Probing stellar populations in the nuclei of early-type galaxies with LGS AO

Davor Krajnović
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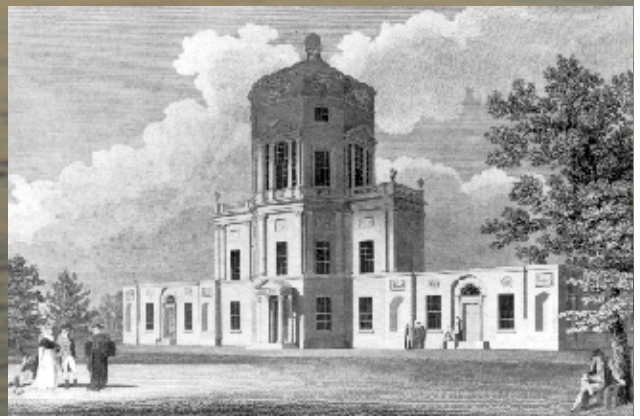
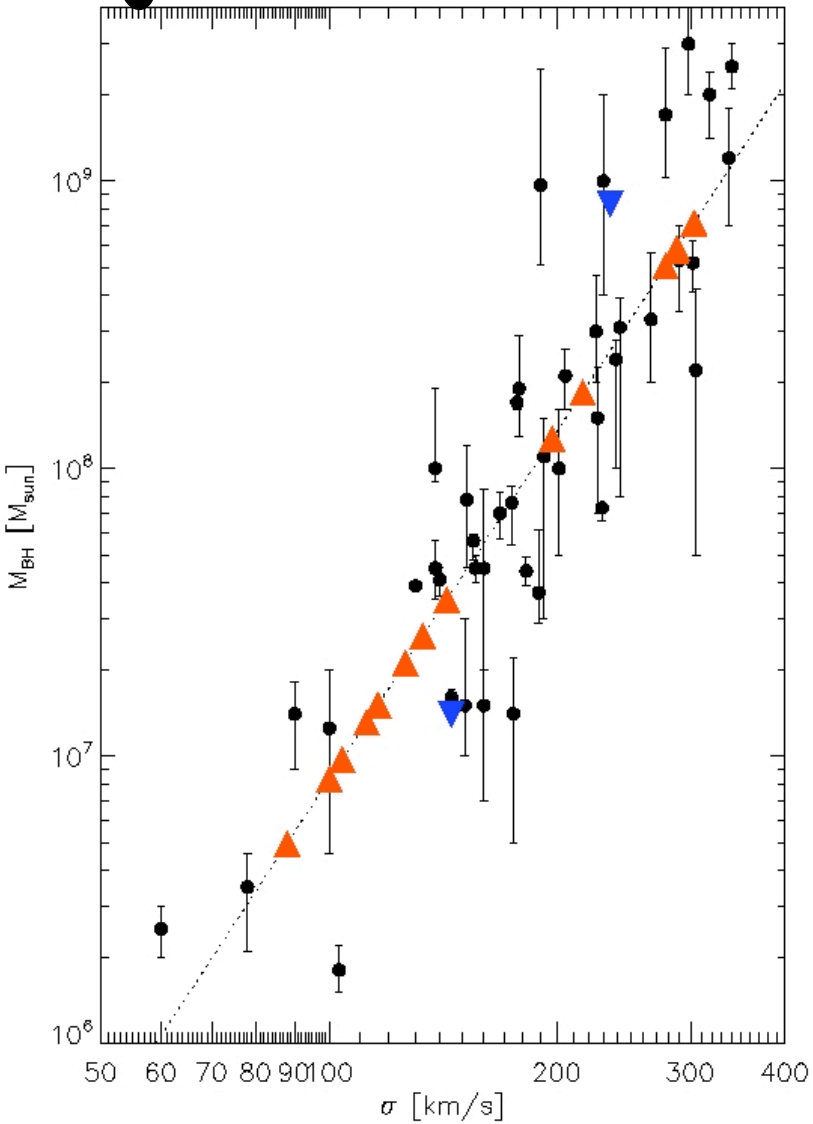


