
G. Cresci for the
INAF – Arcetri
Università di Firenze
BLACKOUT team
BLACK
OUT

INAF – Arcetri
Università di Firenze
BLACKOUT team

Staff:

A. Marconi – UniFi
G. Cresci – INAF
F. Mannucci – INAF
(P. Tozzi – INAF)




Post-doc:

G. Venturi – PUC/INAF
S. Carniani – SNS/INAF
A. Marasco - INAF

Postdoc 1 – UniFi – position out *
Postdoc 2 – INAF - 2021

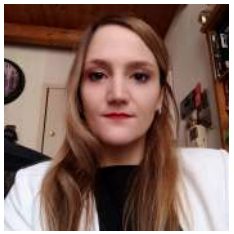




Students:

A. Amiri - UniFi – ciclo XXXV
G. Tozzi – UniFi – ciclo XXXVI
(M. Mingozzi – UniBo-> STScI)



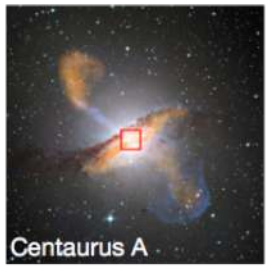


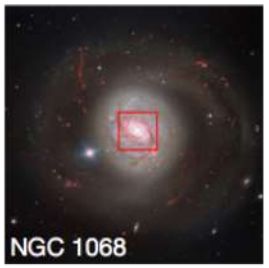
*https://titulus.unifi.it/albo/viewer?view=files/003551648-UNFICLE-c04403f8-f6d2-492d-96a5-a53b1d682a9b-000.pdf

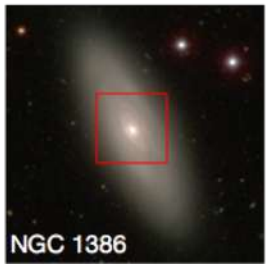
MAGNUM: Measuring Active Galactic Nuclei Under MUSE Microscope

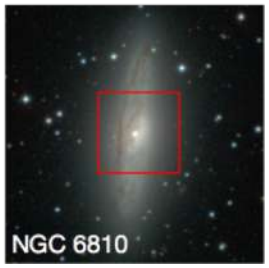
- Targeting Nearby AGNs (D < 50 Mpc) observable from ESO with MUSE
- Seeing limited (~1”):
  15 pc (@4Mpc)
  115 pc (@30Mpc)
- so far 10 objects observed (900,000 spectra!!) + many others in the archive
- Multi-wavelength data available: *Chandra, XMM-Newton, Alma, Galex, HST, Spitzer, Herschel,Radio…*
- ALMA CO follow-up program MAGNUM-FEAR *(PI. S. Carniani, see SNS talk)*

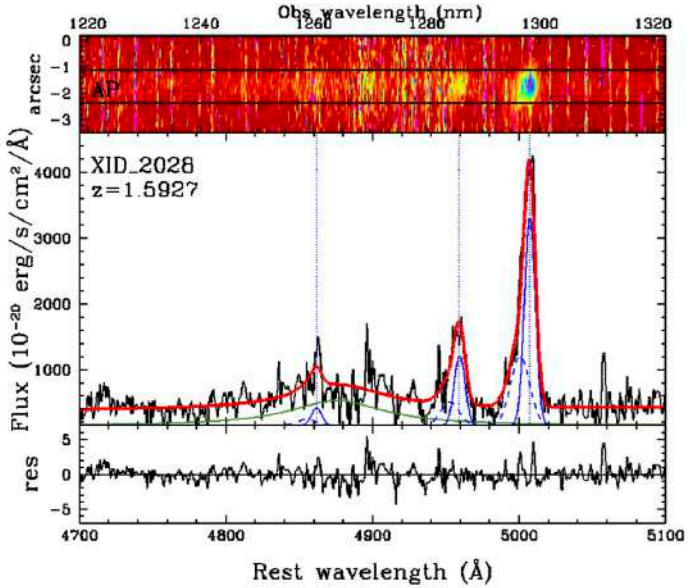
PI: A. Marconi (Univ. Firenze)





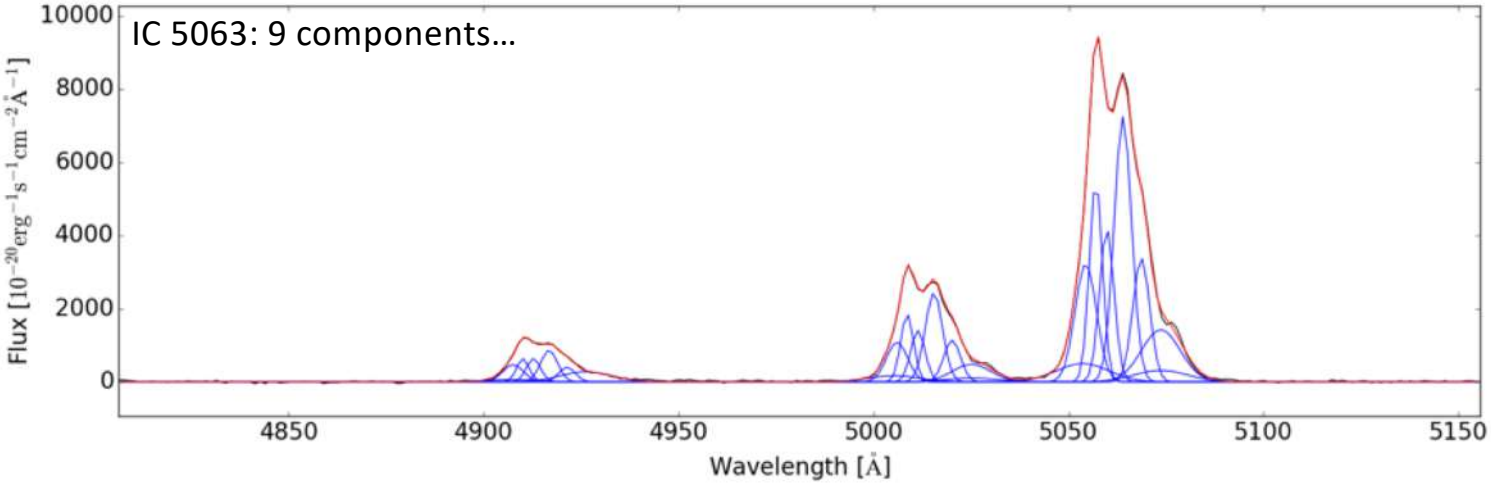




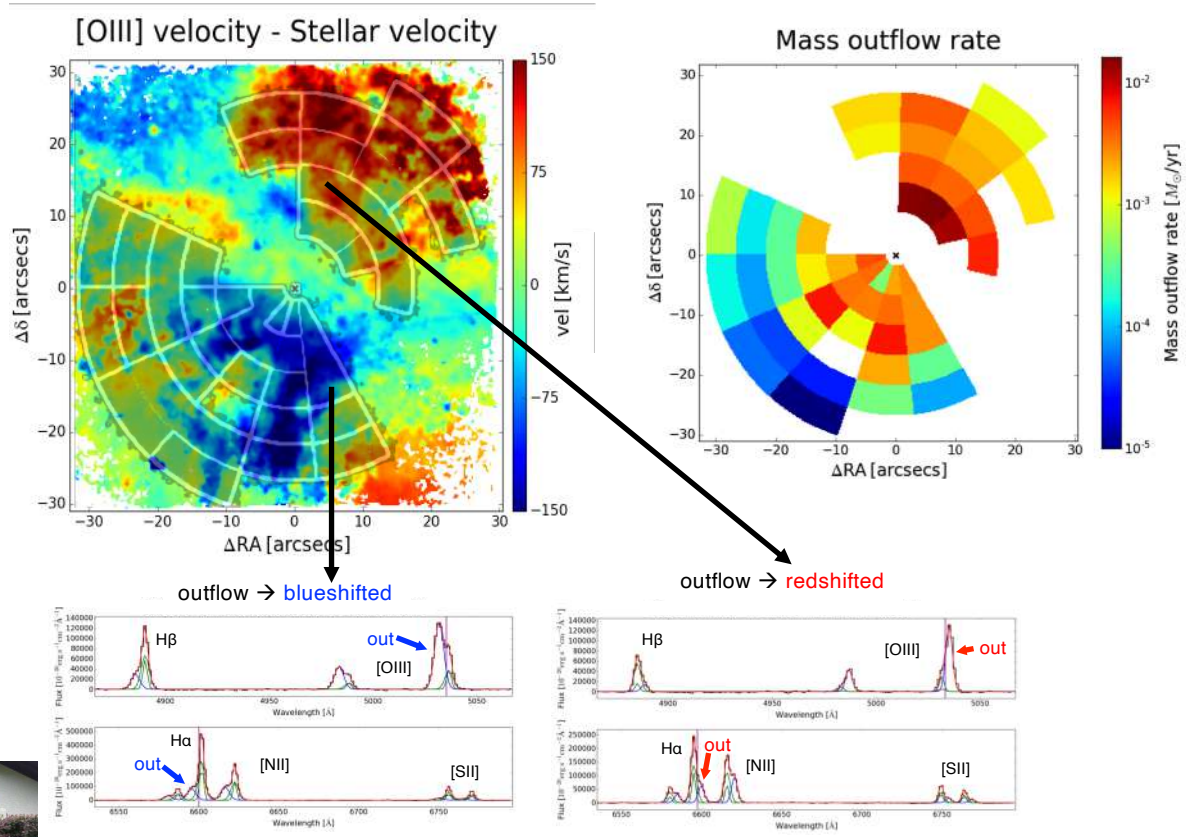


A great idea ??

