The black hole and stellar population in the centre of MCG-6-30-15

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MCG-6-30-15: Introduction

~4 kpc

Malkan et al. 98

Integral Field Spectroscopy

H-band (**SINFONI @ VLT)**

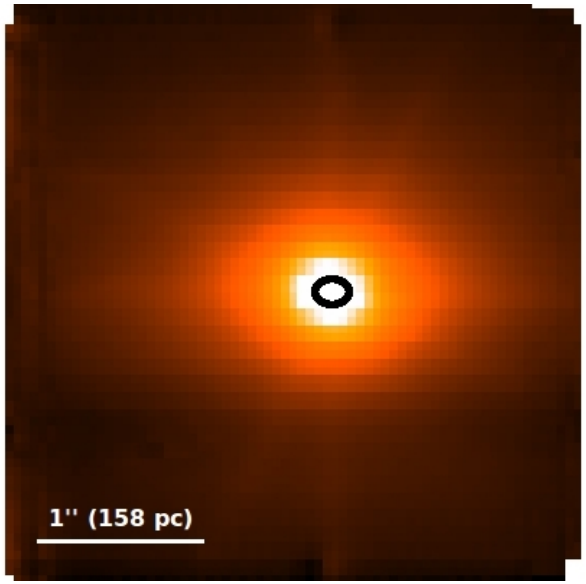
Study of the stellar and gas properties in the inner 400 pc

a > 0.98 (Brenneman & Reynolds 06)

z ~ 0.0077 (33 Mpc)

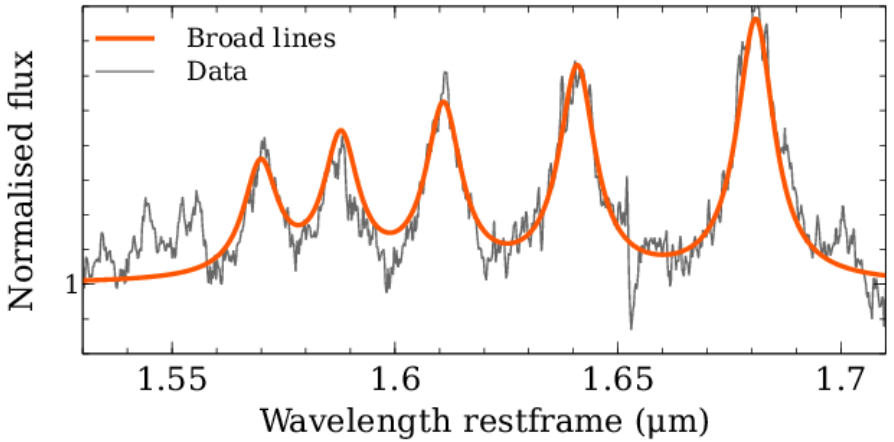
Increase the parameter range:
L_X (2 – 10 keV) = 4 x 10^{42} erg s^{-1}

