Stellar Populations and Kinematics of the Fornax dSph Galaxy

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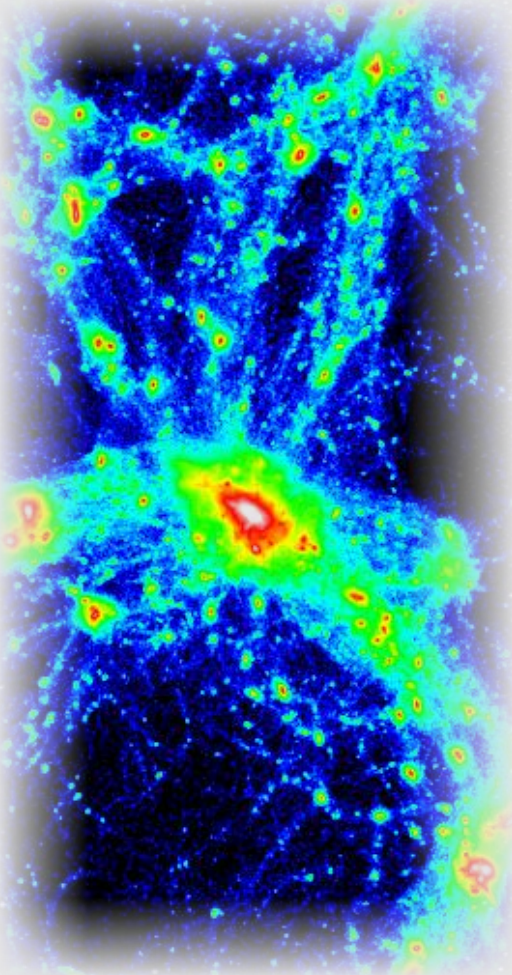
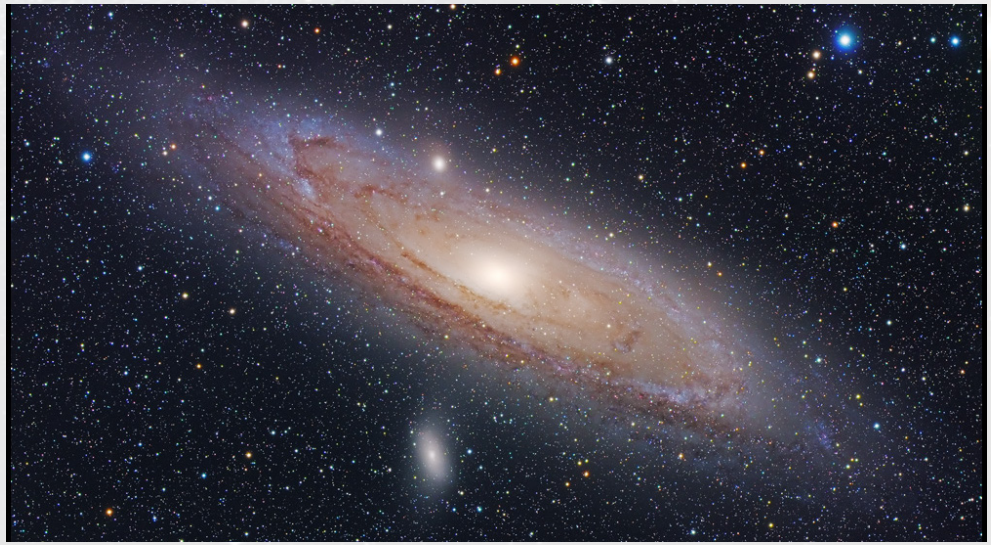
A dark matter Universe
The Λ-CDM cosmological model



First structures: the smallest ones

$\Downarrow$

Dwarf galaxies $=$Mergers$\Rightarrow$ Larger galaxies



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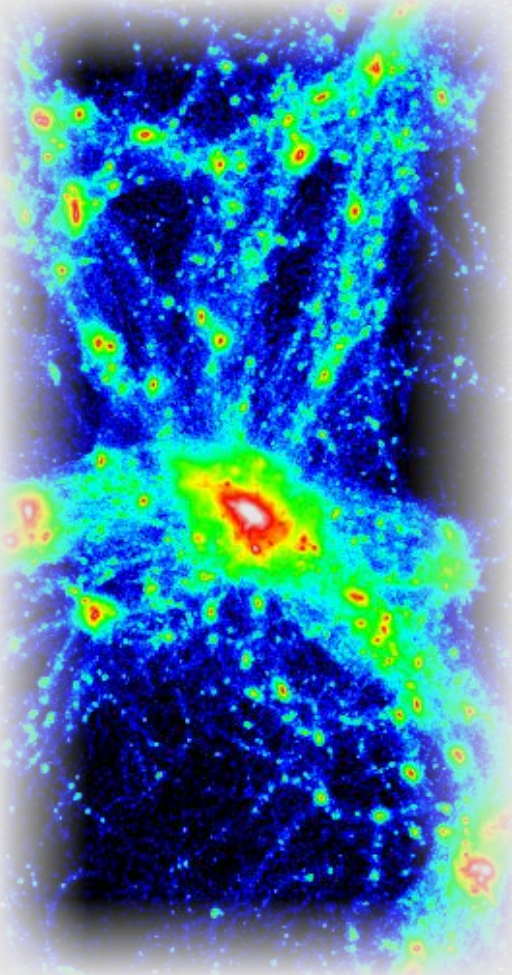