"From the frying pan into the fire"…



NGC1365: Mapping the mass outflow rate



Venturi et al. 2018

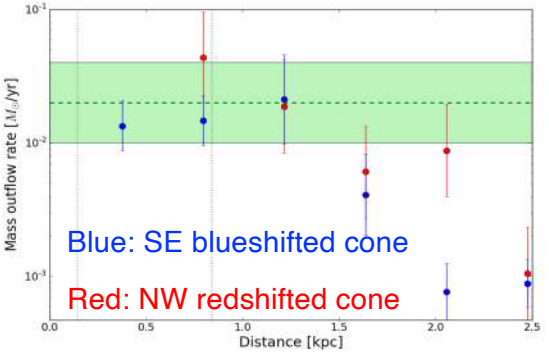
Mass outflow rate comparable to nuclear X-ray wind

($v \sim 3000$ km/s)

from Fe XXV and Fe XXVI absorption lines $\dot{M} \sim 0.04\ M_\odot/\mathrm{yr}$

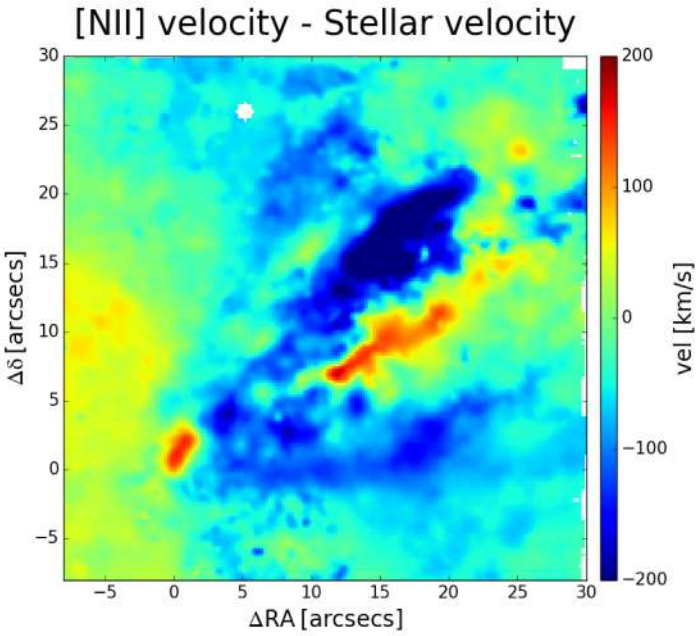
Mass outflow rate decreases at larger distances

AGN activity stronger in the past?



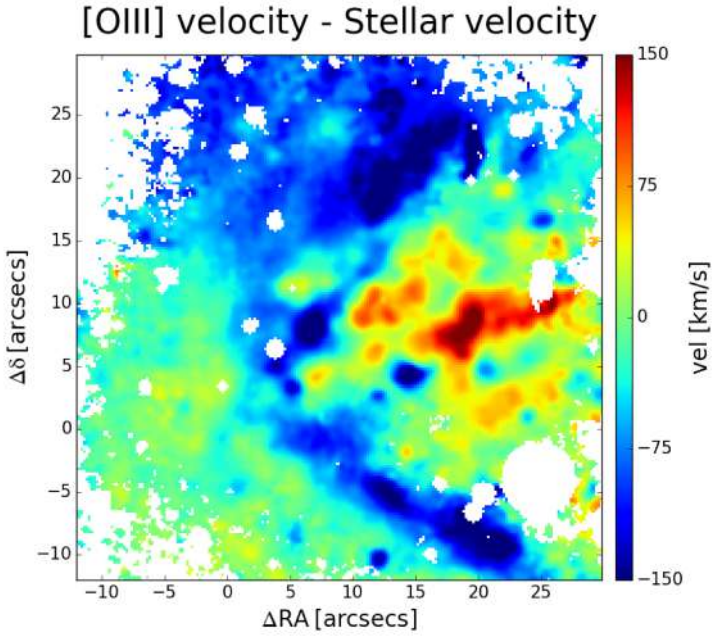
Modeling ionized gas kinematics

NGC 4945

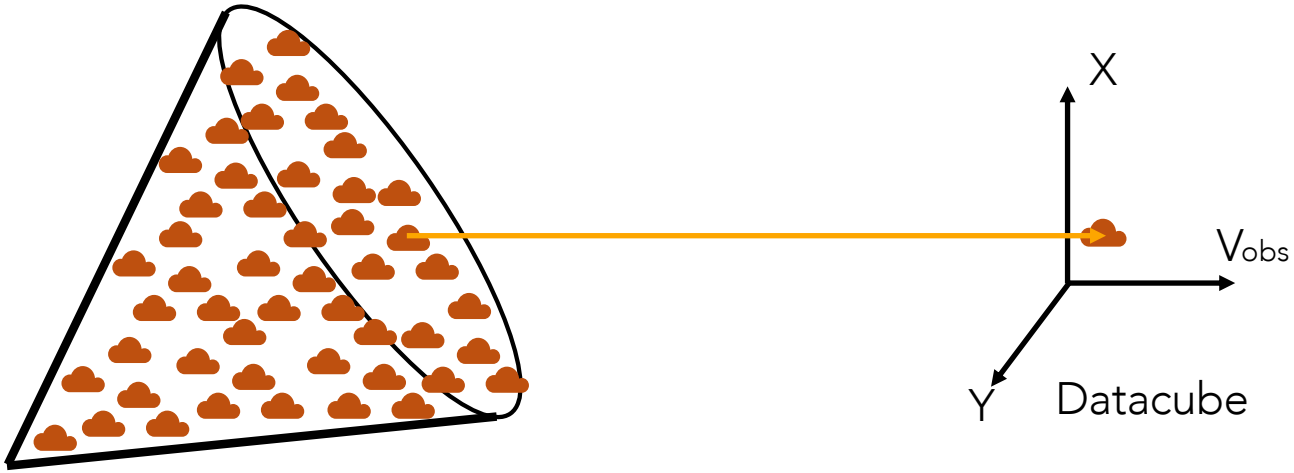


But velocity fields are complex: real motions or effect of clumpy line emission?

Circinus



Next generation kinematical model



Montecarlo "cloud" model, assumed velocity field

Takes into account all geometrical projection effects and observational effects (e.g. beam smearing, binning, etc.)

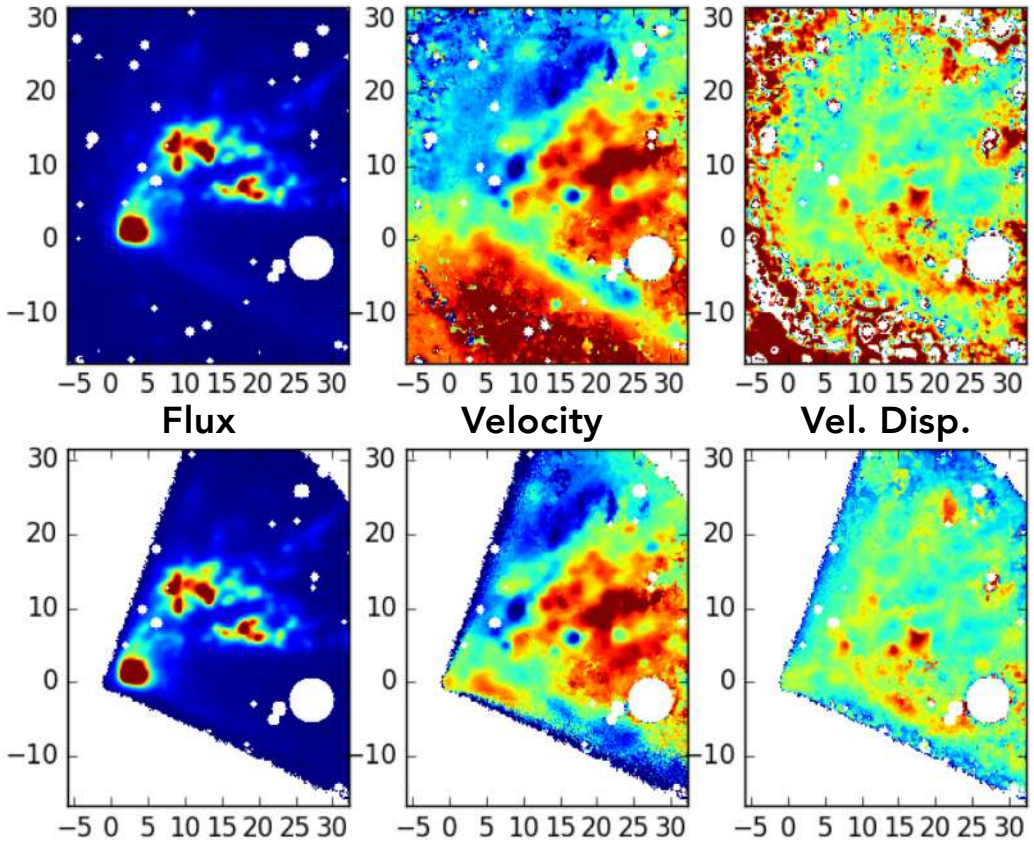
Weigh clouds according to measured flux in spaxel where cloud is "observed"

Extremely versatile: allow tomographic reconstruction of 3D structure following assumption of velocity field

Marconi et al., in prep.

