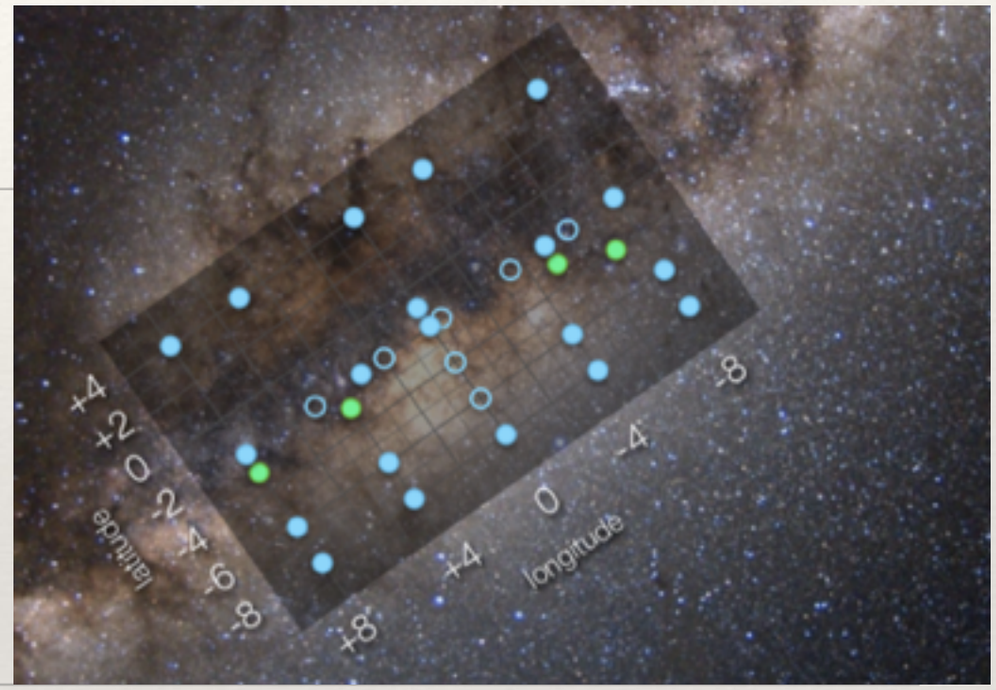
The missing pieces of

The MW bulge puzzle



Oscar A. Gonzalez
European Southern Observatory, Chile

Galactic archeology in the Bulge

- Tracer of formation and evolution of the galaxy
- Fingerprints of mergers, secular evolution

Galactic archeology in the Bulge

- What is MW bulge made of?

- Chemical abundances → Bulge metallicity distributions show a vertical gradient up to inner 700 pc
- Ages → Predominantly old, but a fraction of metal-rich stars are young
- Kinematics → Metal-rich stars show rotation curves with cylindrical rotation (bar-like)
- Morphology → Metal-rich stars trace an X-shape bulge,
  old metal-poor stars trace a spheroid

Thanks to different MOS surveys:
BRAVA, ARGOS, GAIA-ESO, GIBS
and several individual programs (Bensby et al., Johnson et al., Wegg et al., Rich et al., and more)

Galactic archeology in the Bulge

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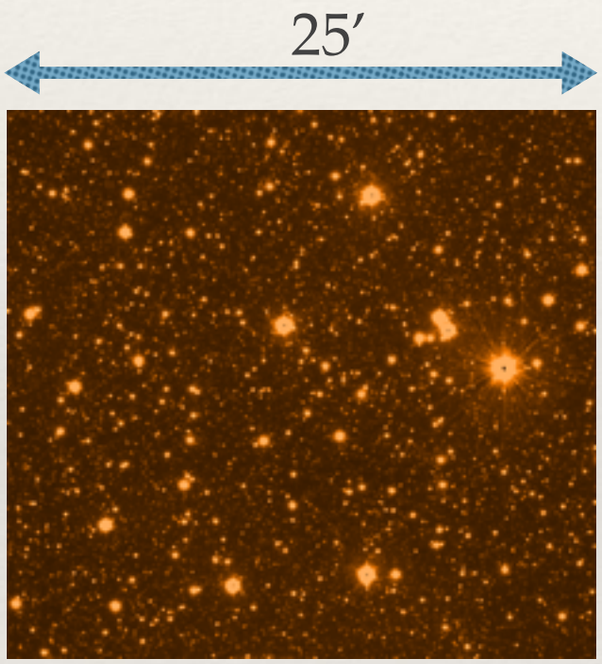
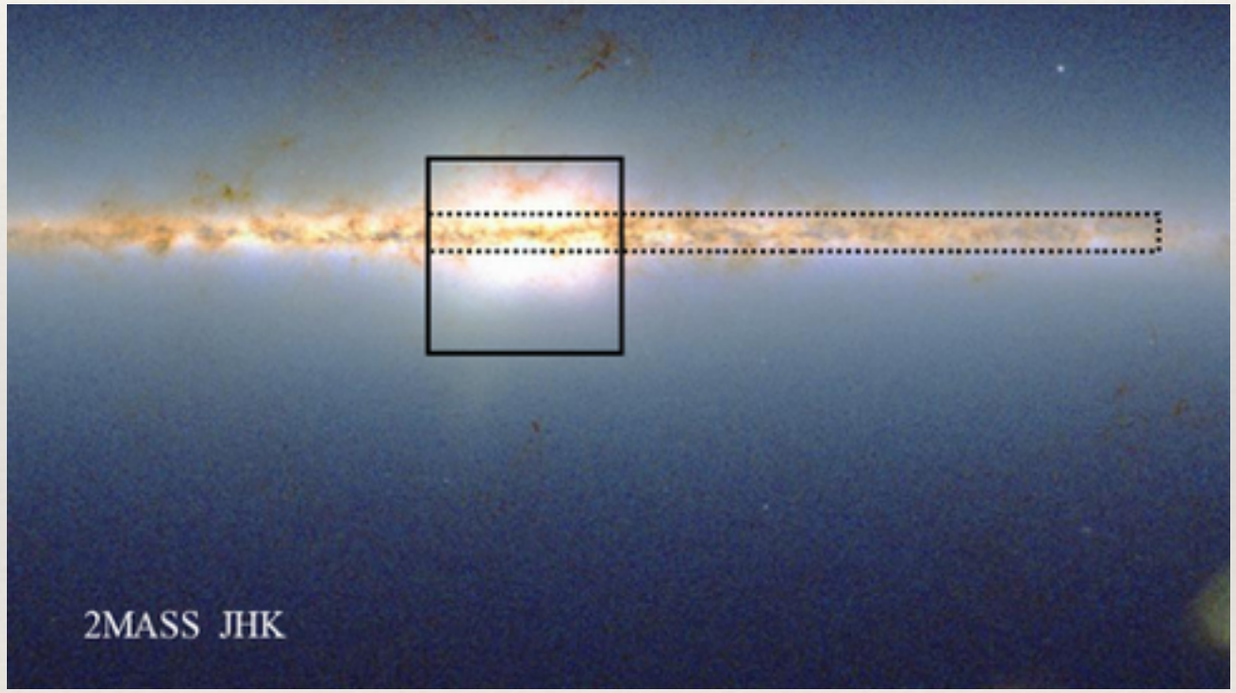
The Bulge is a complex population

Metallicity is FUNDAMENTAL!

MOS in the MW bulge

- Chemical characterisation of a ~400 sq. deg. area





MOS in the MW bulge

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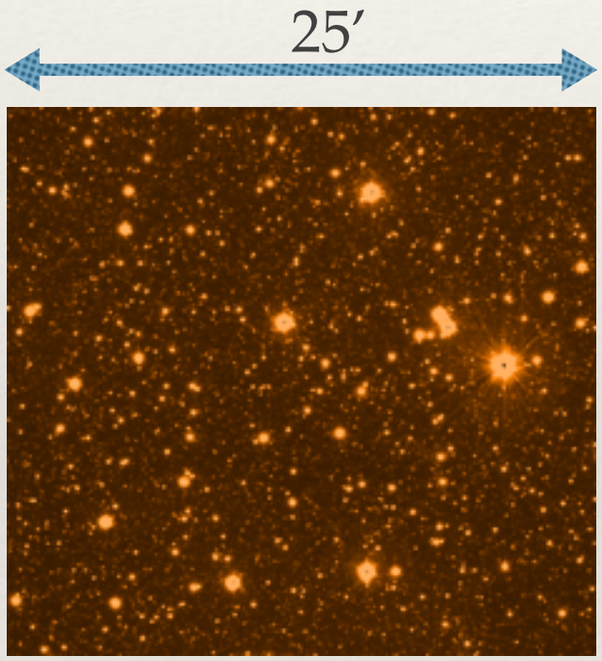
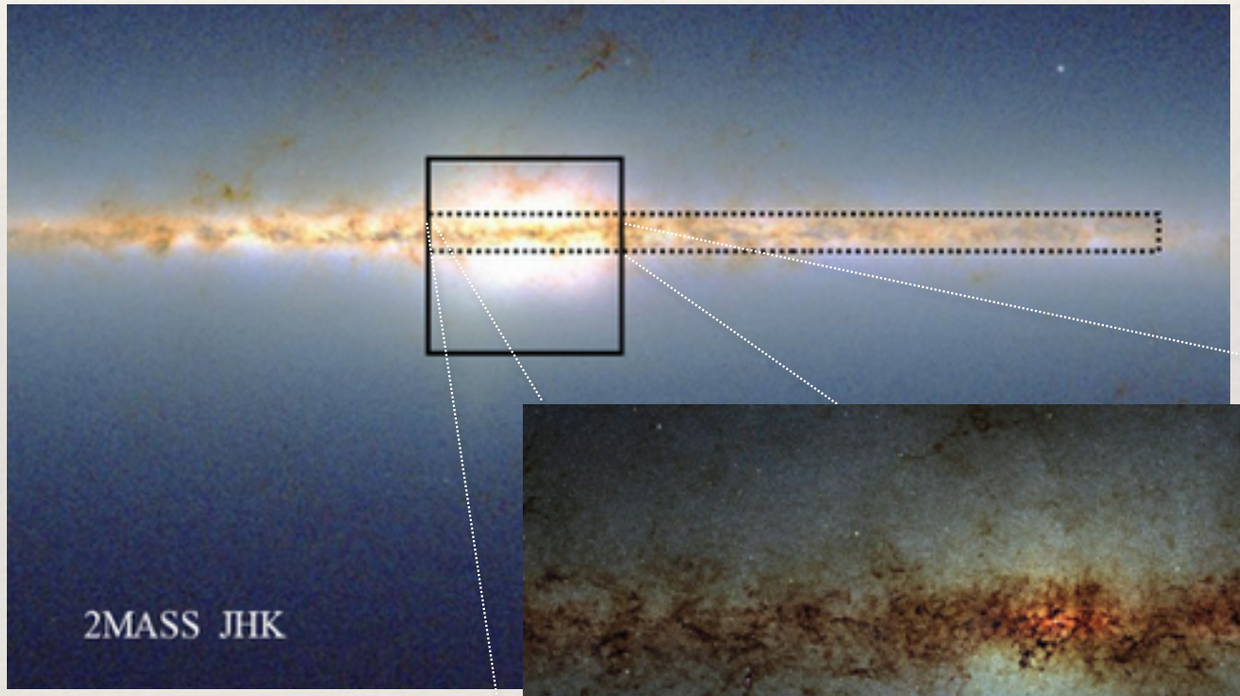