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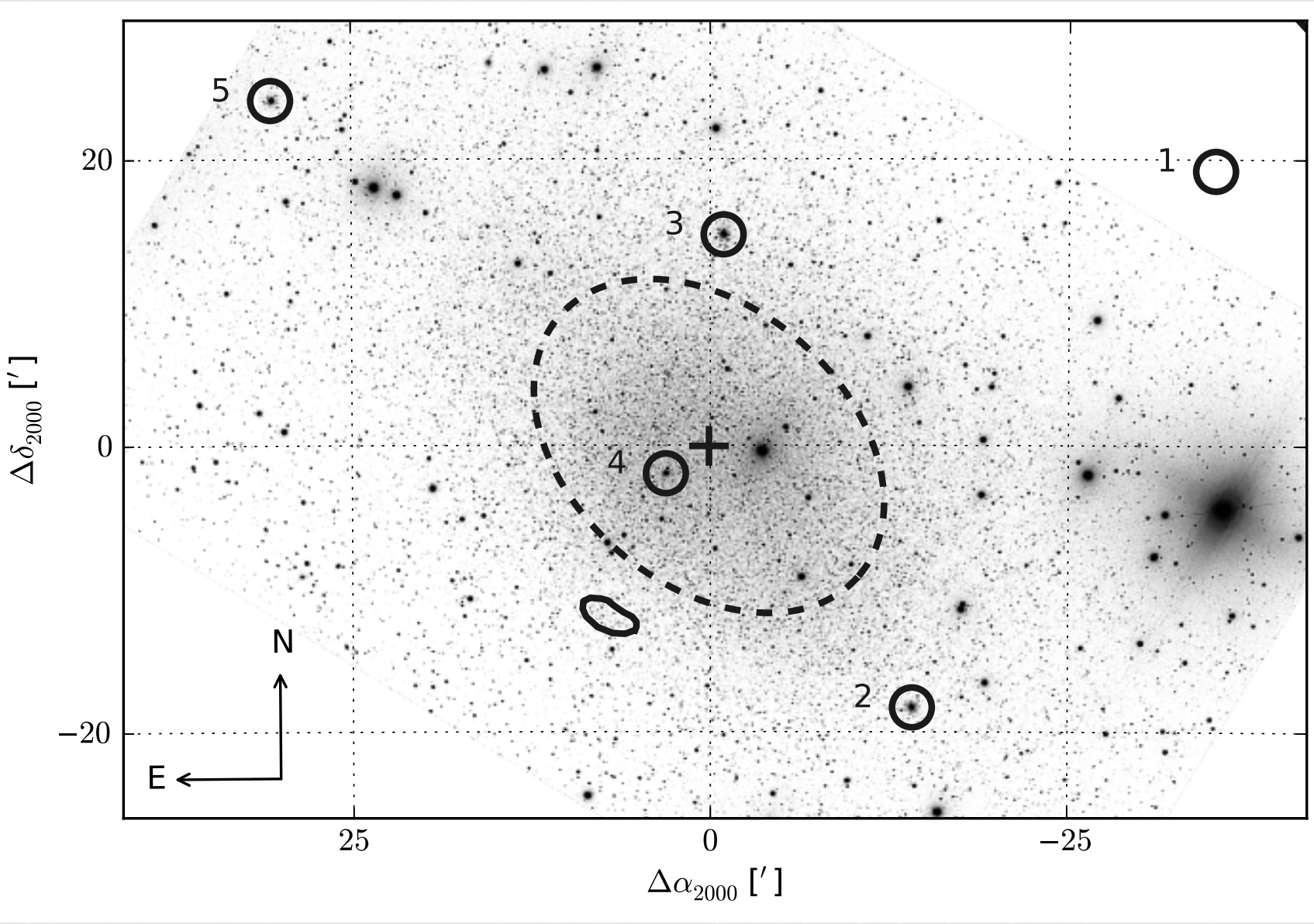
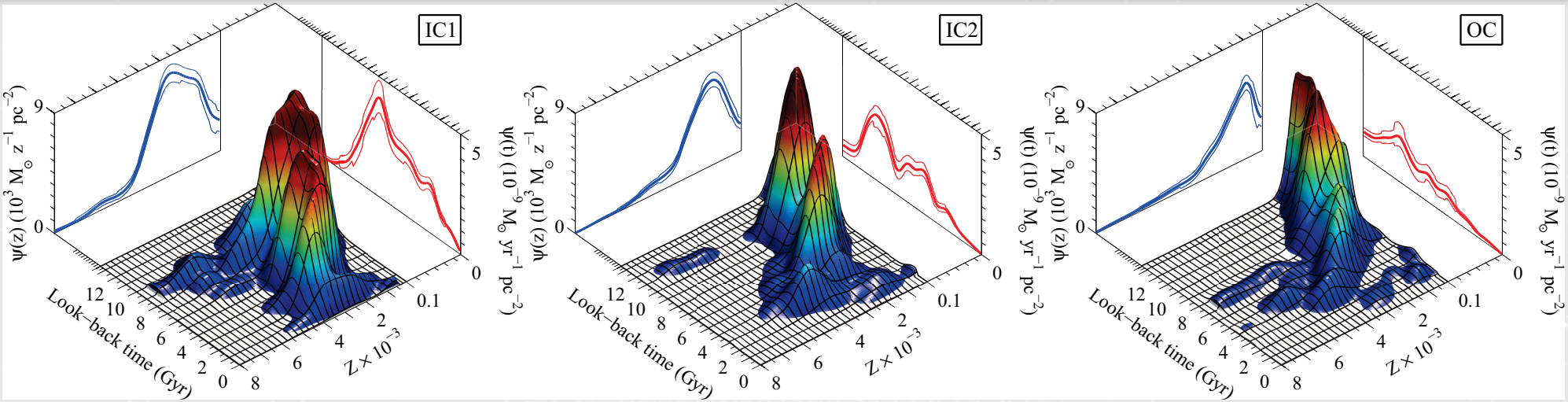
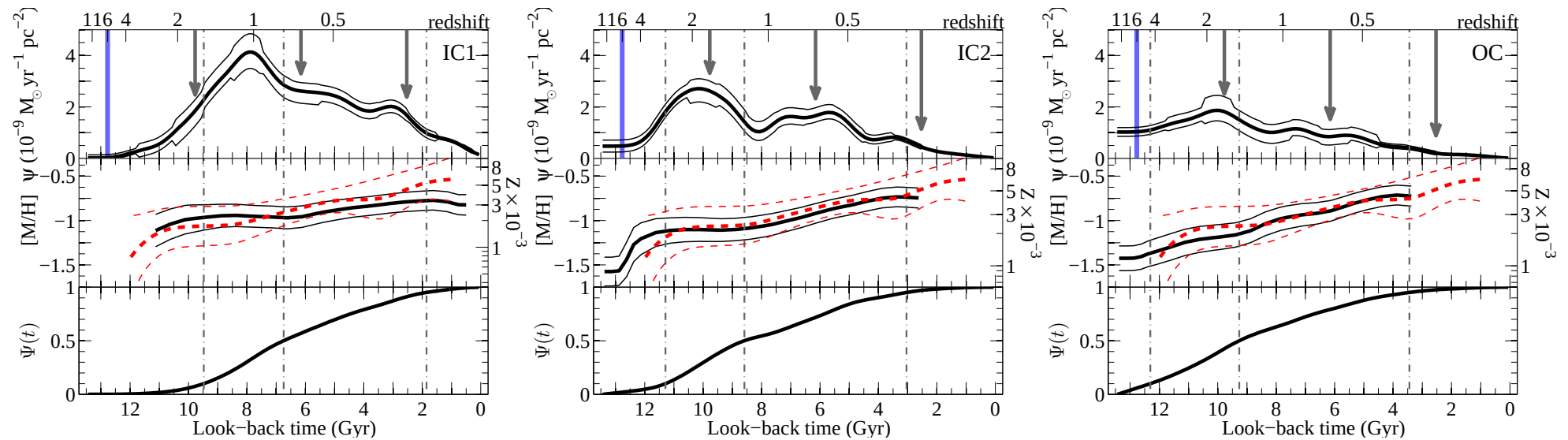