Next generation kinematical model

Circinus galaxy - MUSE observations, MAGNUM survey



Marconi et al., in prep.

Wrong cone orientation + aperture, outflow velocity

Right cone geometry and outflow velocity model reproduces observations

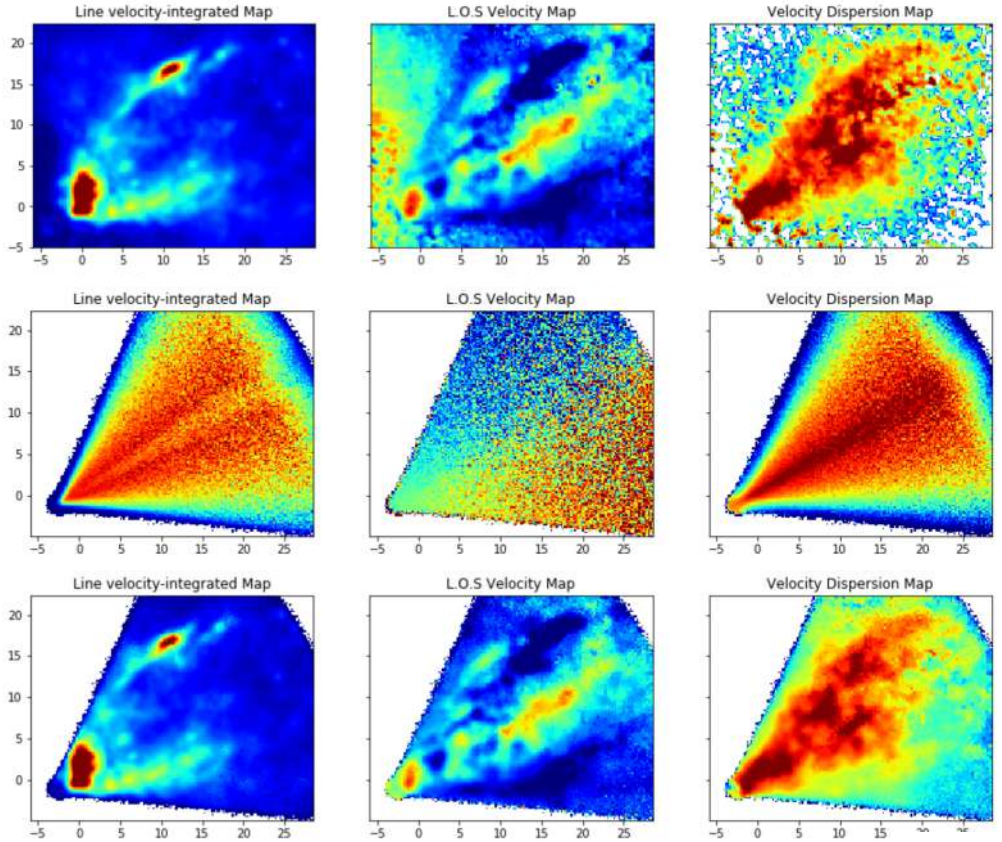
Next generation kinematical model

NGC4945 MUSE observations, MAGNUM survey

Observed

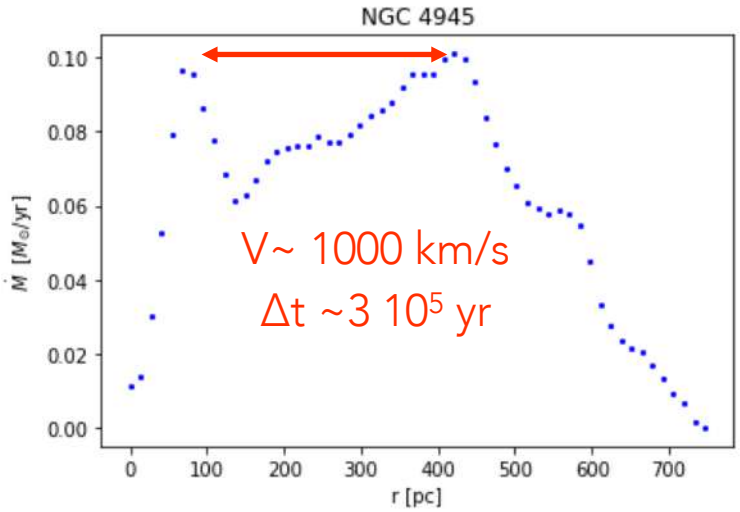
Model Unweighted

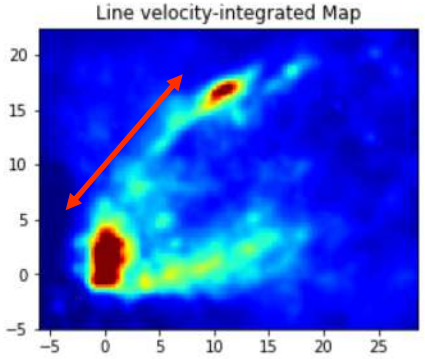
Model Flux Weighted

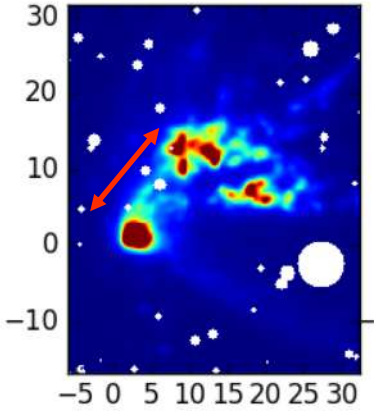


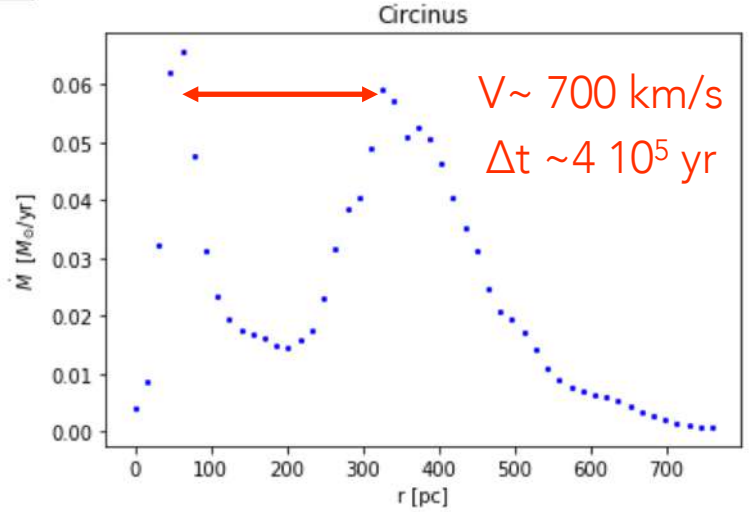
Marconi et al., in prep.

Next generation kinematical model





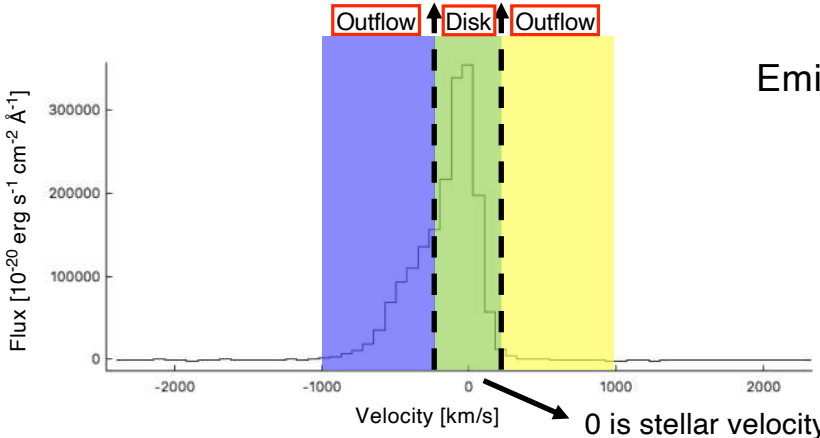




Models feature constant velocity field, complexity is given by clumpiness!