- Large (differential) extinction and heavily crowded

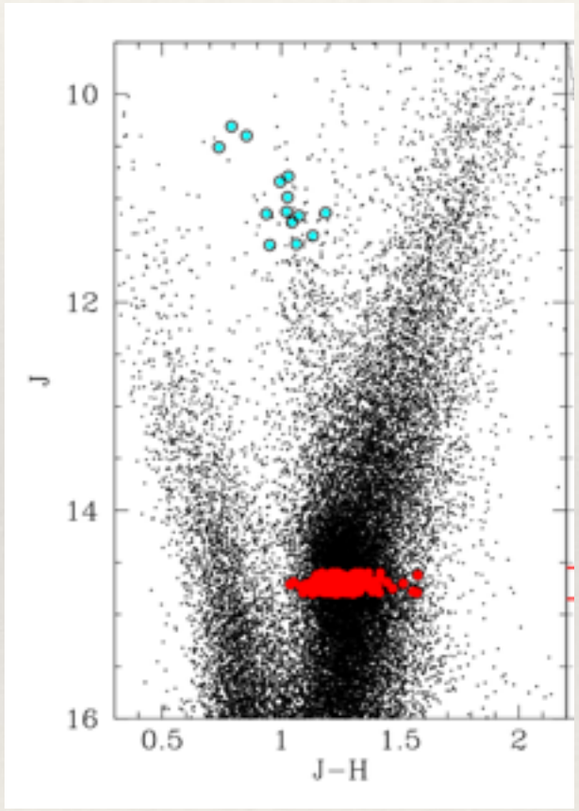
GIBS PI. Zoccali

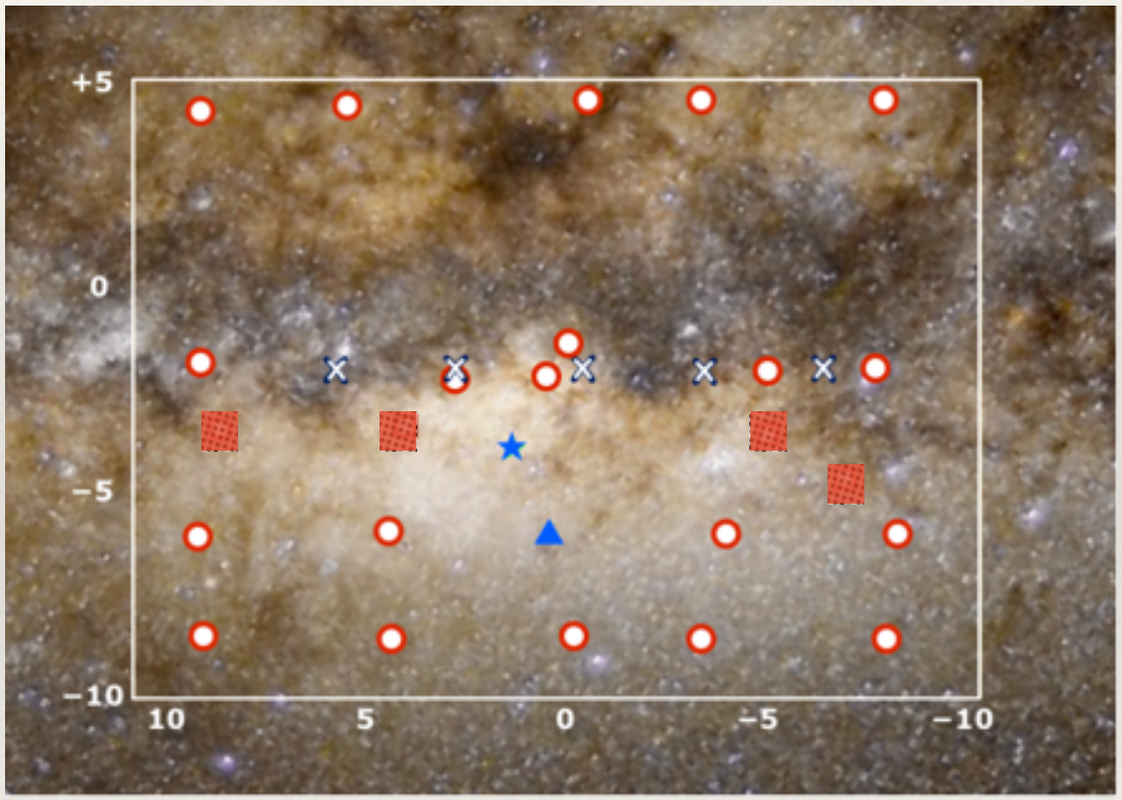
20 LR (R8,000) fields

4 HR (R23,500) fields (b=-4, major axis)

- GIBS: GIRAFFE Inner Bulge Survey (FLAMES-GIRAFFE@VLT)

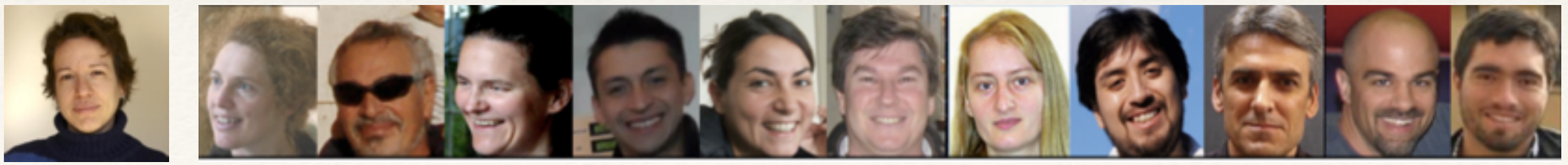
Red Clump stars selected from the (J, J-Ks) CMD





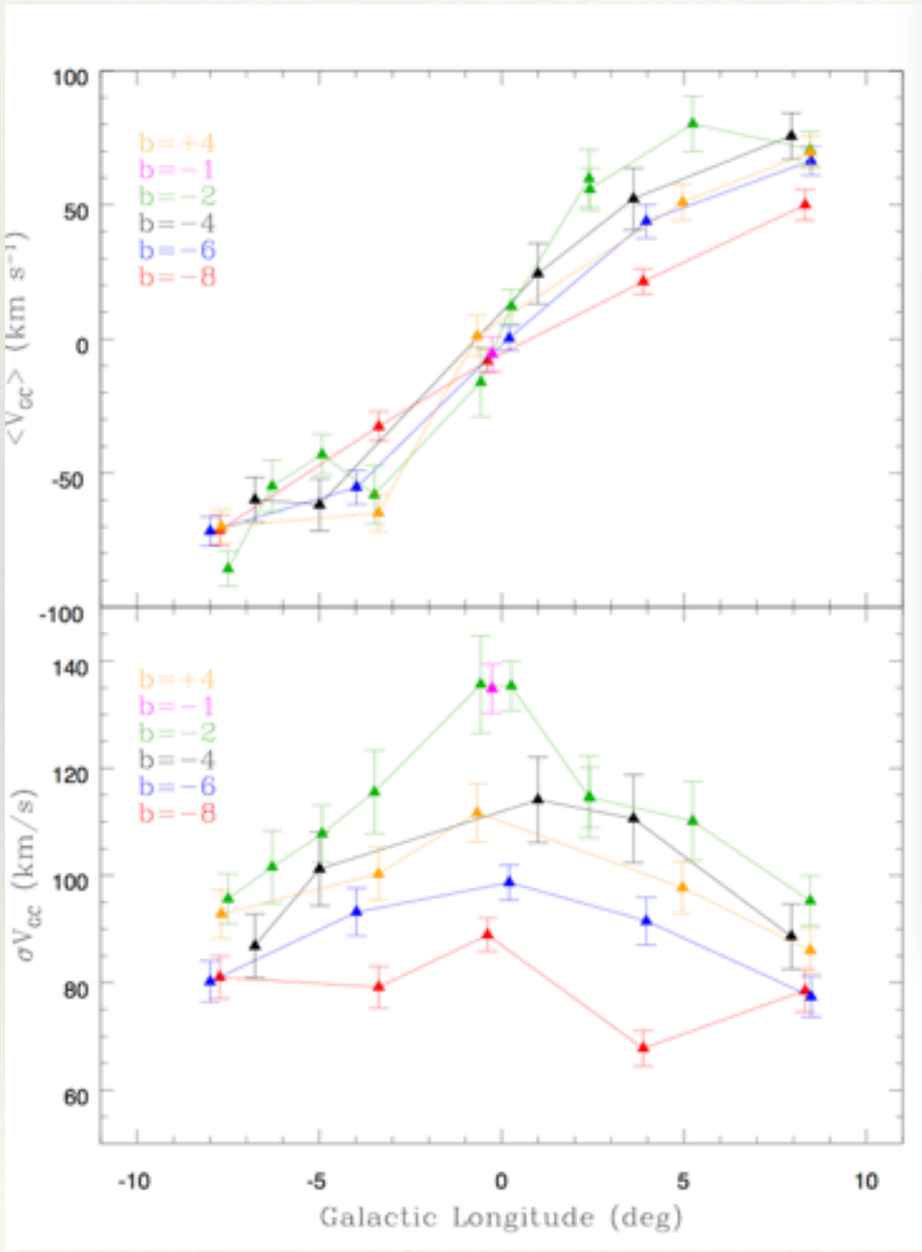
Strategy and observations in Zoccali, Gonzalez, Vasquez+2013

