Strengthening the case for deployable IFUs at the E-ELT

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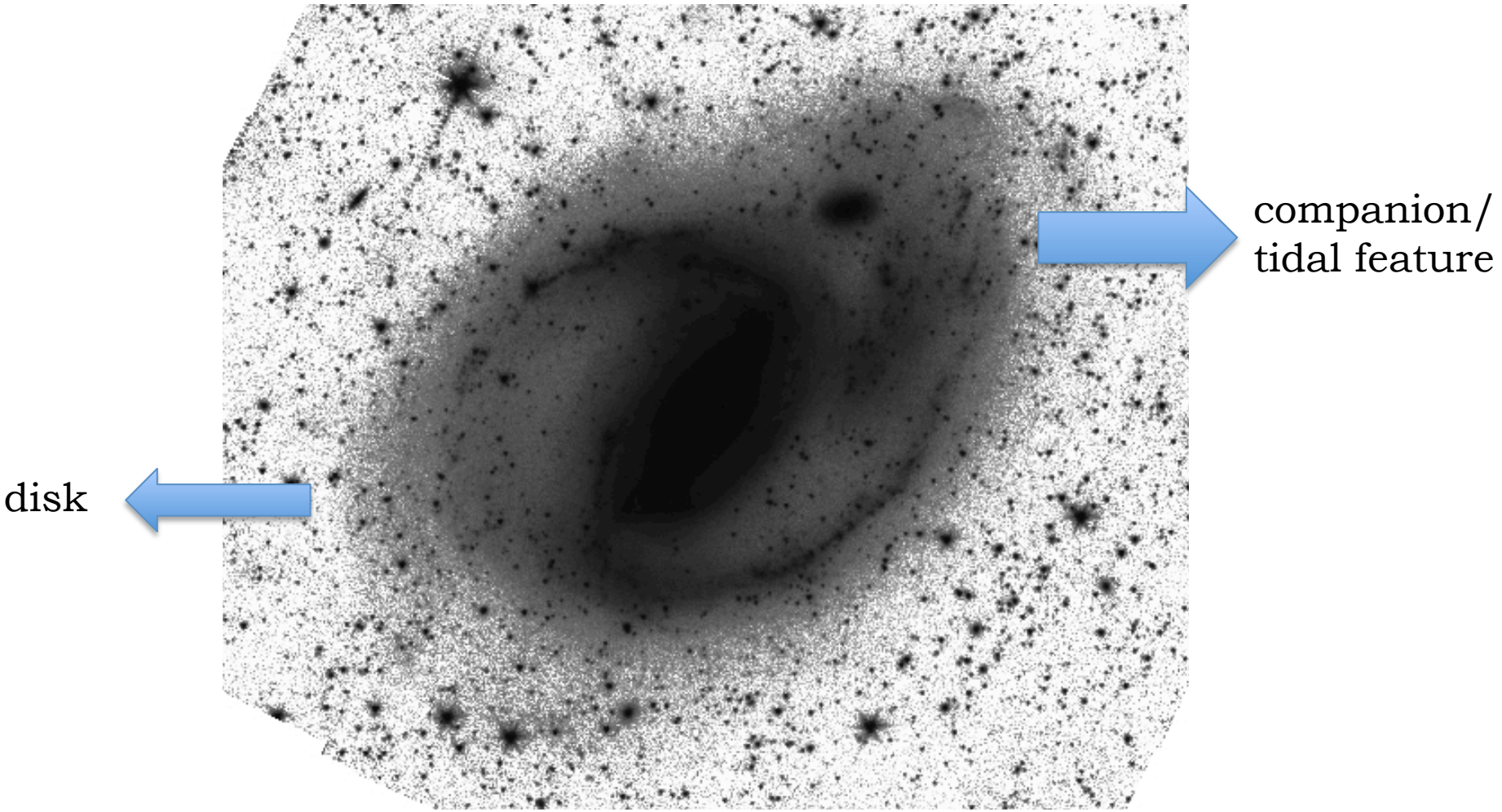
High multiplex capabilities is not only important to study e.g. a field with distant galaxies.

It is at least as important to study different structural components in a single galaxy.

Galaxies are tremendously complex. Check NGC 1097 (IRAC1; Kennicutt et al. 2003; Sheth et al. 2010).