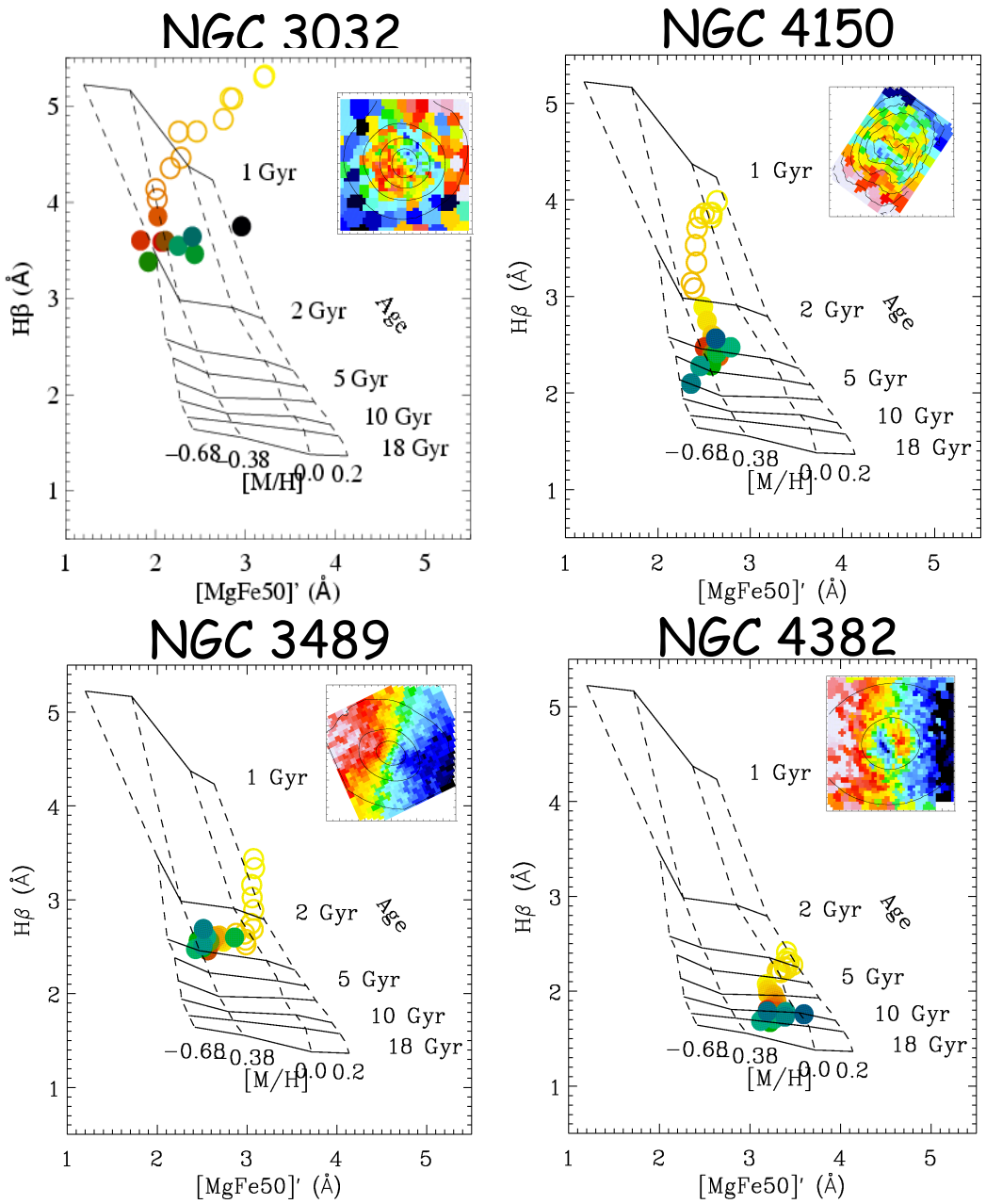
Atlas^{3D} BH project

- Volume limited sample of ETG
  - Observed with SAURON
- Goal: derive a <u>representative</u> M_{BH} - σ_e relation for early-type galaxies!
- Target under-populated regions of M_{BH} - σ_e relation
  - σ_e < 130 km/s
  - σ_e > 270 km/s
- High resolution campaign:
  - Gemini + NIFS
    - LGS AO in 'open loop' mode
    - 09A observing, 09B proposal….
  - VLT+SINFONI
    - No tip-tilt (seeing improver mode)
    - 09B proposal…..



Gebhardt et al. (2000) & Merritt& Ferrarese (2000), Graham et al. (2008), Gültekin et al. (2009)

ETG Nuclei Resolved

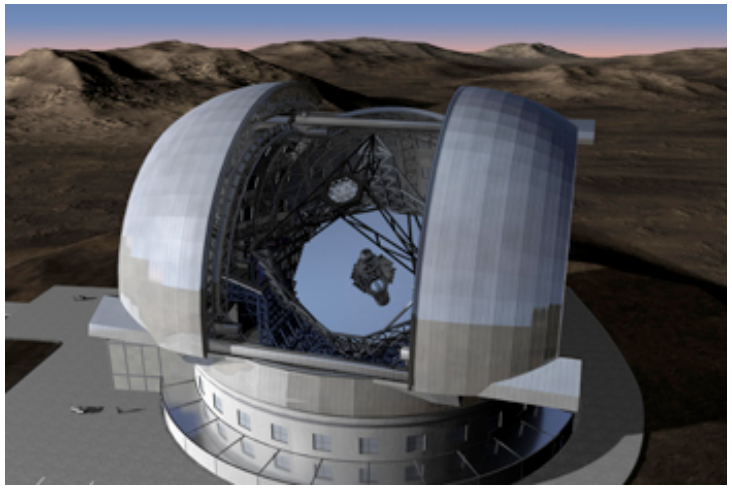


- 'Youngest' galaxies have recent central SF
- Stellar kinematics show small nuclear sub-component

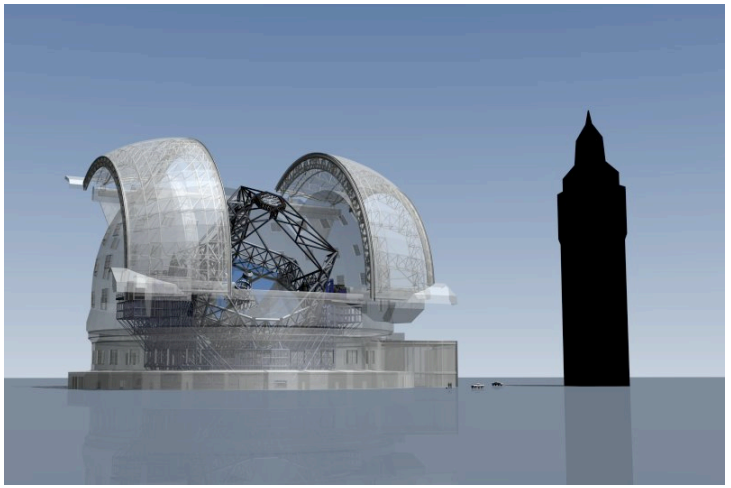
OASIS
SAURON

Radius →

McDermid et al. (2006)



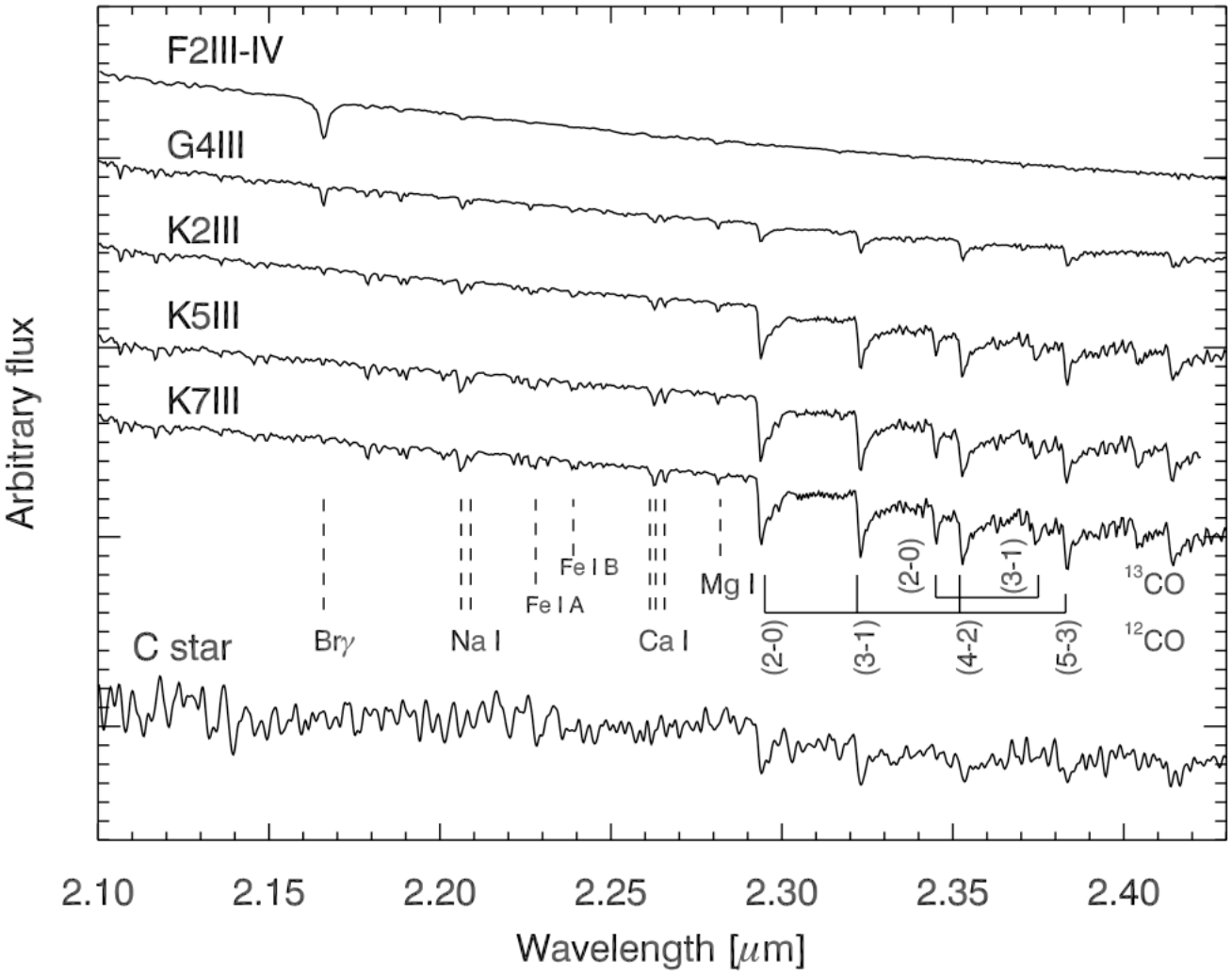
E-ELT



- A suite of IFU instruments
- NIR optimised telescope
- Dedicated adaptive optics
- High spatial resolution (pc scales)
- (Integrated) Stellar populations in nuclei of galaxies