~7,000 red clump stars

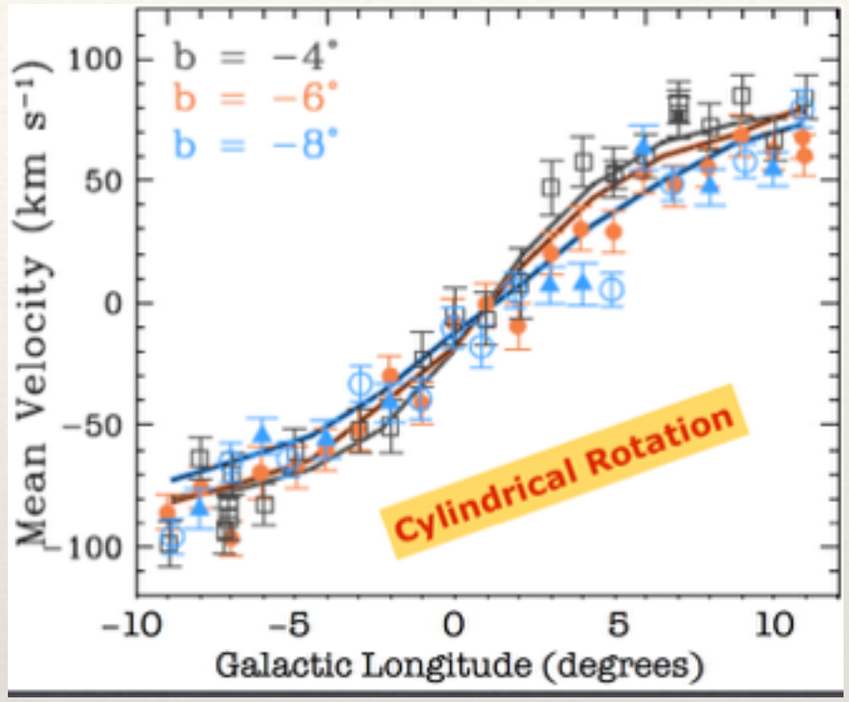


Bulge radial velocities

Rotation curves of the Bulge at different latitudes



Zoccali, Gonzalez, Vasquez+2013



BRAVA survey - Kunder+12

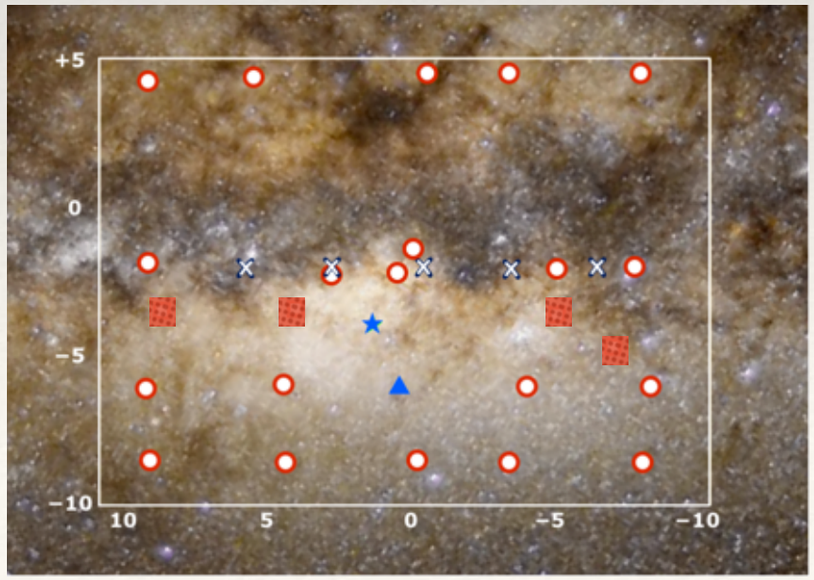
b=+4

b=-2

b=-4

b=-6

b=-8



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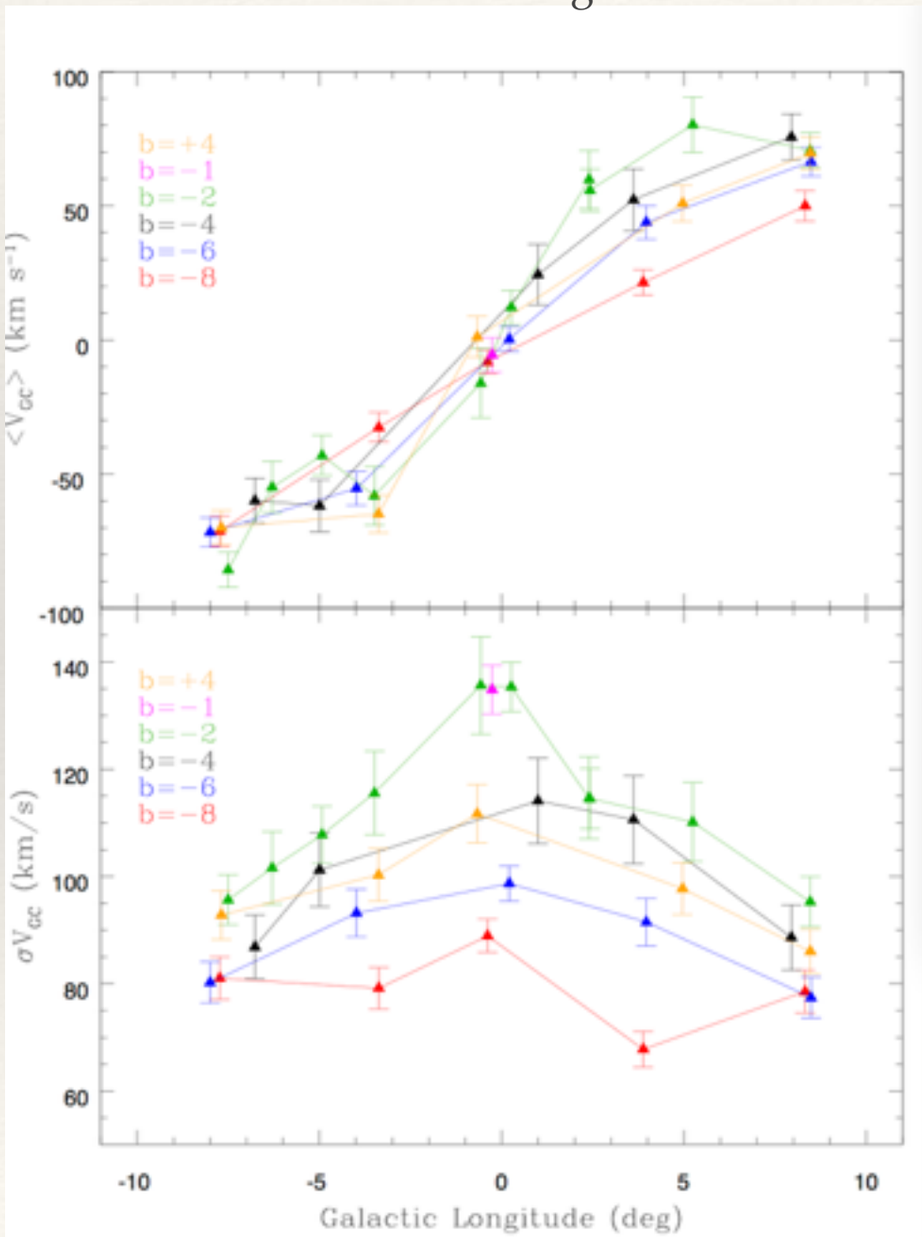
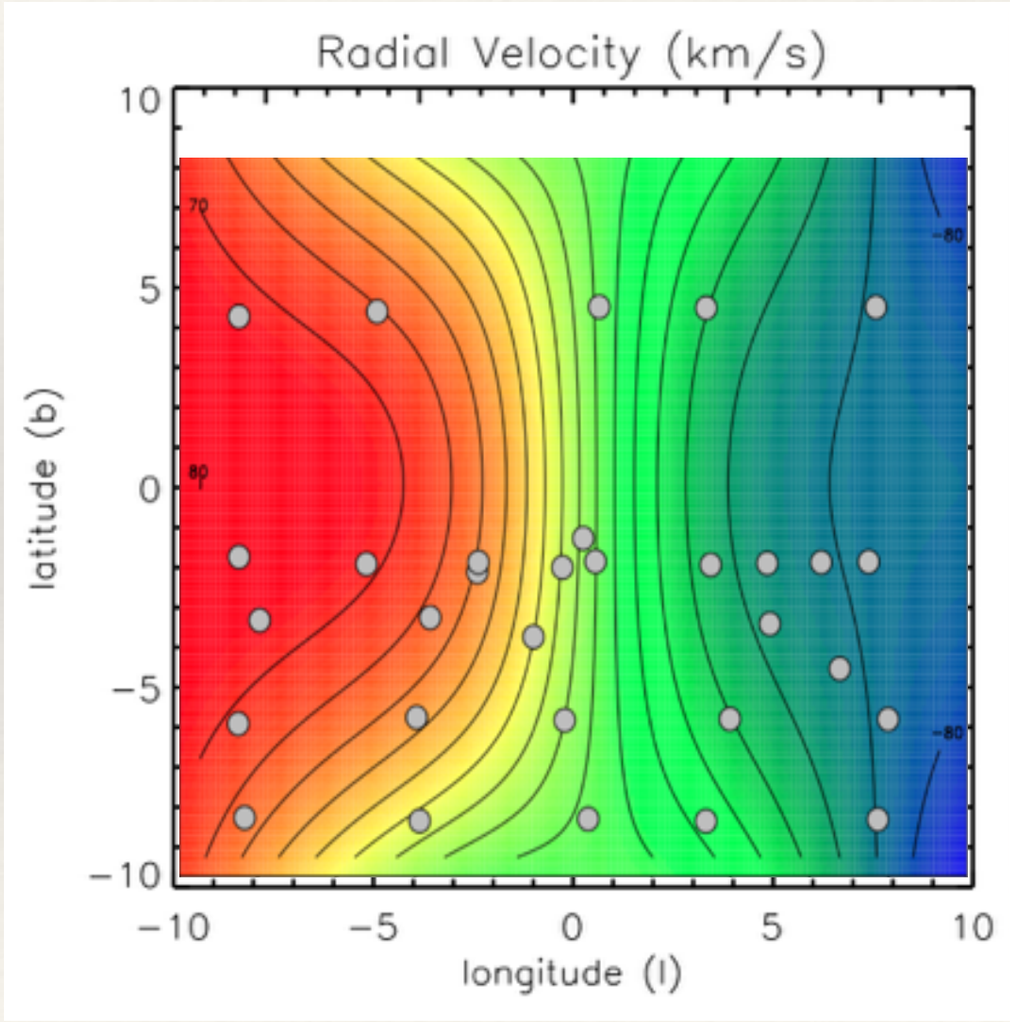


Zoccali, Gonzalez, Vasquez+2013

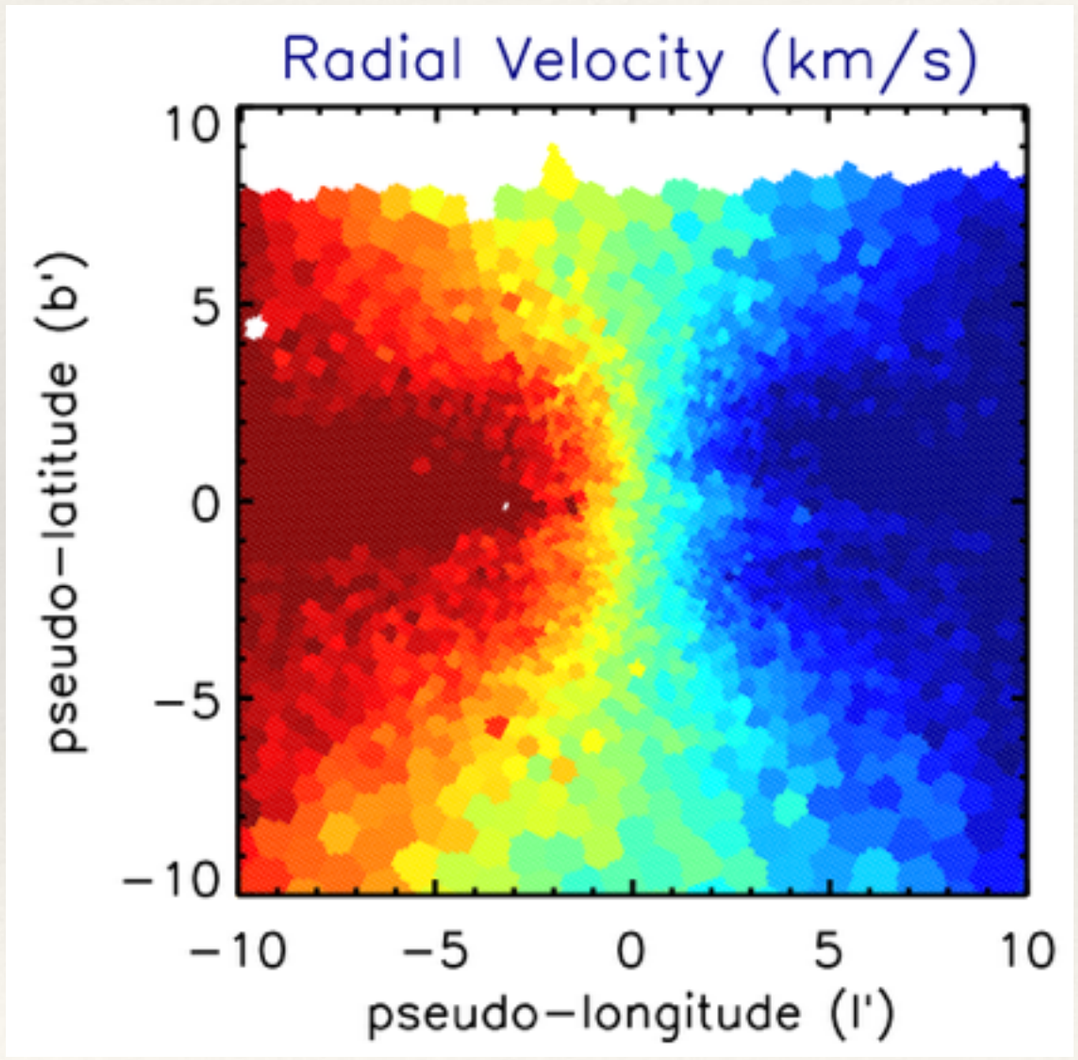
Rotation map of the MW bulge (as seen from an IFU!)