MCG-6-30-15: Observations

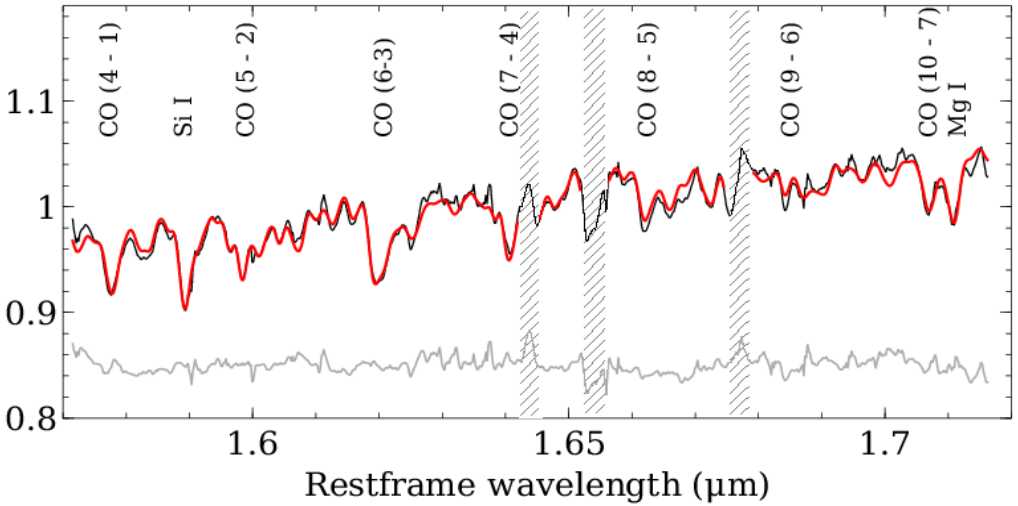


SINFONI FoV

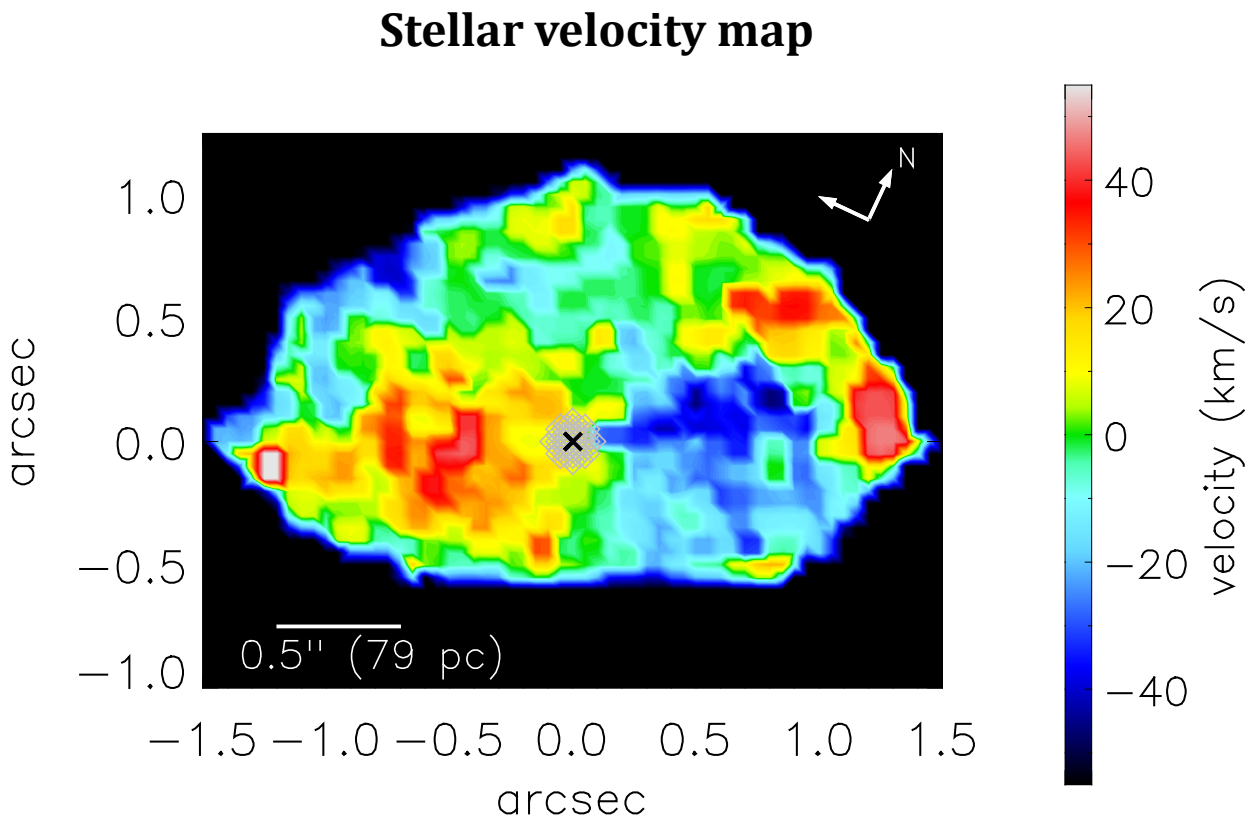
Broad Hydrogen Brackett emission lines



