### Narrow-Line Region Outflows In QSO2s : Implications for quasar-mode feedback

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# AGN feedback believed to have role in M- $\sigma$ relationship







Mrk 573 - Fischer et al. in prep.



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Gemini K-band H<sub>2</sub> 2.12µm FOV ~3"x3"



Mrk 573 - Fischer et al. in prep.

[SIII] arcs are connected to nucleus by H<sub>2</sub> arcs

F

0

 $V_{max} =$ 

+/- 100 km/s

B



0

2



[SIII] .9533µm H<sub>2</sub> 2.1218µm

Knots of [SIII] and H<sub>2</sub> gas are interwoven near the edges of the NLR

> Inner surfaces of molecular gas arms are ionized when inside the NLR

High velocity ionized gas is localized, accelerated off molecular gas lanes





## Spatially-resolved NLRs often intersections between AGN ionization cone and host disk





### NLR outflows in nearby AGN likely not large enough for bulge evacuation

0

 $\bigcirc$ 

S

350 pc

0.7 Kp4

0.7 Kpc

Minimal projection effects max r<sub>true</sub> ~ 1.08r<sub>proj</sub>

### Do NLR outflows scale with luminosity?



## We looked at luminous QSO2s to determine the extent of their NLRs



# NLR extent scales with luminosity



## High velocity outflow kinematics in QSO2s still occur at radii < 1 kpc



Fischer et al. in prep.

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## Take Home

- Gemini NIFS IFU observations: Mrk 573 shows intricate relationship between ionized [SIII] gas inside the NLR and molecular H<sub>2</sub> gas outside the NLR.
- Extended NLR morphology and kinematics due to ionization of host disk material by the central AGN
  - Largely rotation + in situ acceleration of gas off fueling flows
  - Radially outflowing gas located in the plane of the disk —> allows direct measurement of maximum outflow radius
- HST/STIS observations: Nearby (z < 0.12), Iuminous QSO2s show kinematics and morphologies are comparable to nearby Seyferts (Fischer et al. 2010,2013).
  - NLR radial extent scales with AGN luminosity, however, outflows still do not reach distances required in bulge evacuation/quenching scenarios.

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### "This is the end, my beautiful friend"

-The Doors





Fischer et al. in prep.

### Different kinematic profiles exist as a function of radius



 $\begin{array}{ll} \mbox{ign} r < 500 \mbox{ pc}: evacuation \\ r < 1000 \mbox{ pc}: ablation \\ \mbox{0} r > 1000 \mbox{ pc}: illumination \end{array}$ 

#### CLOUDY photoionization models using parameters from Kraemer+ 2009



#### Different kinematic profiles exist as a function of radius

Mrk 573



 $\begin{array}{ll} \mbox{if} r < 500 \mbox{ pc}: evacuation \\ r < 1000 \mbox{ pc}: ablation \\ \mbox{0} r > 1000 \mbox{ pc}: illumination \end{array}$ 













### AGN feedback may be more frequent than originally thought



Disk (Fischer) + Spherical outflow (Liu) = disk ablation?