Zoccali, Gonzalez, Vasquez+2013

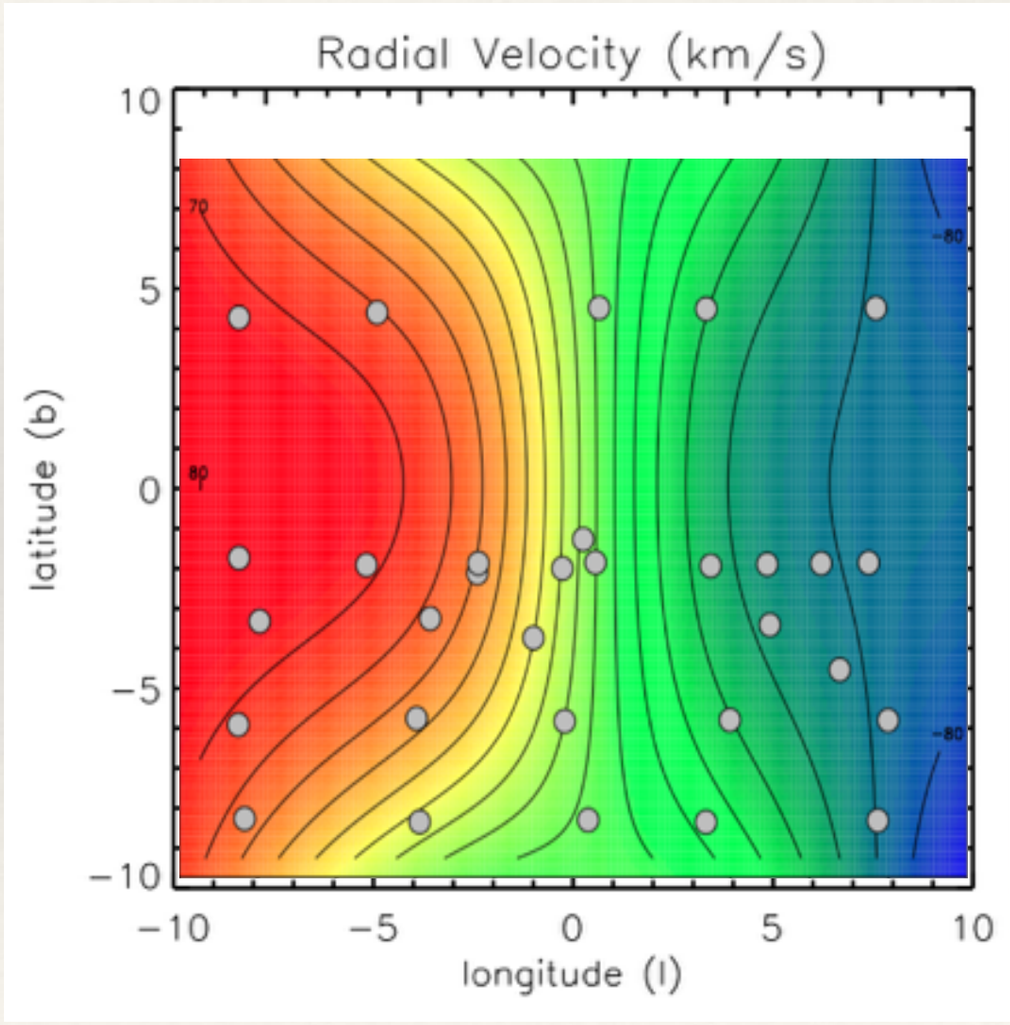
Compared to external galaxies

Rotation map of NGC 4710 (Actually seen from an IFU!)



with MUSE@VLT - Gonzalez, Gadotti, Debattista+2015 (in prep.)

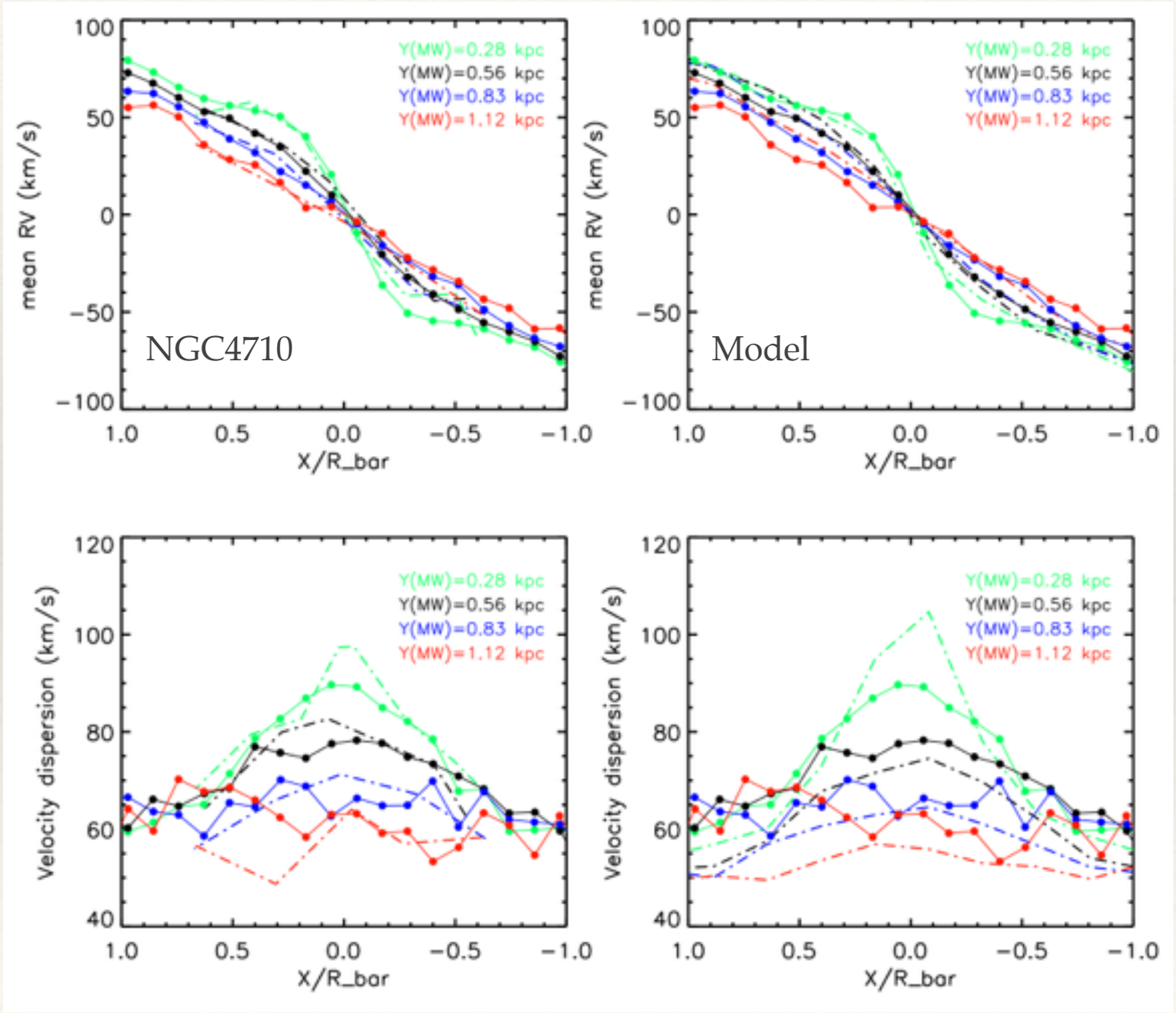
Rotation map of the MW bulge (as seen from an IFU!)



Zoccali, Gonzalez, Vasquez+2013

Compared to models

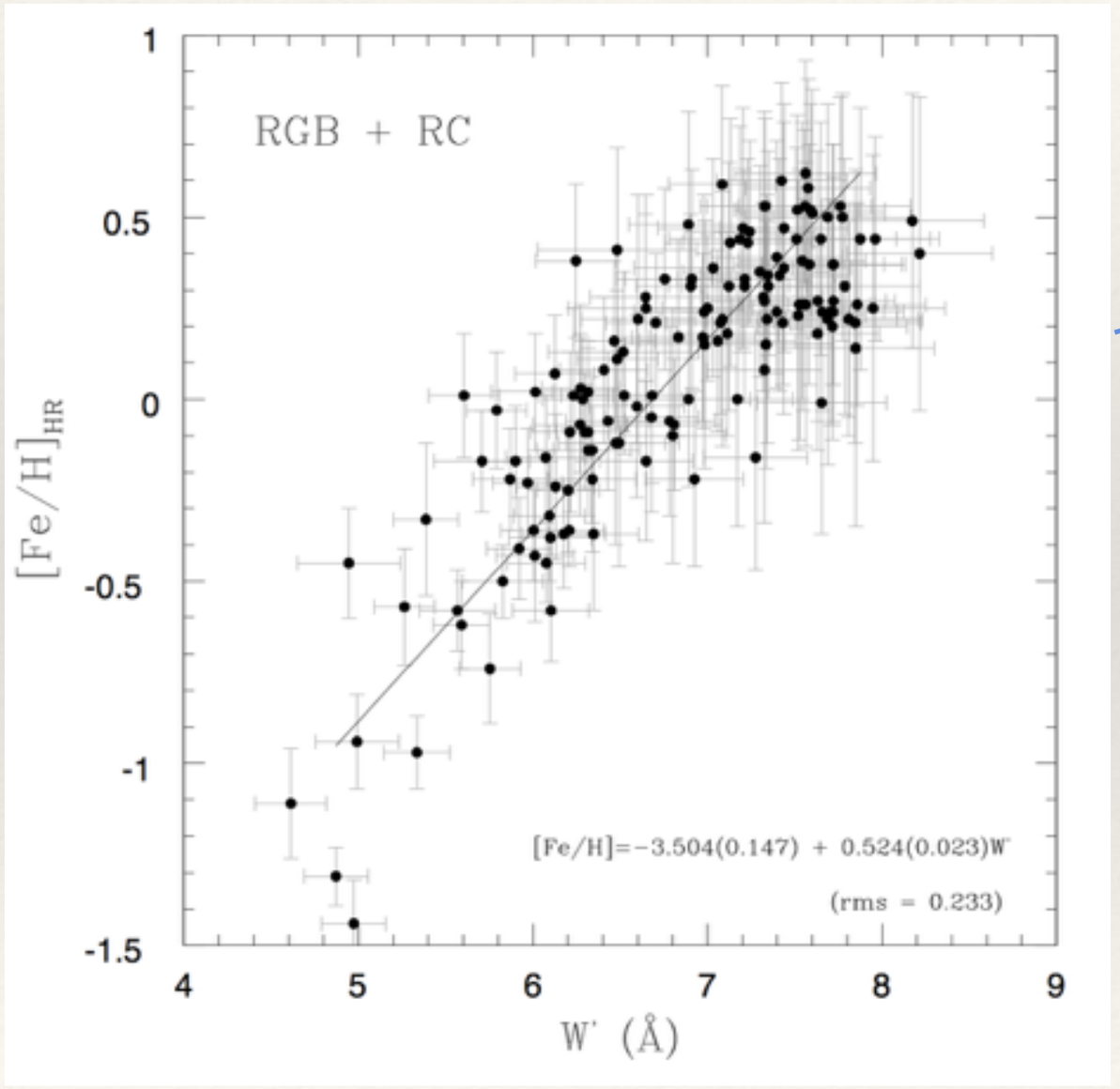
Nice agreement of the rotation curve at different latitudes with models (of a pure B/P bulge)