The star formation history

The ages and metallicities of the stars

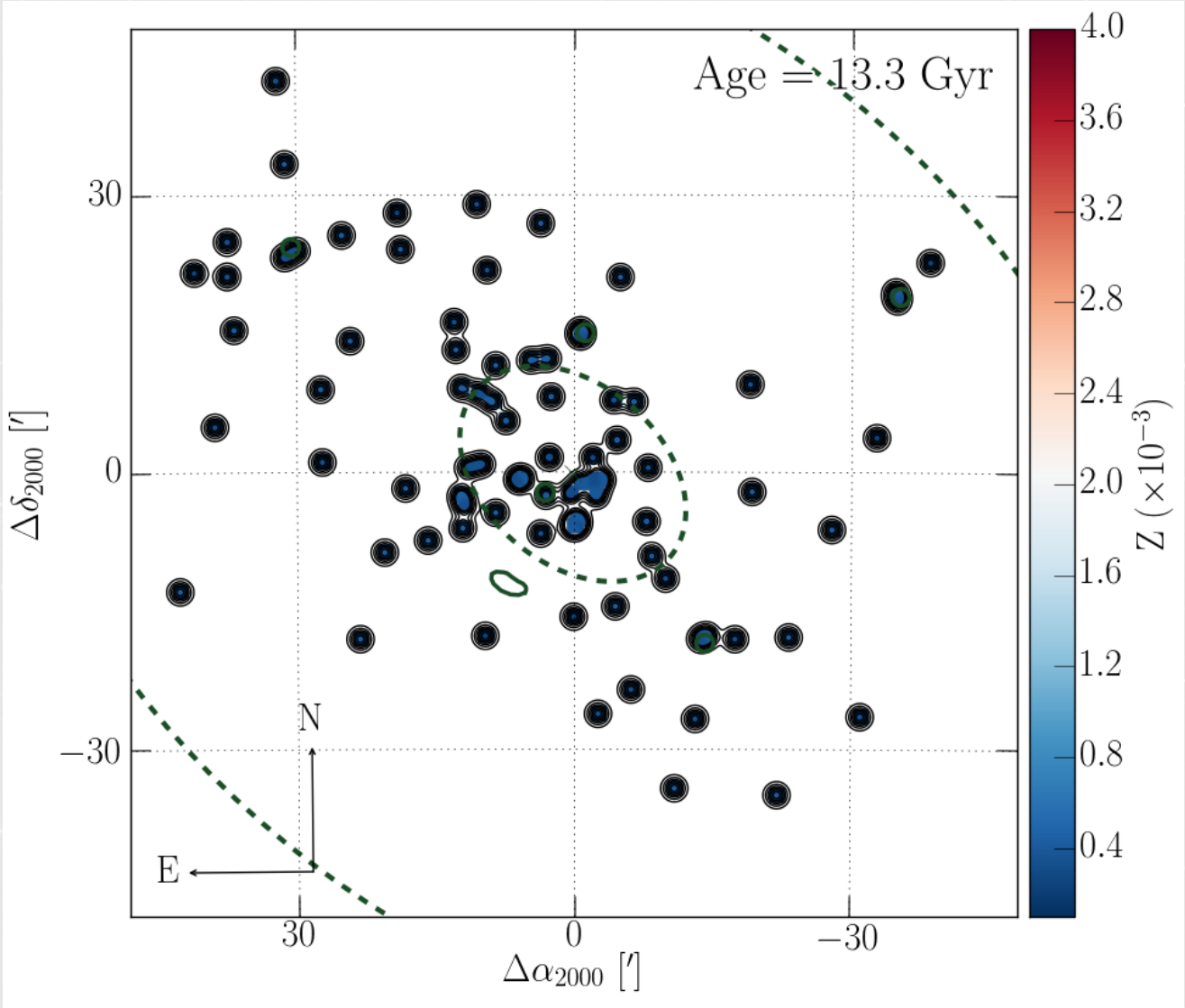


Galactocentric radius →



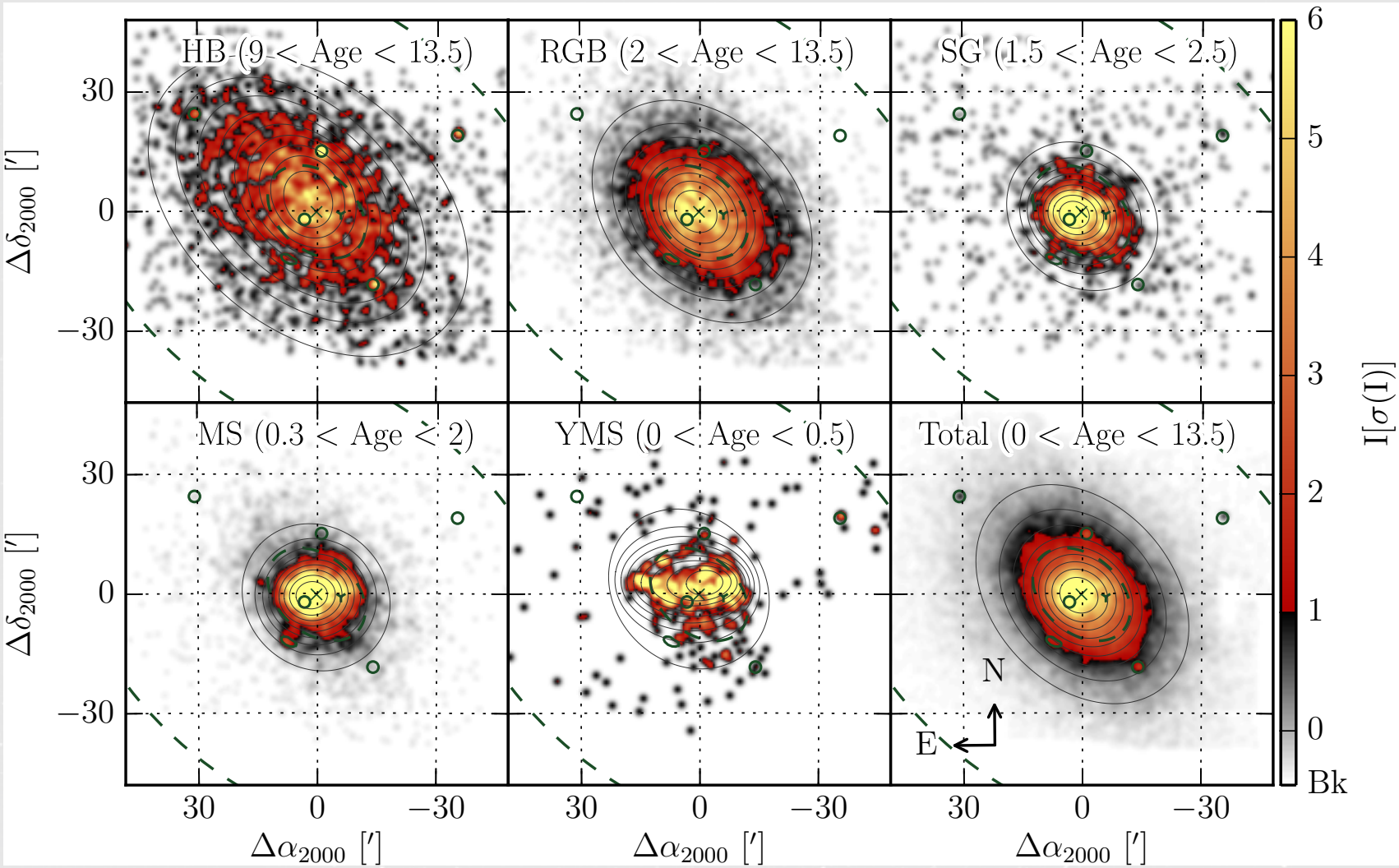
Spatial distribution of the stellar populations