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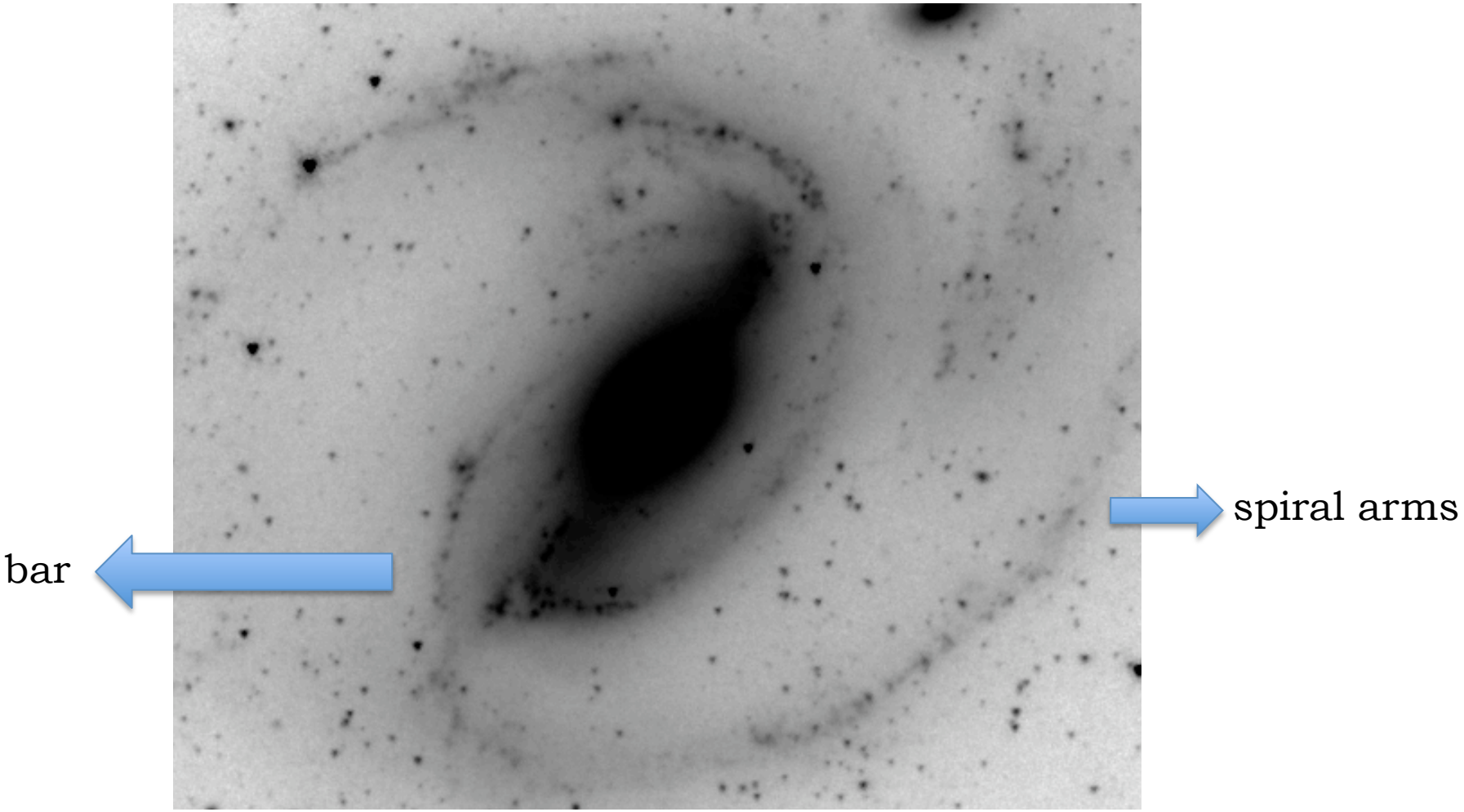

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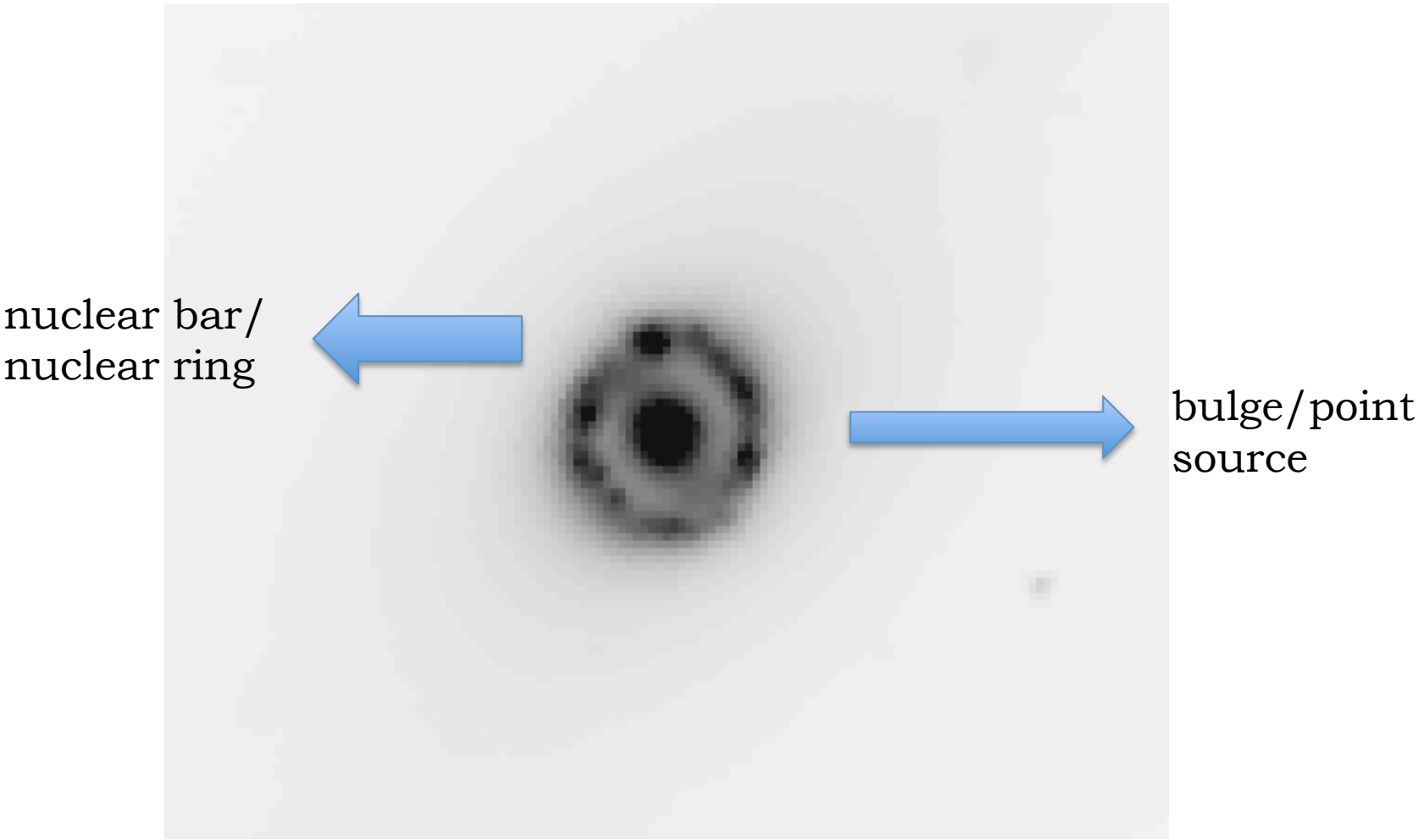

