

# Properties of the Nuclear Cluster in NGC 4395

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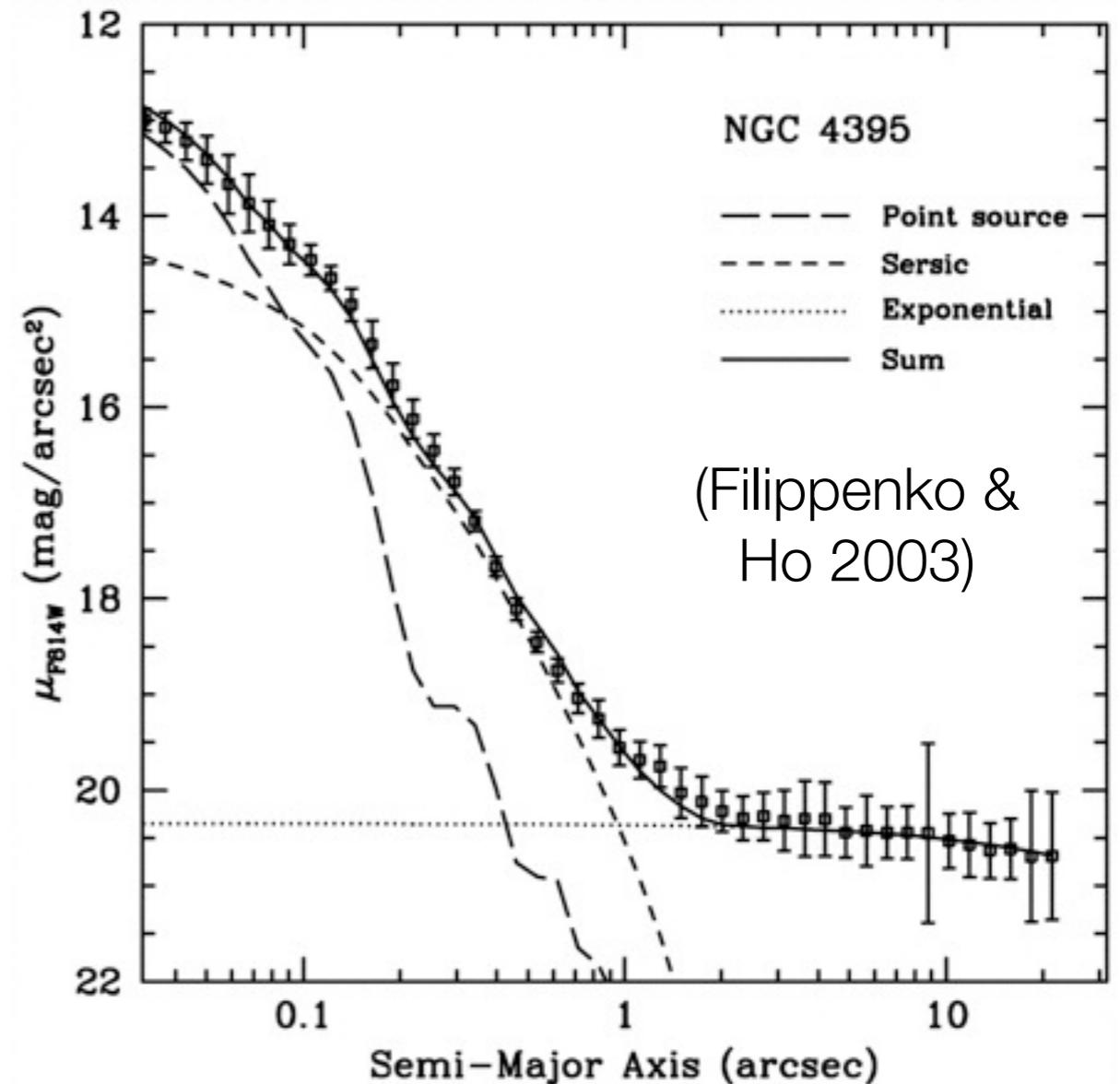
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# NGC 4395: a quick review