Subtracted & integrated spectrum



Stellar kinematics: Decoupled core



Raimundo et al. 2013

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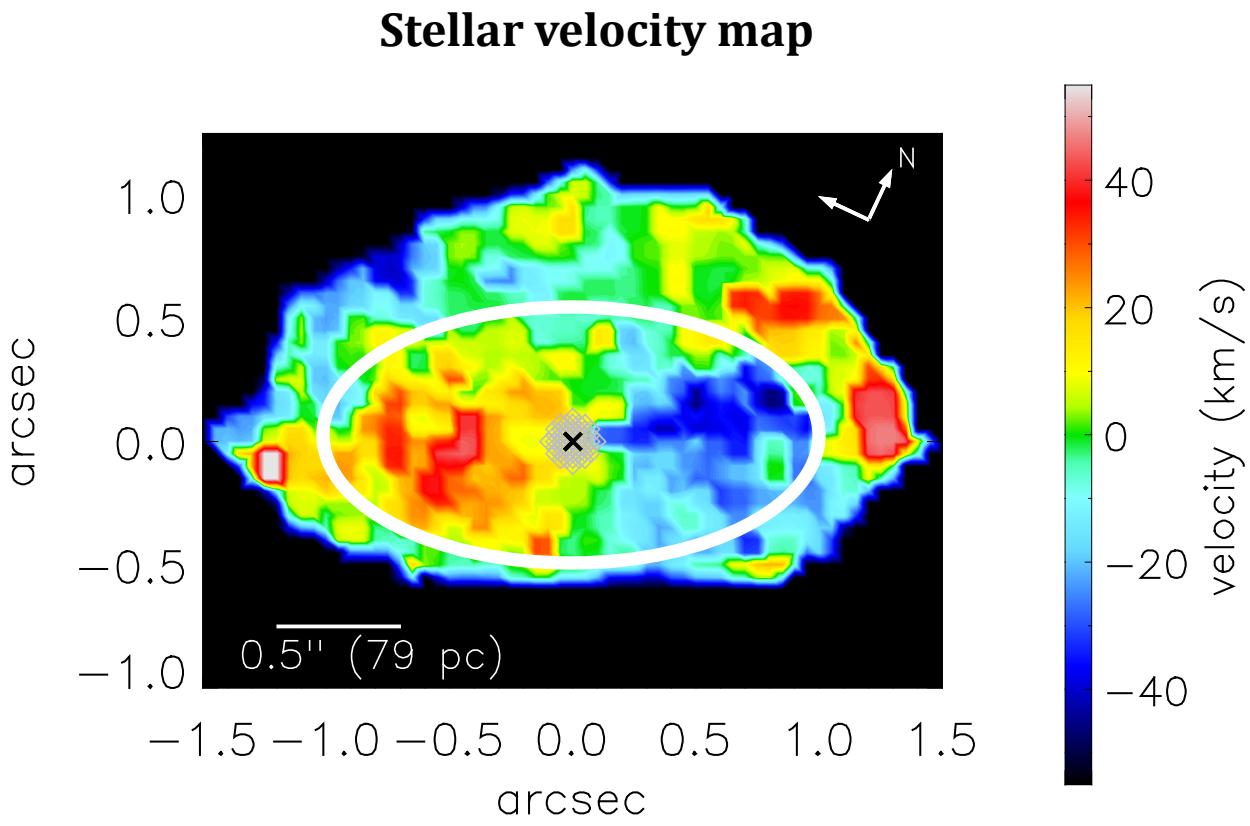