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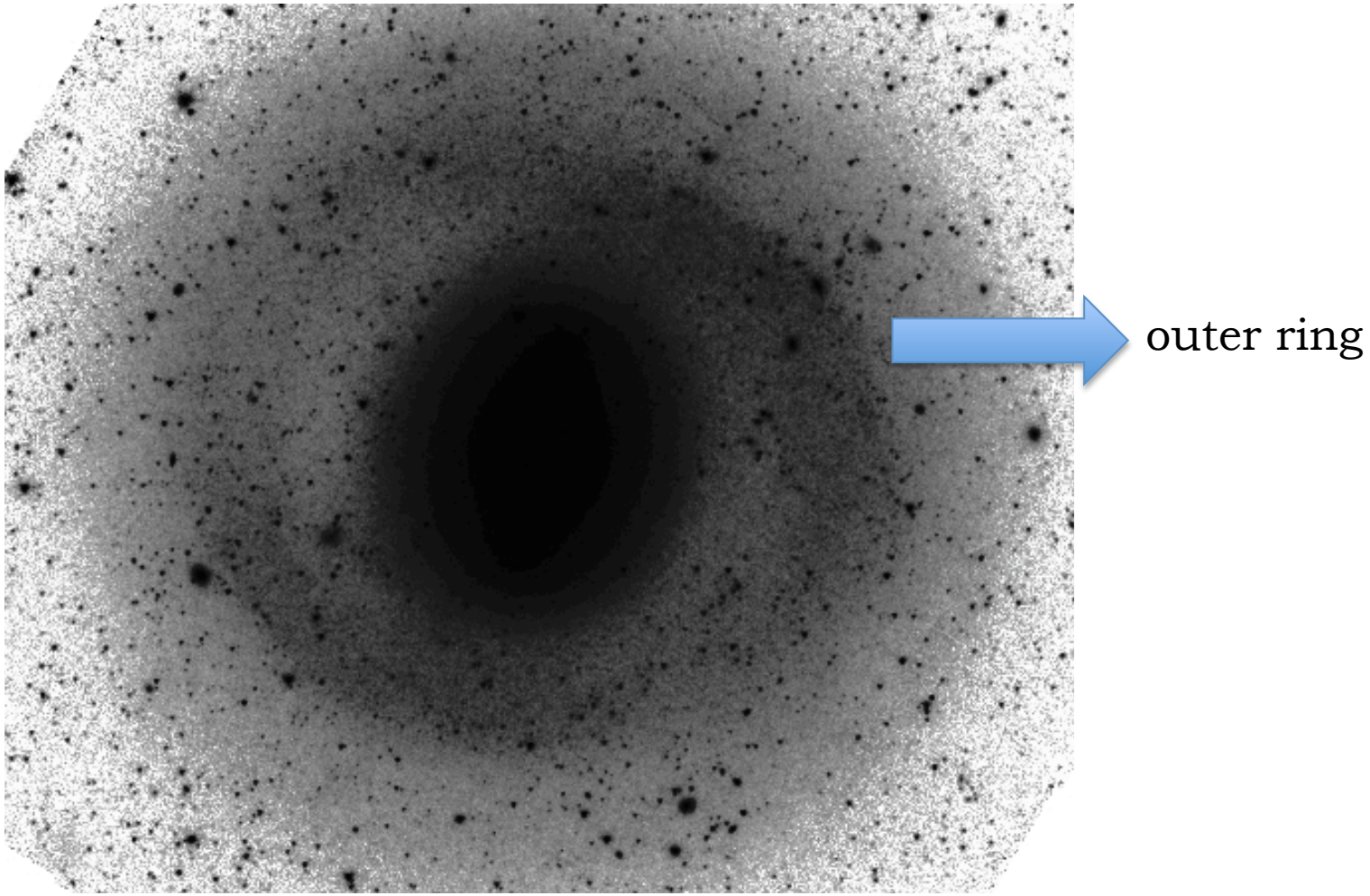