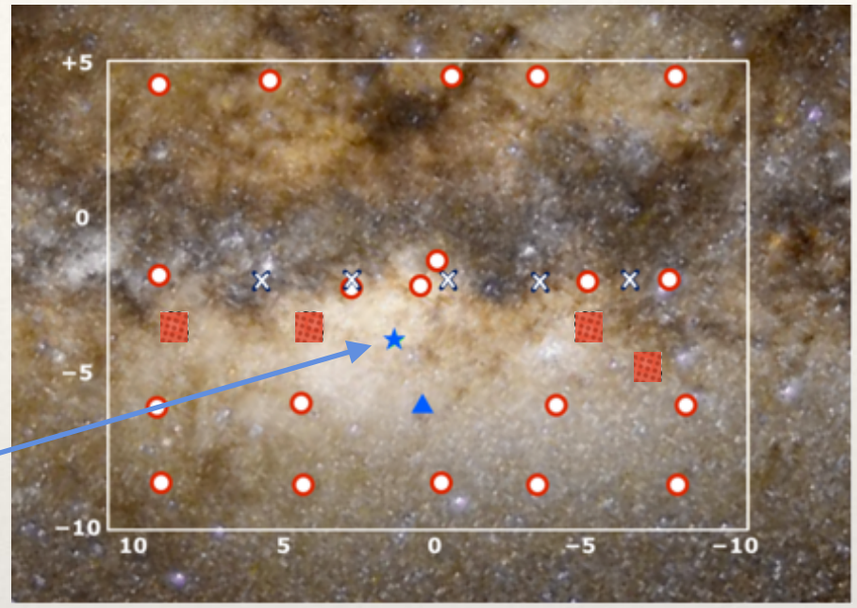
Gonzalez, Gadotti, Debattista+2015 (in prep.)

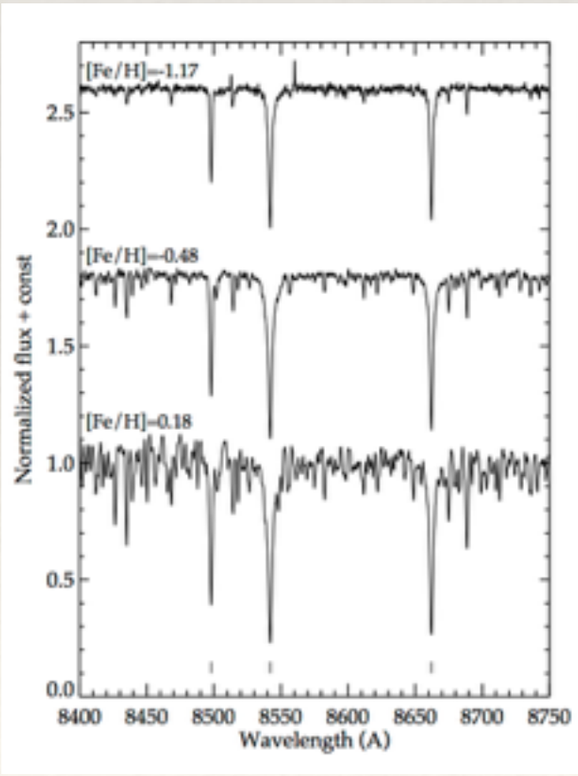
20 LR (R8,300) fields: CaT calibration

The Bulge CaT calibration: [Fe/H] directly from CaT EW measurements

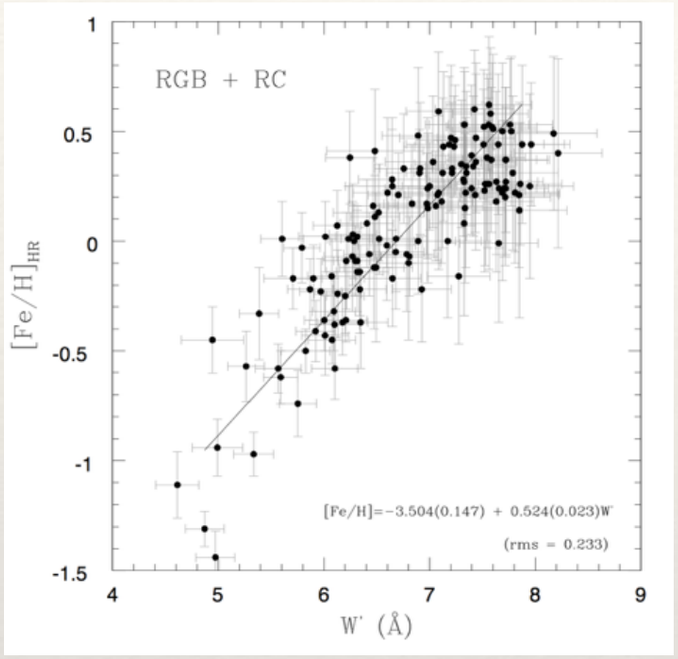


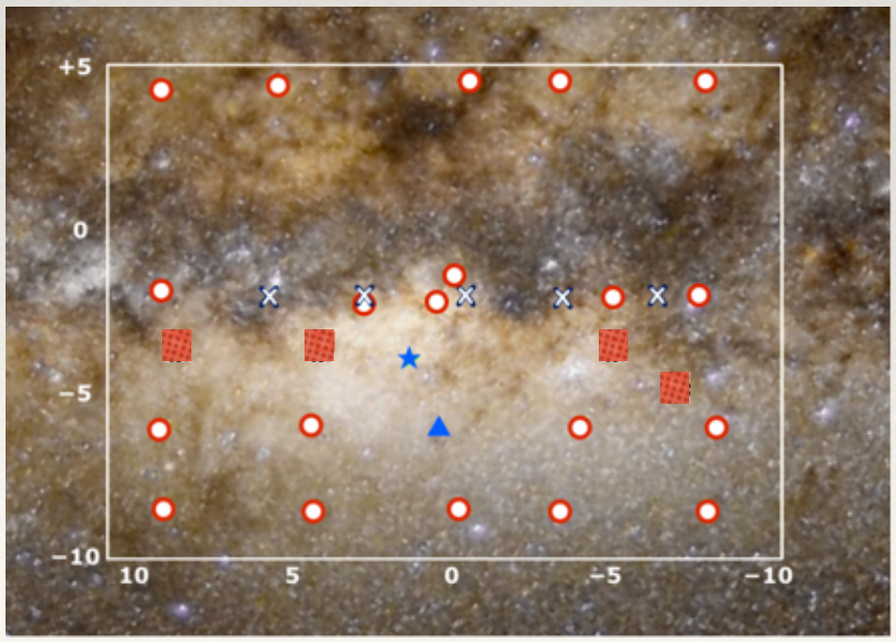
Vasquez+2015 (in prep.)