Evolution with time



Spatial distribution of the stellar populations

Strong differences between populations



- Strong asymmetries found in the young populations
- Shell like structures of young stars ($\sim 2-3 Gyrs$)

Finding chemodynamical patterns
A hierarchical clustering problem

BEACON, a tool for finding chemodynamical patterns

- Core based on OPTICS (Ankerst *et al.* 1999)
- On the basis of
  - Position,(θ, r)
  - Velocities
  - Metallicities
  - ...

Required parameters

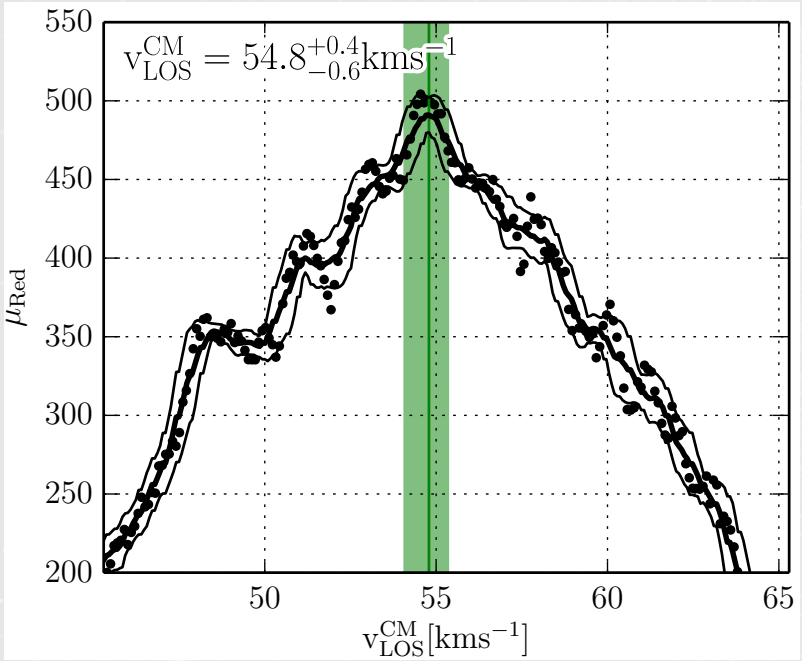
- *Galaxy parameters*
  - The CM coordinates: $(\mathbf{r}^{CM}, \mathbf{v}^{CM})$
- *Clustering parameters*
  - Standardisation method
  - Uniqueness criteria
  - Minimum cluster size (MCS)
  - ...

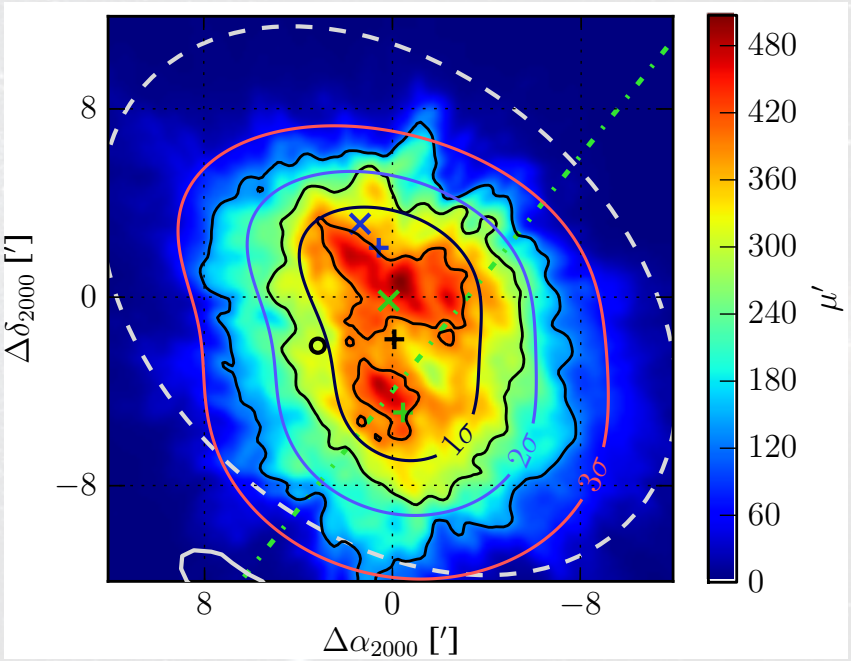
The coordinates of the centre of masses

Deriving velocity and position through BEACON

Maximizing μ

$$\mu(\mathrm{RA}^{\mathrm{CM}}, \mathrm{Dec}^{\mathrm{CM}}, \mathrm{v}_{\mathrm{LOS}}^{\mathrm{CM}}) = \frac{(|\circlearrowleft| + 1)^2}{(|\curvearrowleft| + 1)^2}$$





- Best fitted by two gaussian model → two rotation centres
- Main centre coincides with the optical centre
- Secondary one aligned with the arc defined by the shells

} Merger?