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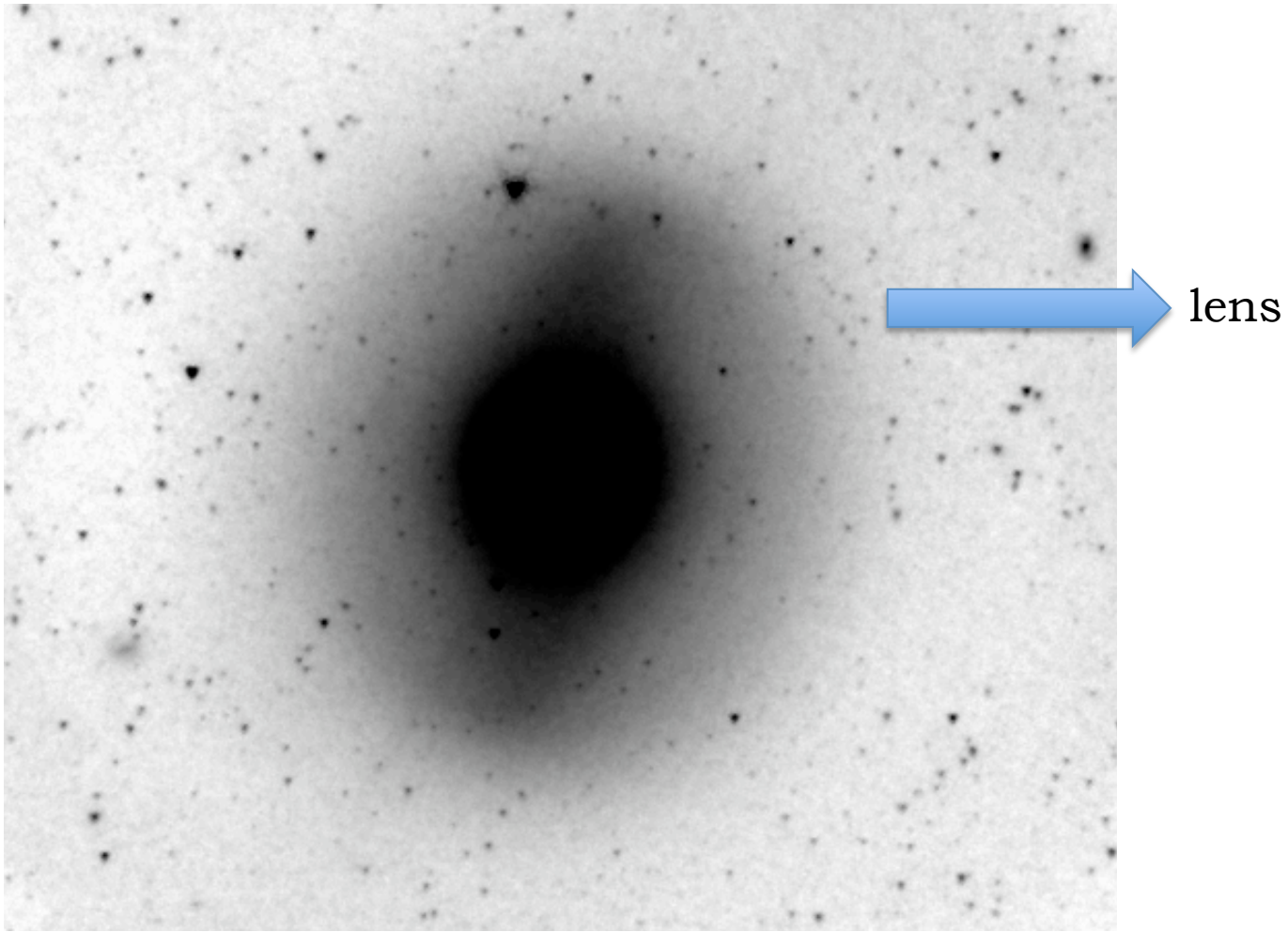

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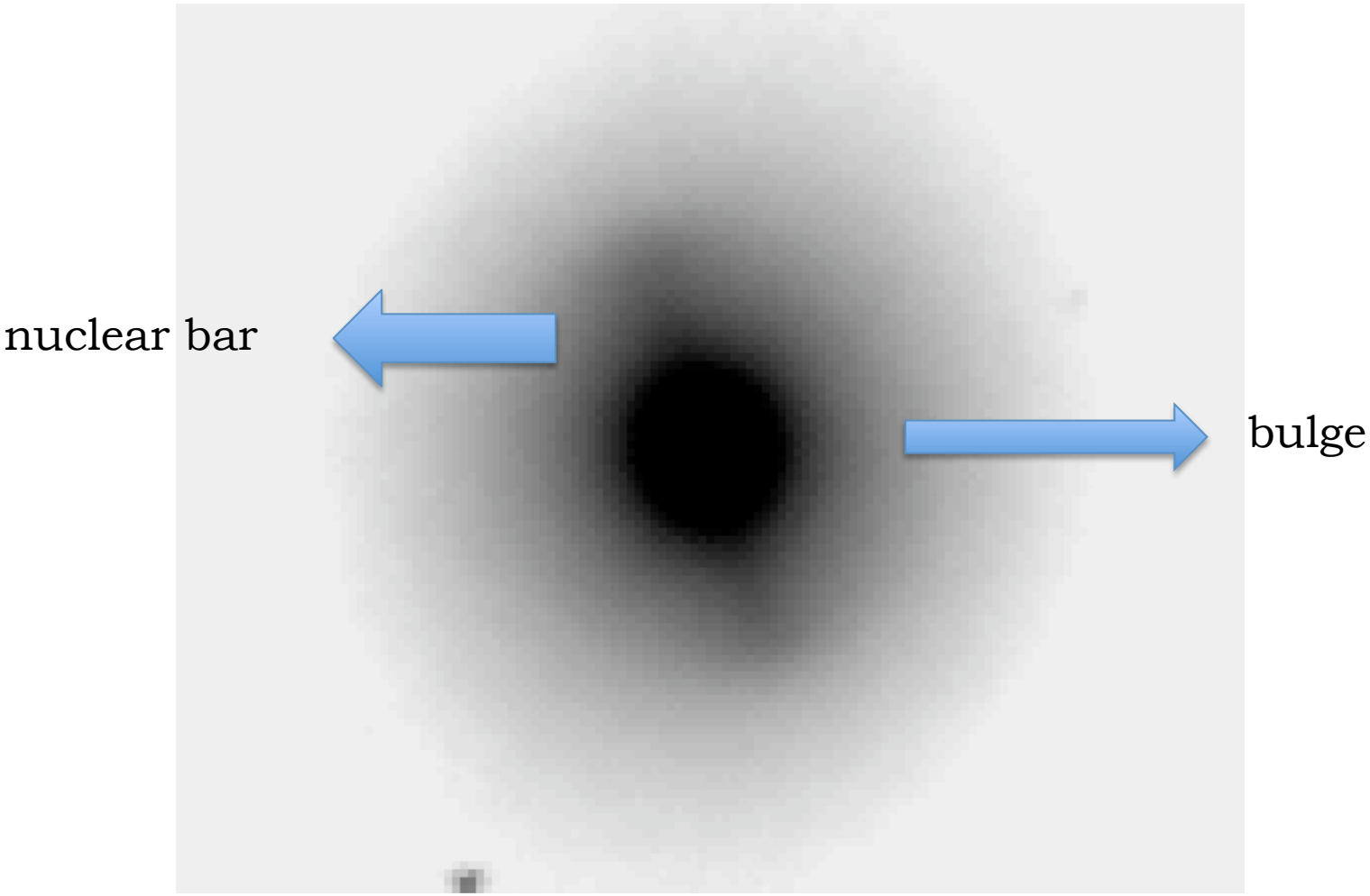