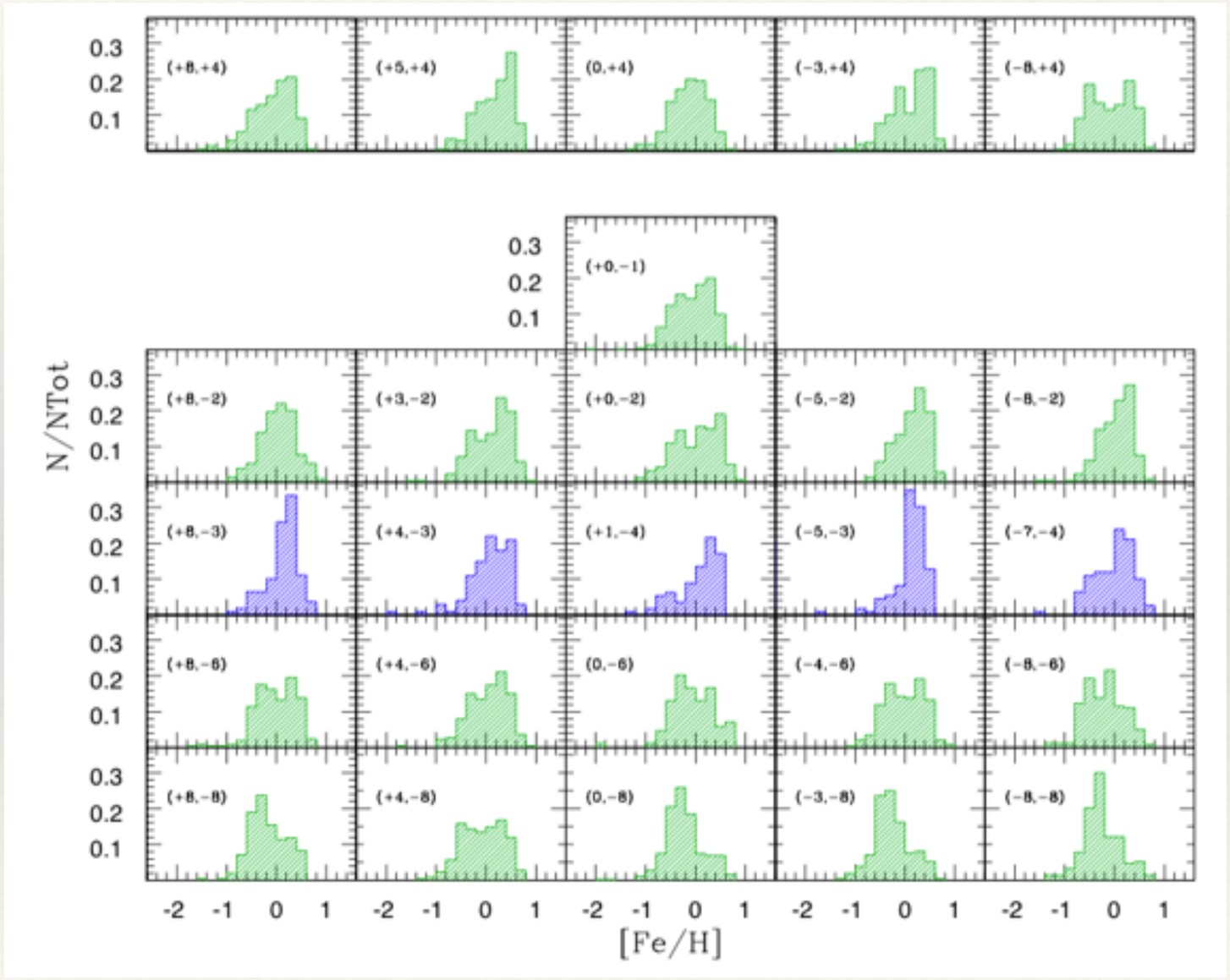


GIBS metallicity distributions





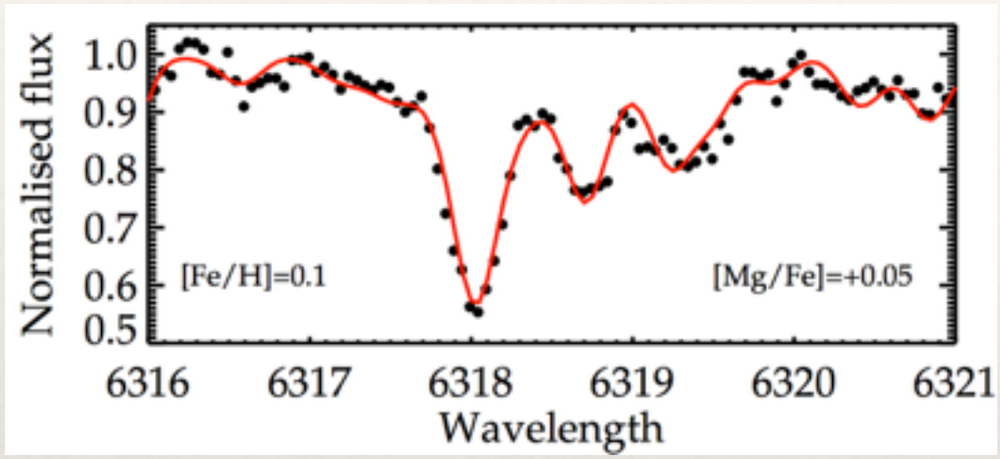
Metallicity distributions across the Bulge - a global view to [Fe/H] gradients

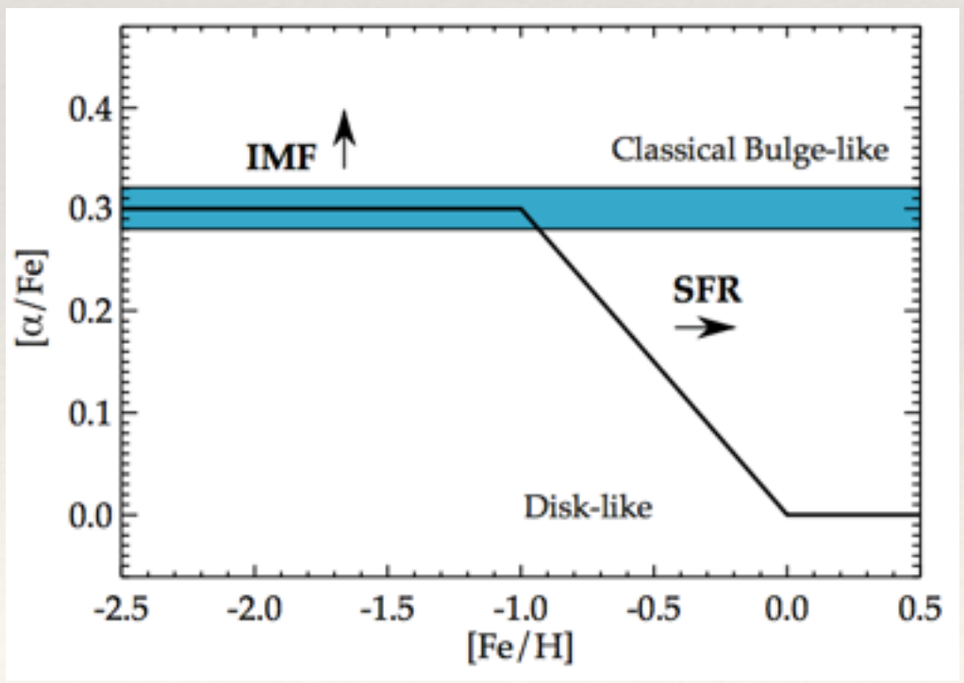


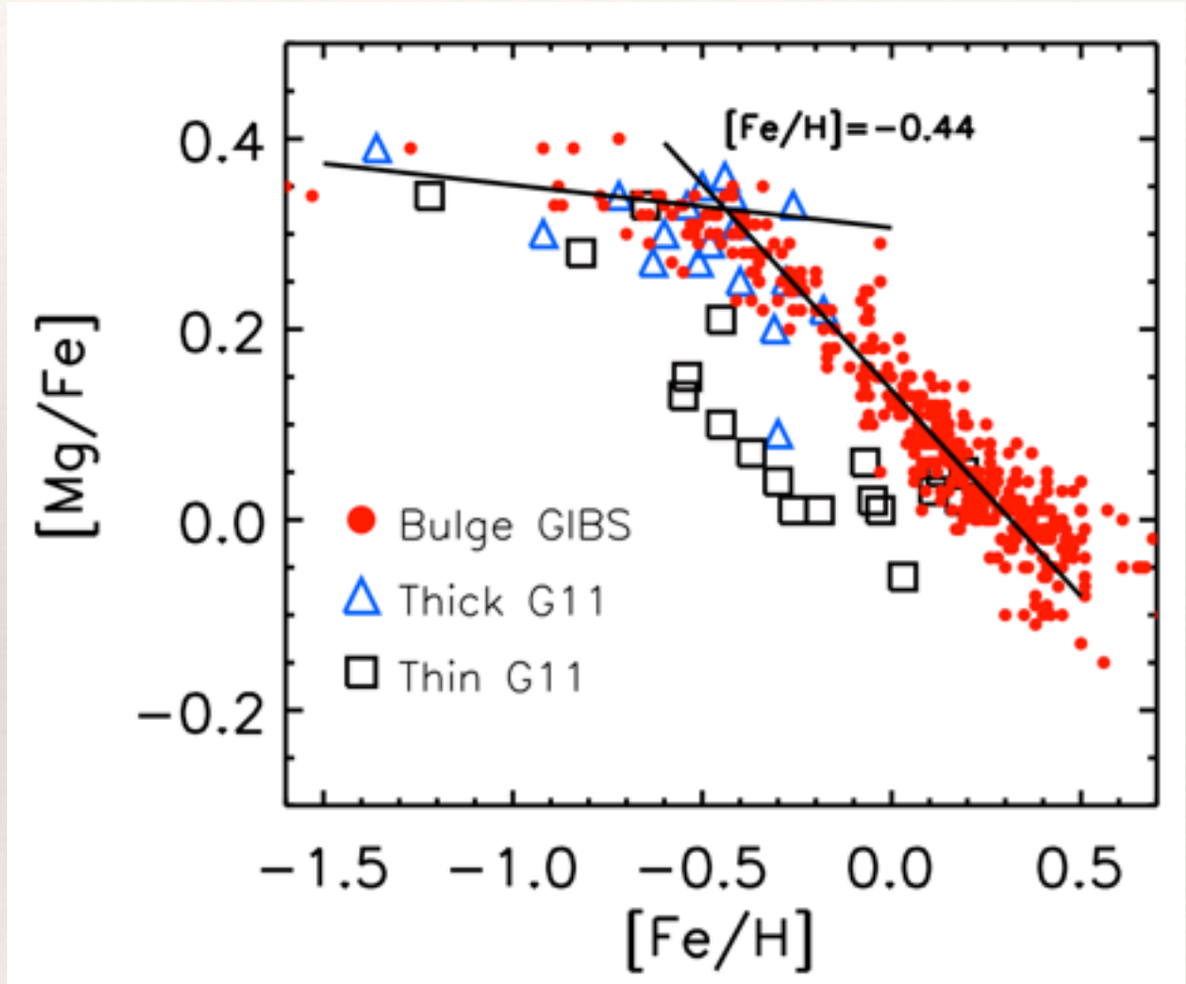
Vasquez+2015 (in prep.)