Raimundo et al. 2013

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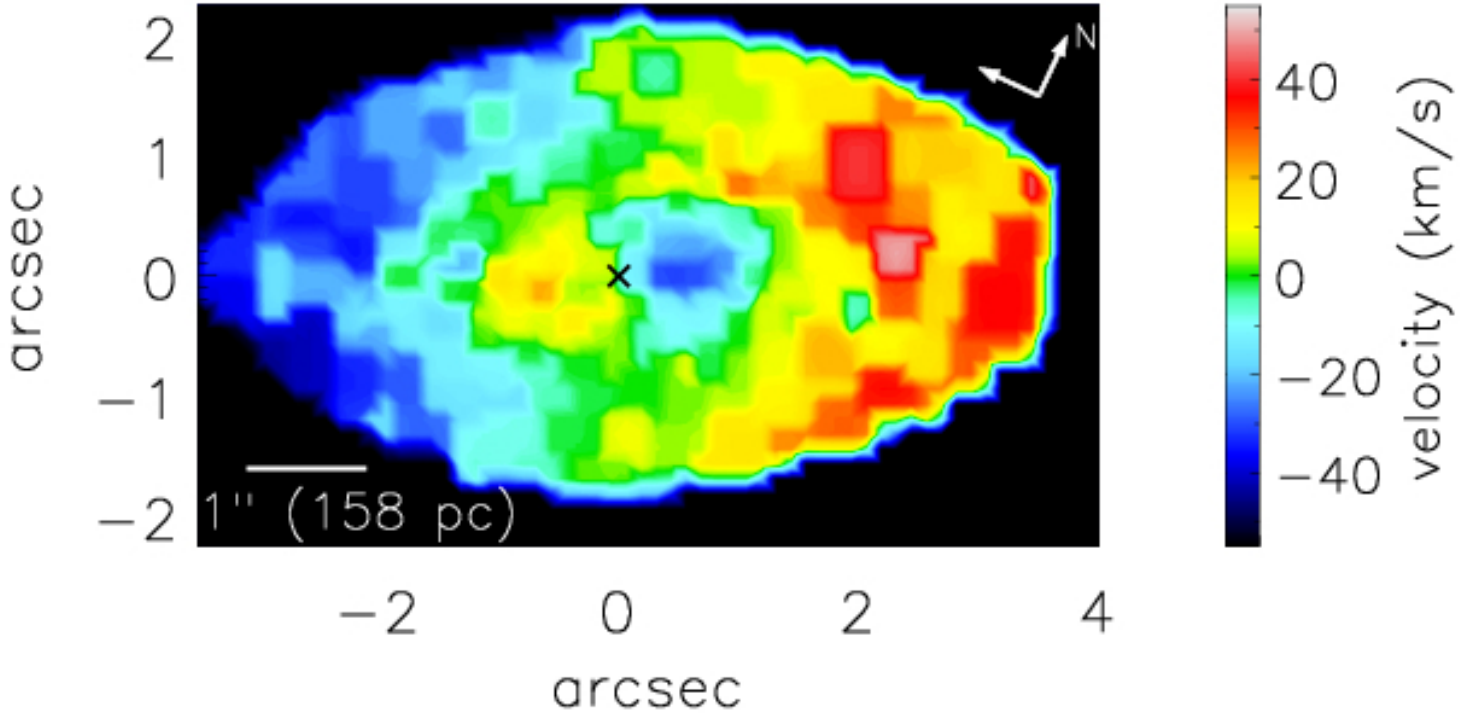