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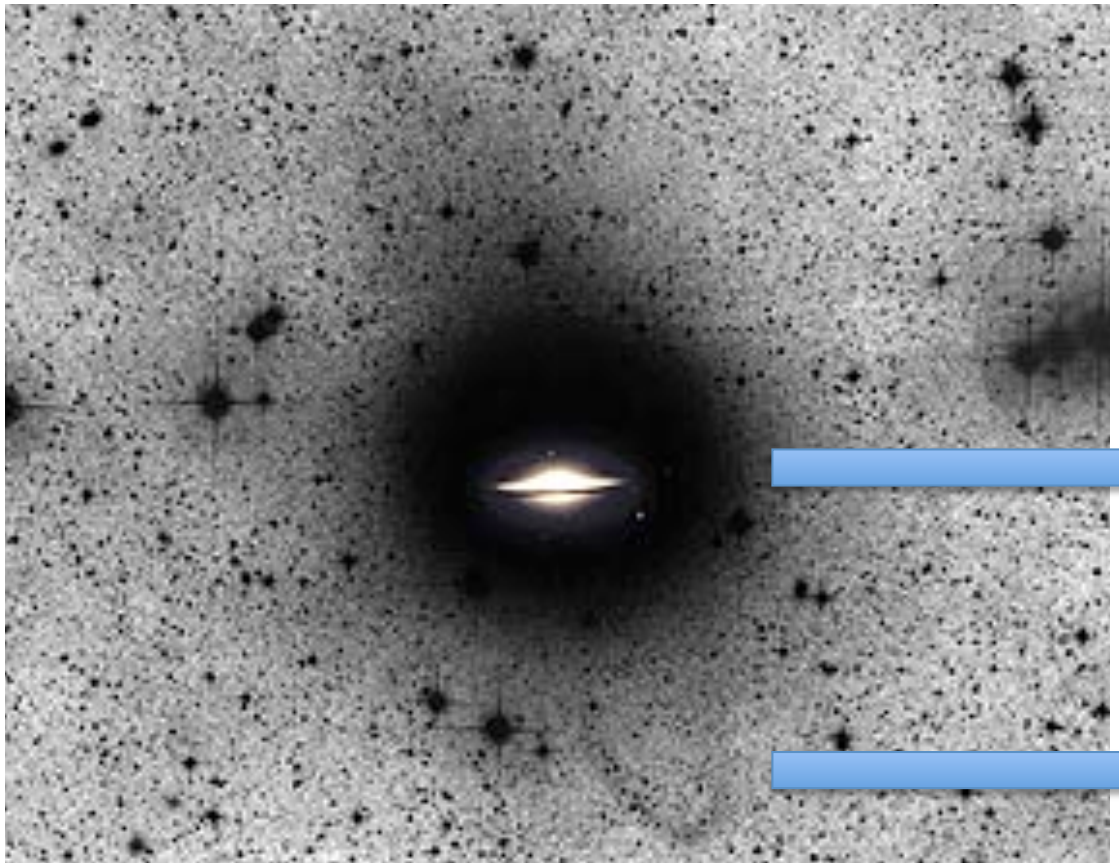
Galaxies are tremendously complex. Check NGC 4594 (R, AAT).
[See e.g. Gadotti & Sánchez-Janssen (2012).]



Galaxy components:

1. disk (thin/thick)
2. bulge
3. bar
4. spiral arms
5. nuclear disk
6. nuclear bar
7. nuclear spiral arms
8. lens(es)
9. nuclear ring
10. inner ring
11. outer ring
12. stellar halo

...

Plus:

13. tidal features
14. satellite accretion
15. gas accretion

...

All these components provide important clues to understand how galaxies form and evolve.

2. bulge

- with hot kinematics: violent events such as mergers
- with cold kinematics: slow, internal building through disk instabilities – secular evolution

- implications for merger rates

[See e.g. Kormendy & Kennicutt (2004); Athanassoula (2005); Gadotti & Kauffmann (2009); Fisher & Drory (2010); Fabricius et al. (2012).]

3. bar

- presence and properties have implications on dynamical properties and coupling of the disk and dark matter halo
- redistribution of angular momentum: fueling of gas to the central regions (star-formation, AGN, building of bulges); shaping of the dark matter halo

3. bar

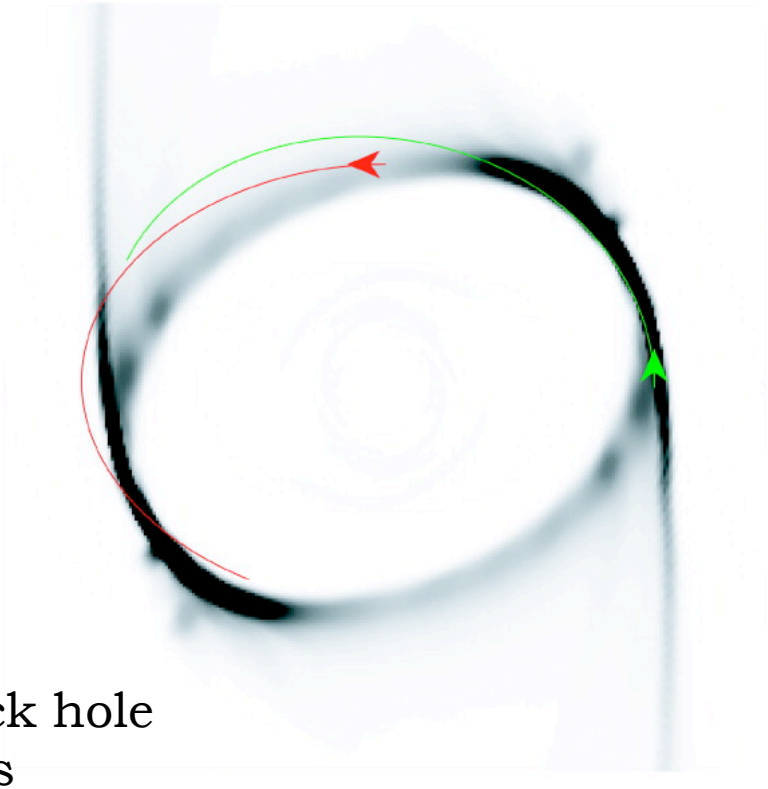
[See e.g. Athanassoula (1992); Sakamoto et al. (1999); Sheth et al. (2005); Ellison et al. (2011); Coelho & Gadotti (2011).]