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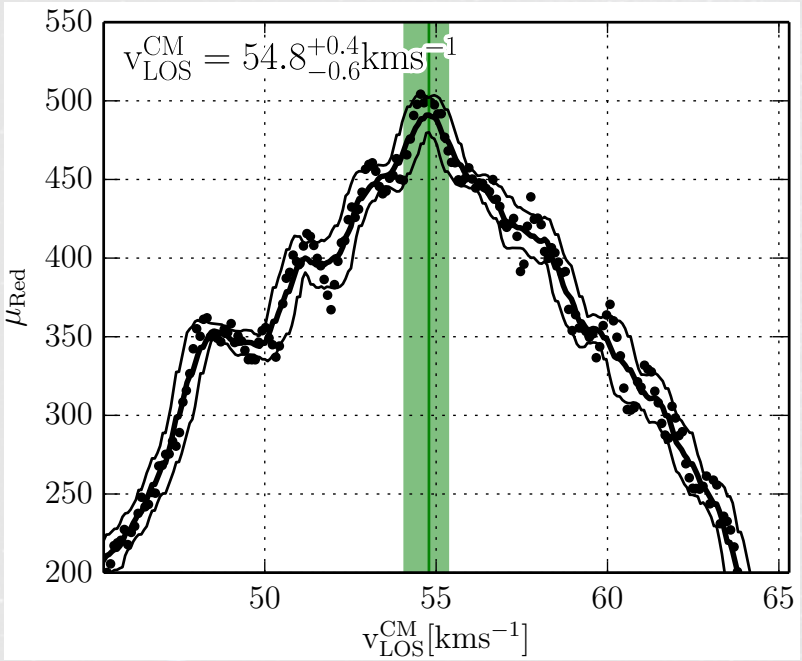

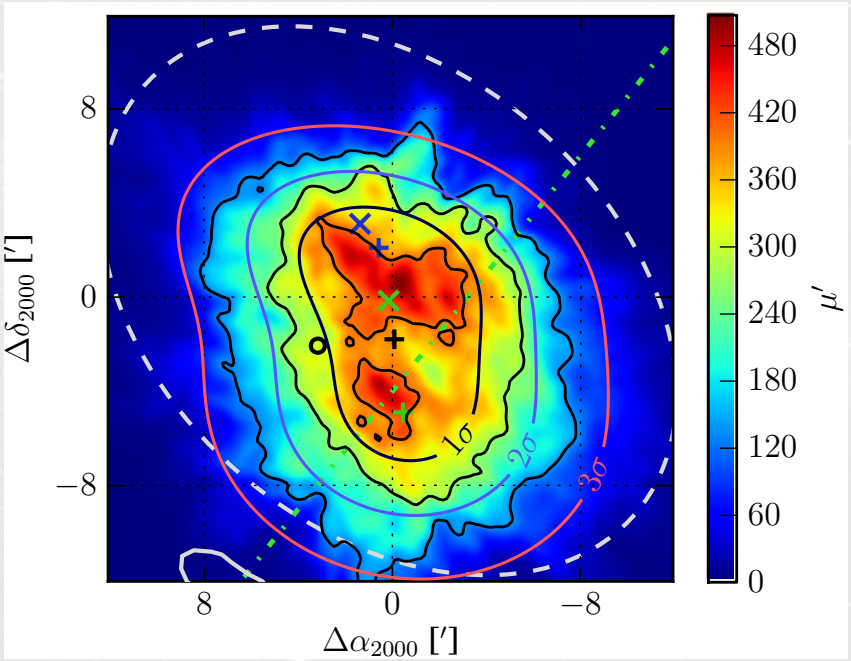

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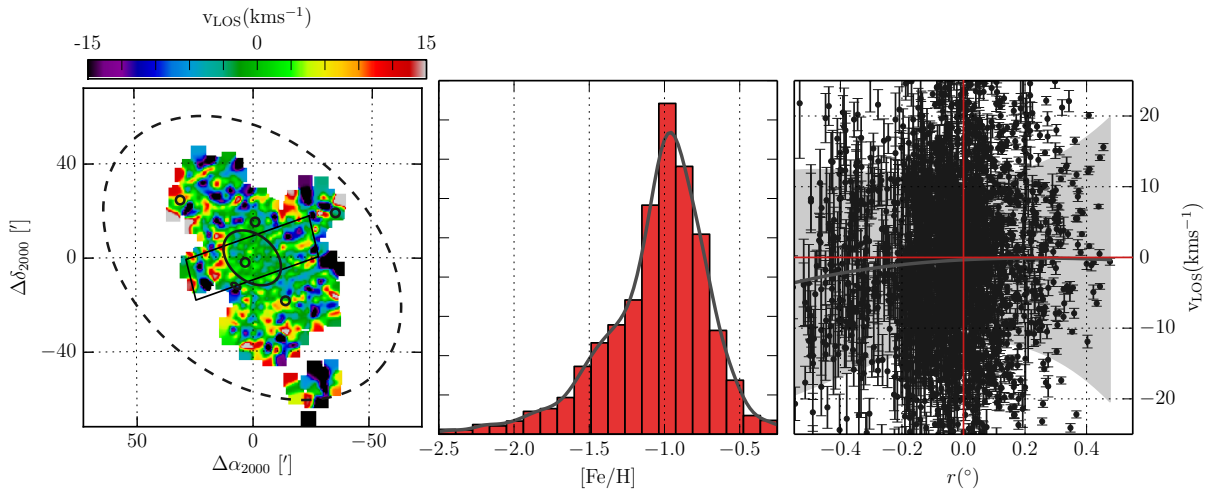
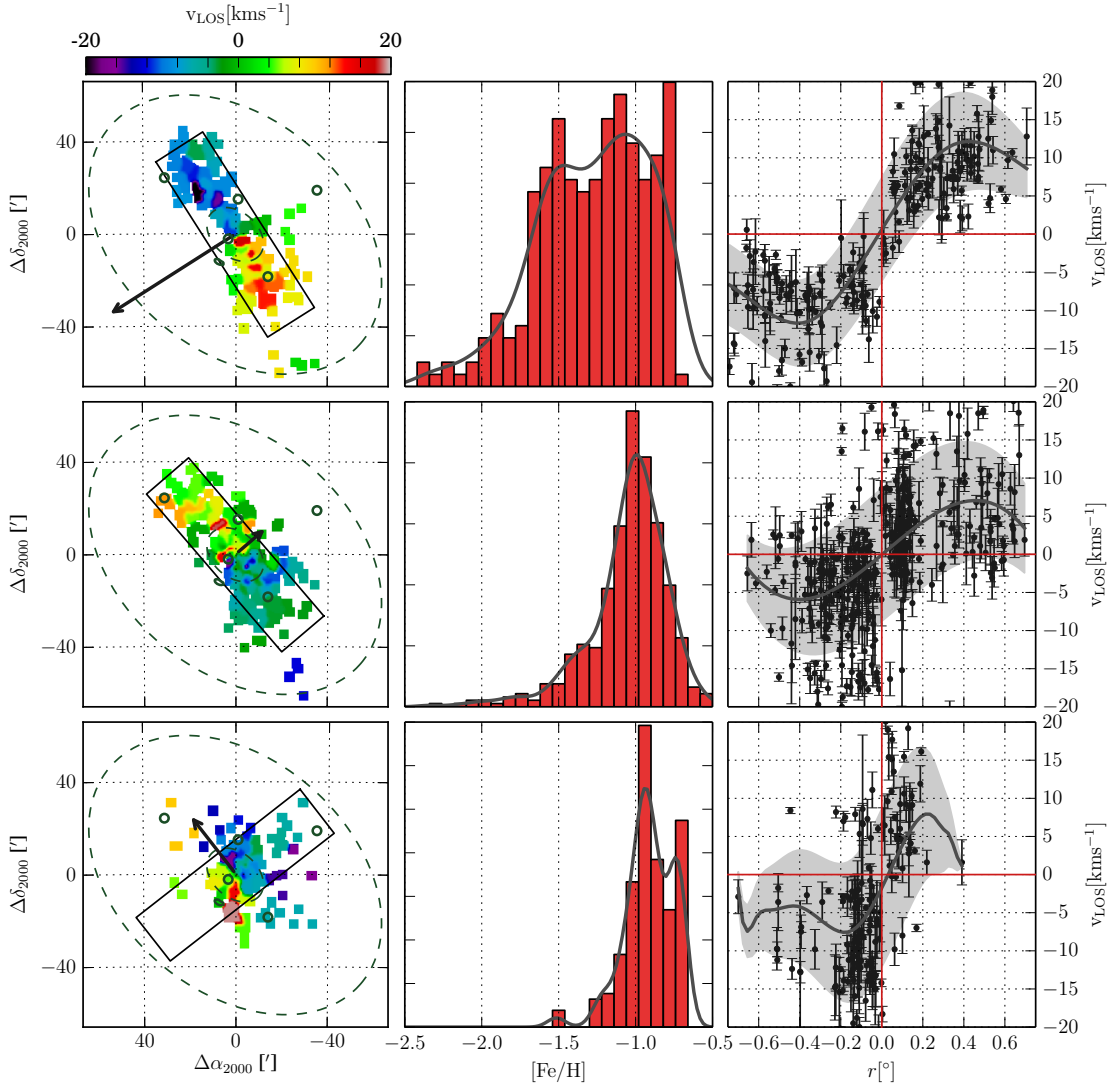
BEACON, a powerful tool!