Raimundo et al. in prep

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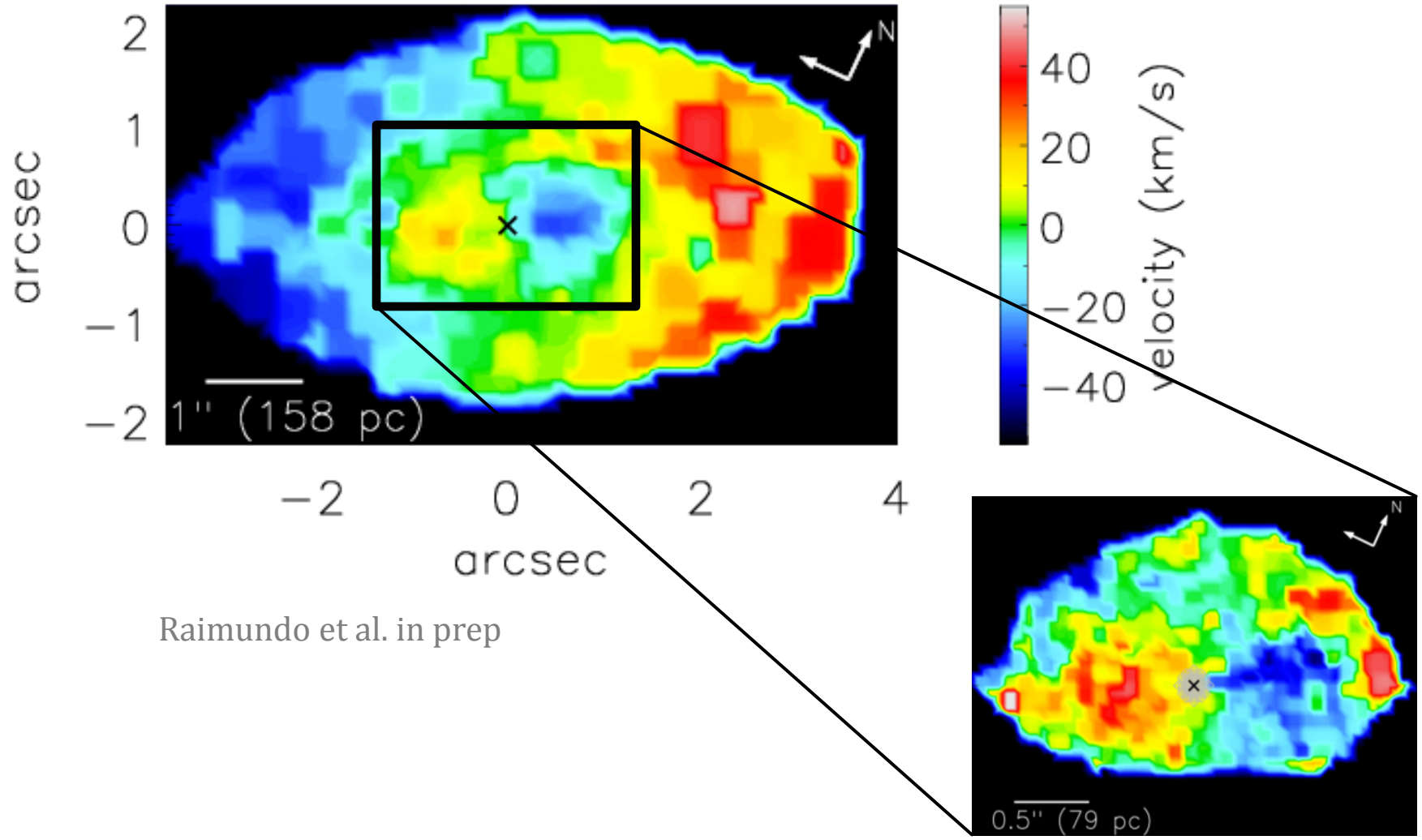

Raimundo et al. in prep

Kinematically decoupled cores

Observed in < 10% of S0 galaxies
and ~30% of early type galaxies

Formation: - Dry merger with small elliptical
- Merger with small gas rich object
- Early merger between pair of galaxies (with gas)
- Secular gas transport

Was merging important in the formation of these galaxies?