4 HR fields (R23,500): alpha-element abundances

[Mg/Fe] as function of metallicity - The formation timescale constraints



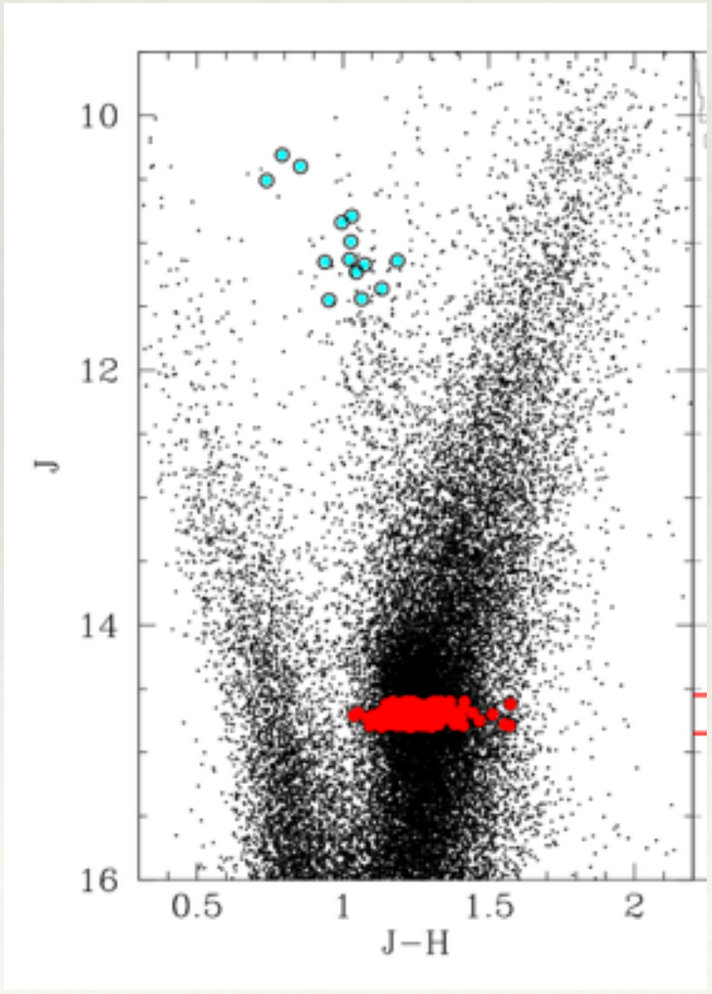


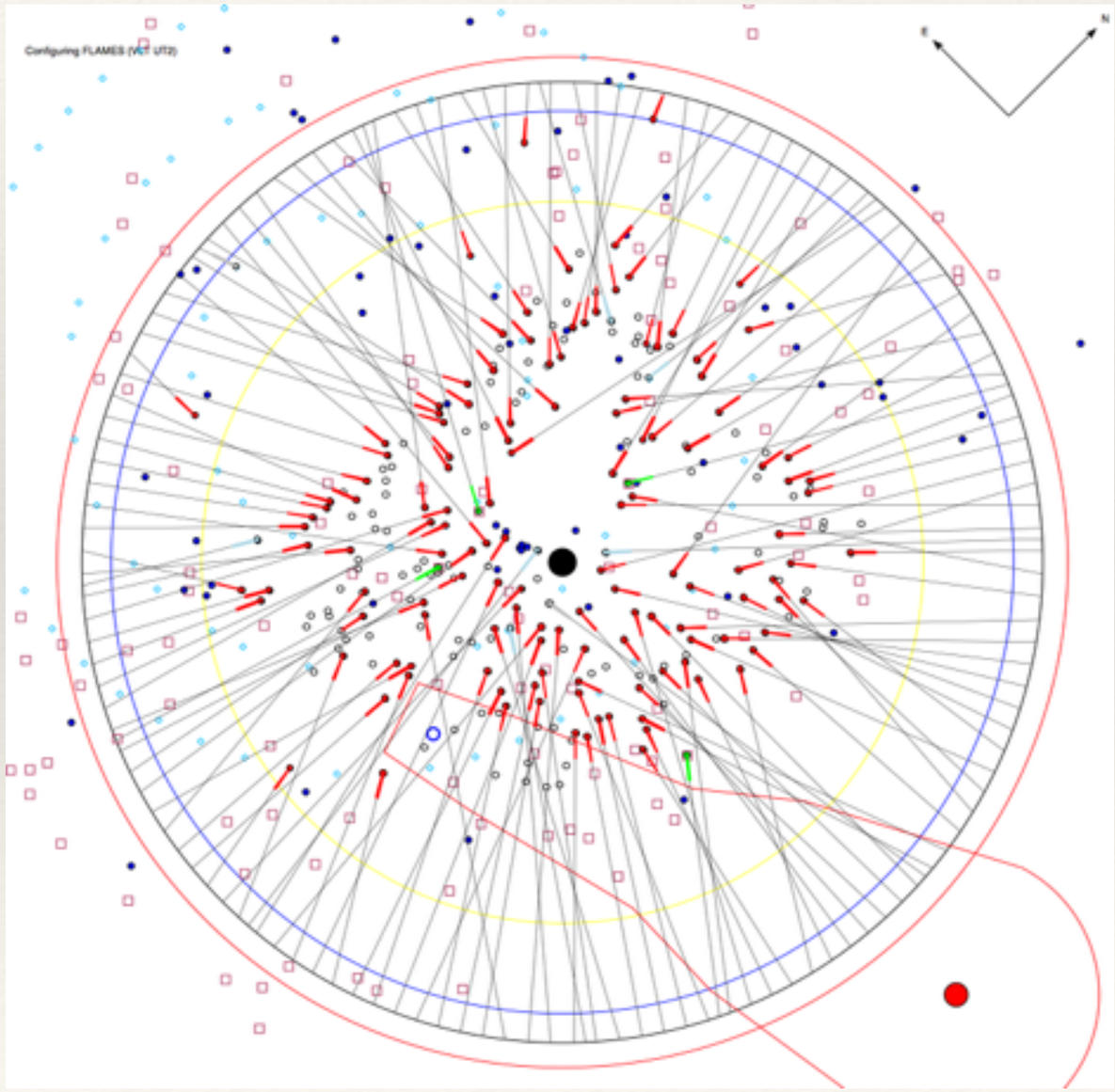


Gonzalez+2015 (in prep.)

The future (with MOONS)

- GIBS
  - ~100 targets / 20 sky fibres
  - CaT (R8,000) and 630nm (R23,500)





The future (with MOONS)

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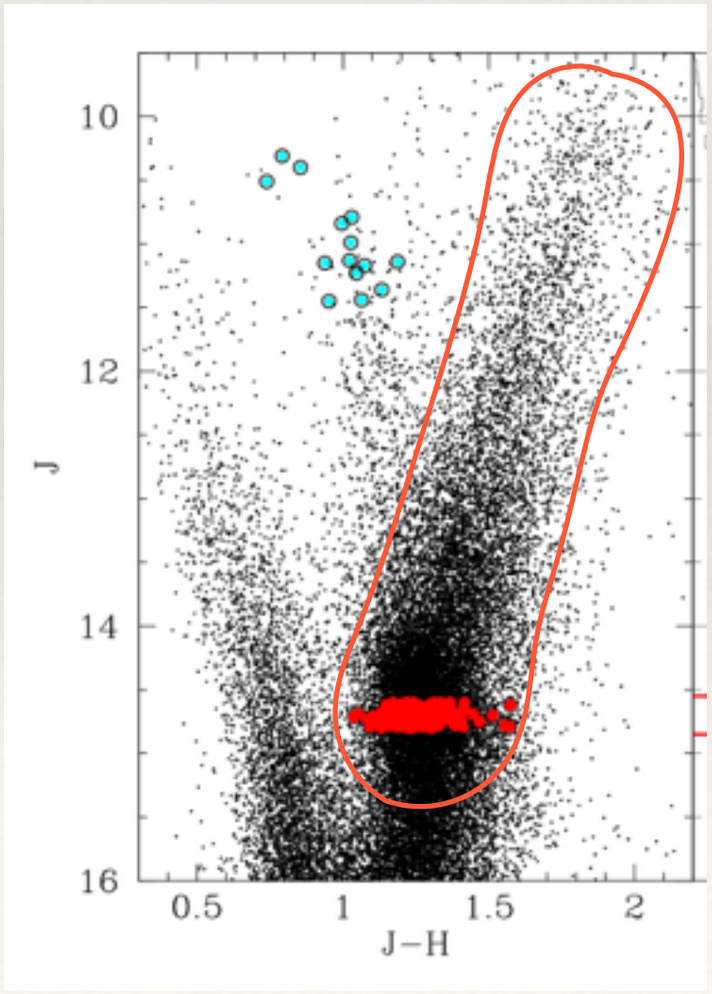

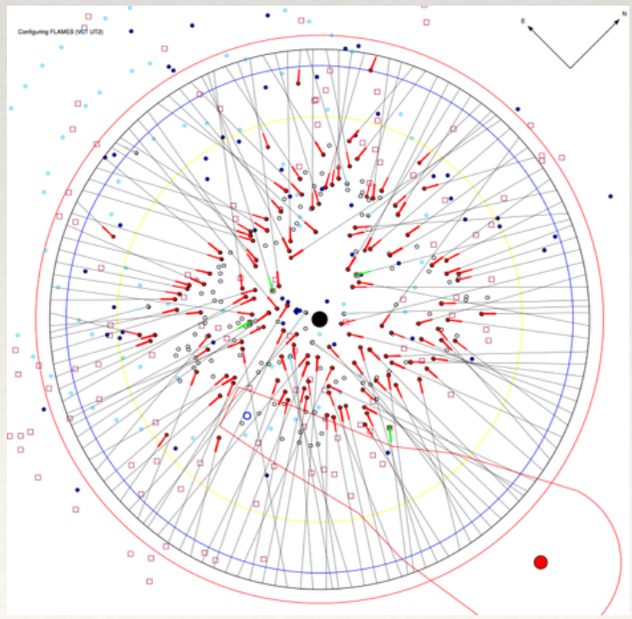

X 9

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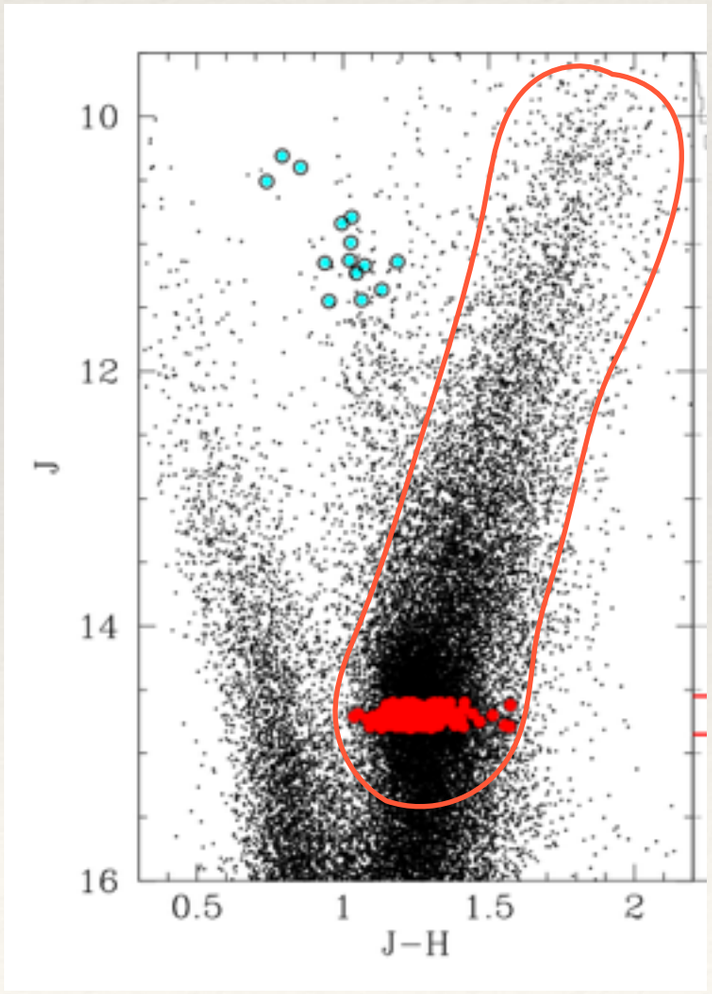

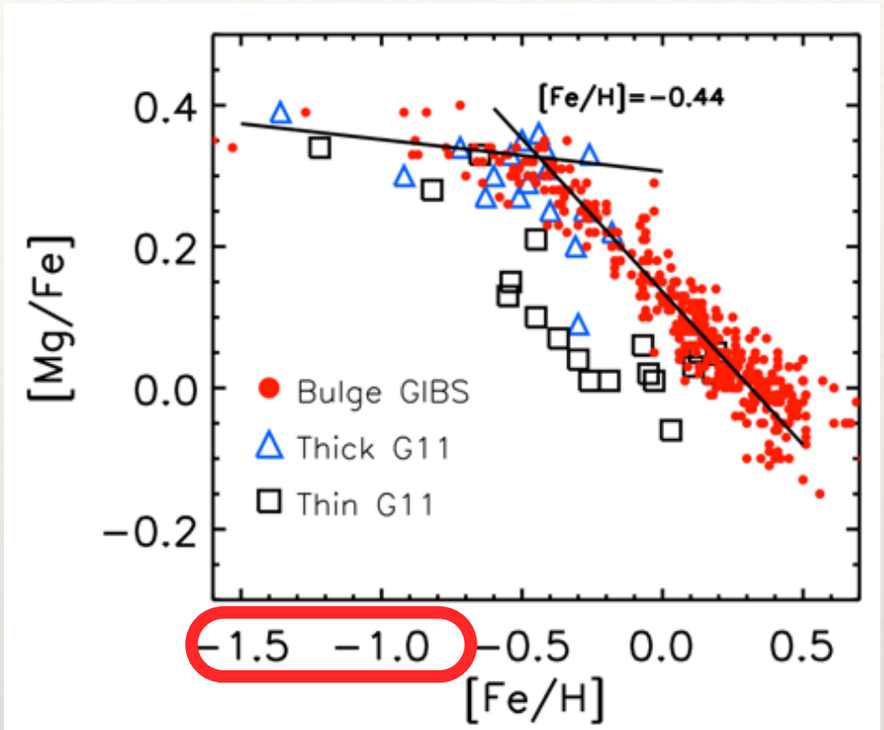

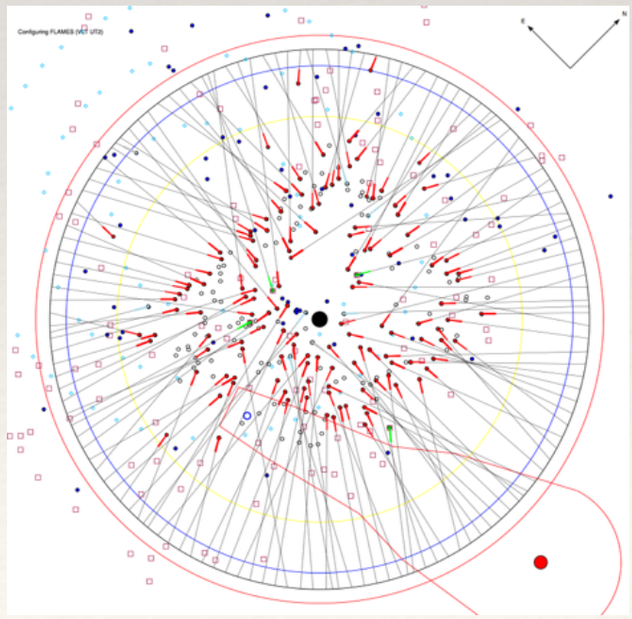

Multiplicity!!