- Lowest-luminosity Seyfert 1 nucleus known (Filippenko & Sargent 1989), in a bulgeless, Sd-type host galaxy
- Nuclear cluster seen in HST WFPC2 images (Mathews et al. 1999; Filippenko & Ho 2003)
- BH mass from C IV reverberation is  $3.6 \times 10^5 M_{\odot}$  (Peterson et al. 2005)

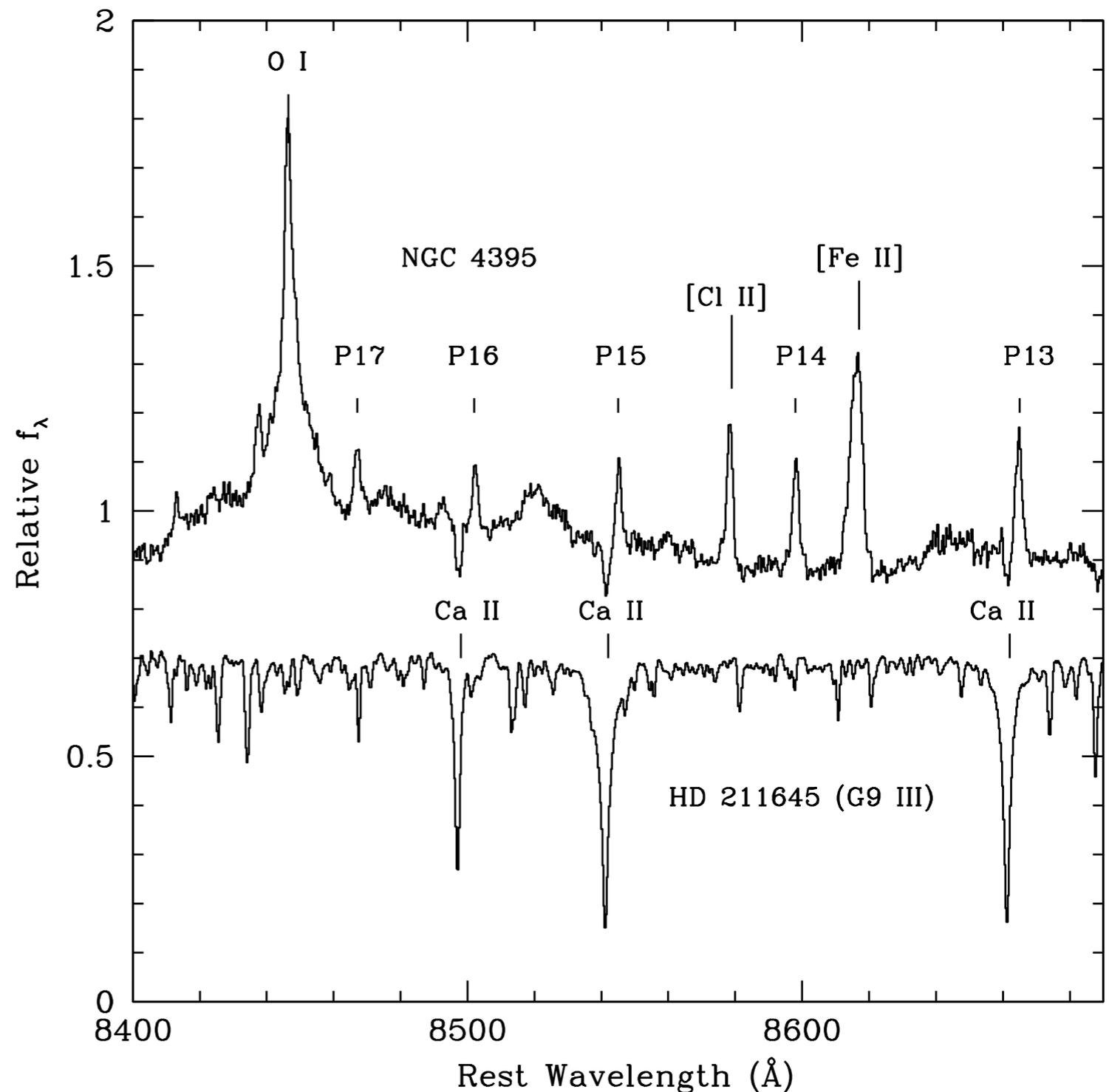


Can we obtain independent constraints on  $M_{\text{BH}}$  from the stellar dynamics of the nuclear cluster?

