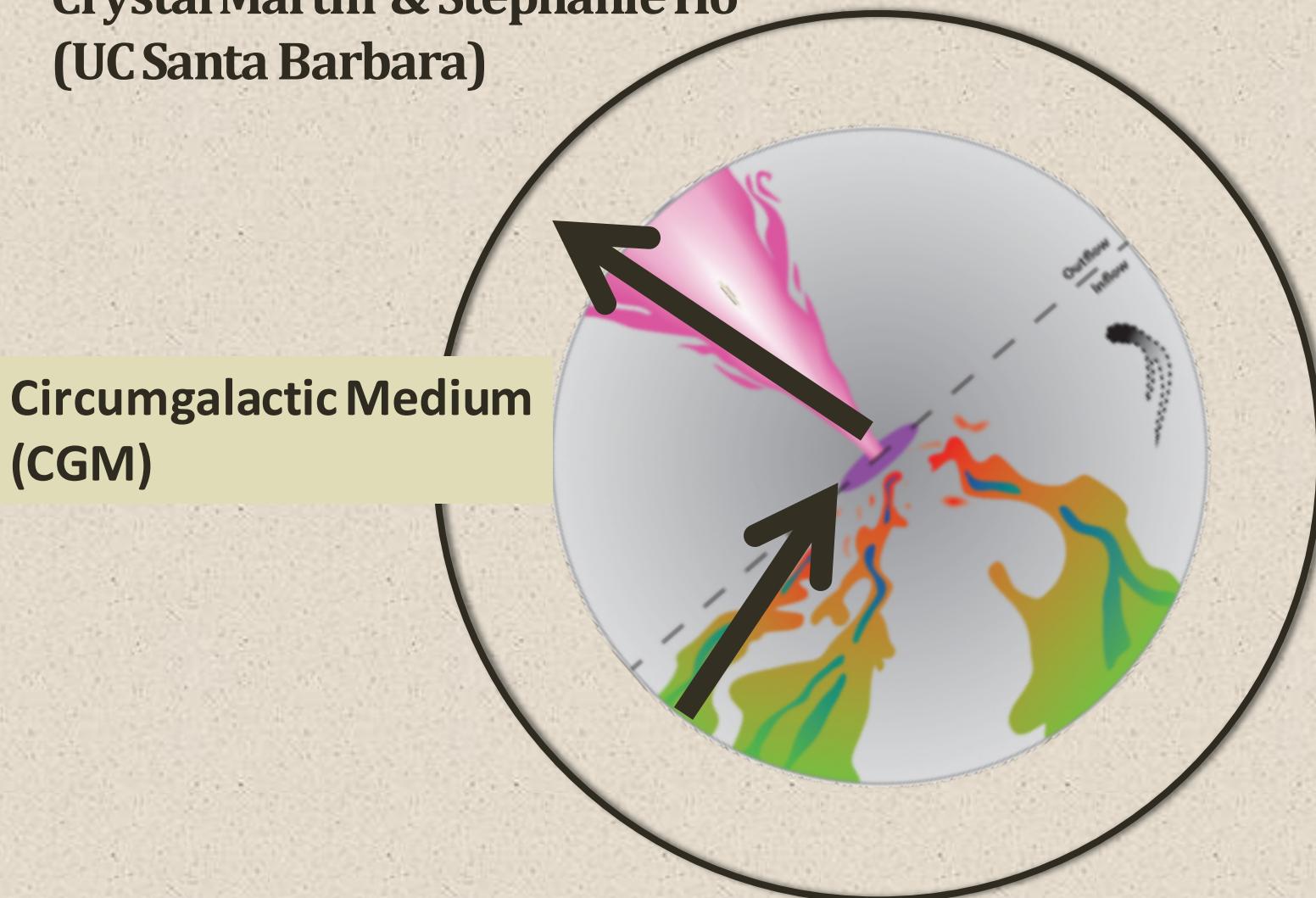
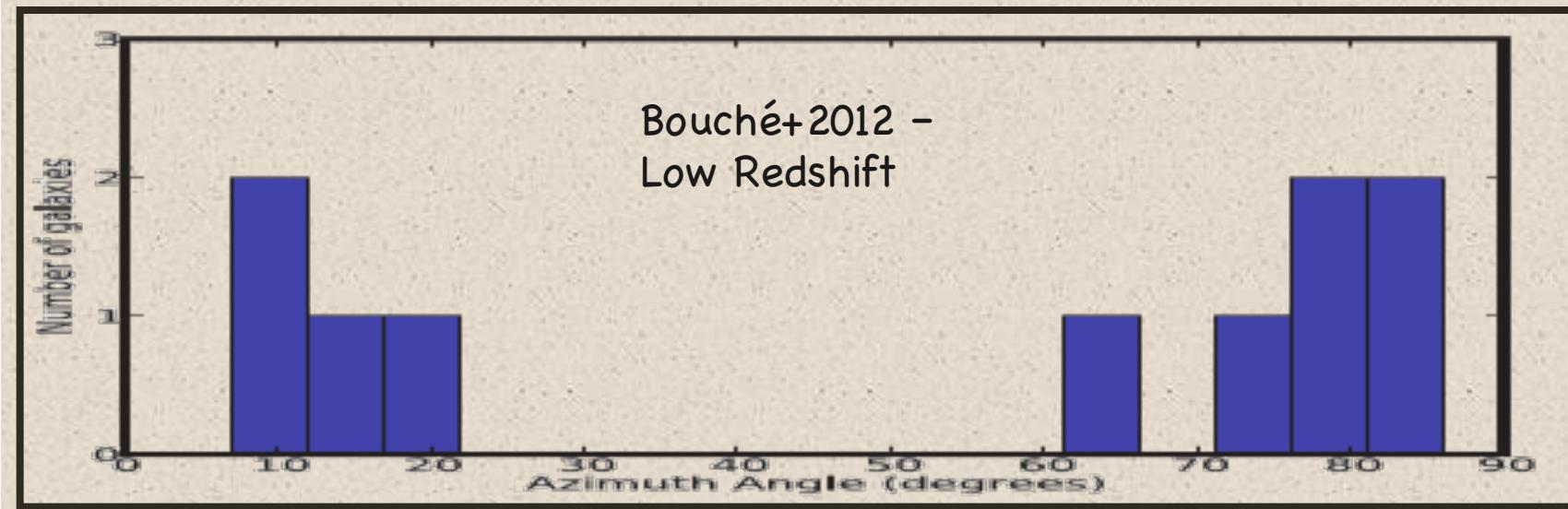
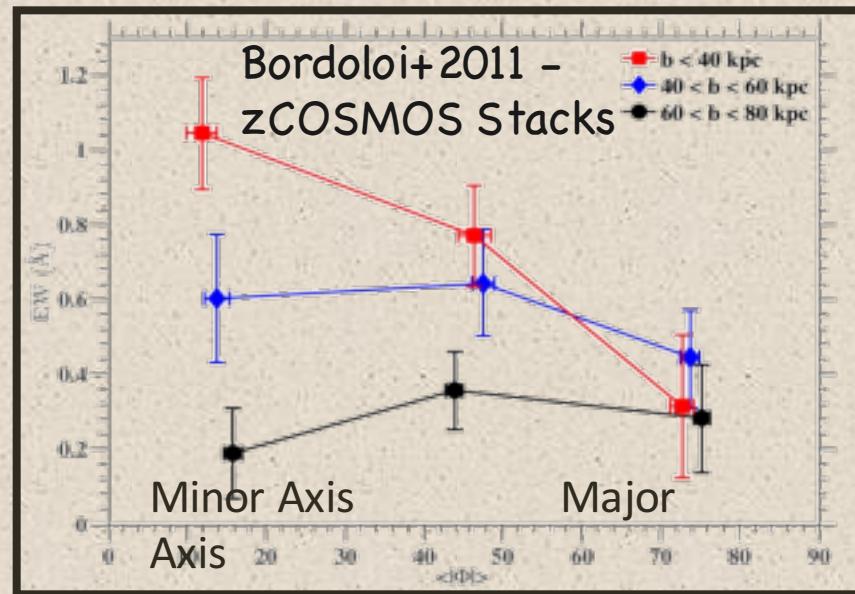
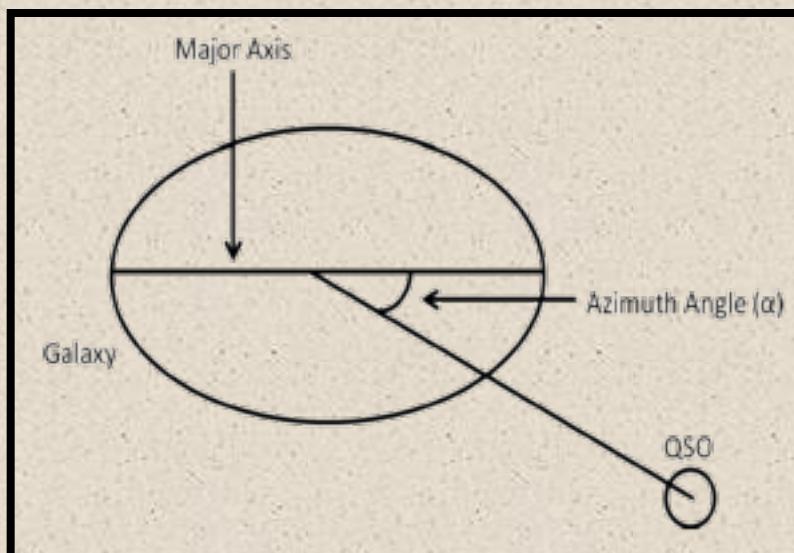