Line-strengths in K band

- Number of absorption features at 2.2-2.4 μm
- Atomic indices: NaI, FeI, CaI, MgI
- Molecular indices: CO(2-0)

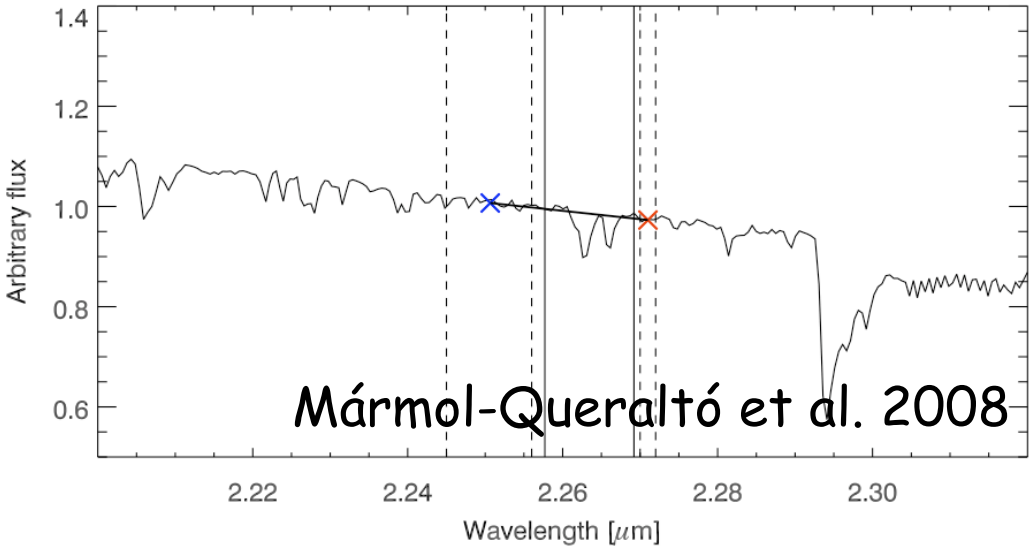


IRTF library; Rayner et al. (2009), Lyubenova (2009, PhD)

Definition and measurement of indices

- Atomic indices: similar to optical Lick index definitions (Frogel et al. 2001, Silva et al. 2008)
- Molecular index: no red continuum
  - Substitutes on blue side (Frogel et al. 2001)
  - Generic discontinuity (Mármol-Queraltó et al. 2008

Frogel et al. 2001



Images from Lyubenova (2009, PhD)

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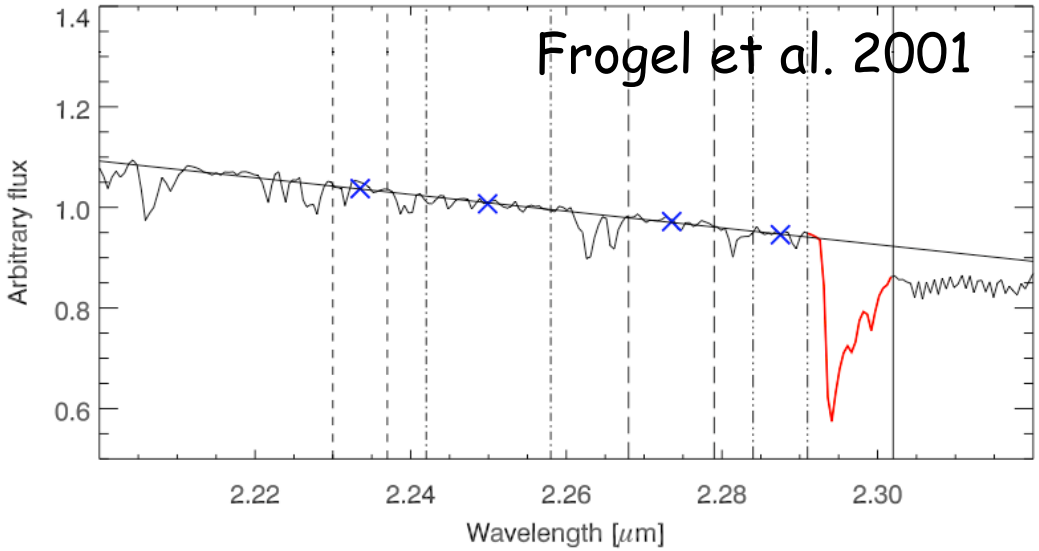
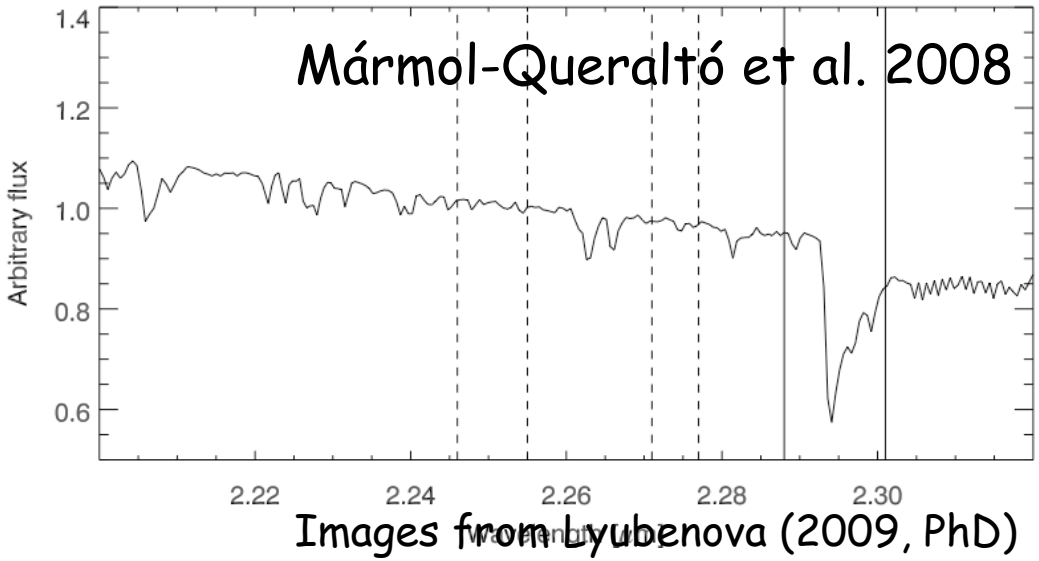
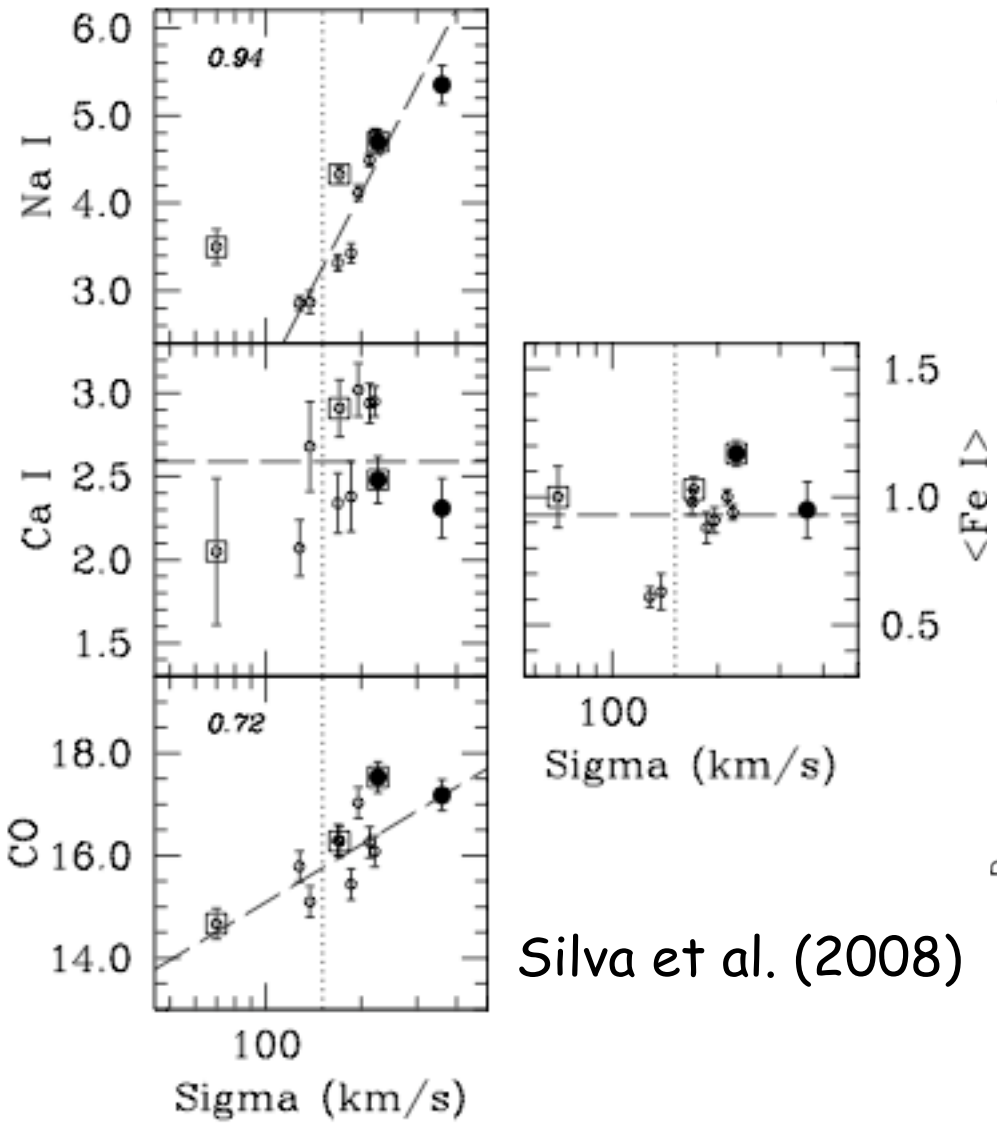