# The optical spectrum

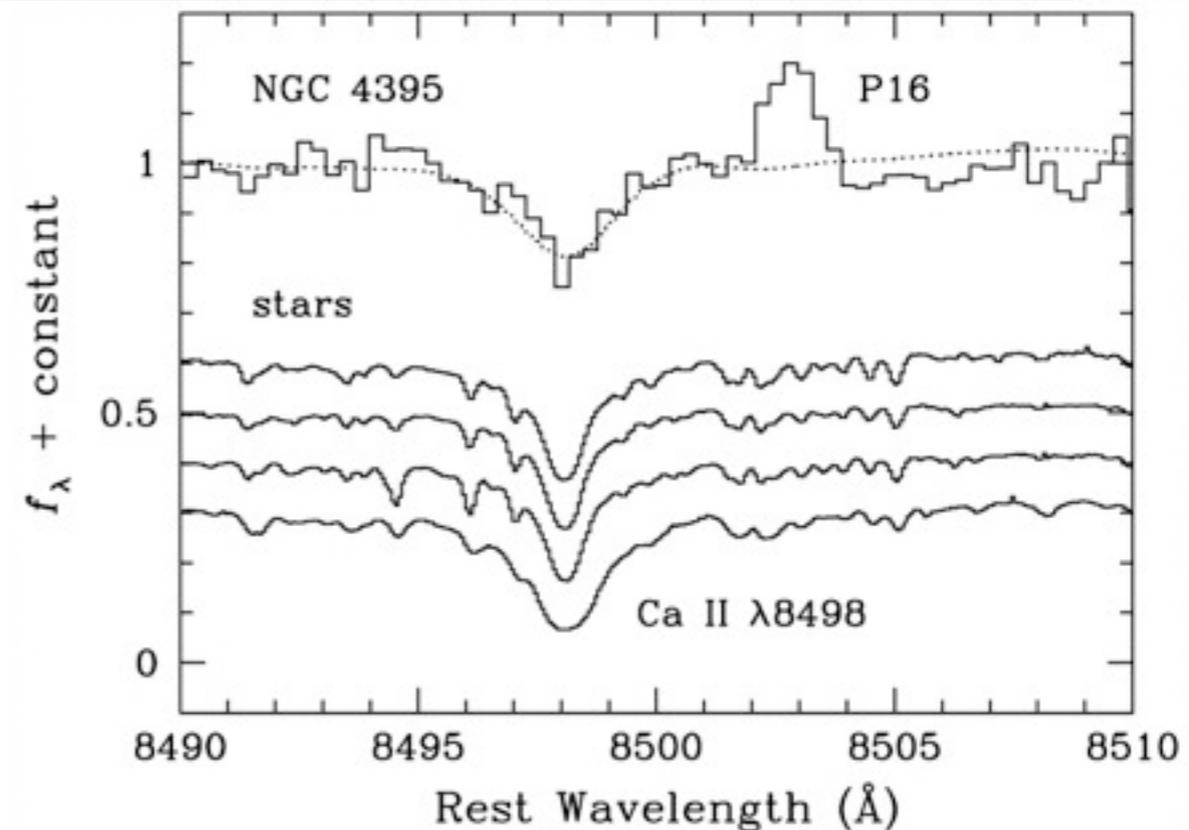
- In the blue, the nuclear spectrum is completely dominated by the AGN continuum
- At the Ca II triplet, the stellar features are heavily contaminated by high-order Paschen emission lines and diluted by the AGN continuum

It's very difficult to measure the stellar velocity dispersion accurately from the optical spectrum!