Quasars Probing Galaxies: Gas Accretion in Extended Galactic Disks

Crystal Martin & Stephanie Ho
(UC Santa Barbara)

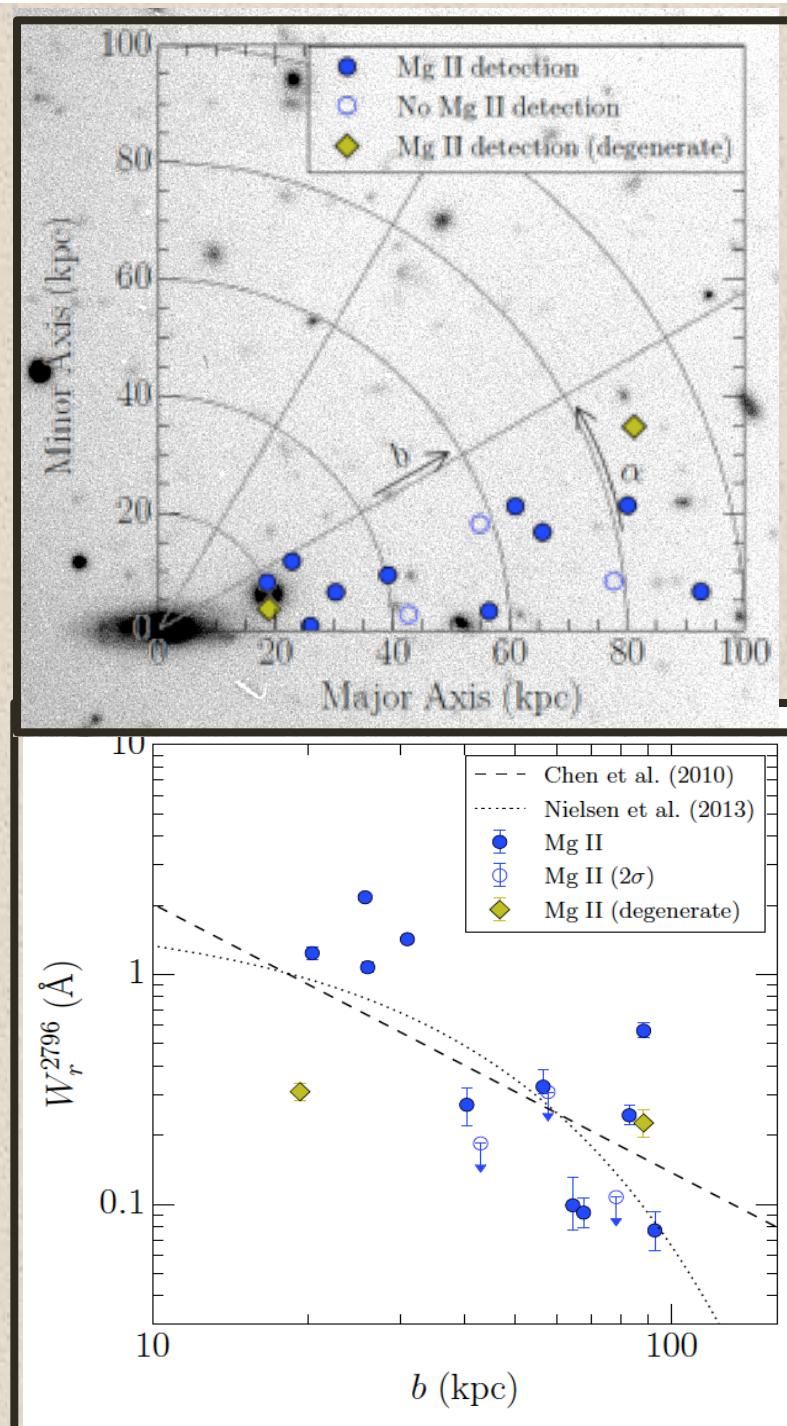


Orientation of Sightline Relative to the Disk May Determine Origin of Strong Absorption



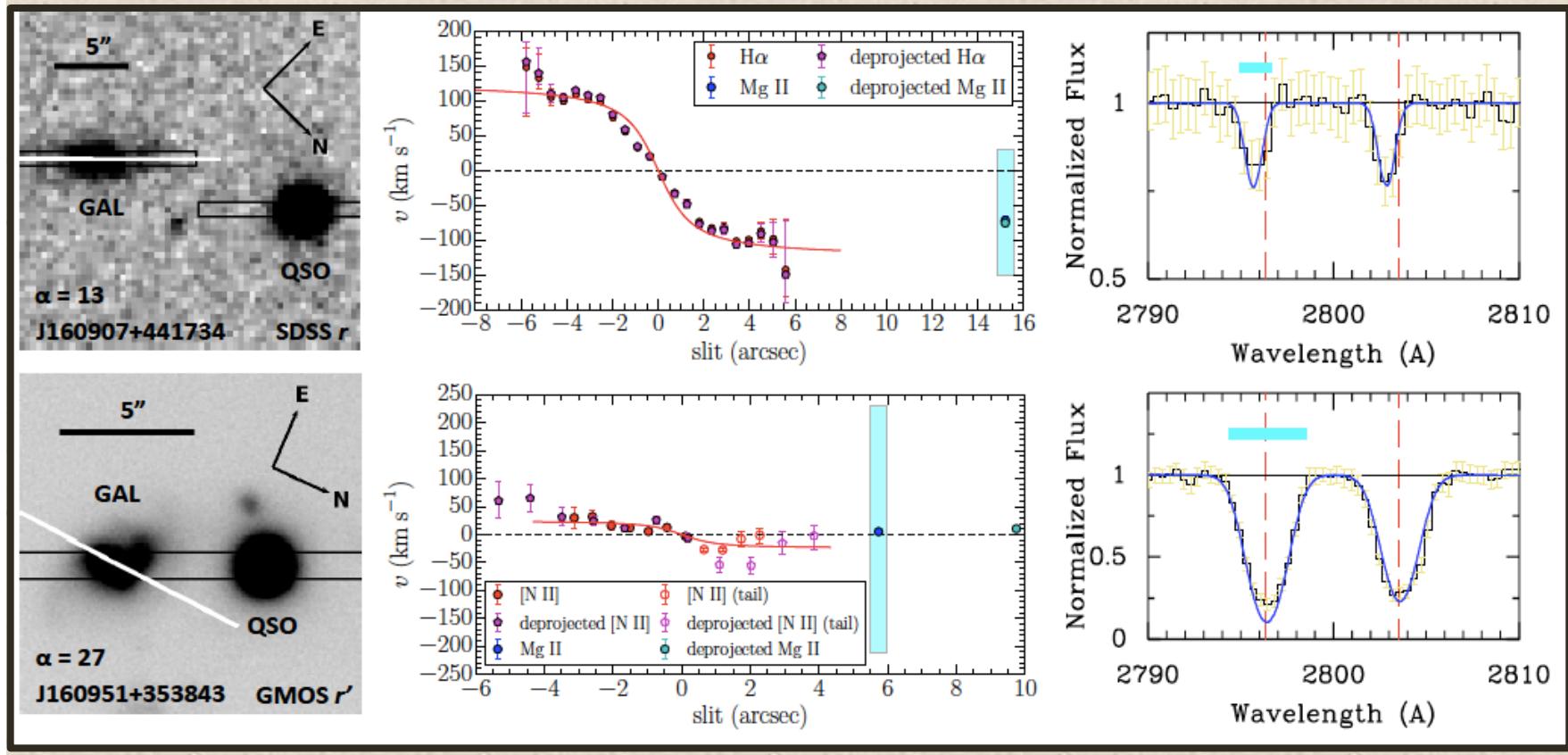
Keck Quasars Probing Galaxies: Major Axis Sightline Results

1. Sign of CGM Doppler shift correlated with sign of disk rotation.
2. If the gas is near the disk plane, then it is not Doppler shifted enough to be on a circular orbit.
3. An inflow component in the disk plane easily reproduces the measured CGM kinematics.