Marconi et al., in prep.

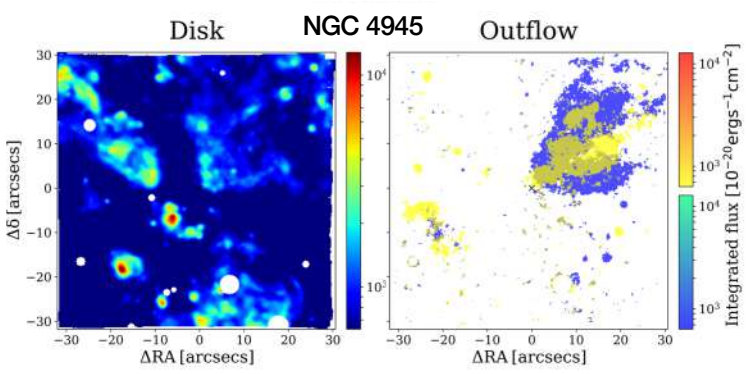
Velocity resolved ISM conditions

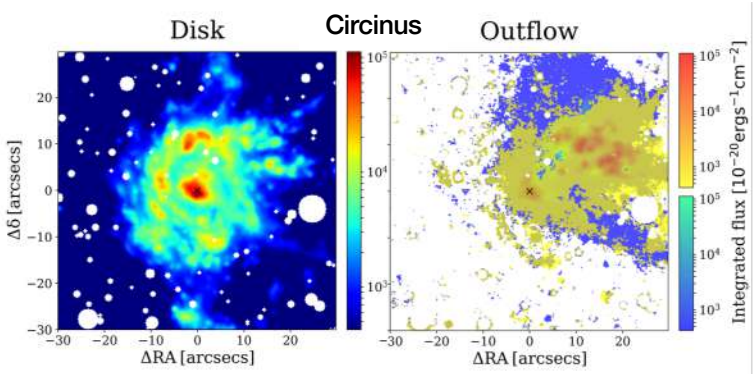


0 is stellar velocity measured in each spaxel

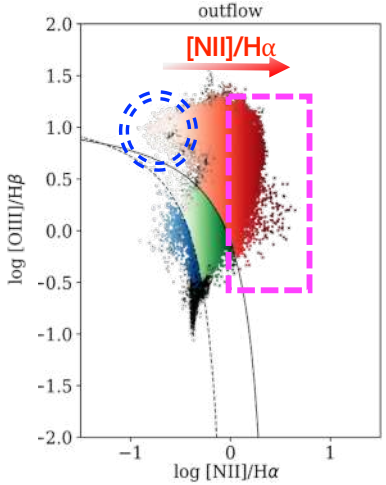
Emission line profiles divided in **velocity bins** to **separate outflows from disk**

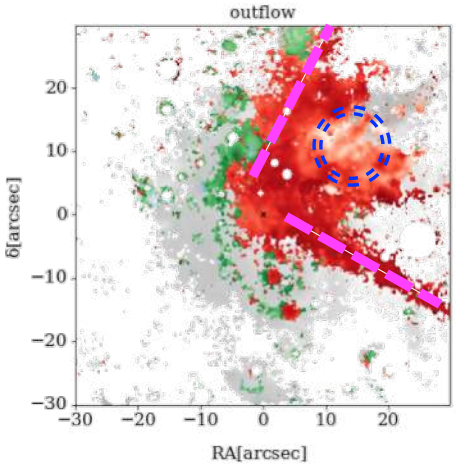
Mingozzi et al. 2018



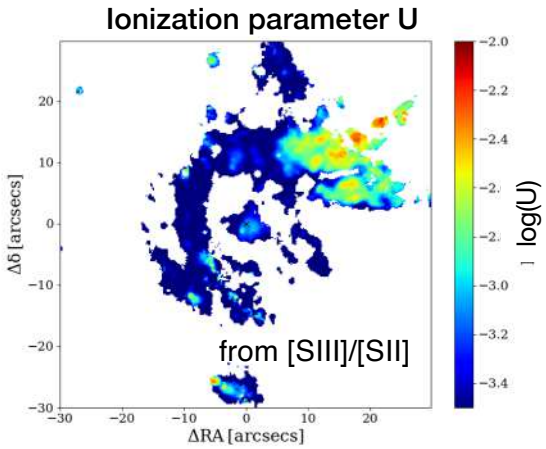


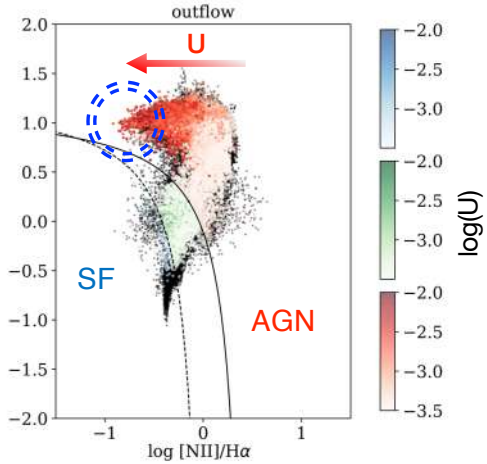
Velocity resolved ISM conditions





The highest **[N II]/Hα** ratios correspond to the **edges of the outflow and highest velocity dispersions:**
Shock excitation





The **lowest [N II]/Hα** ratios correspond to the **highest ionization parameters U in the center of the outflow:**
Matter bounded Clouds

Mingozzi et al. 2018

Photoionization modeling

Existing Photoionisation models mostly consider "**single clouds**"

Multiple clouds are considered in LOC (Locally Optimally-emitting Cloud) models or models with pre-defined density structures (e.g. $N(r) \sim r^{\alpha}$)

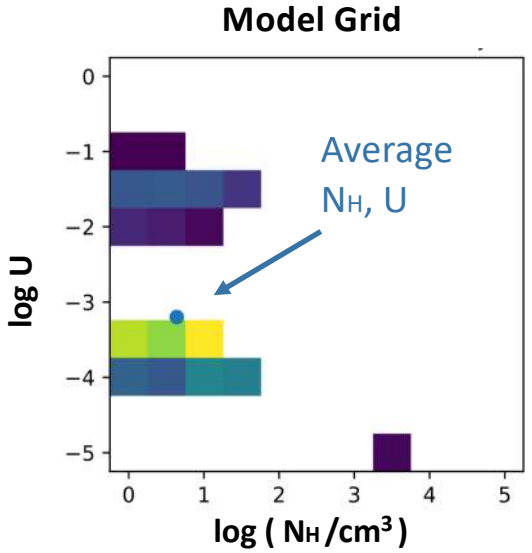
New photoionization models to consider different cloud physical conditions in a way similar to LOC but which allows more flexibility

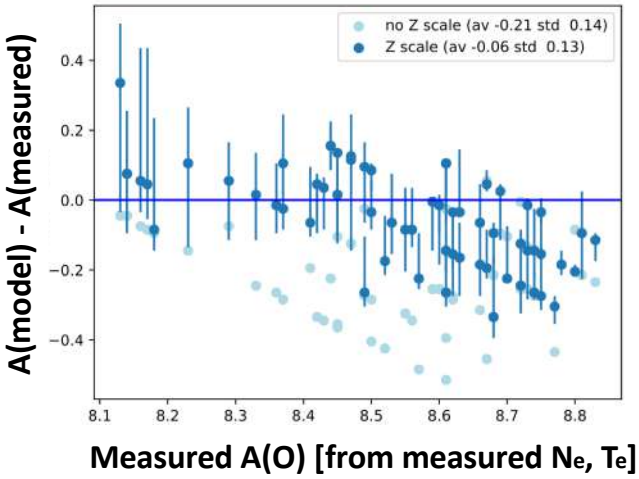
Aims: determine average physical conditions of emitting medium (e.g. to estimate emitting gas mass for outflow mass rates)

Results: being tested with star forming galaxies spectra, observed line ratios reproduced within ~10%, good agreement with measured abundances