# Previous stellar-dynamical measurements

- Results from Filippenko & Ho (2003):
- Cluster  $r_e = 3.9$  pc
- $\sigma < 30$  km/s
- Total virial mass of cluster + BH:  
 $< 6.2 \times 10^6 M_\odot$

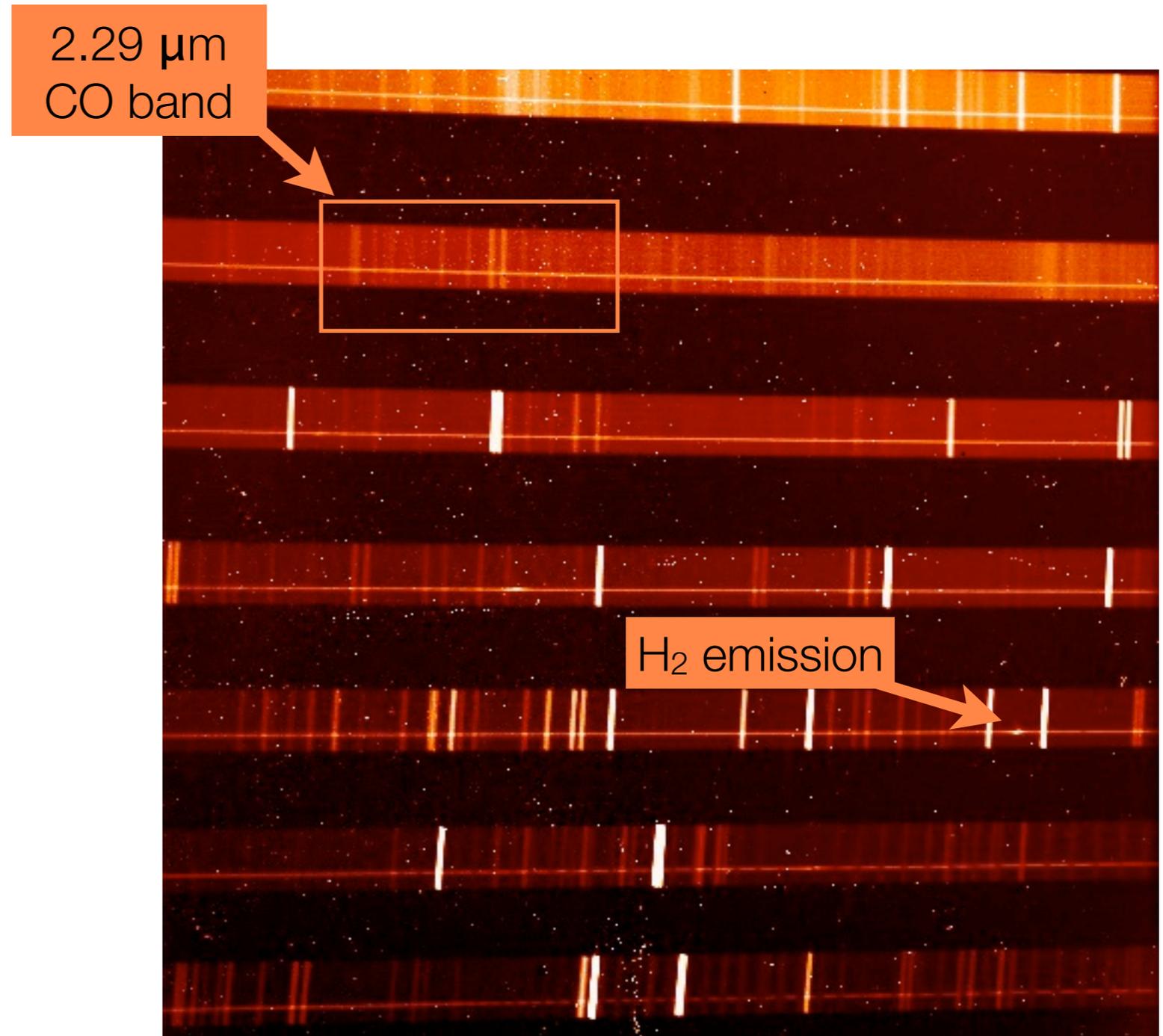


Our goal: to improve the stellar-dynamical constraints on  $M_{\text{BH}}$  by:

- Obtaining a definitive measurement of the stellar velocity dispersion
- Carrying out more detailed dynamical modeling