A distinct stellar population is expected

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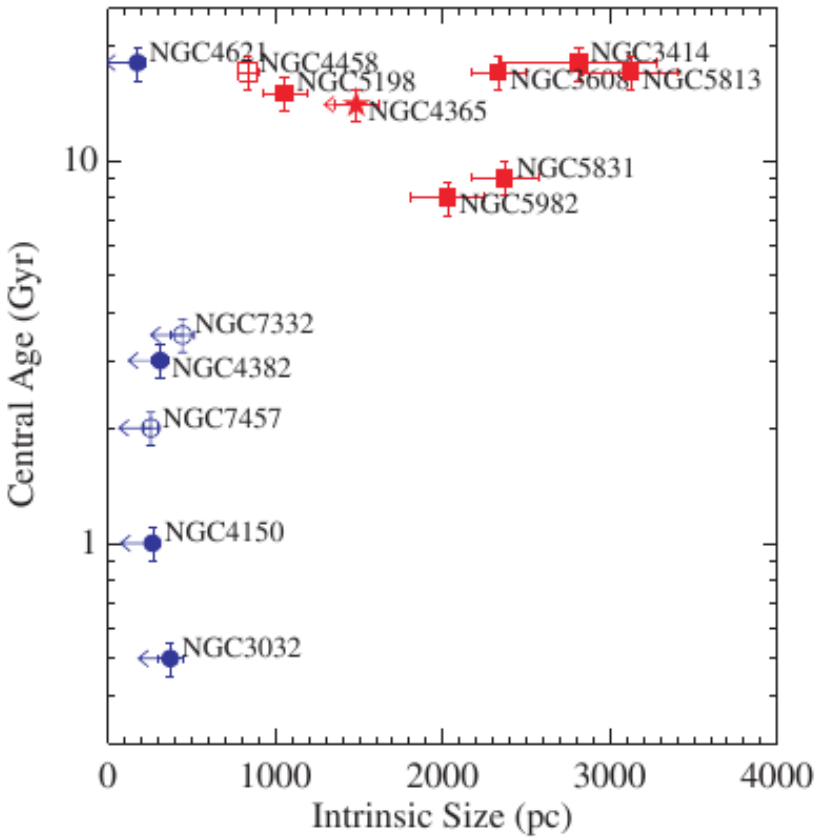
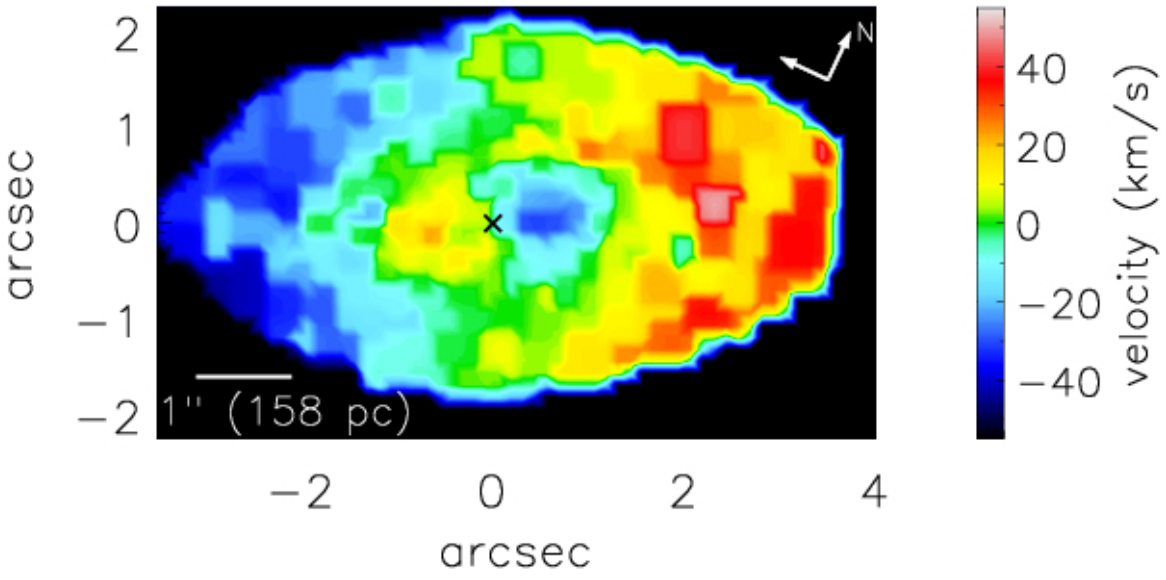


McDermid et al. 06

Kinematically decoupled cores



Where does MCG—6-30-15 fit in?

Brightest AGN with stellar decoupled core (out of > 50) – bias?

- Young stellar population
- Small core
- Evidence for interactions (dust lane)
- Counter-rotation