Future: extension to spectra ionised by AGN-like continua

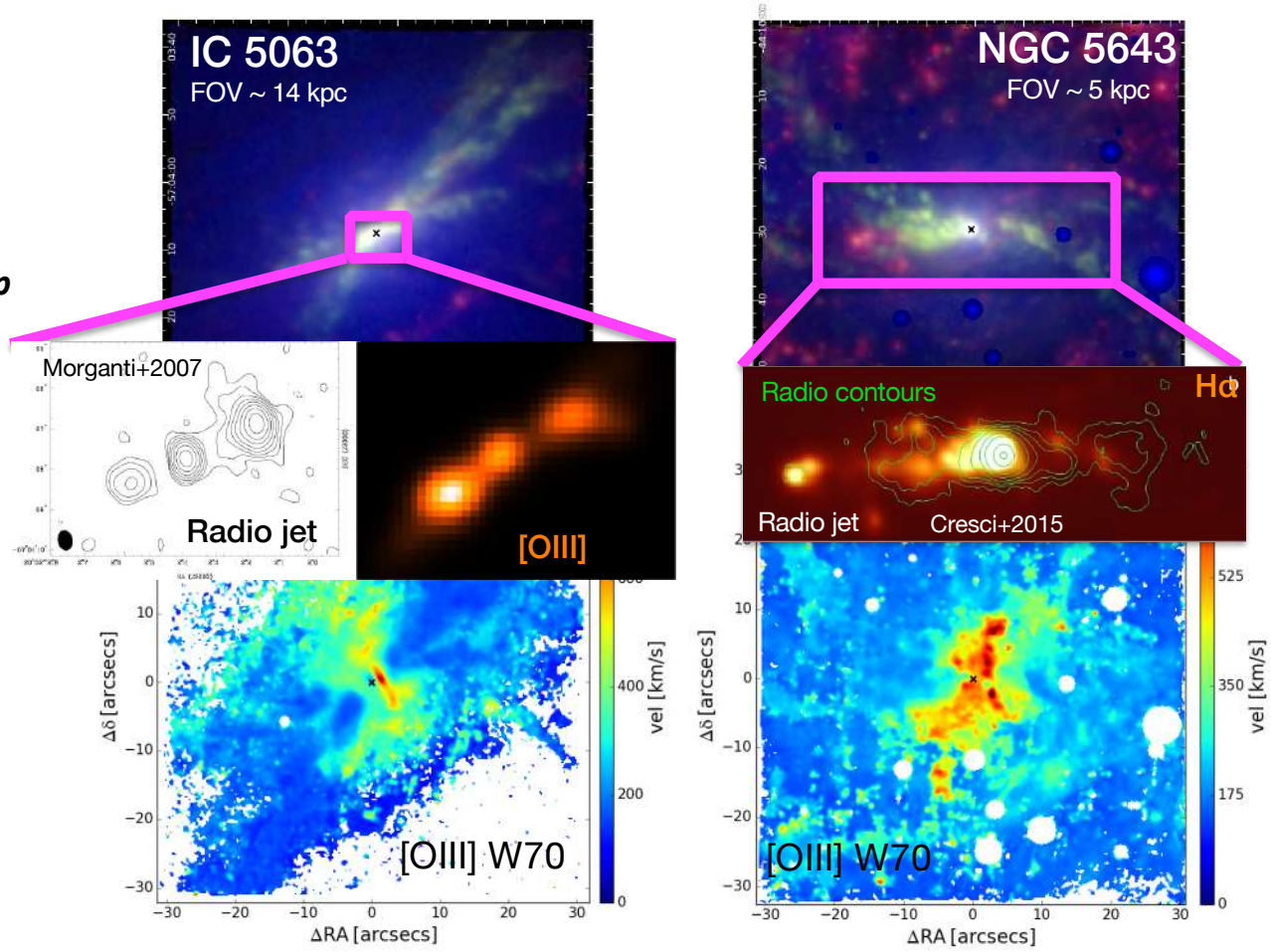
A. Amiri et al. in prep





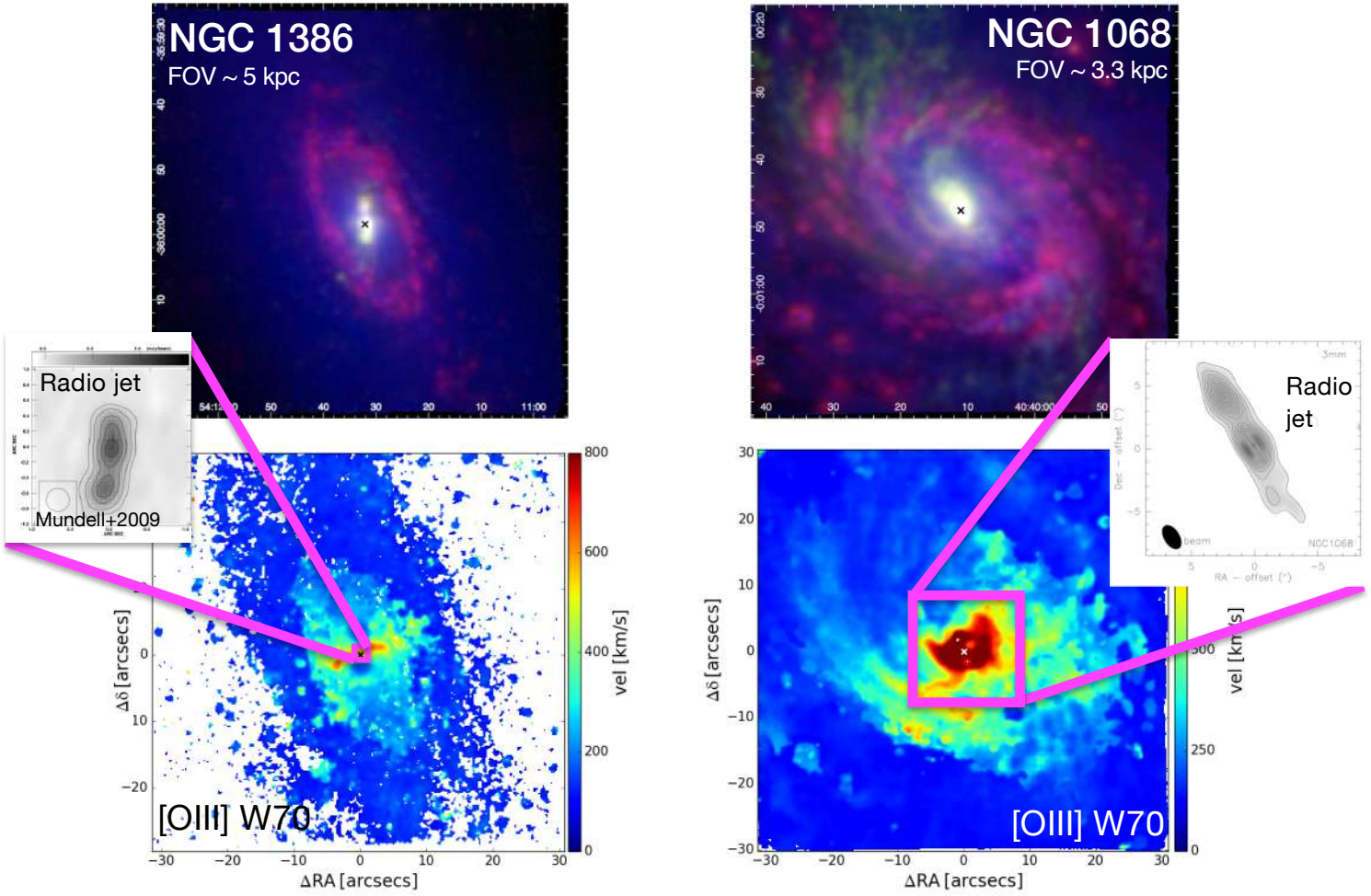
Impact of Outflows: Jet induced turbulence in the disk

Venturi et al. in prep



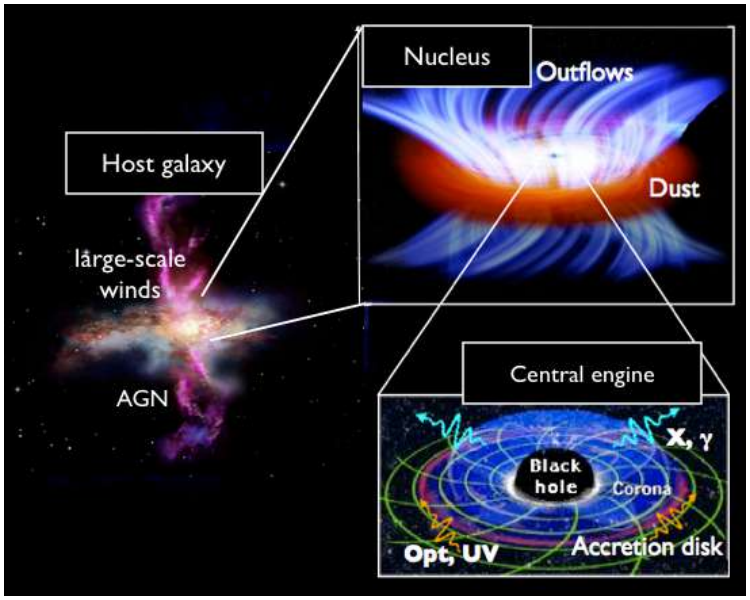
outflows/turbulence perpendicular to AGN cones and radio jet!