3. bar

- presence and properties have implications on dynamical properties and coupling of the disk and dark matter halo
- redistribution of angular momentum: fueling of gas to the central regions (star-formation, AGN, building of bulges); shaping of the dark matter halo

- can probe dark matter properties
- implications for AGN, feedback, gas outflow, disk breaks

[See e.g. Athanassoula (2003); Gadotti (2011); Athanassoula et al. (2012).]



9. nuclear ring

- halts gas inflow to central black hole
- induces formation of new stars

- implications for AGN, feedback, gas outflow
- implications for bulge building

[See e.g. Regan & Teuben (2003); Böker et al. (2008).]

11. outer ring

- seems to halt planar gas inflow
- implications for gas accretion, disk growing, star formation

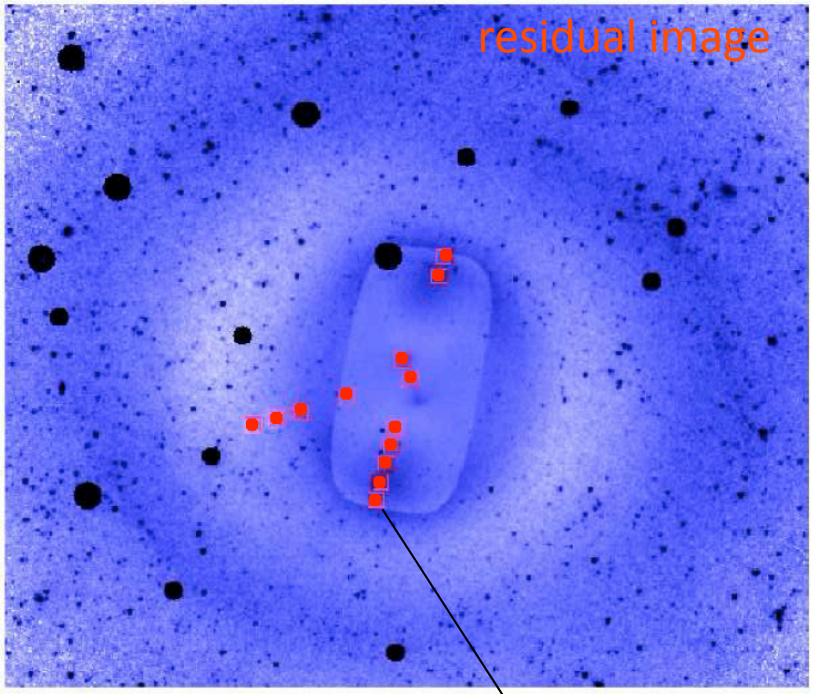
[See e.g. Bournaud & Combes (2002).]

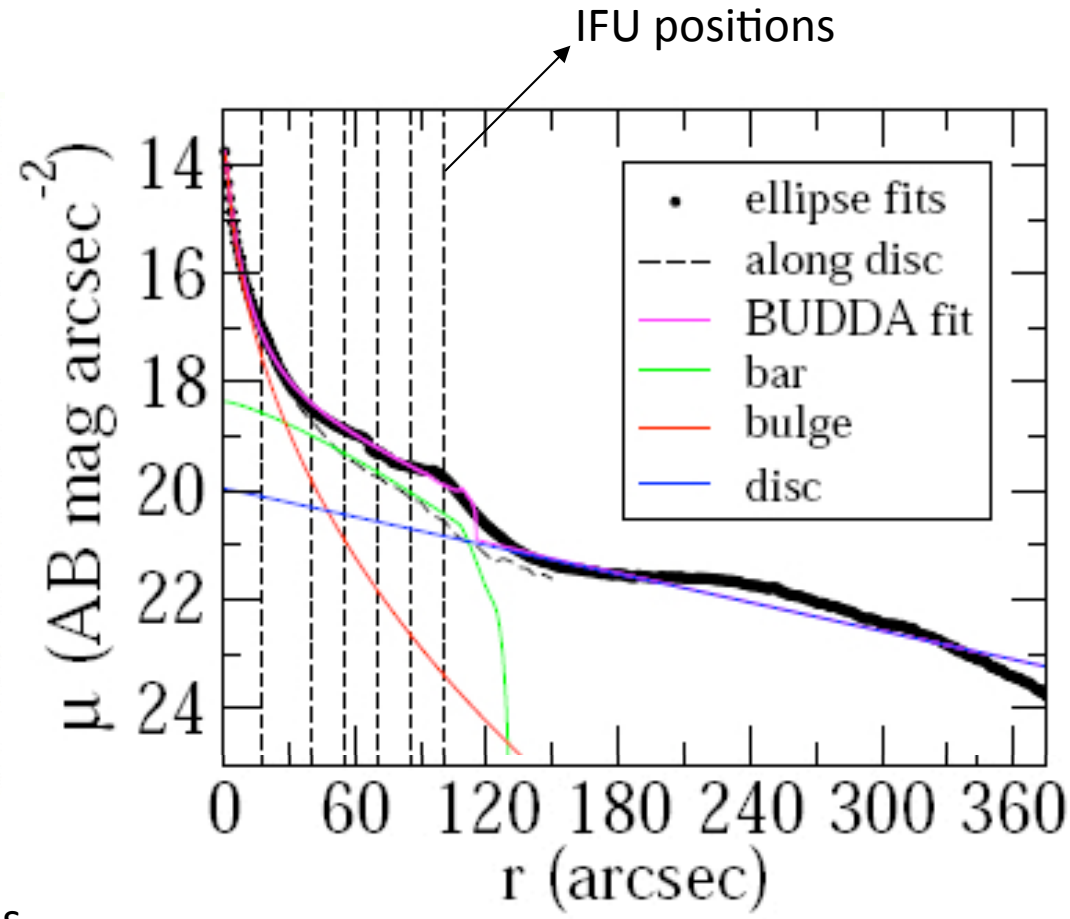
To understand galaxies we have to understand their different structural components. IFUs provide both structural information (from reconstructed image) and spectral information on both gas and stars, i.e.:

- kinematics
- chemical properties
- other physical properties

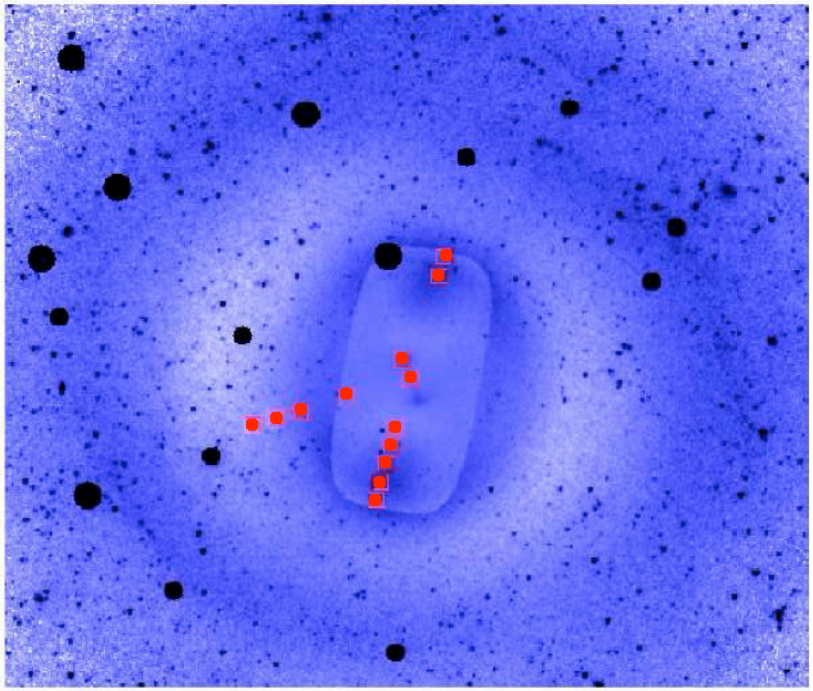
If stellar population is resolved, understanding is boosted immensely (color-magnitude diagrams, distribution of properties, star-formation histories etc.). This is a major E-ELT Science case.

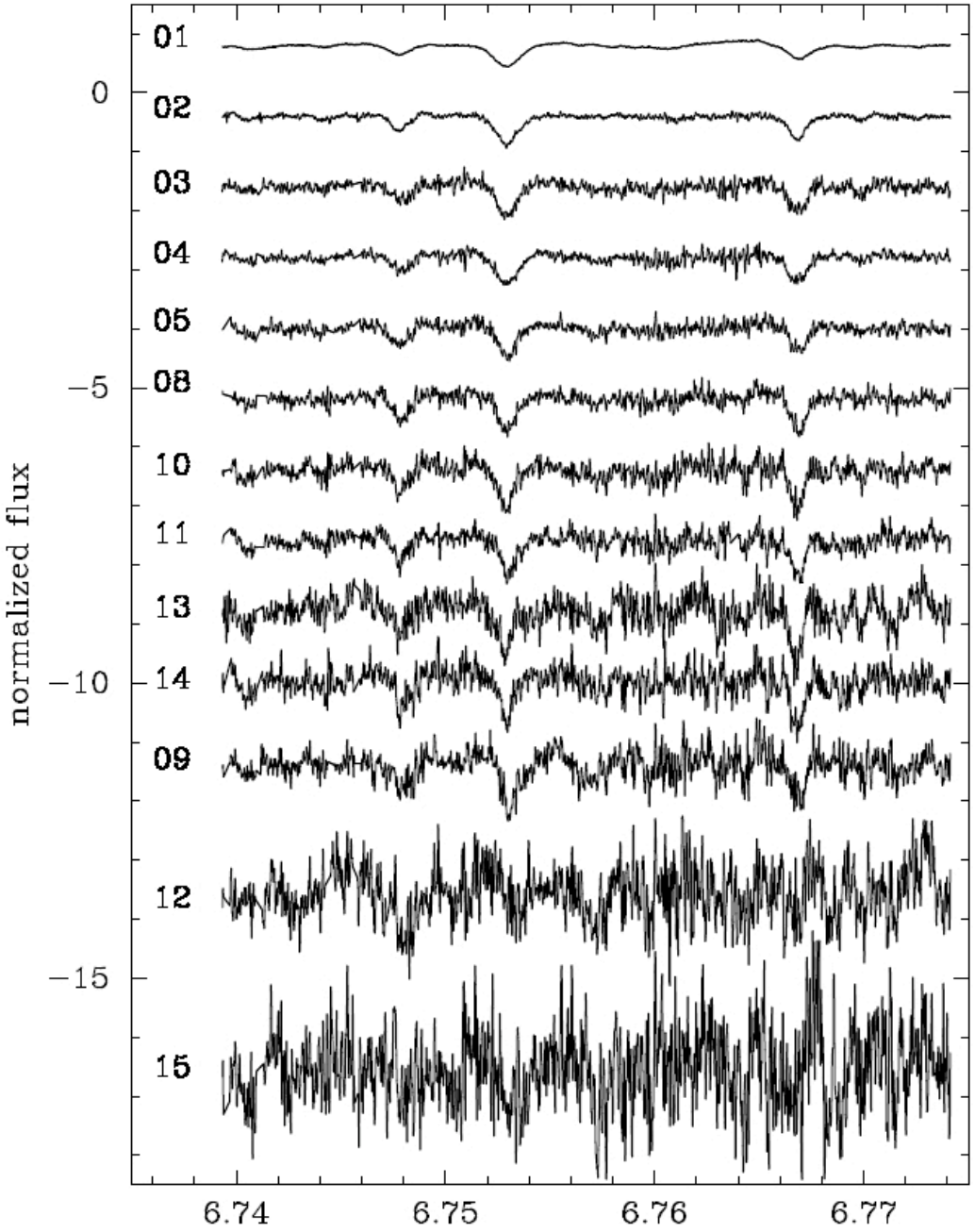
An experiment with FLAMES on NGC 1291 (Bosma et al. 2010):