Without BEACON: In principle... Nothing :-(

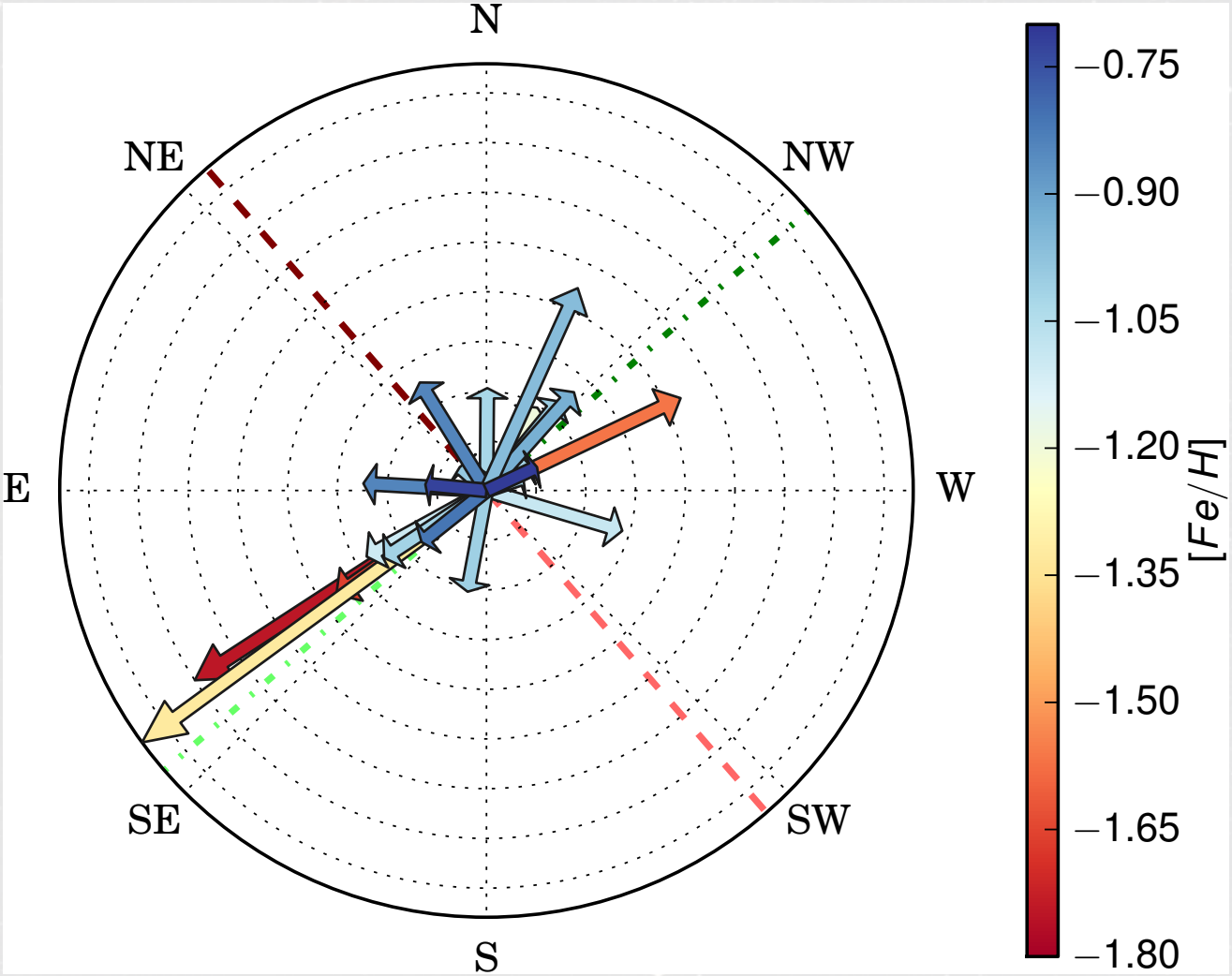


BEACON, a powerful tool!