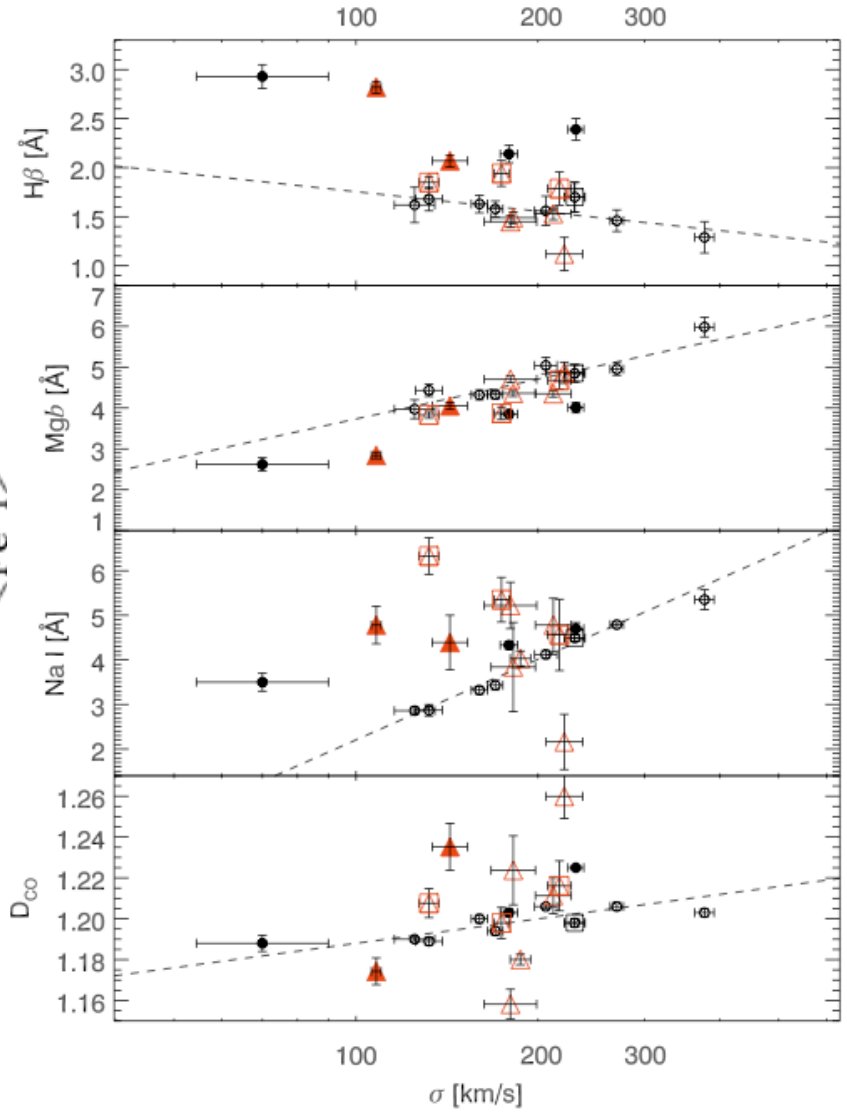


Images from Lyubenova (2009, PhD)