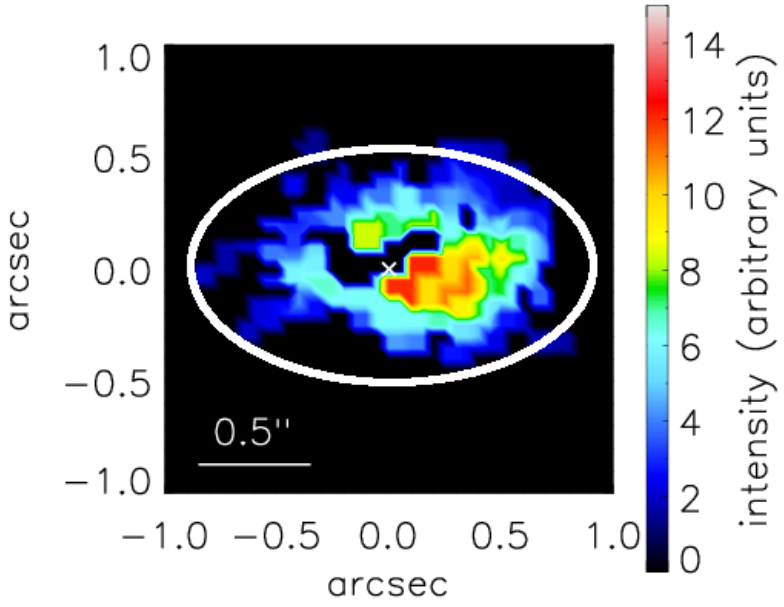
The gas needed to fuel the black hole is ~1% of that used to form stars.
Accreting from counter-rotating gas?

Conclusions

- Integral Field Spectroscopy is a powerful technique even for bright AGN
- Presence of a stellar counter-rotating core in the inner 250 pc – could be associated with recent inflow of gas
- Future observations: determine the stellar population and possible gas inflow structures

Results: Gas Dynamics & Stellar population

[Fe II] Intensity



S/N > 3

- [Fe II] emission as a tracer of supernova rate?
(Moorwood & Oliva 88, Alonso-Herrero+03, Rosenberg+12)

- What stellar population would produce these values?

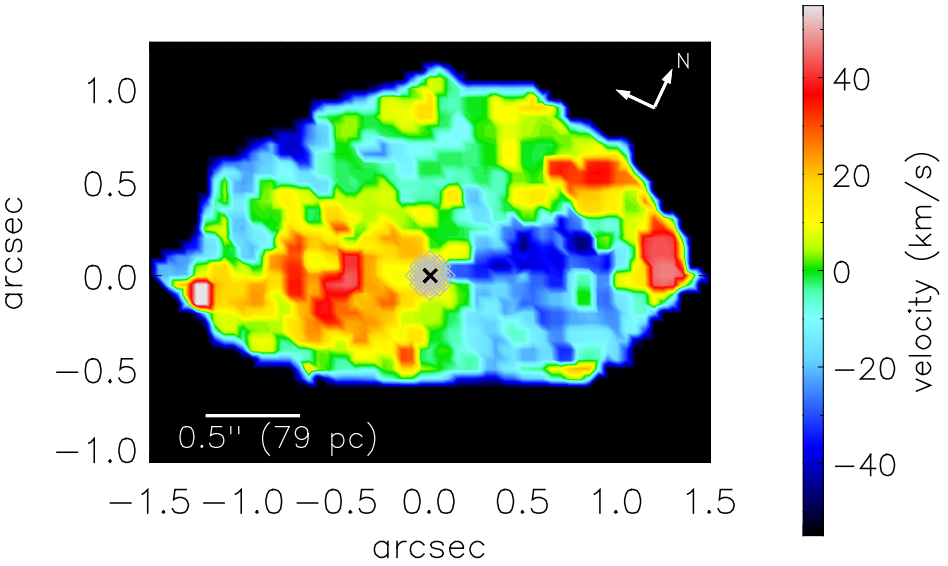
- STARS code follows the evolution of a stellar population (finds a stellar age of 65 Myr)