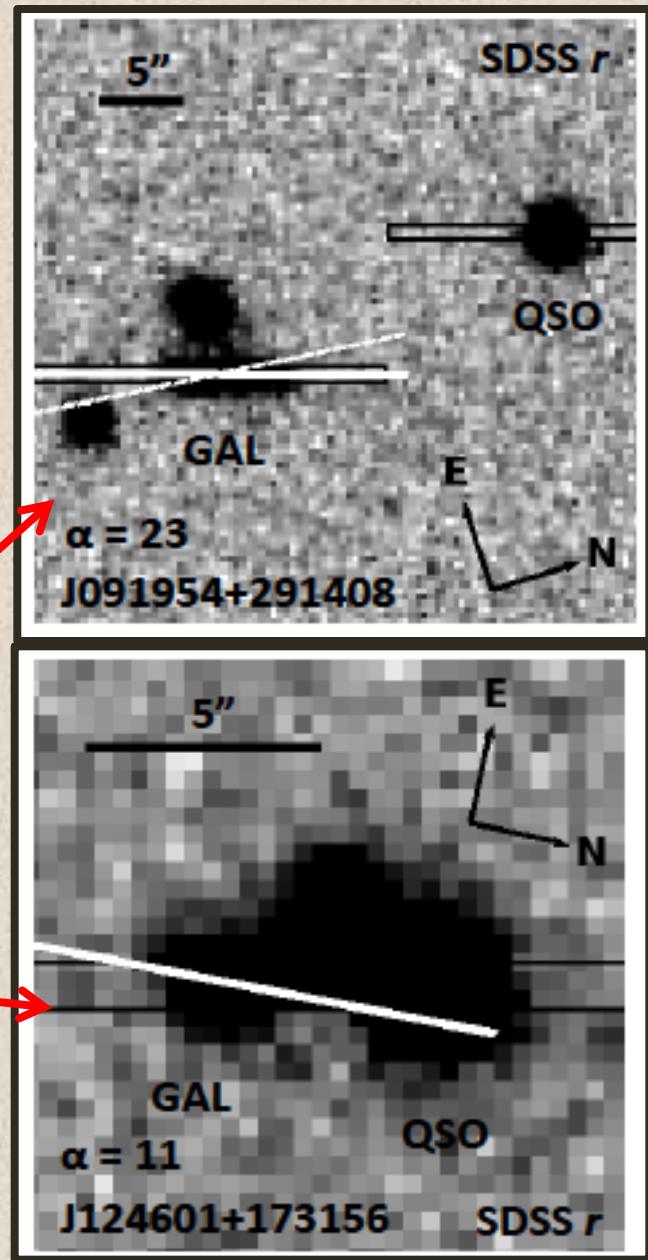
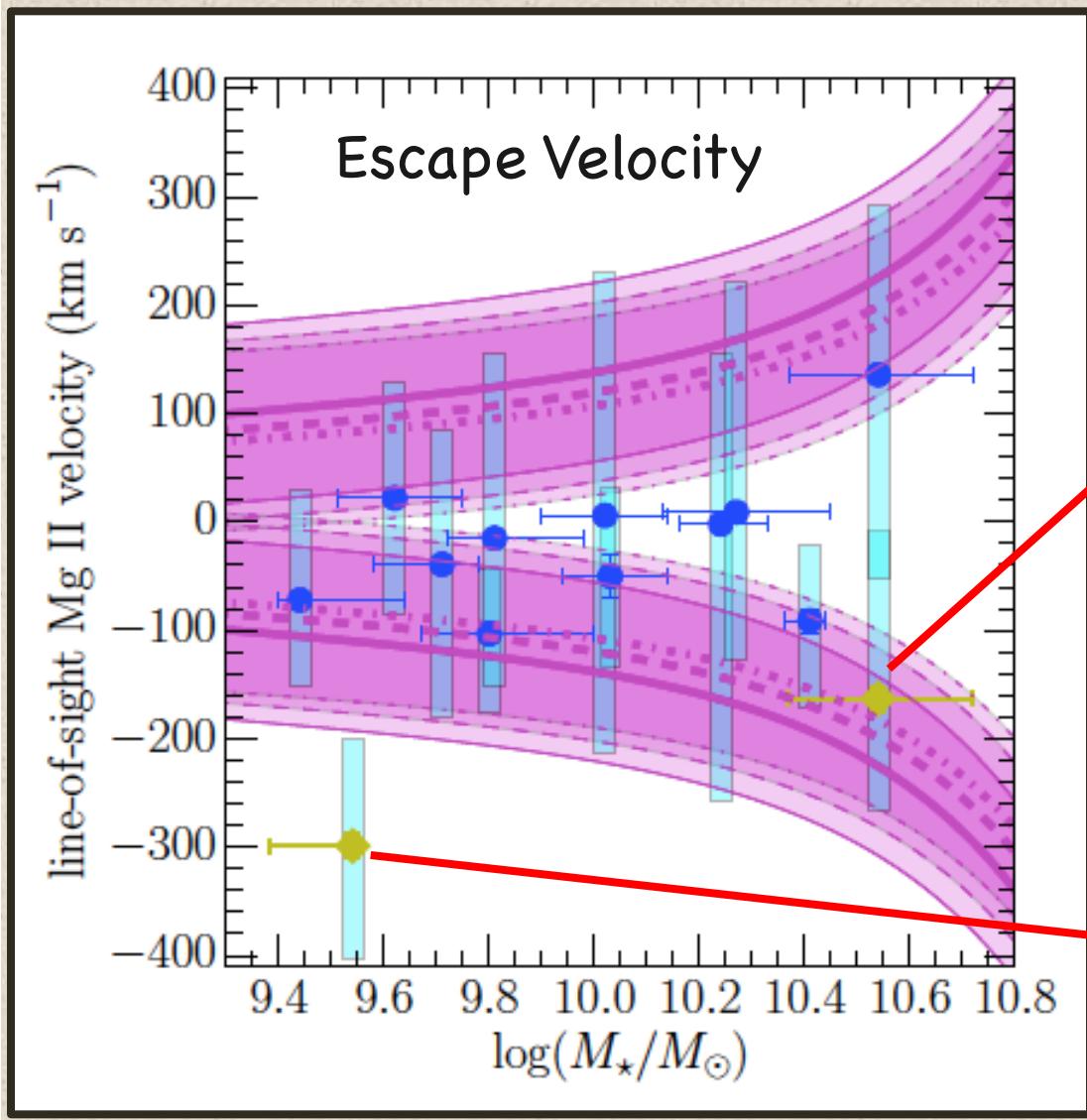


LRIS & APO Spectroscopy

- 15 quasar sightlines within 30 degrees of major axis
- Mg II 2796, 2803 absorption
- Galactic rotation curves from H α
- Galaxy colors, luminosities, and masses from SDSS