Global LS in NIR



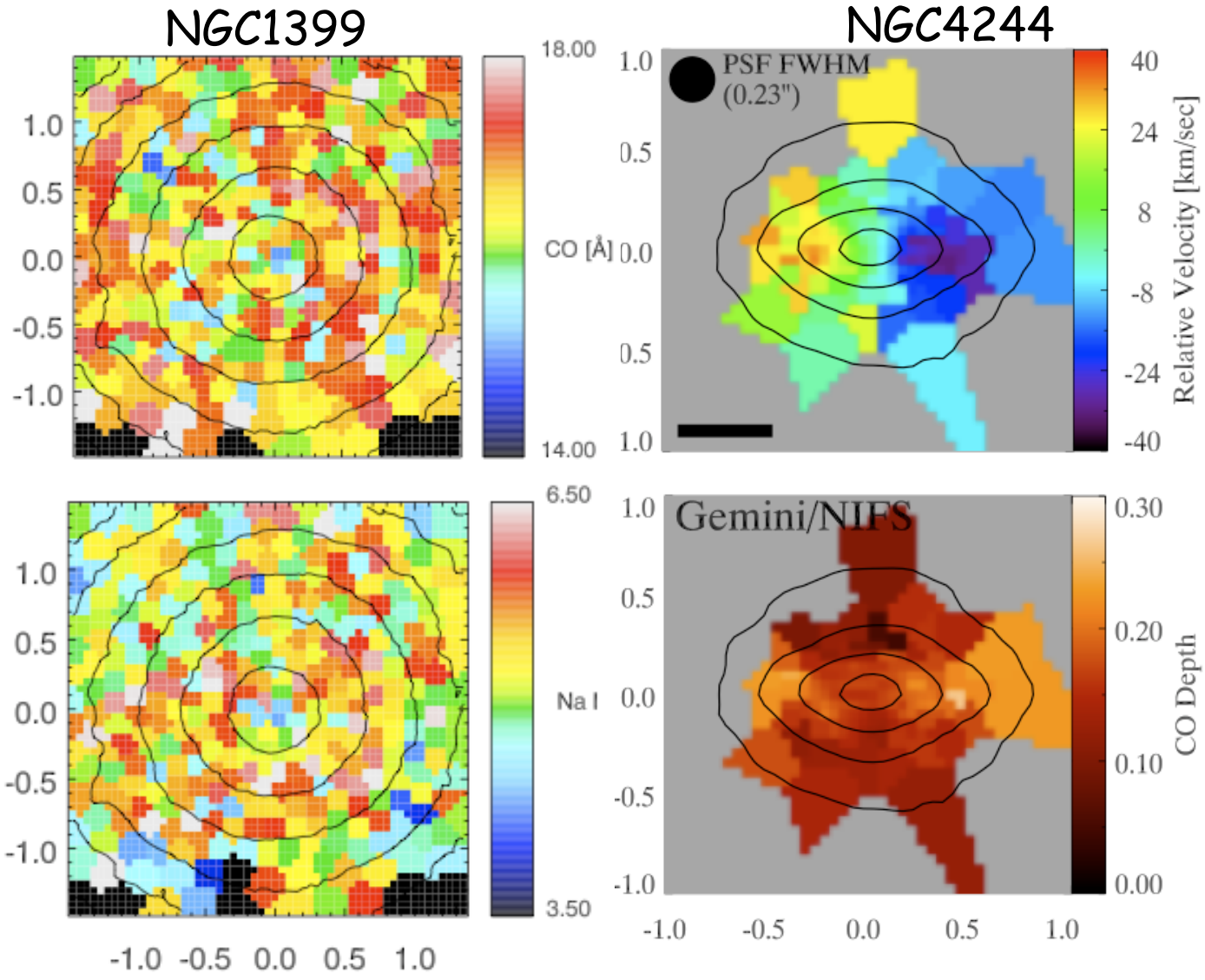
Silva et al. (2008)



Lyubenova (2009, PhD Thesis)

Local LS in NIR

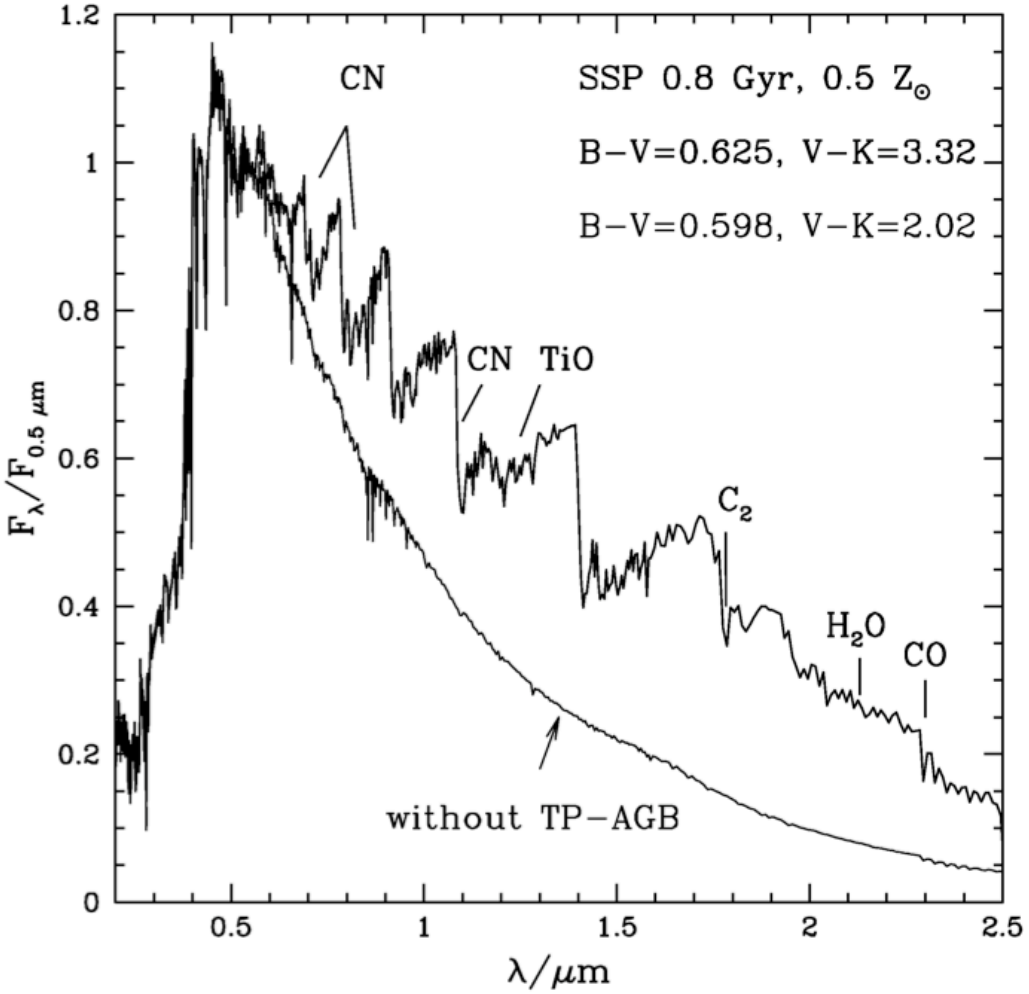
- NGC1399 – decrease in line-strengths in centre
- NGC4244 nuclear cluster - increase in CO depth with rotation components