X 9

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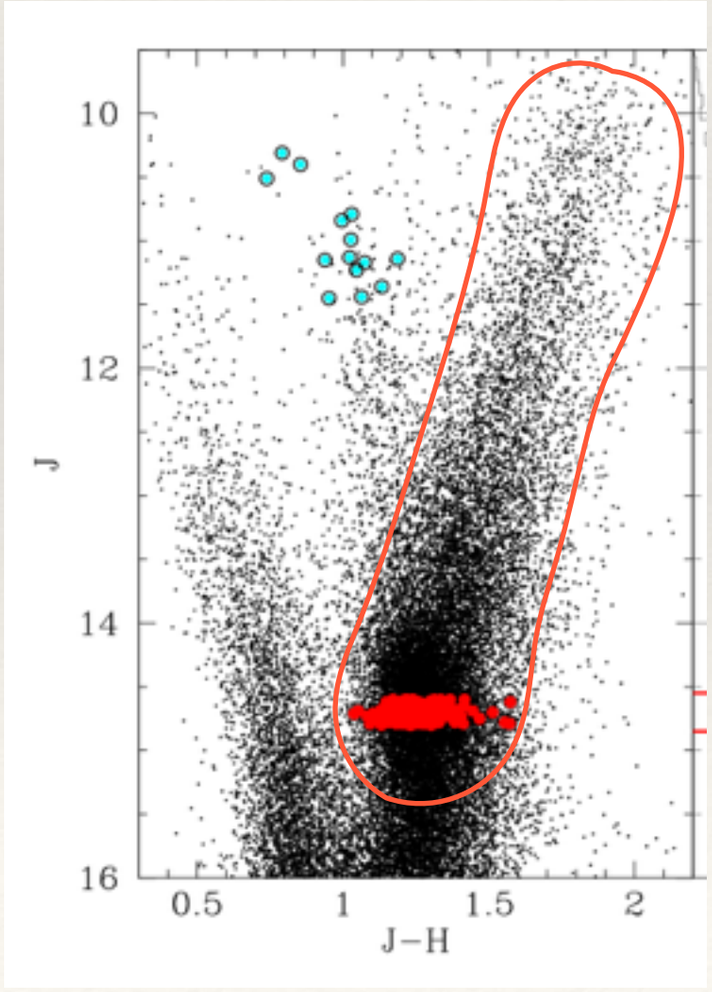
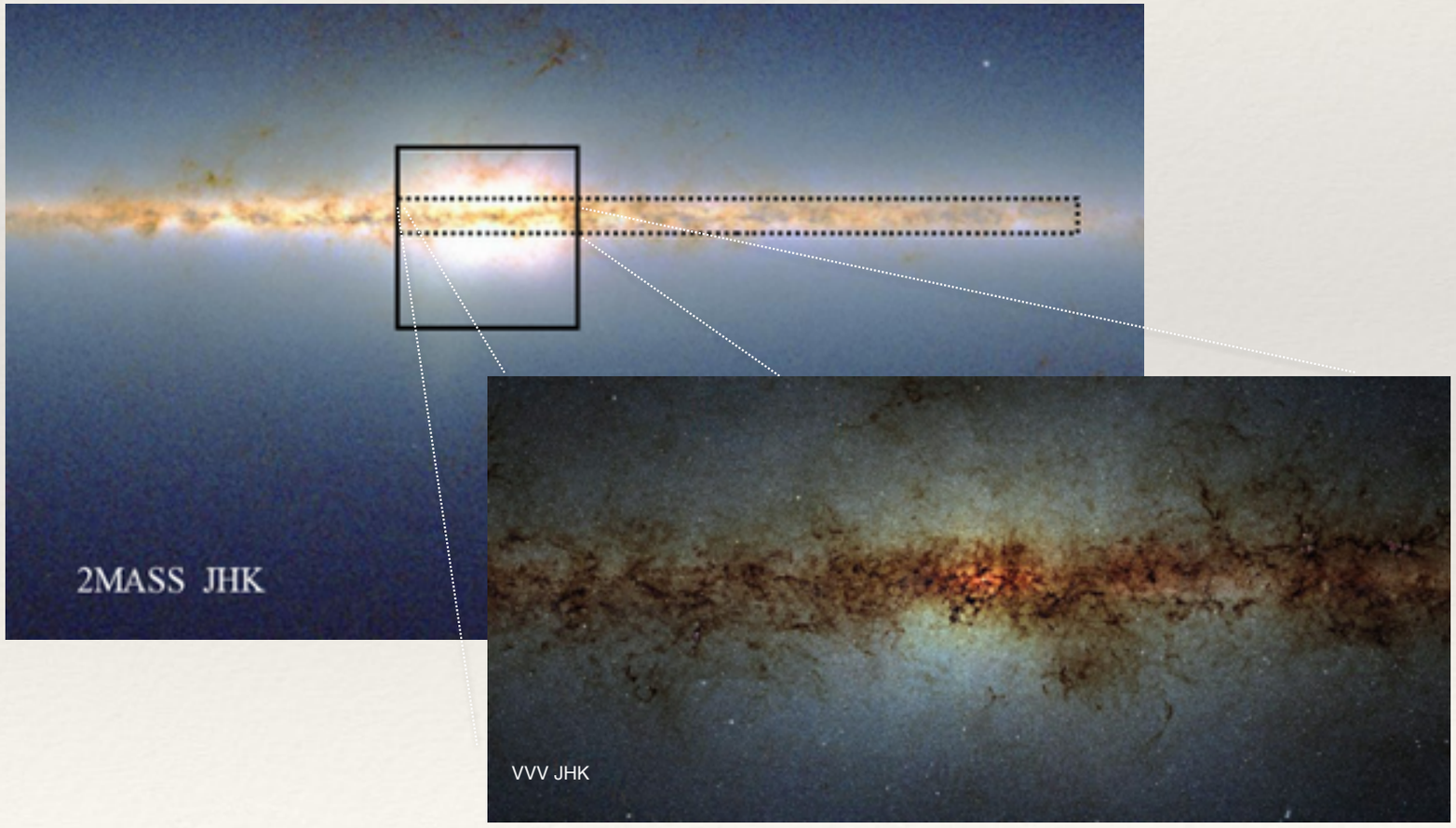
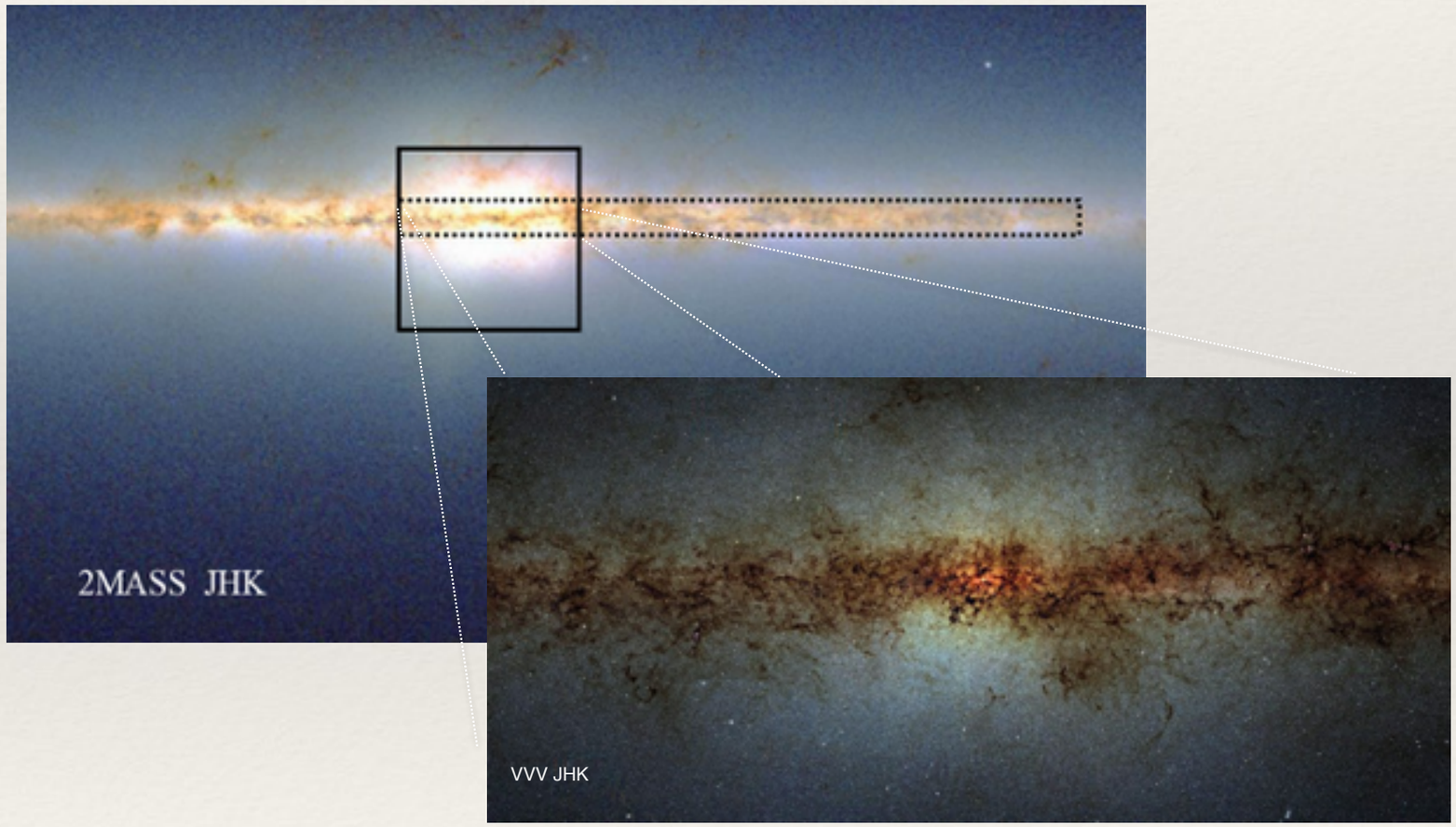




MOS in the MW bulge

- Chemical characterisation of a 350 sq. deg. area

BECOMES FEASIBLE!



- Large (differential) extinction and heavily crowded