Impact of Outflows: Jet induced turbulence in the disk



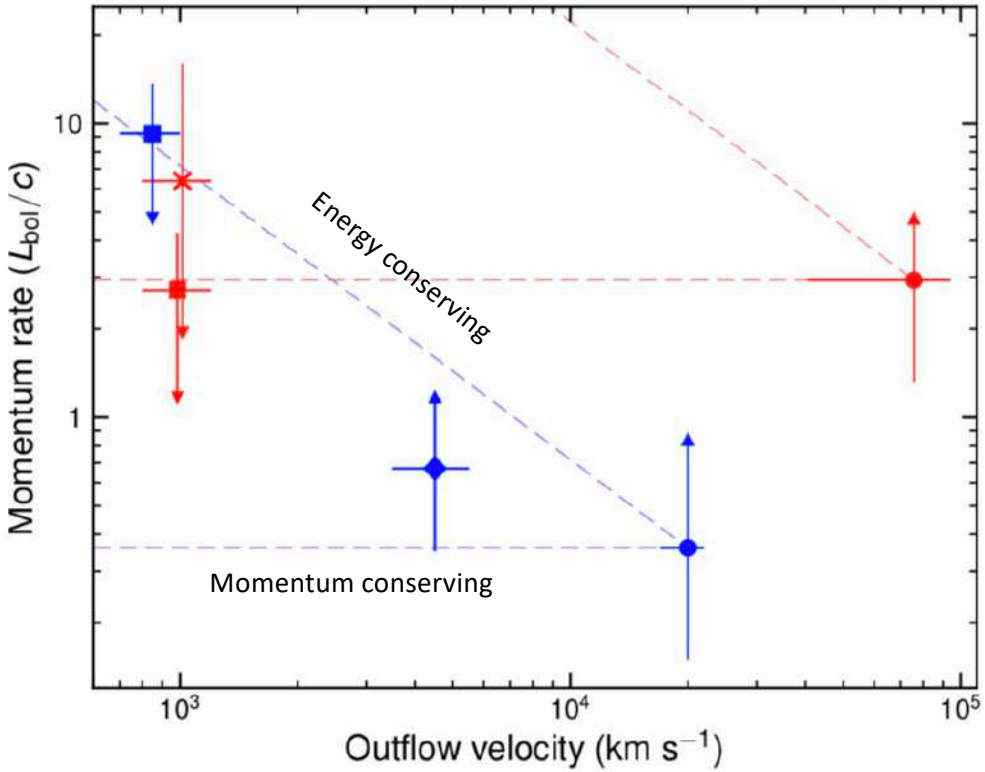
Venturi et al. in prep

Connecting UFOs with large scale outflows



Are large scale outflows energy conserving?

Link between pc-scale and kpc-scale
but till now only few sources…



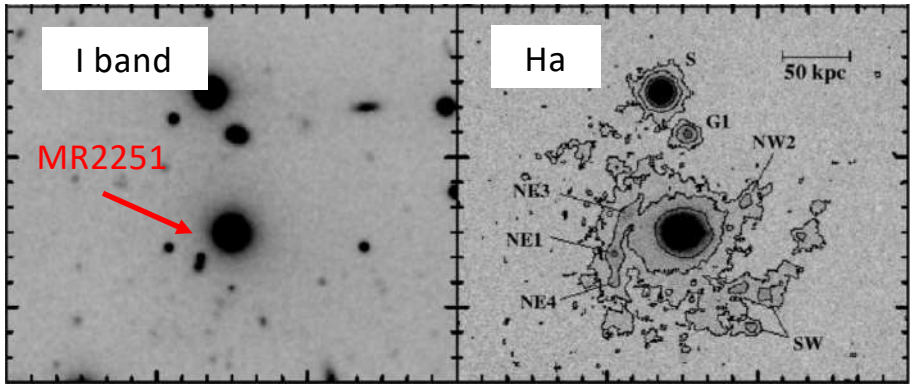
Nardini & Zubovas 2018
(see also Tombesi+15 Nature, Feruglio+15, Veilleux+17, Feruglio+17)

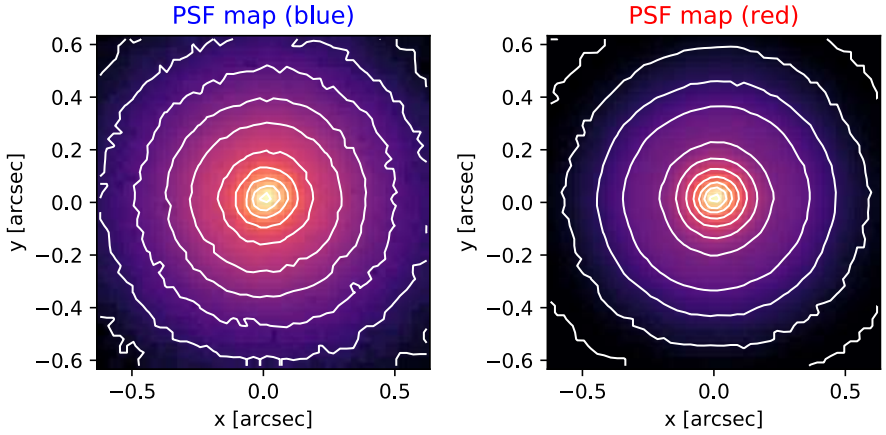
Connecting UFOs with large scale outflows with MUSE NFM

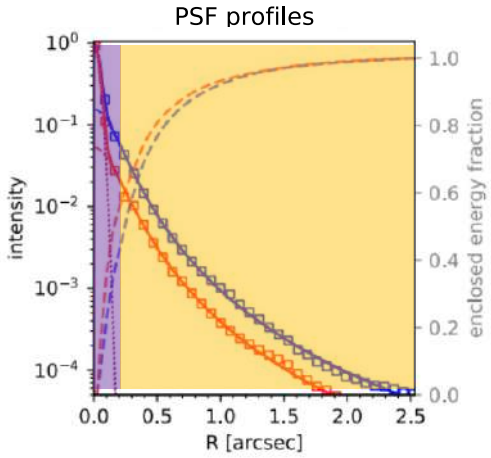
Marasco et al. submitted

Close encounters of the third kind: P103 proposal for MUSE NFM+AO (PI Cresci) to resolve the large scale ionised outflows in 3 bright UFO hosts :

50% completed, 2 sources observed MR2251 and PG1126



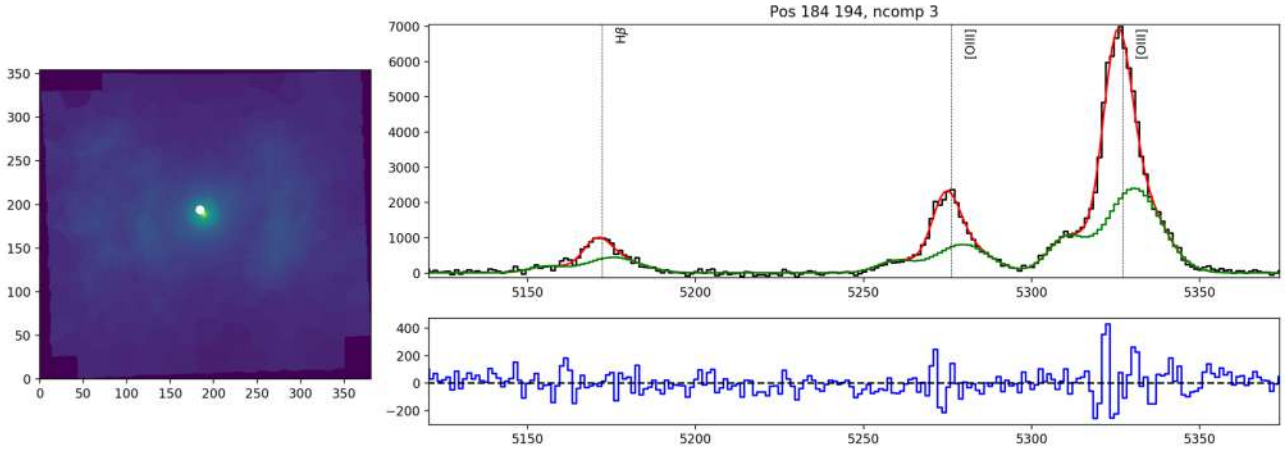




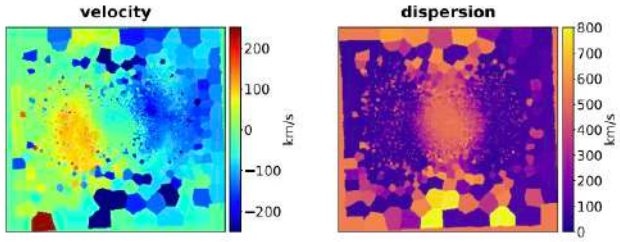
PG1126 (H=11.9)
PSF images
from Ha (red)
and Hb (blue) BLR