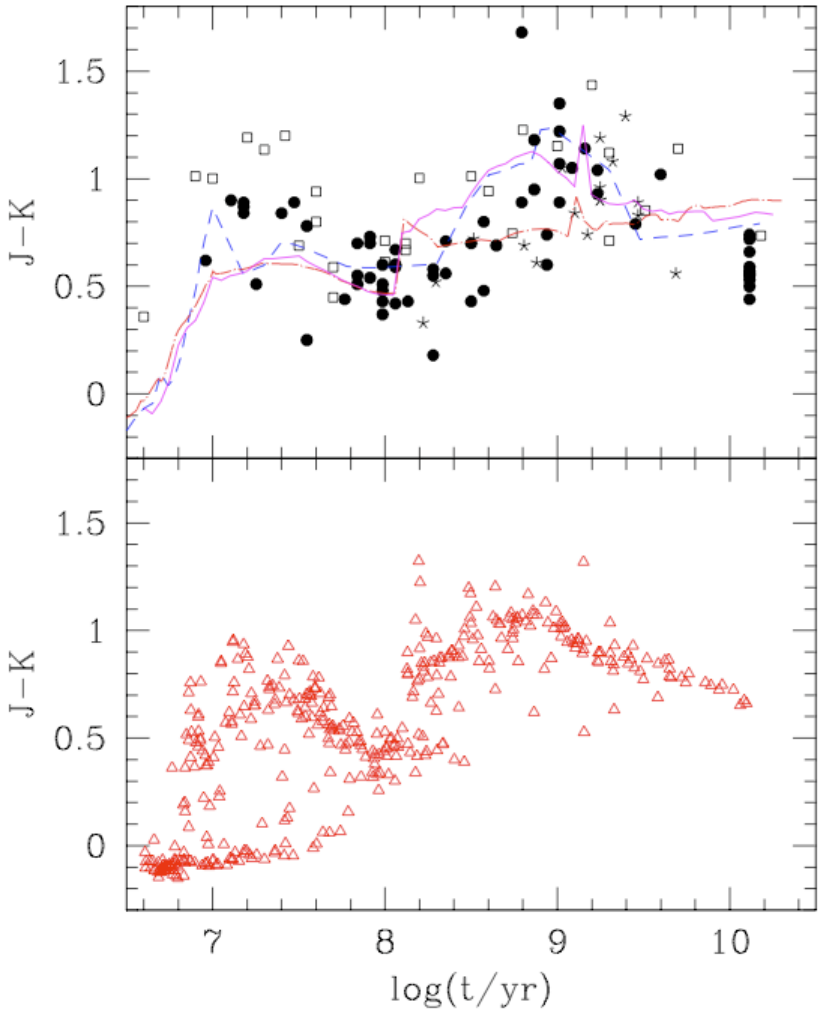
Lyubenova et al. (2009)

Seth et al. (2008)

Where are the models?



Maraston (2005)

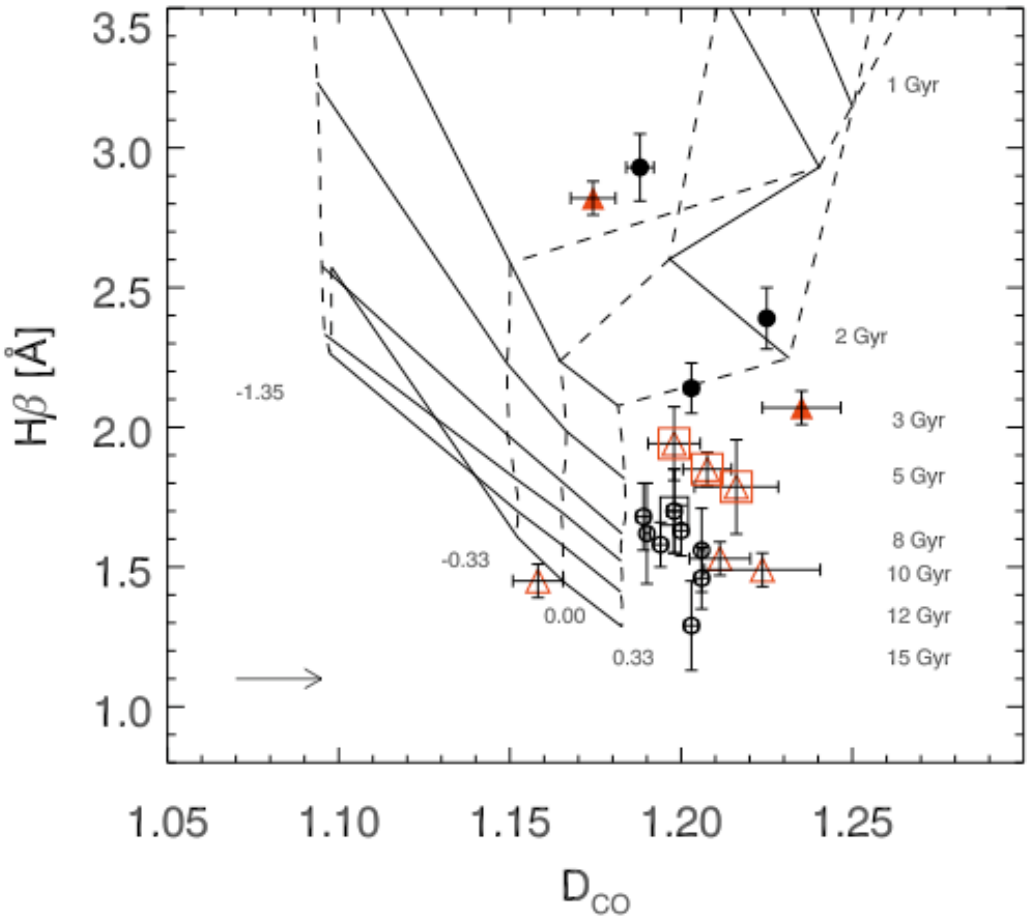


Marigo et al. (2008)

Where are the models?