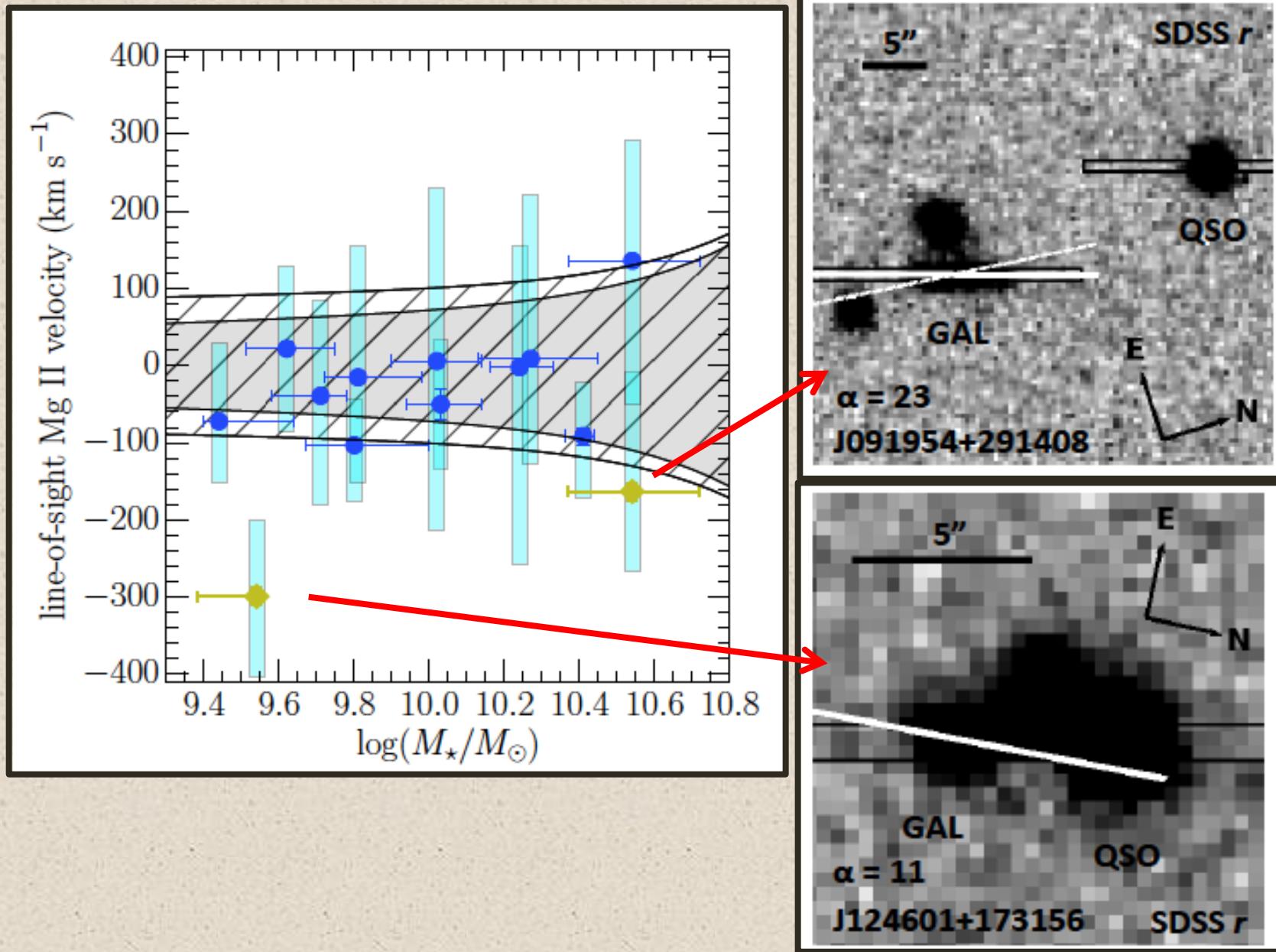


Gas Bound to Target Galaxies



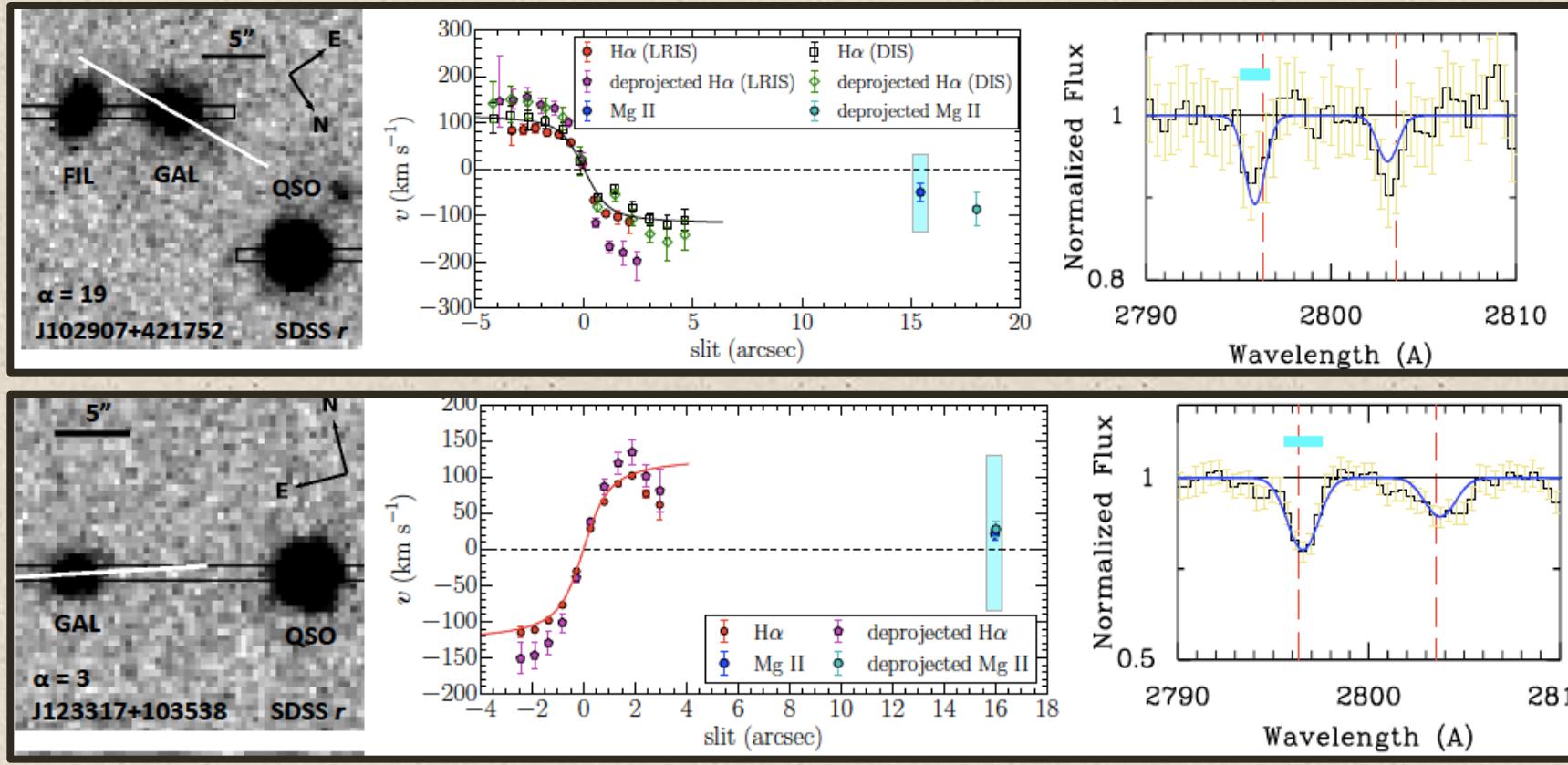
Stephanie Ho, CLM, Kacprzak, Churchill 2016

Line Widths → Virialized Gas

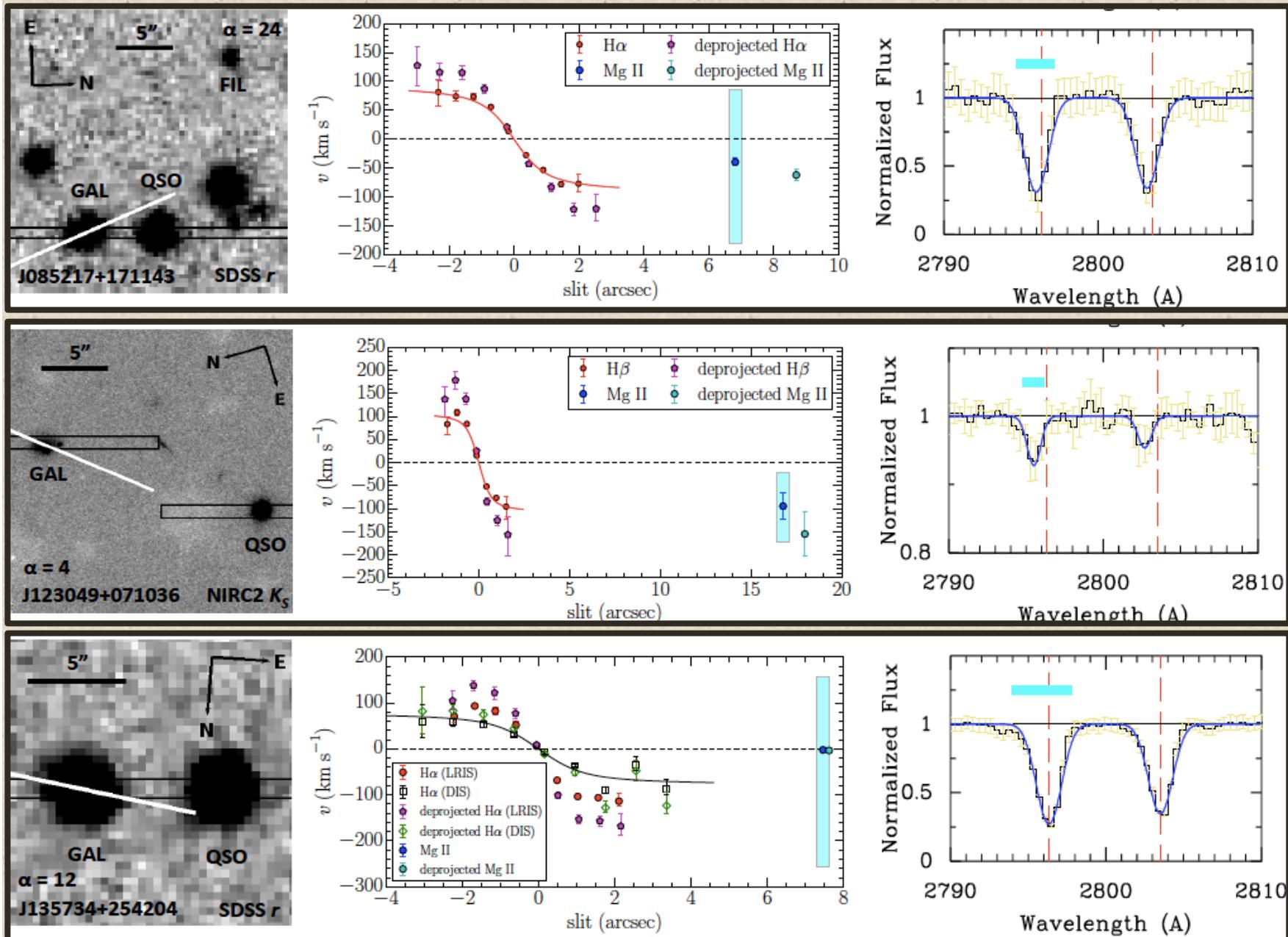


Mg II Doppler Shifts & Galactic Rotation

- Seven of 11 detections have a net Doppler shift.
 - Sign matches sign of galactic rotation in every case
 - Same result holds for the 3 $z=0.5$ systems (Steidel et al. 2002)
- Four systems have a net Doppler shift < 20 km/s.