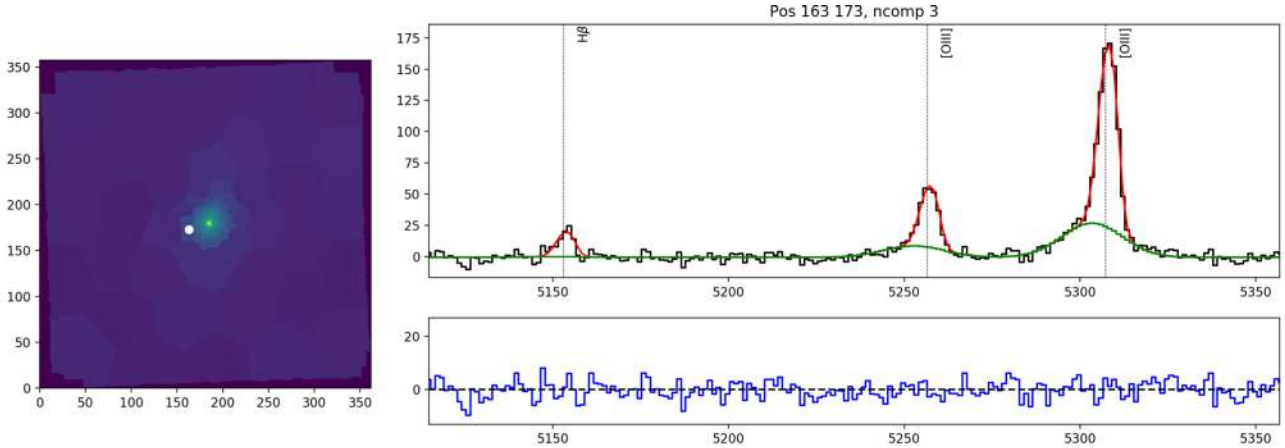
Corrected core
(FWHM ~ 37 mas
~ 39 mas)
Halo (FWHM ~ 300 mas)

New version of MAGNUM fitting code optimize for type 1 AGN

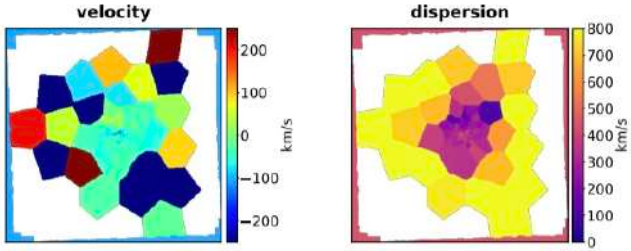


MR2251





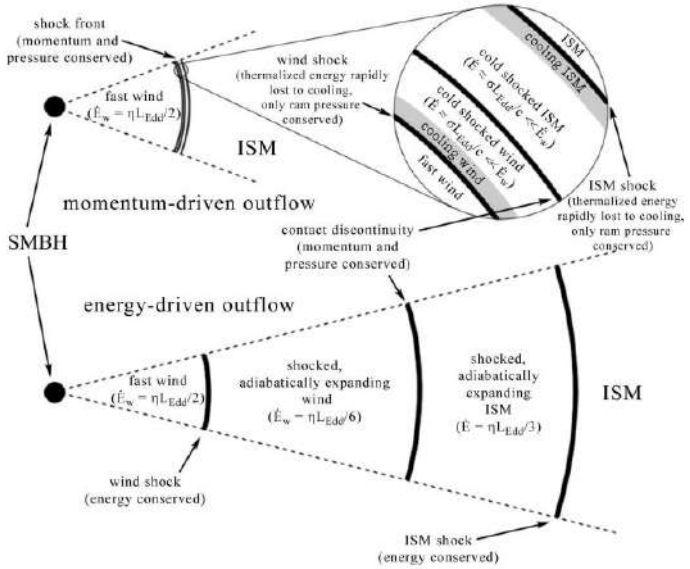
PG1126



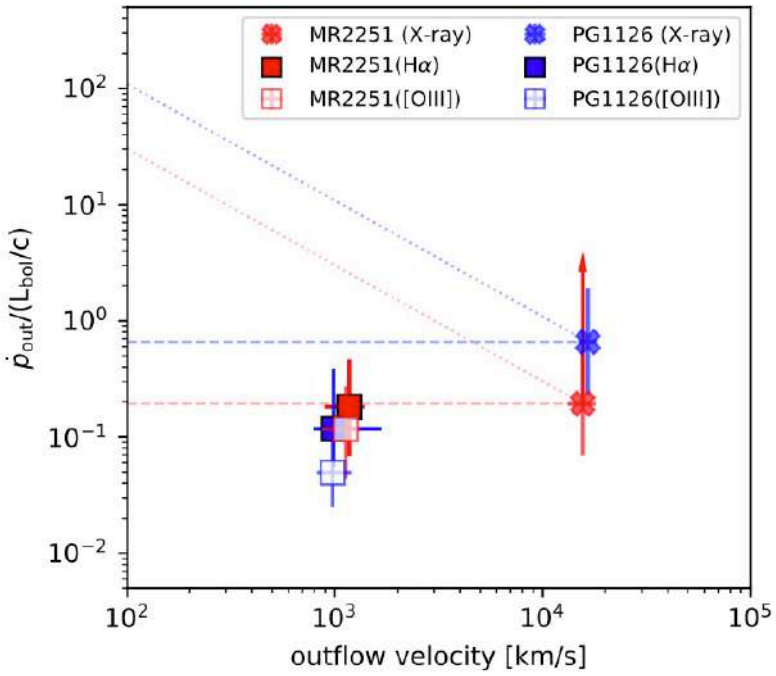
Marasco et al. 2020

Connecting UFOs with large scale outflows with MUSE NFM

Our data seem to show better agreement with a momentum conserving scenario for the two AO QSO



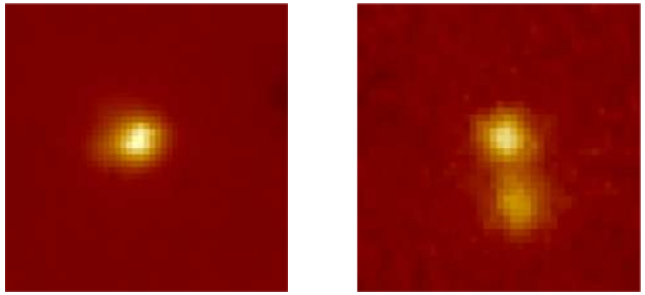
King & Pounds 2015



Marasco et al. 2020

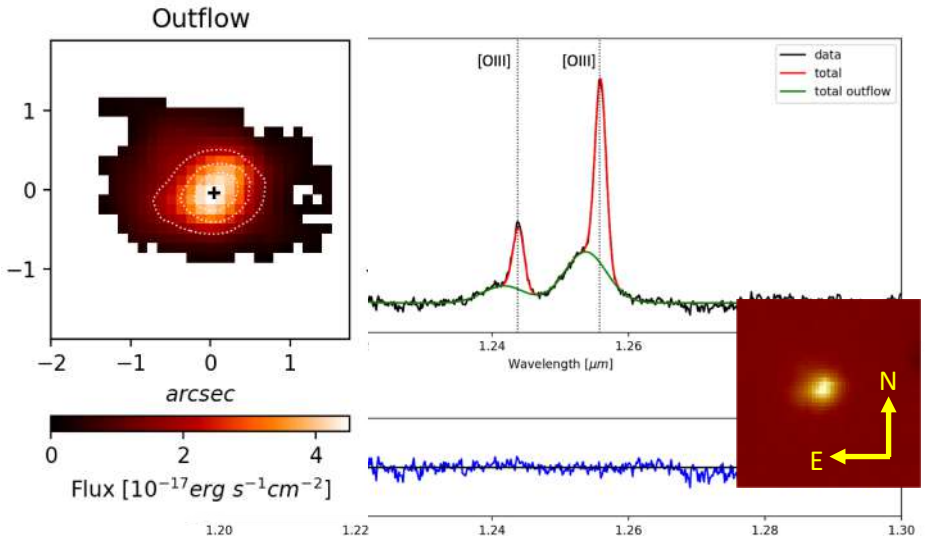
Connecting UFOs with large scale outflows at high-z