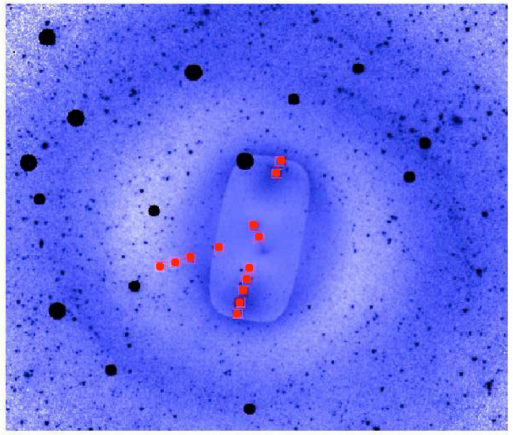




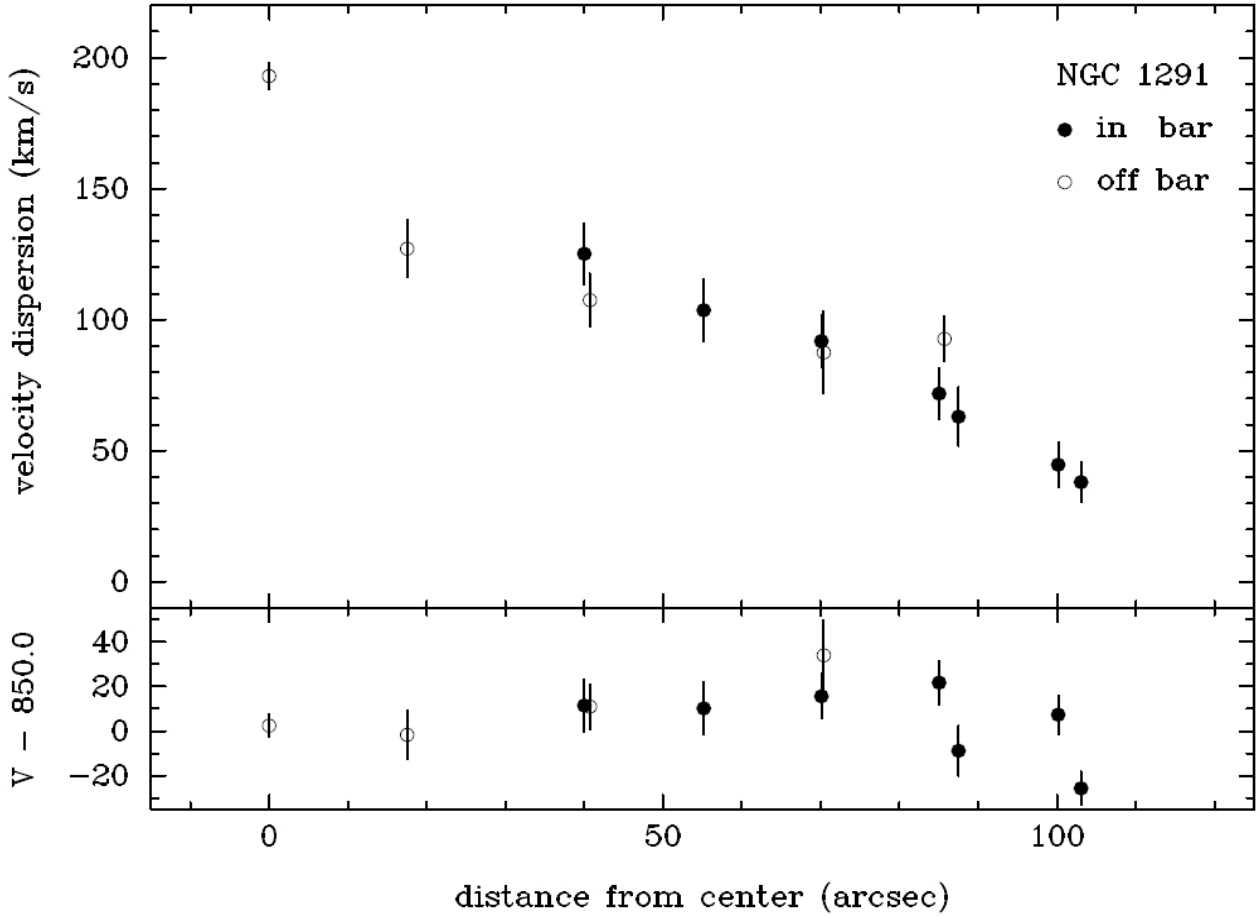
spectra are fitted with template stars and a Gaussian LOSVD to obtain σ_Z







Results suggest interaction between bar and dark matter halo was weak.



Wish list:

- large patrol field: ~ 5x5 arcmin^2 (at least)
- ~ 40 or more IFUs (that can be close to each other)
- ~ 2x2 arcsec^2 (variable?)
- variable spatial resolution (10mas – 40mas)?
- optical – NIR
- R ~ 5000-20000
- MOAO?