Mg II Doppler Shifts & Galactic Rotation

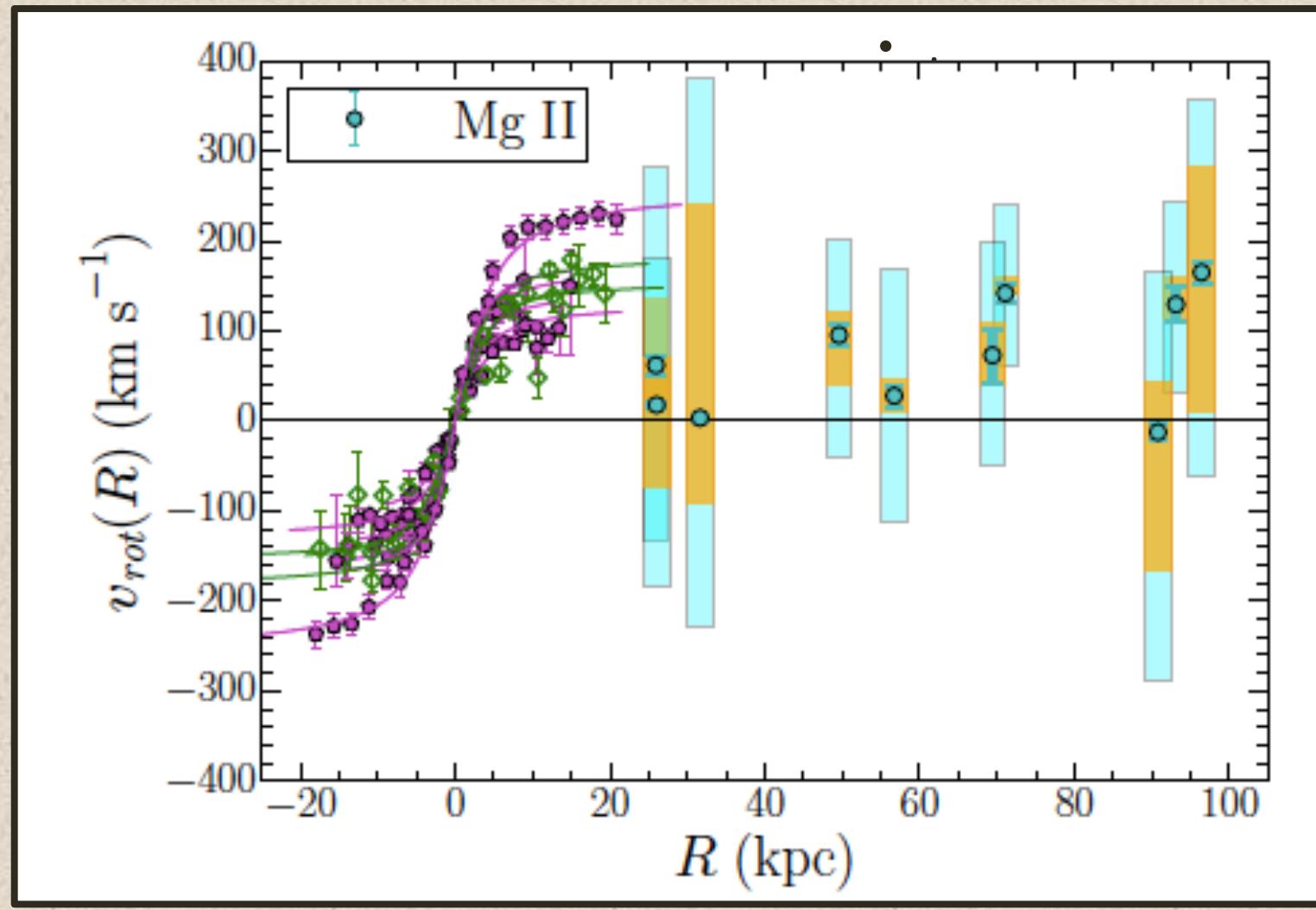


Stephanie Ho, CLM, Kacprzak, Churchill 2016

Keck QpG Survey: Dynamics of Circumgalactic Gas

Galaxy Rotation Curves

Mg II in Quasar Sightlines

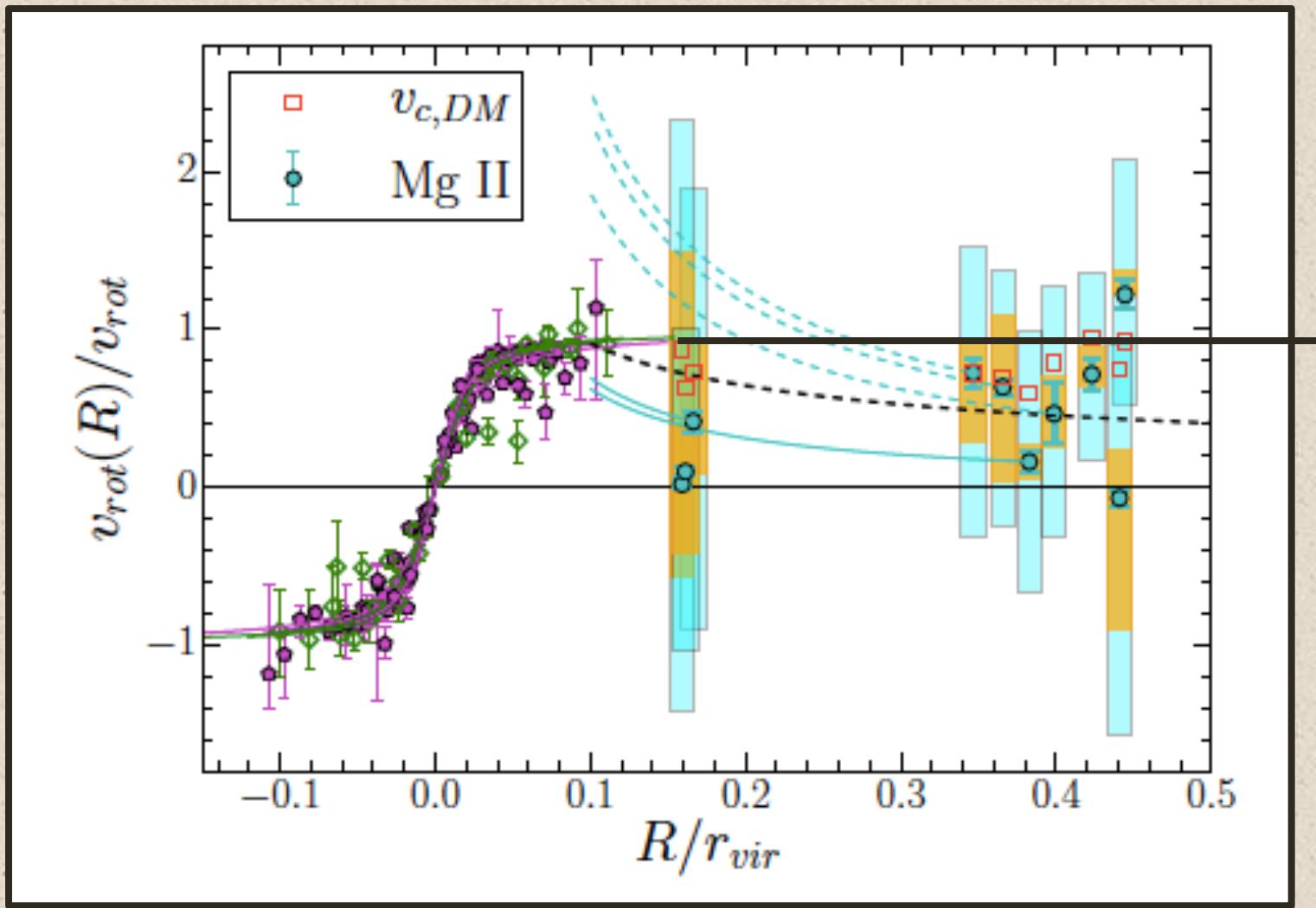


Stephanie Ho, CLM, Kacprzak, Churchill, Bouche

Keck QpG Survey: Dynamics of Circumgalactic Gas

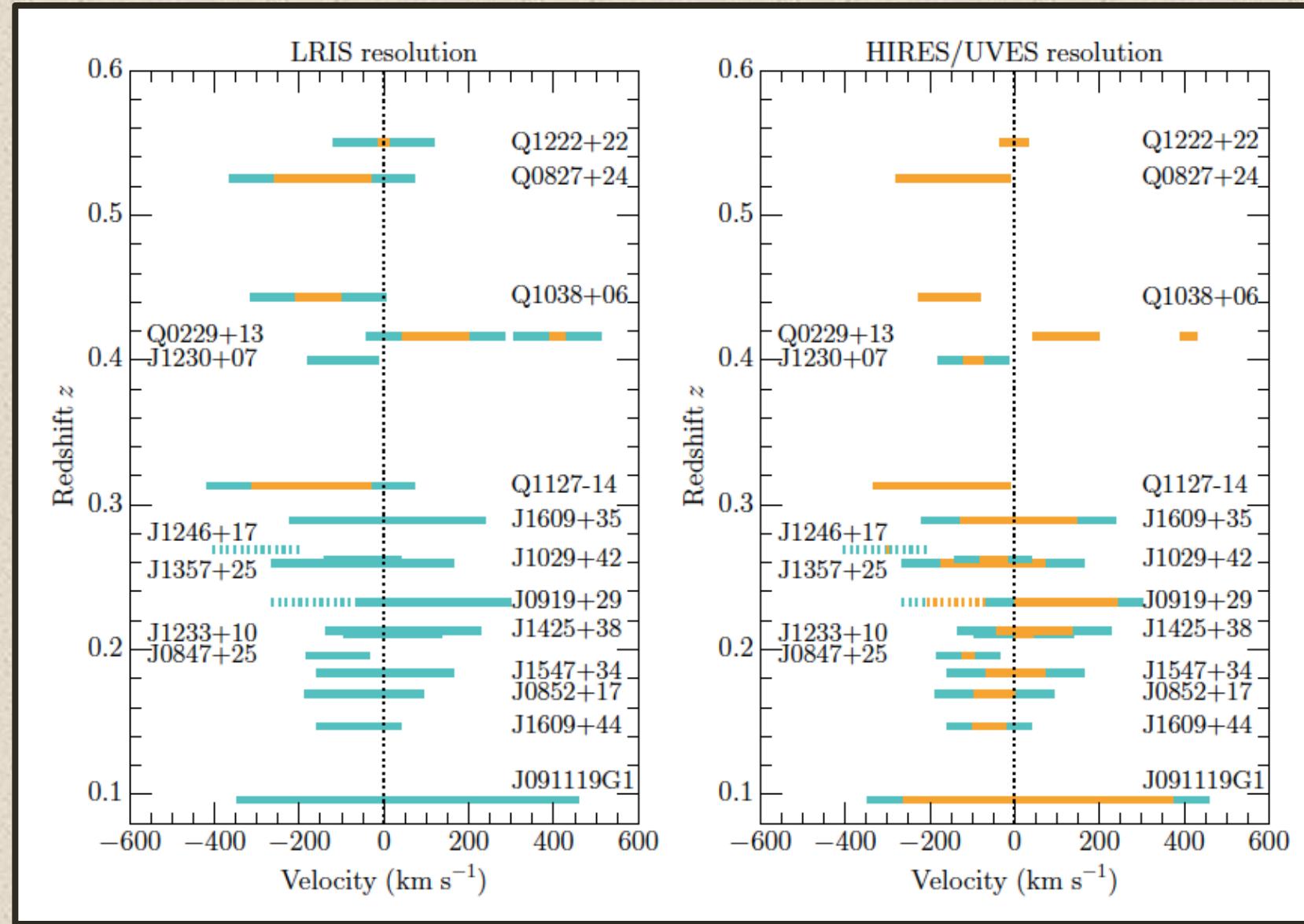
Galaxy Rotation Curves

Mg II in Quasar Sightlines