# The near-IR spectrum: new Keck NIRSPEC data

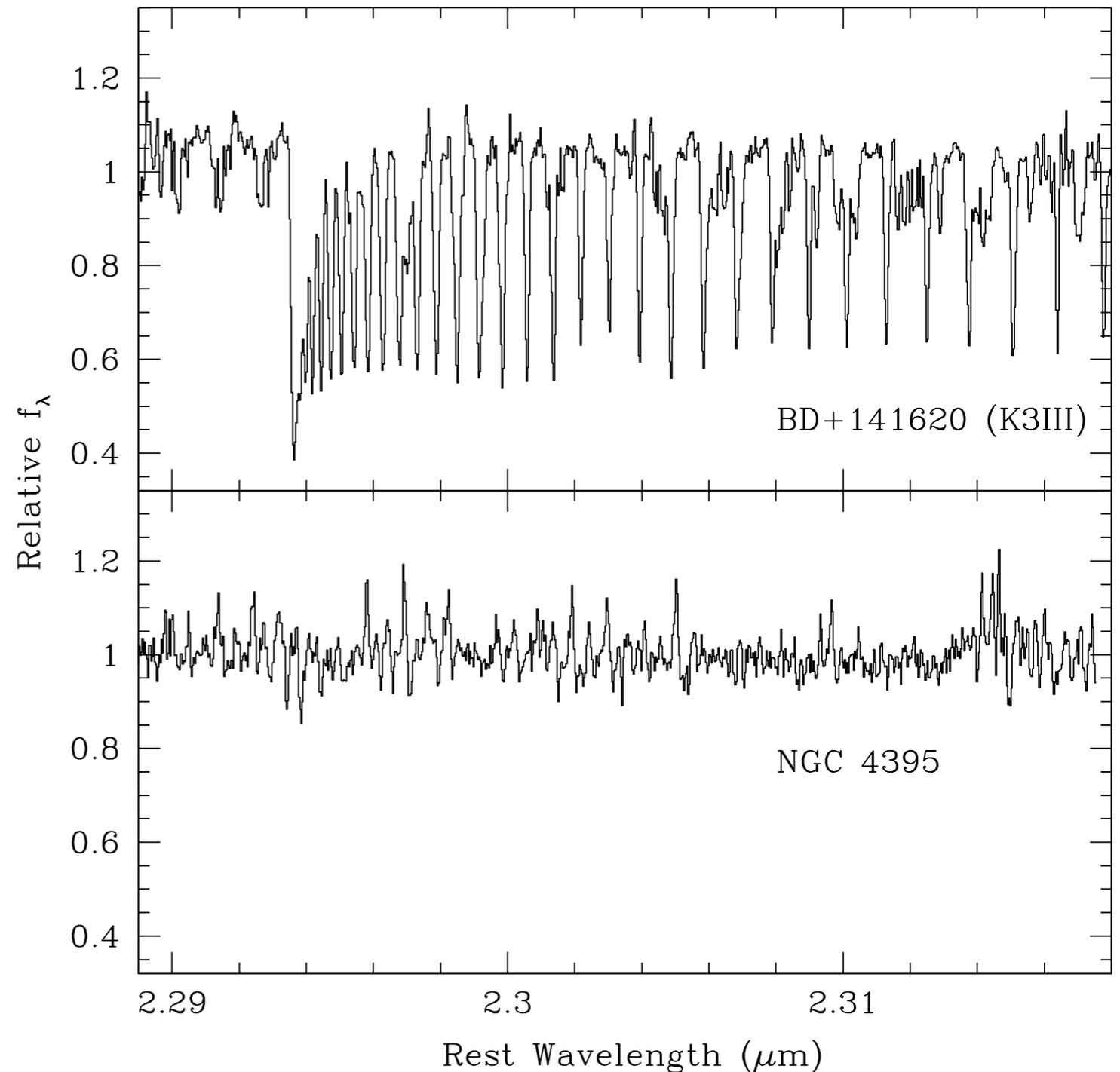
- CO band may be diluted by AGN & dust continuum emission but shouldn't be contaminated by emission lines
- Observed with Keck NIRSPEC echelle in March 2010
- $R \sim 13000$  with  $0.72''$  slit
- 2 hours on source in K band, and 2 hours in H band