- Total mass used to form stars 2×10^8 M_{sun}

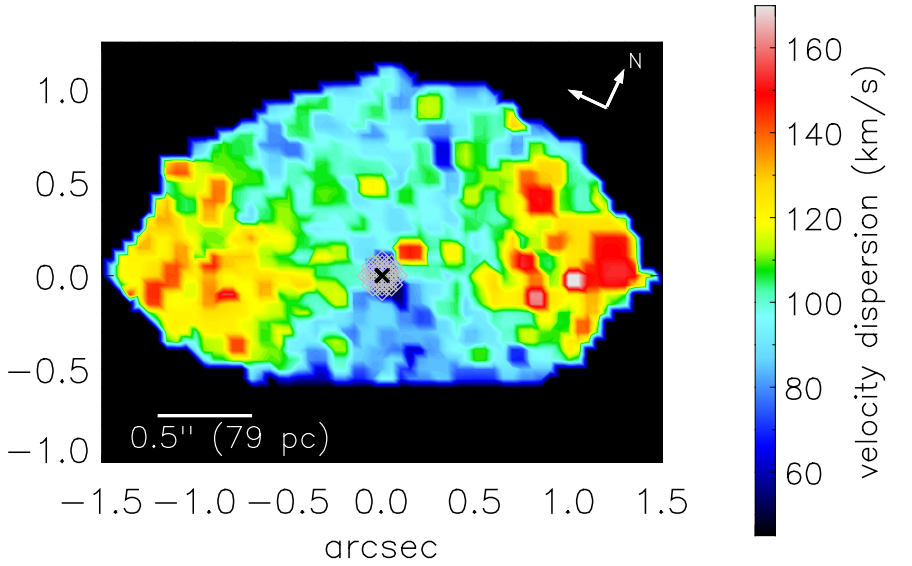
How were these stars formed?

Results: Stellar kinematics

Velocity



Velocity dispersion



Low rotational velocity
Counter rotating core

Results: Mass budget

General mass budget:

Total mass needed since new gas inflow = 65 Myr x Mass accretion rate
$= 1.4 \times 10^6 M_{sun}$

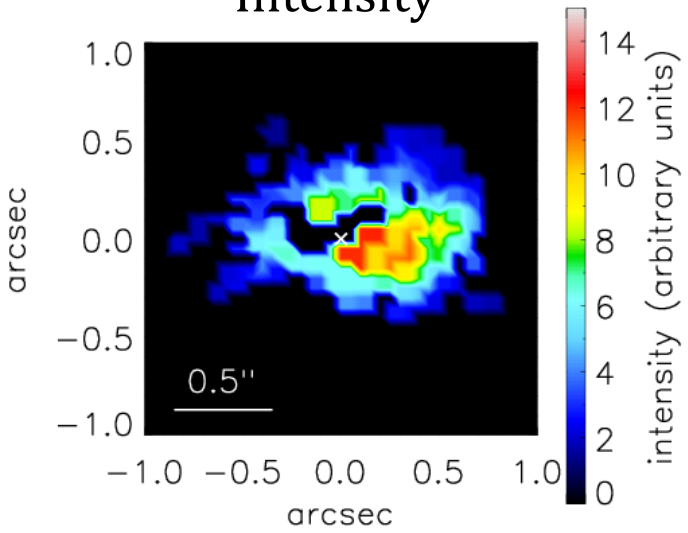
The gas needed to fuel the black hole is ~1% of that used to form stars

Alternatively, stellar mass loss (1 M_{sun}/yr) enough to maintain AGN accretion

How efficient is this fuelling process?
Ongoing work: Is there a relation KDC <-> gas inflow -> nuclear activity?

Results: Gas Dynamics

Intensity



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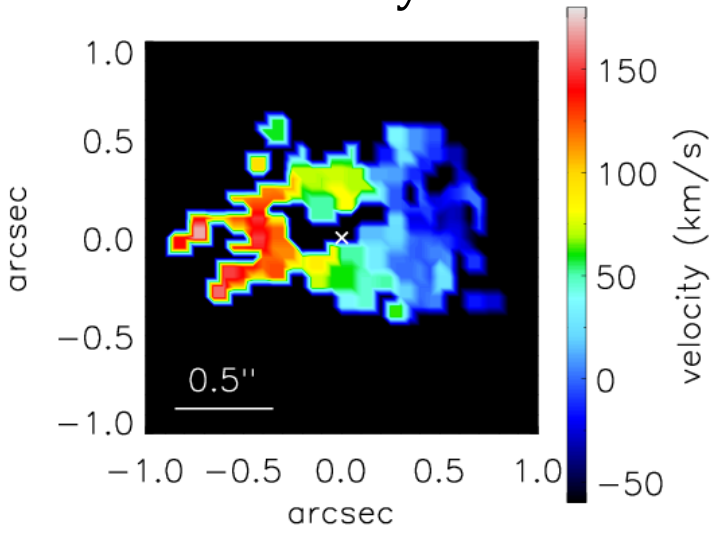

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