Stephanie Ho, CLM, Kacprzak, Churchill, Bouche

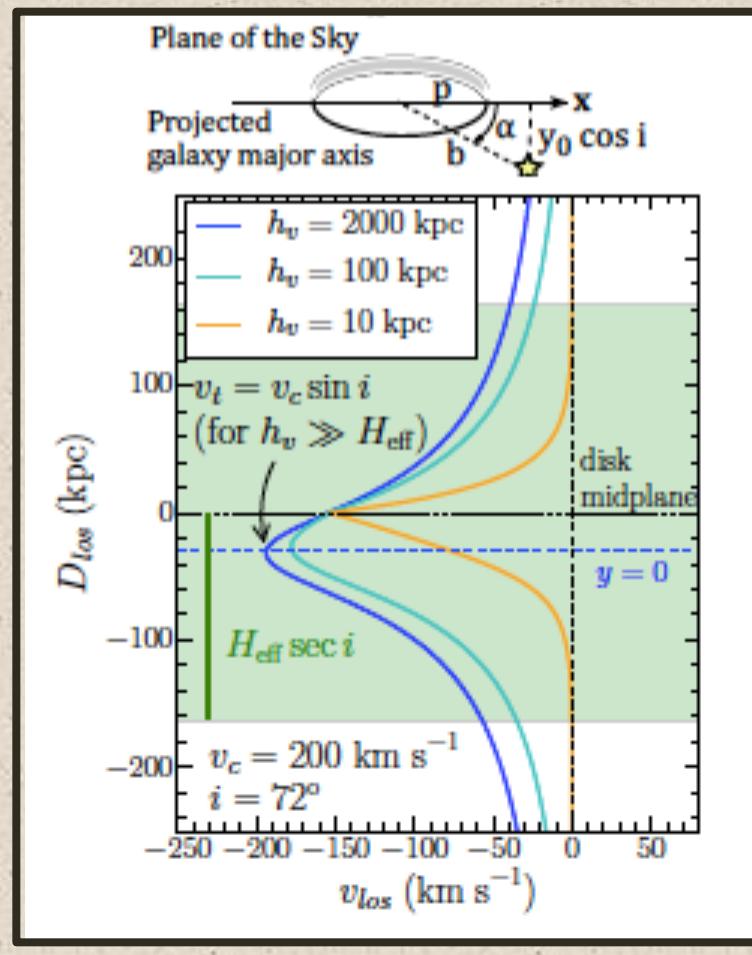
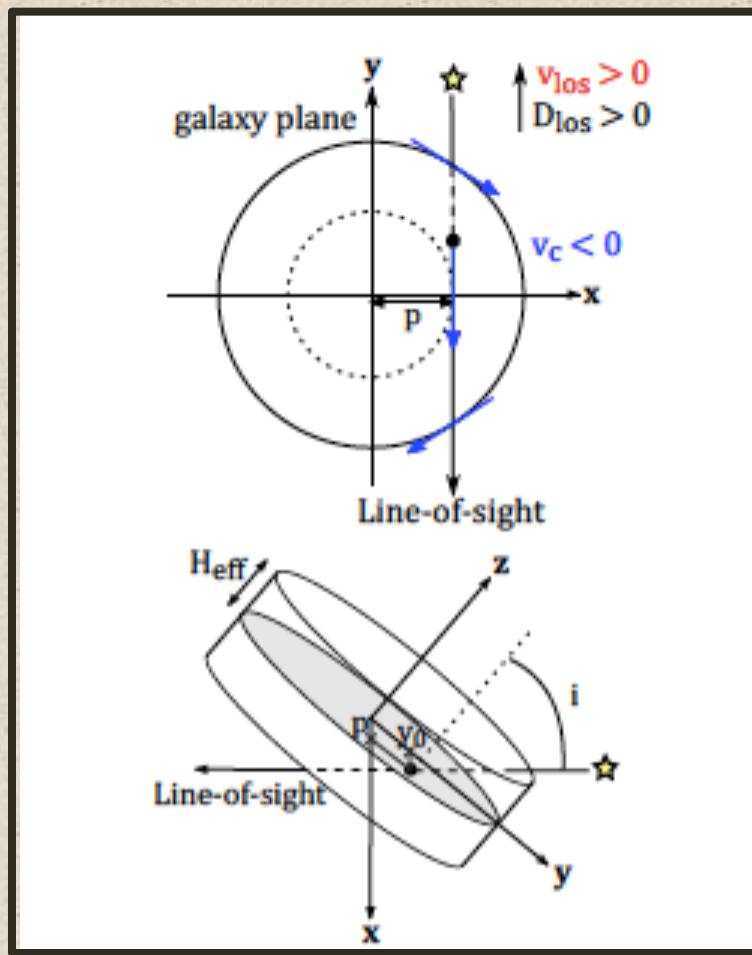
Line Widths Challenge Disk Models



Stephanie Ho, CLM, Kacprzak, Churchill, Bouche

Geometrical Model for Disk Absorption

- Disks cannot produce absorption on both sides of V_{sys} .
- Thin disks produce a narrow profile.
- Fitting disks models has awkward implications ($H_{\text{eff}} \approx r_{\text{vir}}$).