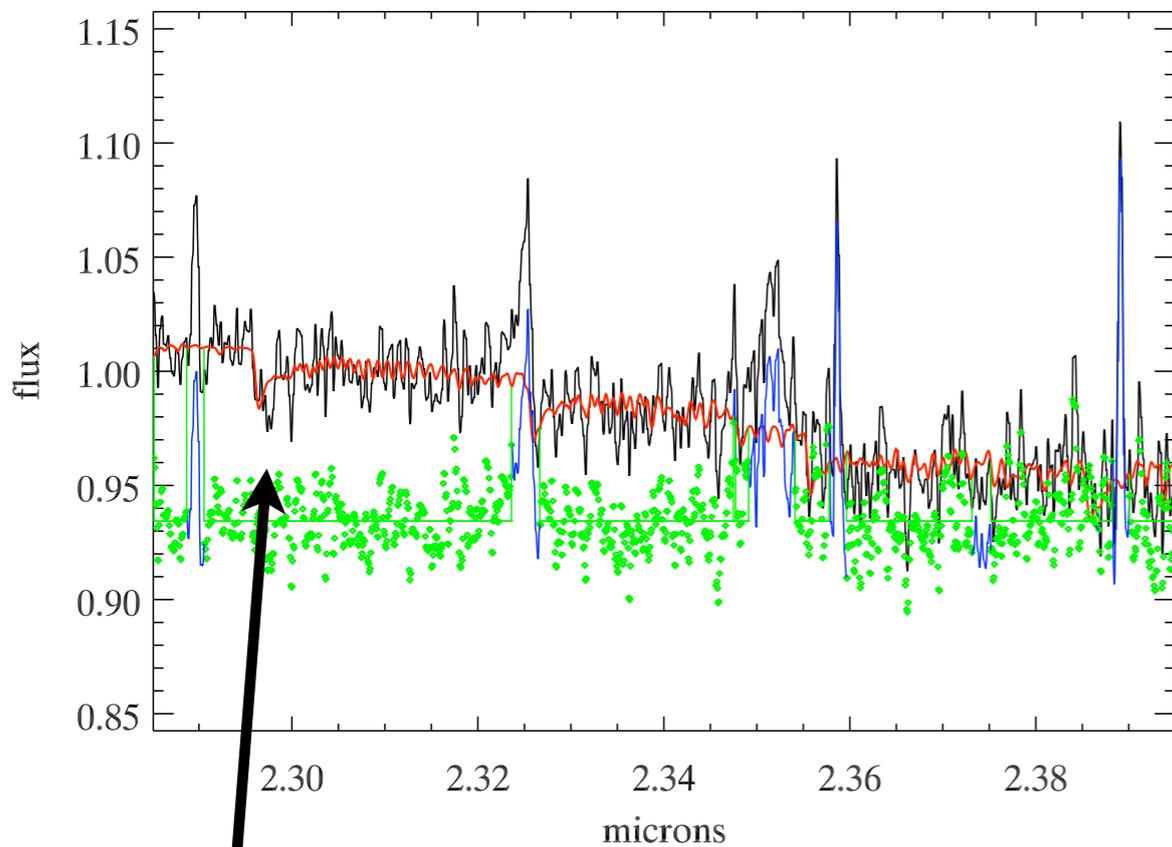
# Results so far...