HS 0810+2554 **SDSS J135306**

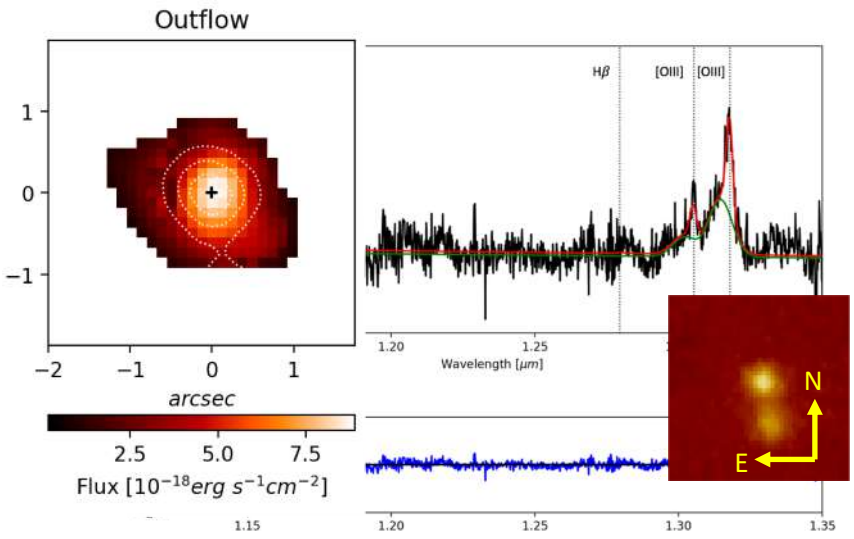


Two lensed QSOs at z~1.5 hosting a X-ray UFO observed with SINFONI in P102 (P.I. G. Cresci):

- J-band (1.1−1.4 μm) - Seeing limited: angular resolution ~ 0.7''



HS 0810+2554



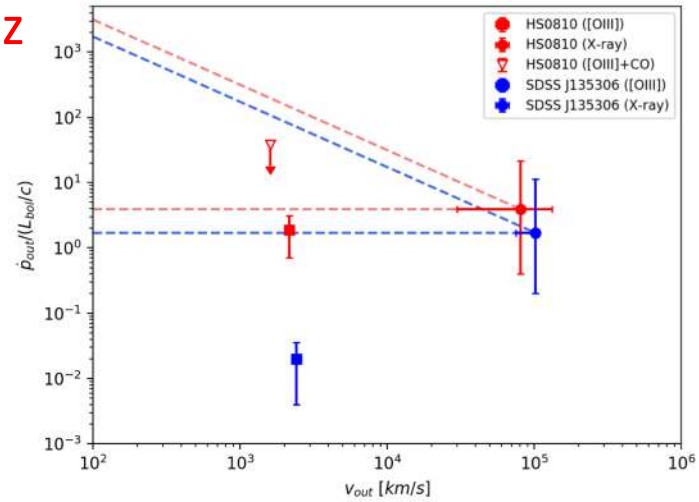
SDSS J135306

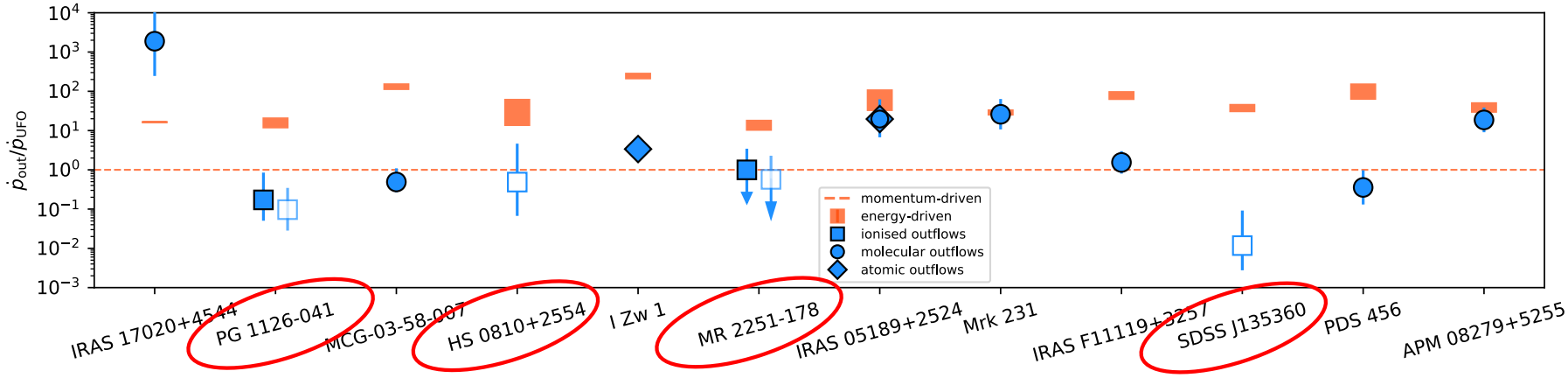
G. Tozzi et al. in prep

Connecting UFOs with large scale outflows at high-z

- **HS0810:** consistent with a momentum-conserving scenario but not with an energy-driven one once CO-molecular outflow contributions included (Chartas et al. 2020)

- **J135306:** unrelated energetics on different scales: either the presence of a massive molecular outflow or high-variability in the AGN-activity of J135306





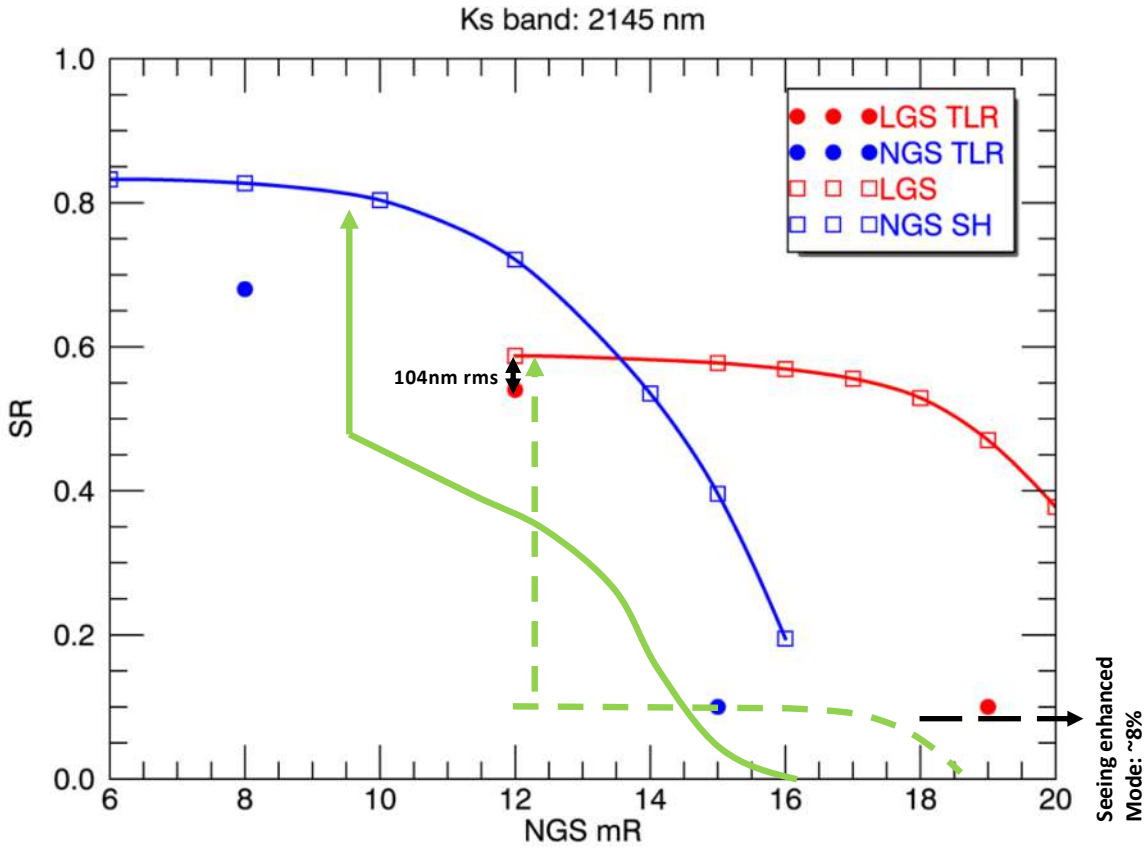
10 out of 12 compatible with momentum driven (7) or energy driven (3)

G. Tozzi et al. in prep

The future: from SUPER to HIPER

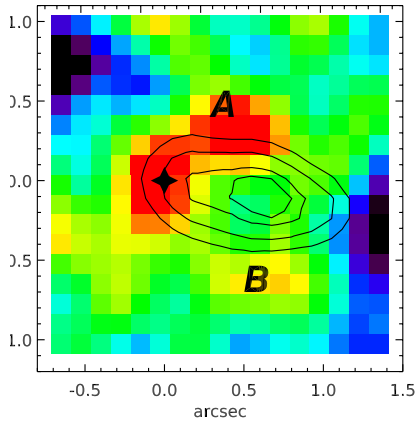
(**H**igh-resolution **I**nvestigation of feedback **P**rocesses with **ER**is)

First light 2021



Main advantages of ERIS:

- Higher AO correction
- Larger sky coverage
- R=8000 resolution available for better kinematic studies and BLR/narrow Ha decomposition



Narrow Ha map

[OIII] wing contours

(Cresci+15a)