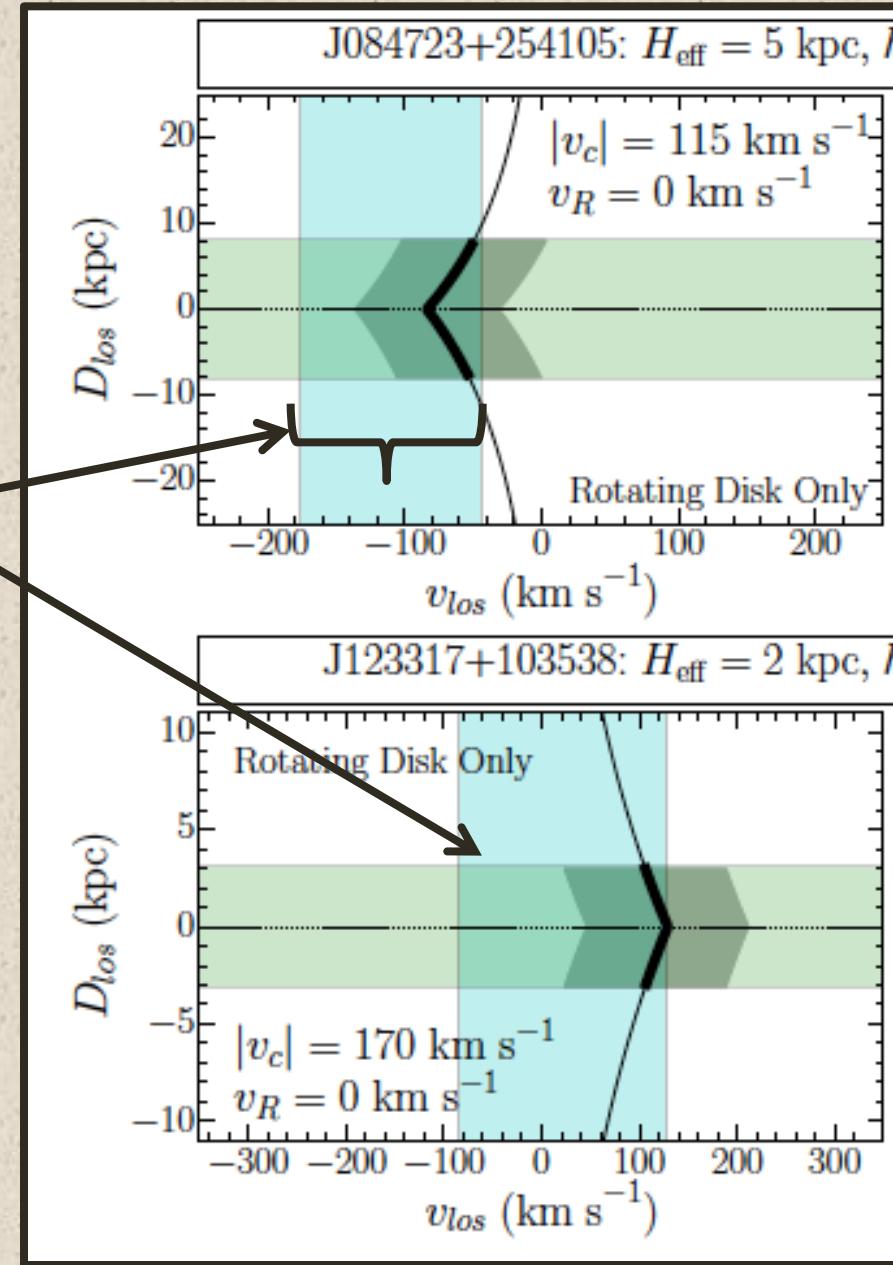


Two Examples Where Even a Thick Disk Fails

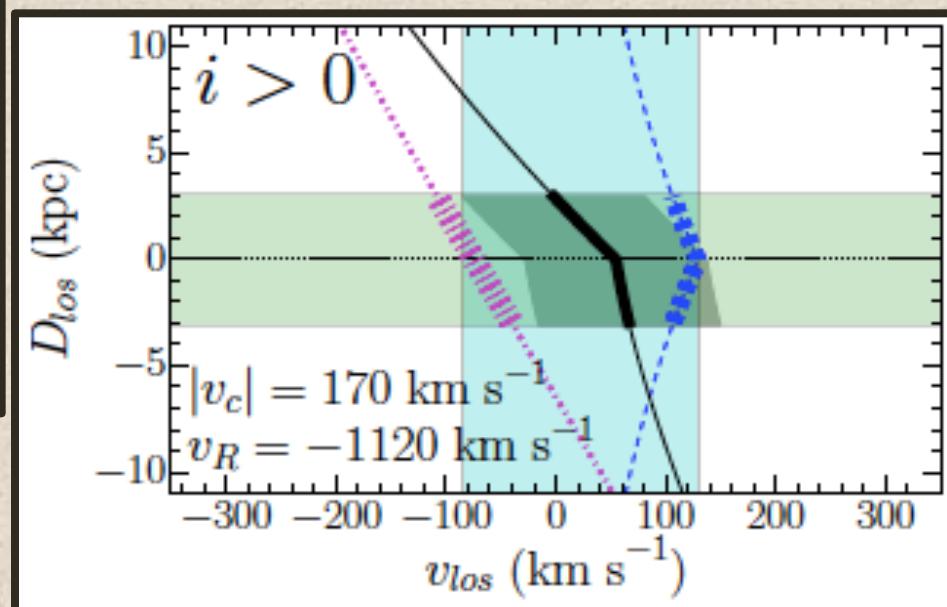
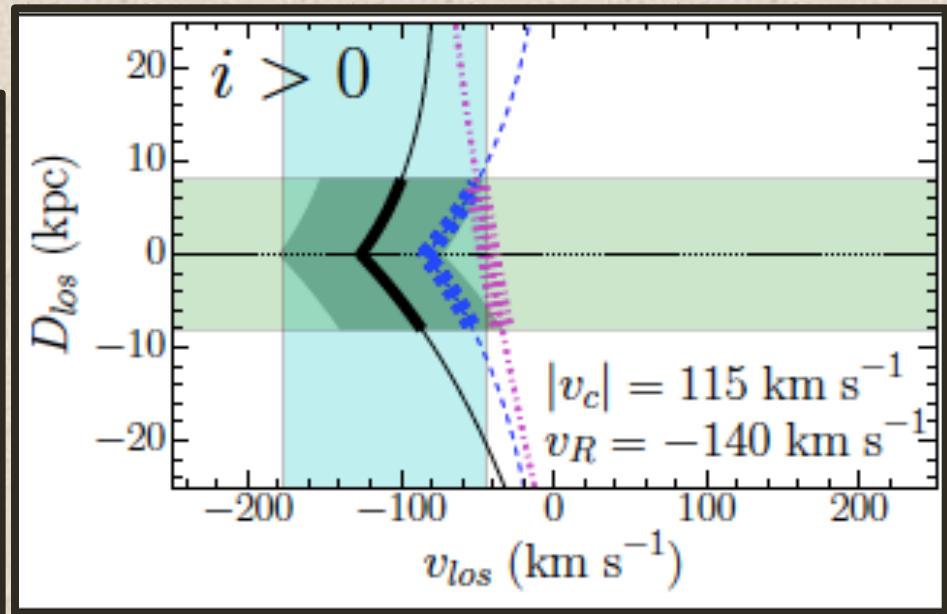
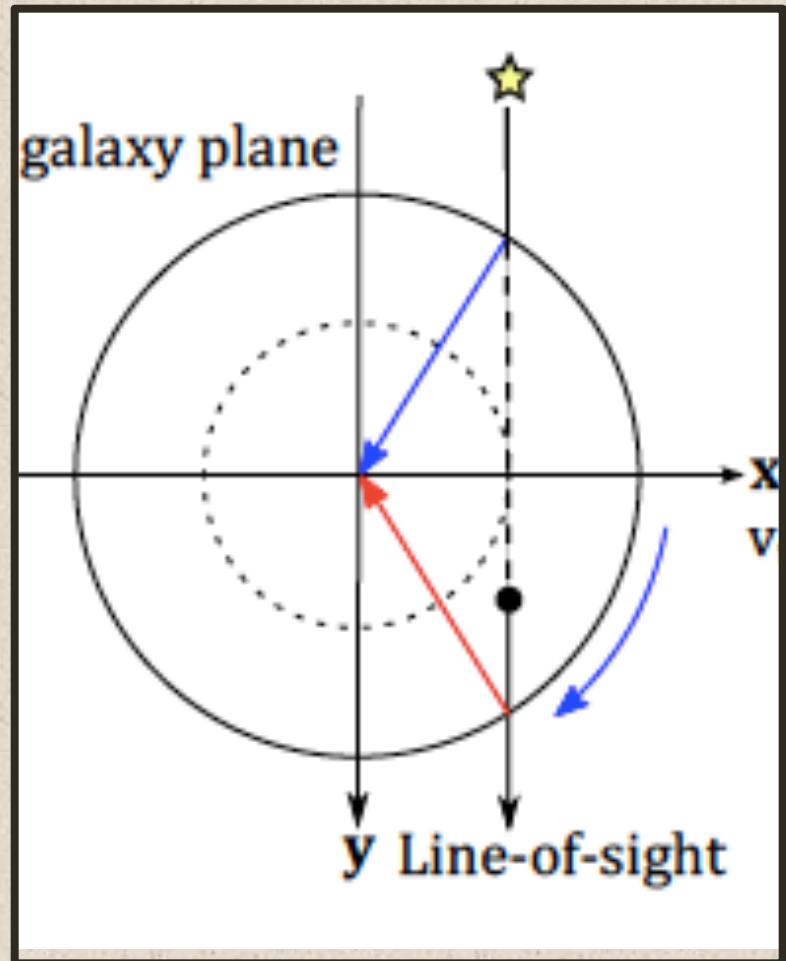
J084723+254105:
**Disk rotation is too slow
to produce observed
blueshifts.**

Observed Linewidth

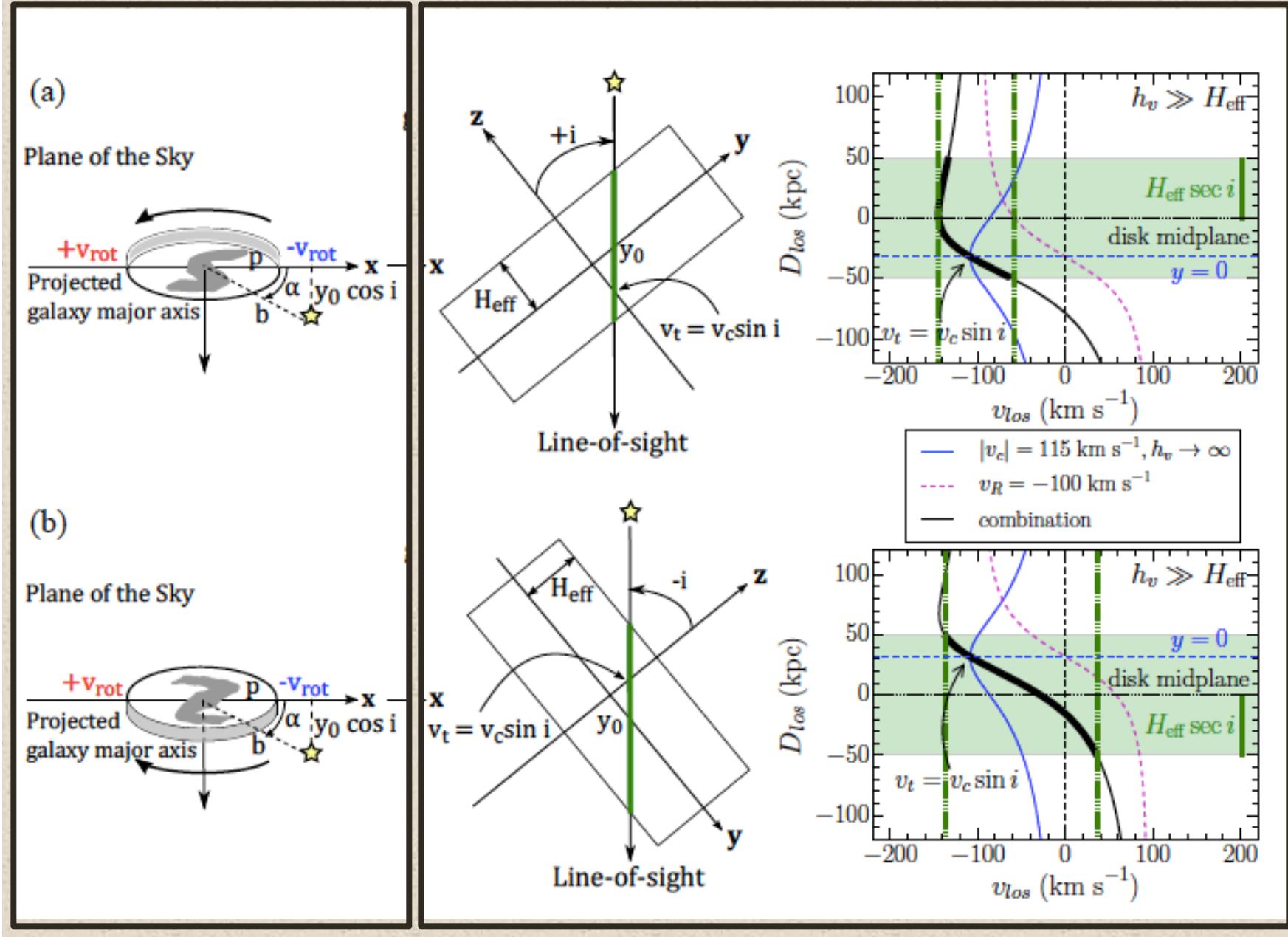
123317+103538:
**Disk rotation requires
larger redshifts than we
observe.**