With BEACON: We can disentangle different streaming motions :-)



The angular momentum (L)



Metallicity dependent

- Metal poor
  - Larger $|L|$
  - $|L_b| > |L_a|$
- Metal rich
  - $|L_a| \sim |L_b|$
- Supported by rotation ✓

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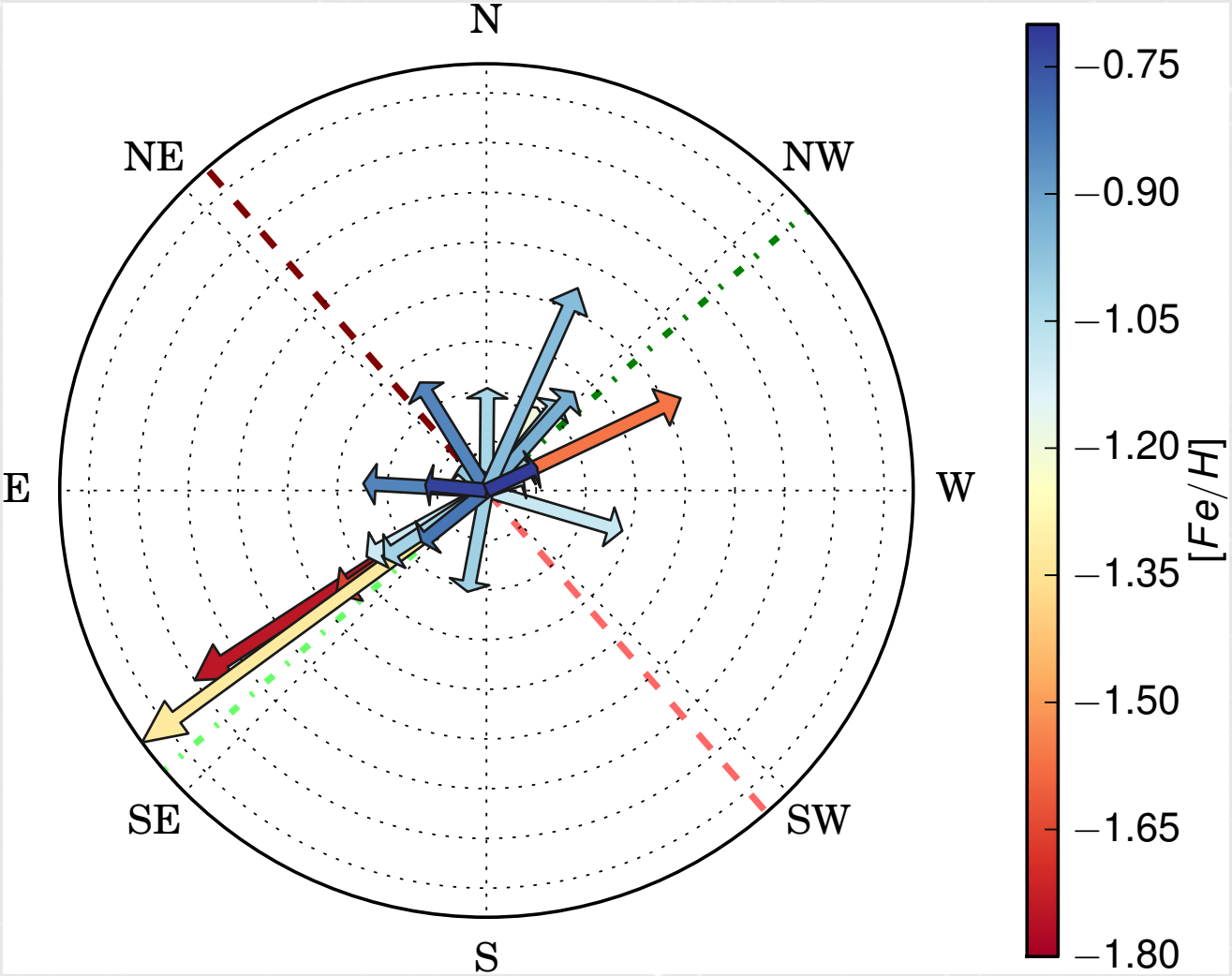

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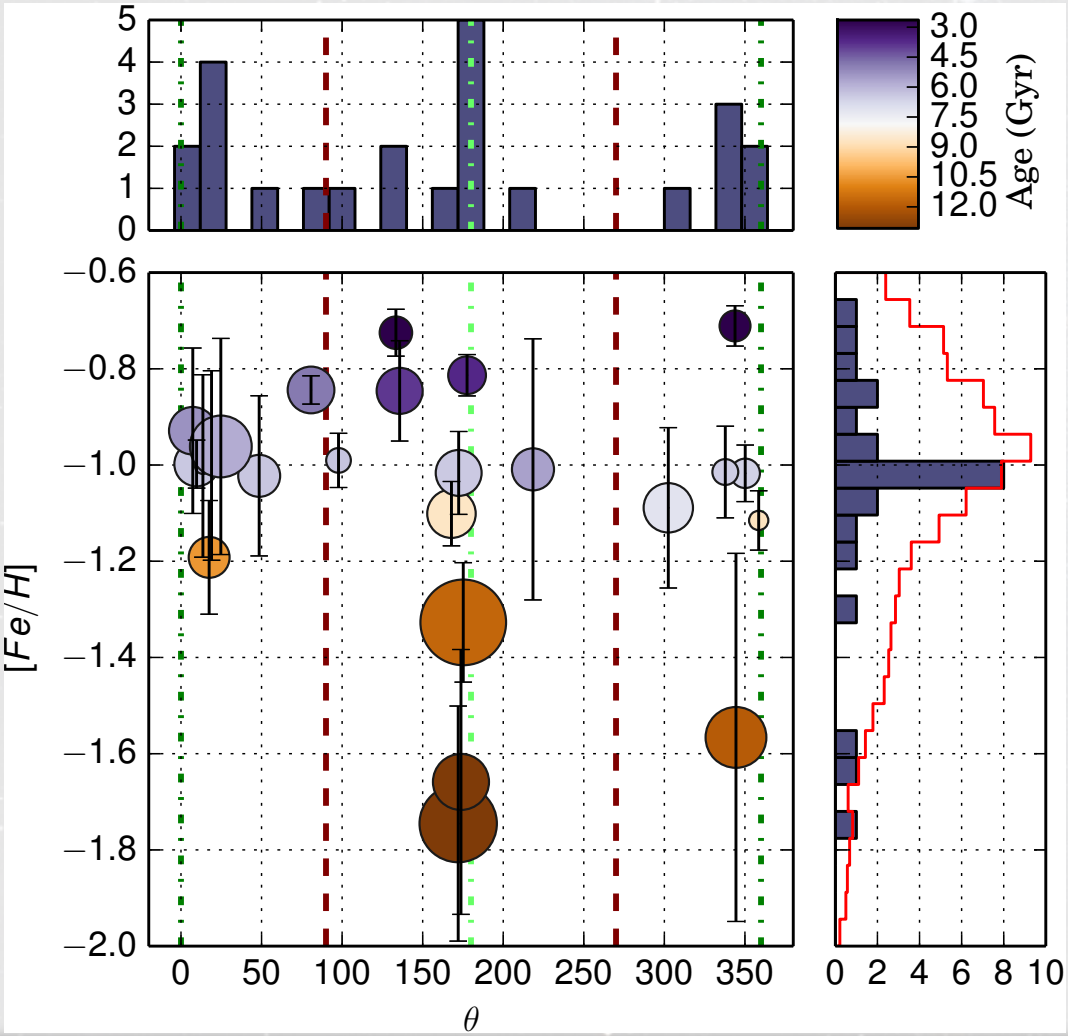
The Metallicity, θ plane