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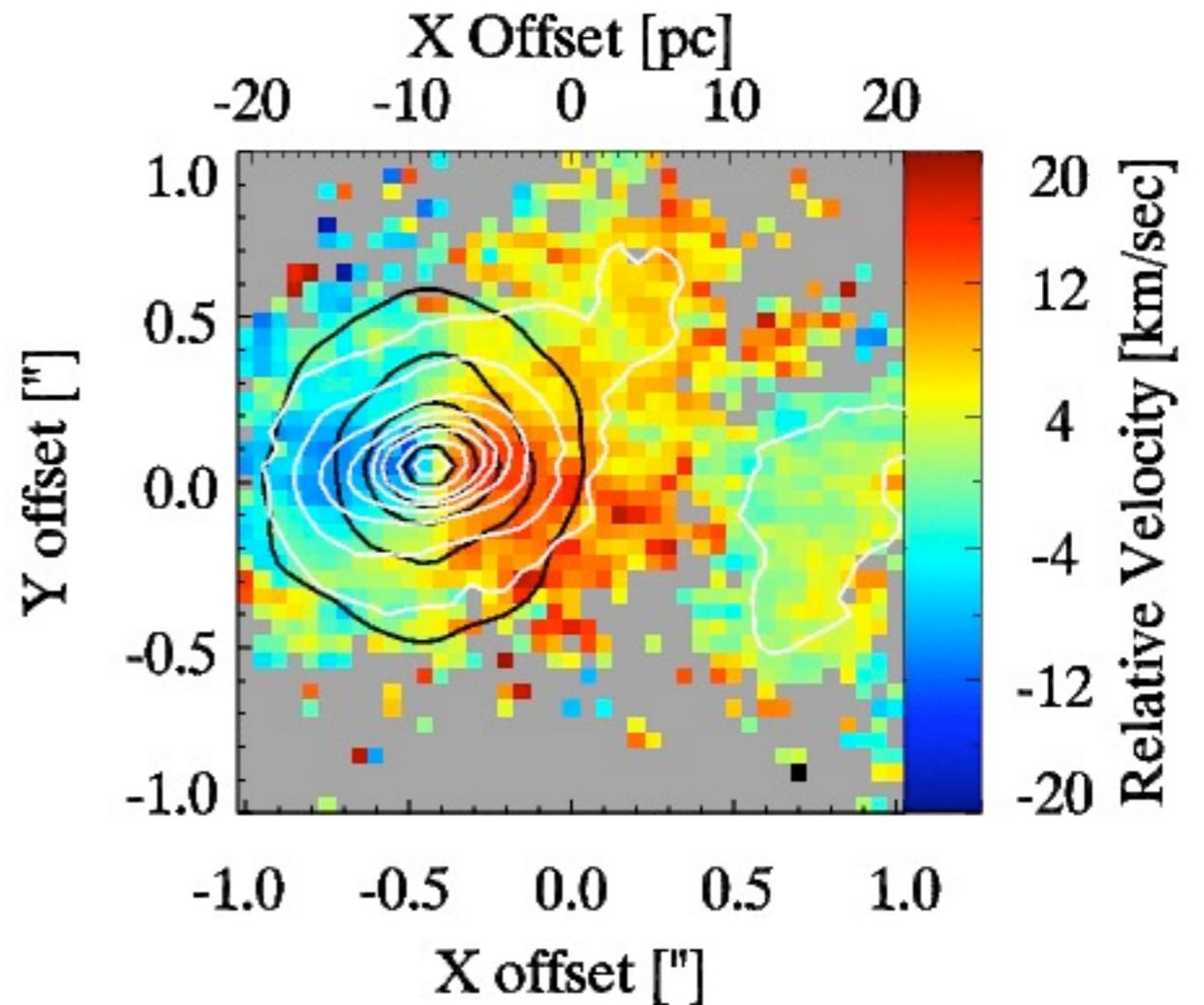
- We don't detect any significant absorption feature at the CO bandhead from the NGC 4395 nucleus; the hot dust emission dominates the spectrum
- This leaves us with few other options to measure the nuclear cluster kinematics



# Anil's Gemini IFU data: preliminary results



CO bandhead detected in  
an annular extraction of  
 $0.15''$ - $0.35''$



Rotational velocity field of  
H<sub>2</sub> emission

# The future: IRIS on TMT

- InfraRed Imaging Spectrograph: one of the first-light instruments for TMT
- AO-assisted IFU spectrograph / imager covering 0.8 - 2.3 microns
- IFU capabilities:
  - Lenslet IFU: 4 and 9 mas scales, FOV 0.5" - 1.15"
  - Slicer IFU: 25 and 50 mas scales, FOV 2.3"×1.1" and 4.6"×2.2"
- Primary mode will have R~4000; an R~8000 mode is possible and would be ideal for nuclear cluster dynamics!