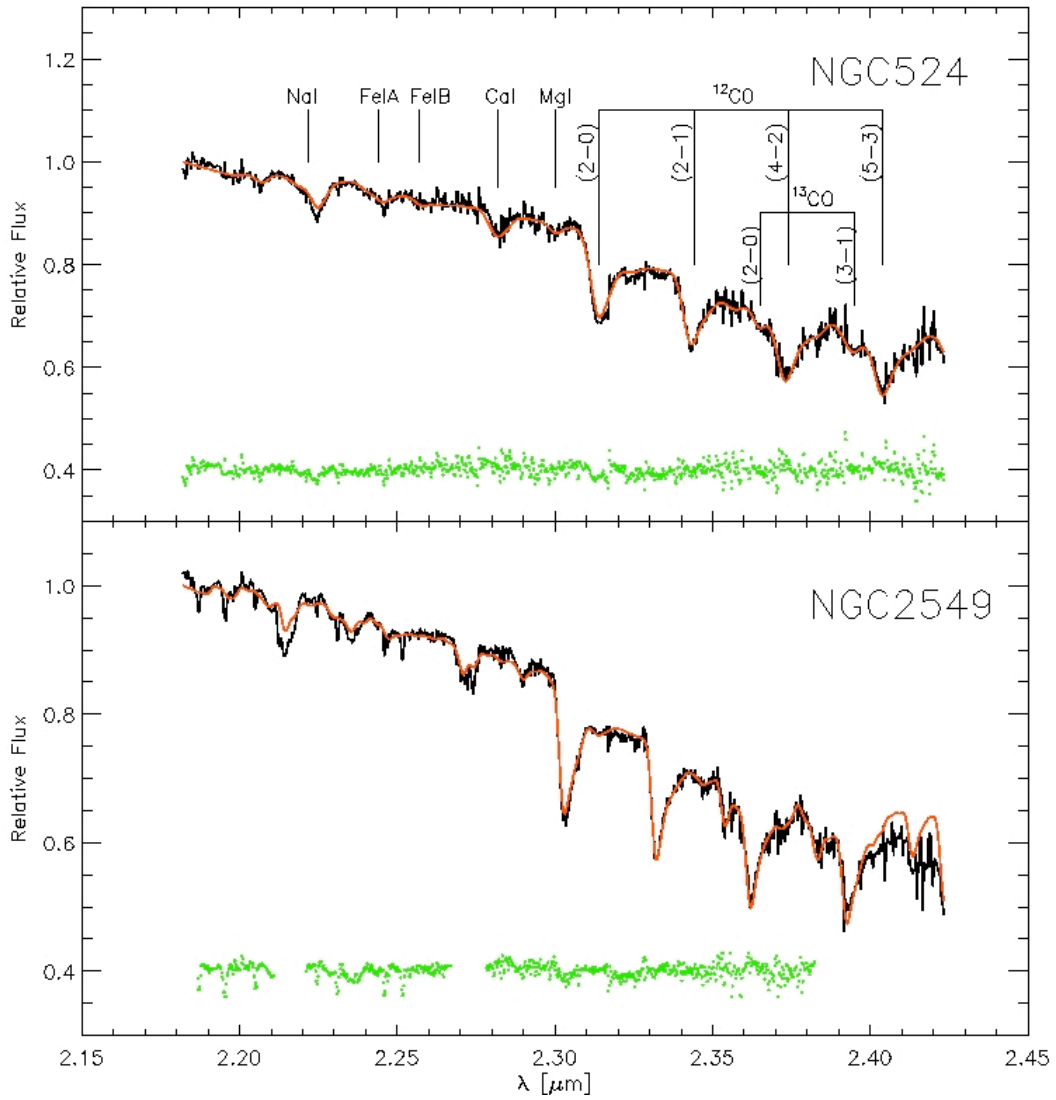
- Important contribution of *AGB* stars
- Importance of *C* stars (1 Gyr)
- Models not yet mature enough

Lyubenova (2009, PhD)

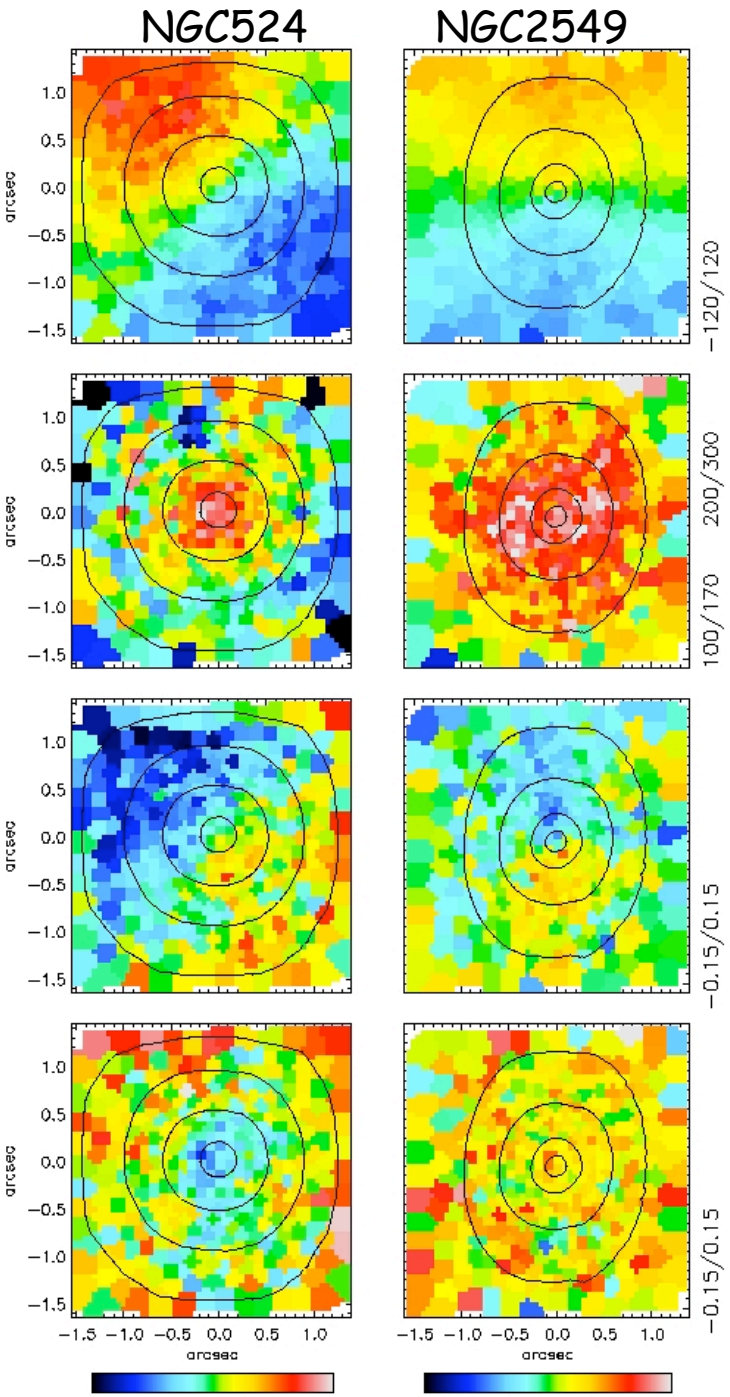


D_{CO} from Maraston (2005) SED predictions

NIFS spectra

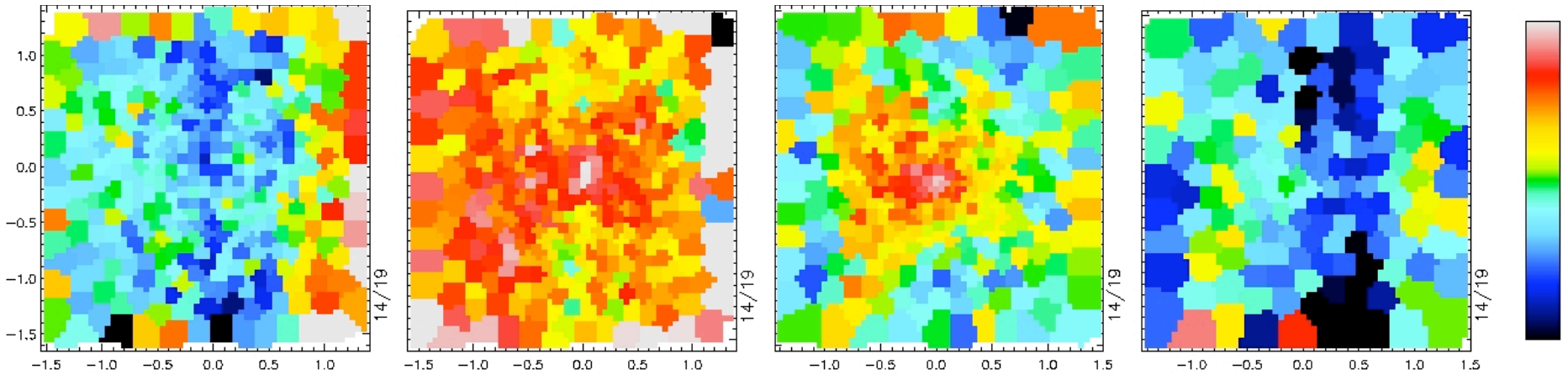


Krajnović et al. (2009)