One Solution: Radial Inflow in Disk Plane



Inflow Model Predicts Sign of Disk Inclination



Stephanie Ho, CLM, Kacprzak, Churchill, Bouche

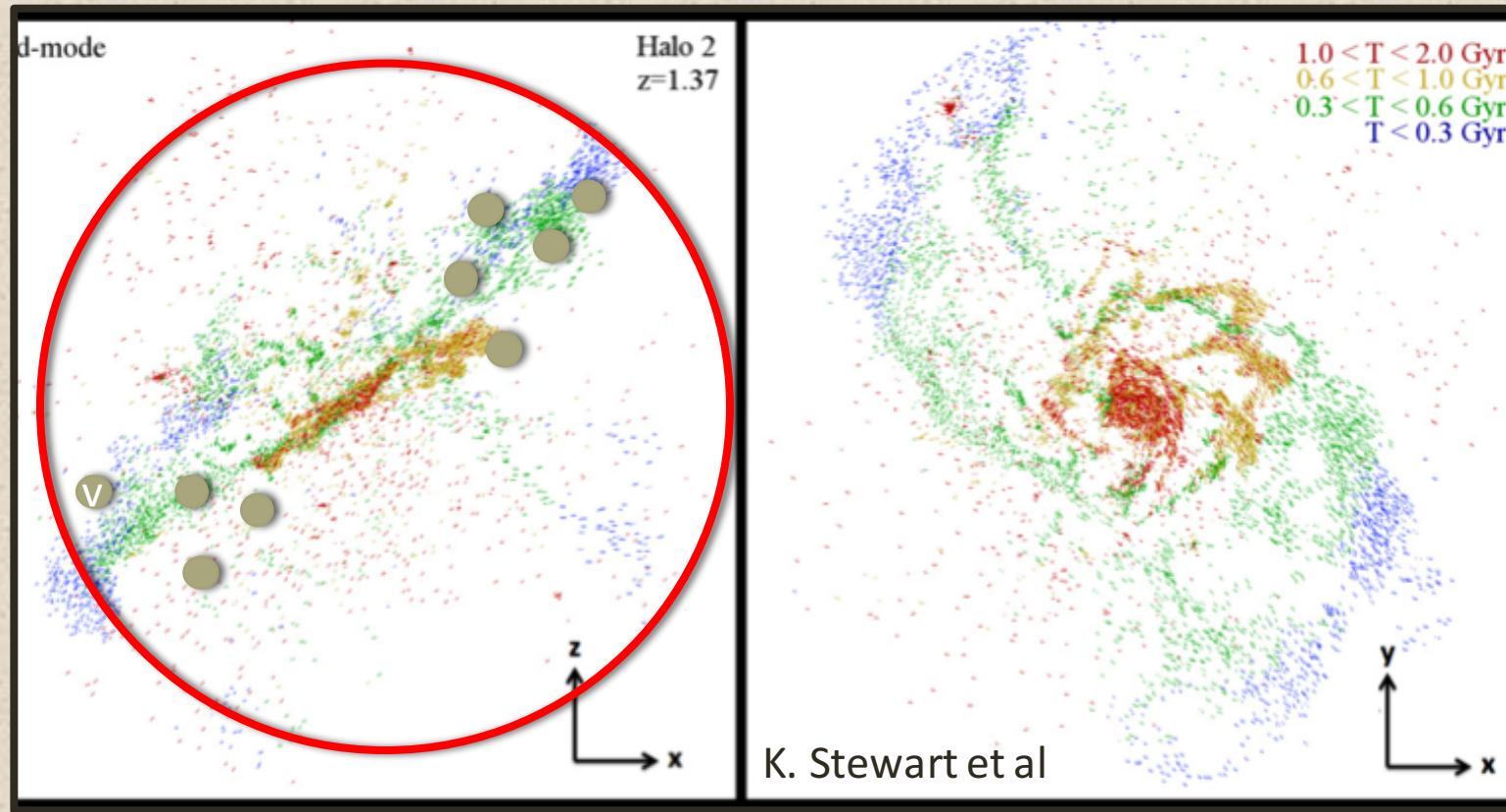
Summary: CGM Kinematics around Star Forming Galaxies

- The angular momentum of the inner CGM is at least partially aligned with that of the galactic disk.
- The equivalent widths near the major axis exceed those at random azimuthal angles.
- Simple, thin disk model fails to explain velocity widths.
 - Rotating, cylindrical CGM?
 - Disks with radial inflow component fit linewidths and Doppler shifts.

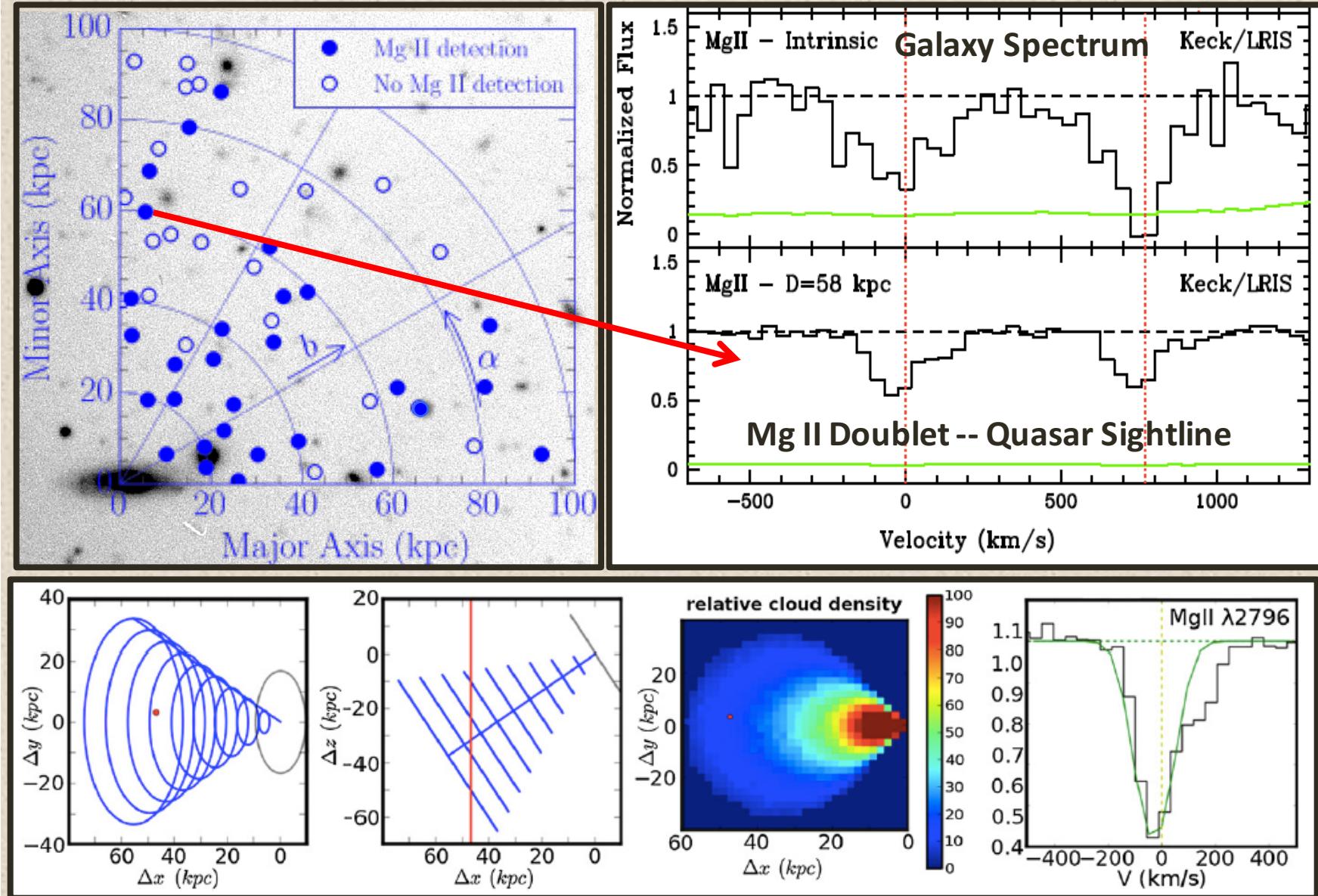


Implications: CGM Gas Dynamics

- Some of the inflowing gas from these circumgalactic disks reaches the galactic disk
- The infall prolongs the disk lifetime beyond a few Gyr.
- Quenching requires the elimination of the circumgalactic disk.



Quasars Probing Galaxiesp: Outflow Example



Fitted Model: $V = 40-80 \text{ km/s}$; $\text{SFR} = 5-15 \text{ Msun/yr}$; $\eta = 0.1-0.9$

QpG Survey (Martin + 2016)
Kacprzak, CLM, Bouche + 2014