Can we assign an age to each group?

- Dynamics-Metallicity relationship
- Age-Metallicity relationship

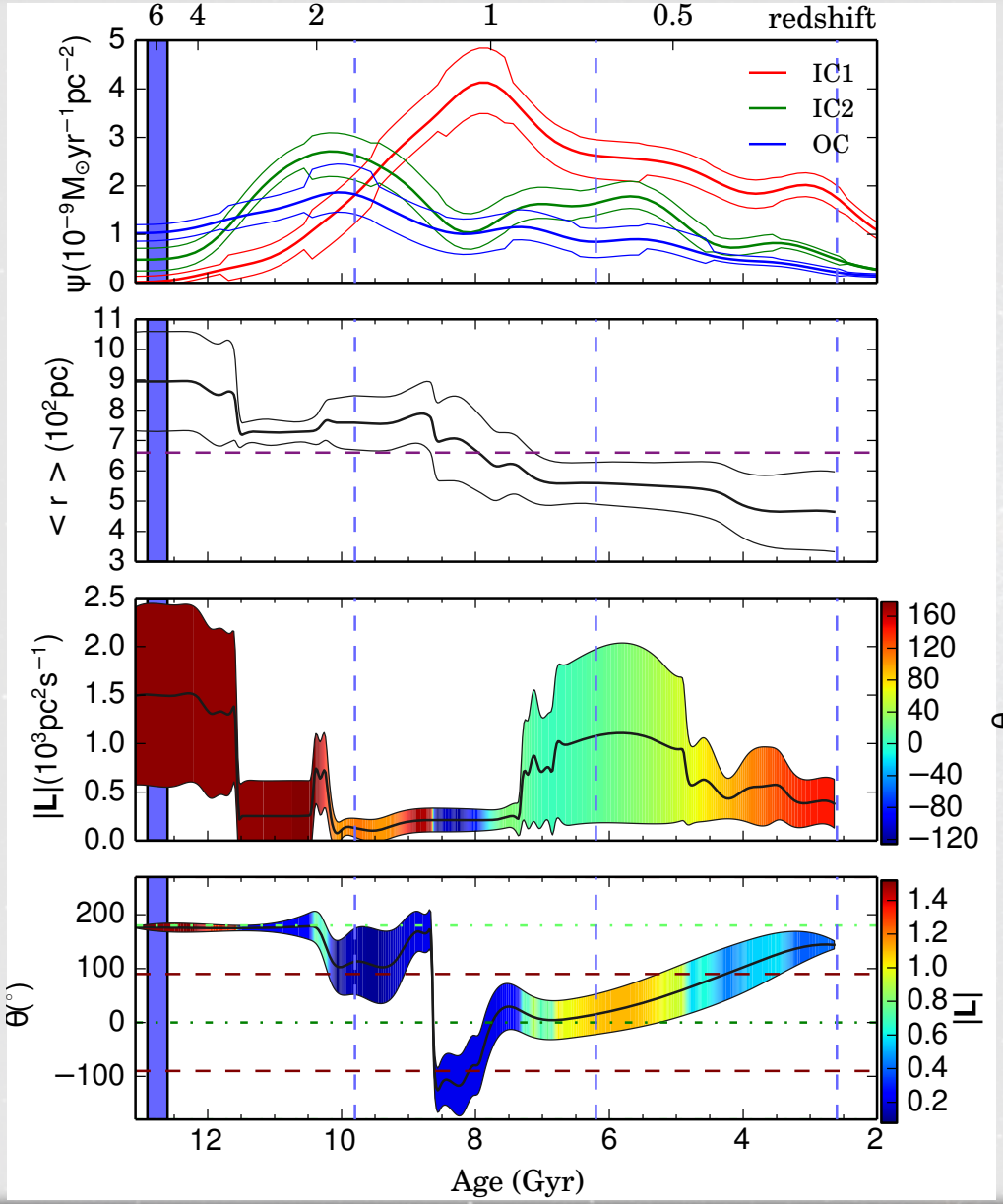
} Age-Dynamics relationship



Groups distributions

- Mainly about minor axis
- Random $\sim 7 - 8$ Gyr ago
- $\langle [Fe/H] \rangle$ distributions differ

The Rotation History of Fornax



Evolution with time

- Oldest stars around $-b$
- Tidal interactions?

Comparison with the SFH

- Correlations
- What happened at $z \sim 1$?

Conclusions
Global and local considerations

Reionization and SNe effects on Fornax

- $\sim$ 90% stars formed after UV.
- Has retained gas against SNe feedback

$\Big\}$ $M_{Total} \gtrsim 8 \times 10^8 M_\odot$

Possible tidal interactions with the MW

- SFH changes near perigalacticon
- Gas reservoir exhausted earlier in the outskirt
- Isopleths variations as a function of r
- Older populations well fitted by king's profile

$\Big\}$ Mild tidal forces ?

Possible merger with a smaller system

- Strong asymmetries in young populations
- Shell like structures populated by young stars ($\sim$2-3Gyrs)
- Rotation signal fluctuations at $z \sim 1$
- Main burst of SF delayed in the centremost regions
- Low average metallicity ($\langle [Fe/H] \rangle \sim -1.1$)
- Two centres of rotation

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