NIFS Line-strengths

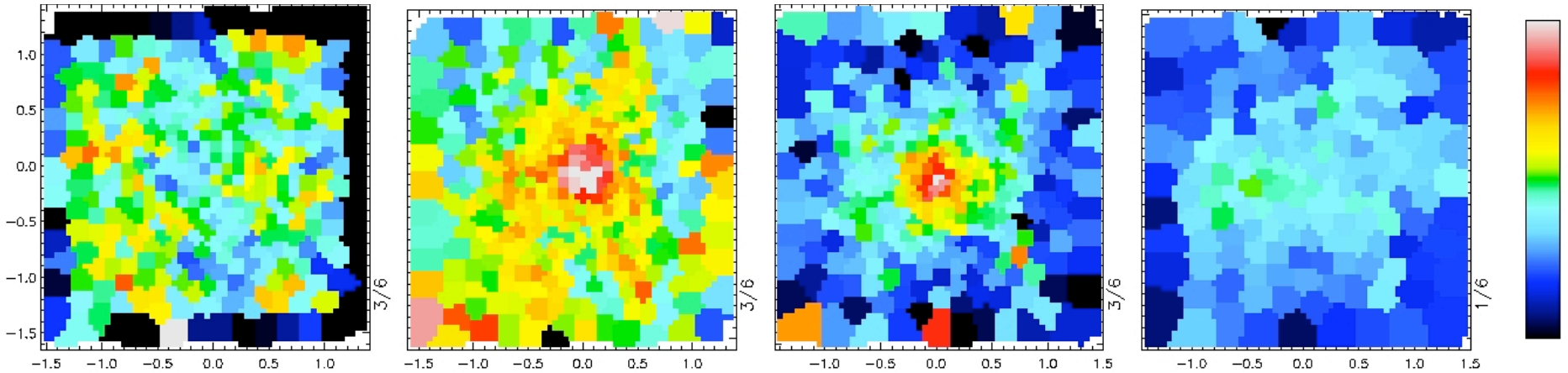
CO (as defined in Frogel et al. 2001)



- AGE: Increase in CO -> Decrease in age (up to 2 Gy)
- METALLICITY: Increase in CO → increase in metallicity

NIFS Line-strengths

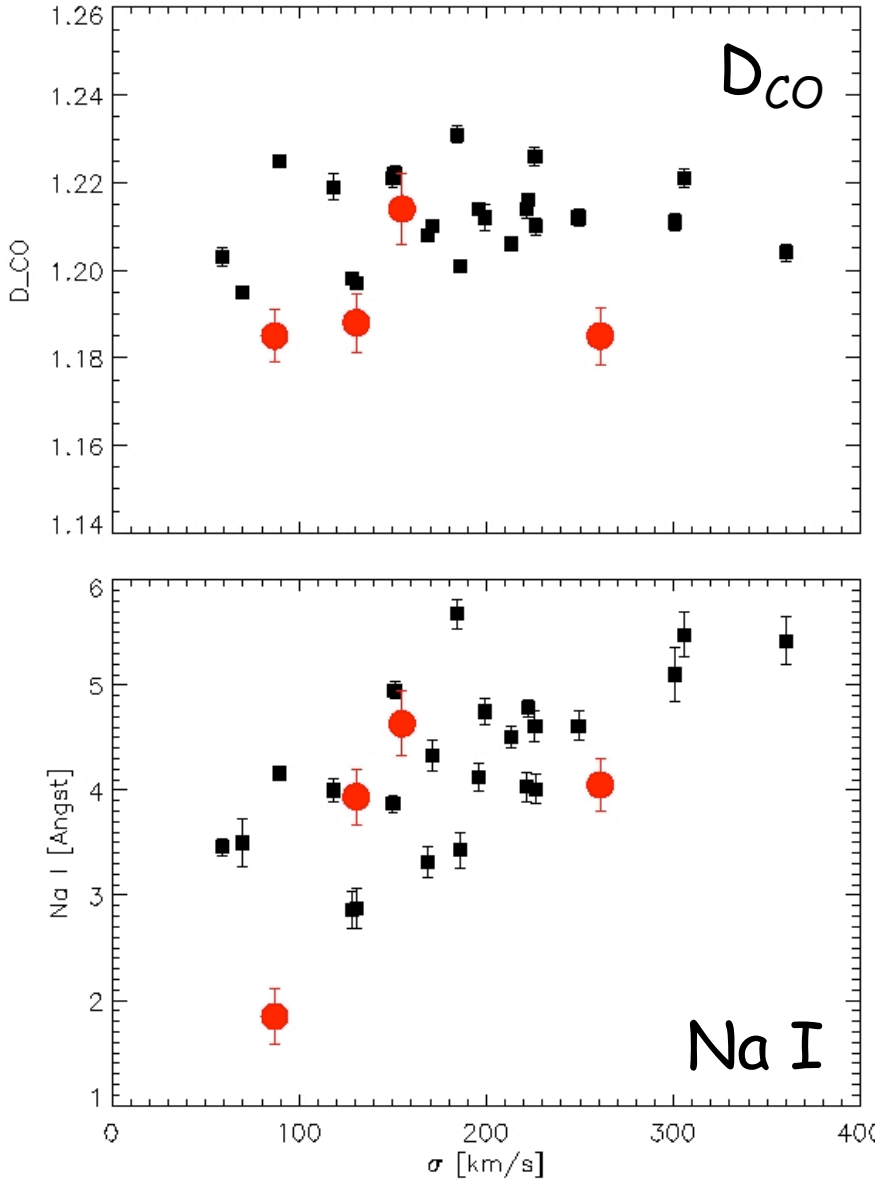
Na I (as defined in Silva et al. 2008)



- AGE: Increase in Na I → Decrease in age
- METALLICITY: good metallicity indicator
  → empirical calibration (Lyubenova 2009, PhD)
  - Increase in Na I → increase in metallicity

Global trends

- No real correlation in NIFS D_{CO} (nor CO)
- Data reduction issues or intrinsic problems in measuring CO(2-0) LS ??
- Na I data in agreement with previous studies (correlation with σ)



Data form H. Kuntschner

Conclusions

- Good prospective
- Necessary:
  - observations for calibration of different indices (Na I as metallicity; age?)
  - theoretical models for physical parameters
  - better understanding of AGB phase
- Business oriented talk: There is a (growing) market for stellar populations models in NIR!