

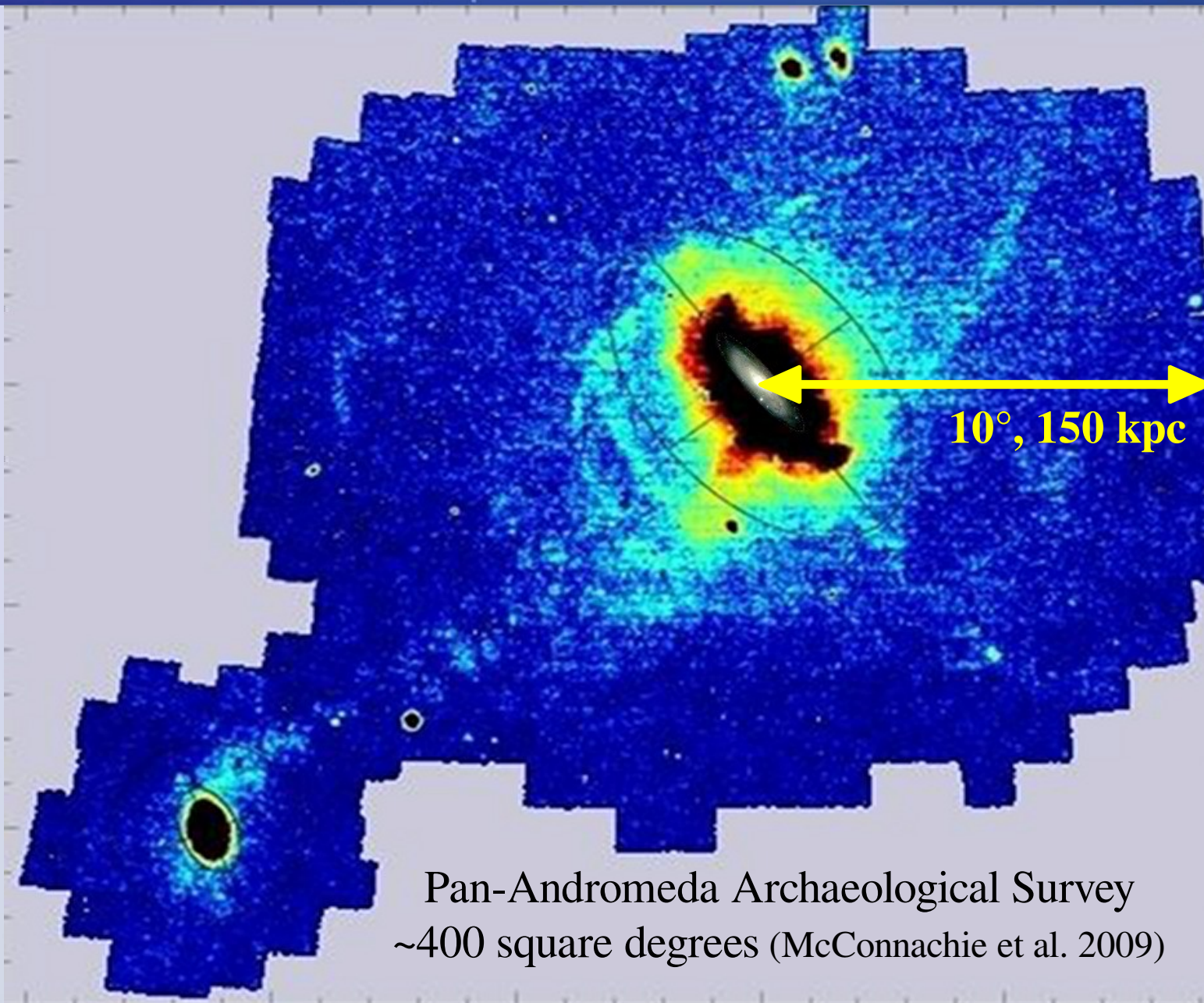
Star formation history of the Local Group spirals



Edouard Bernard
Observatoire de la Côte d'Azur

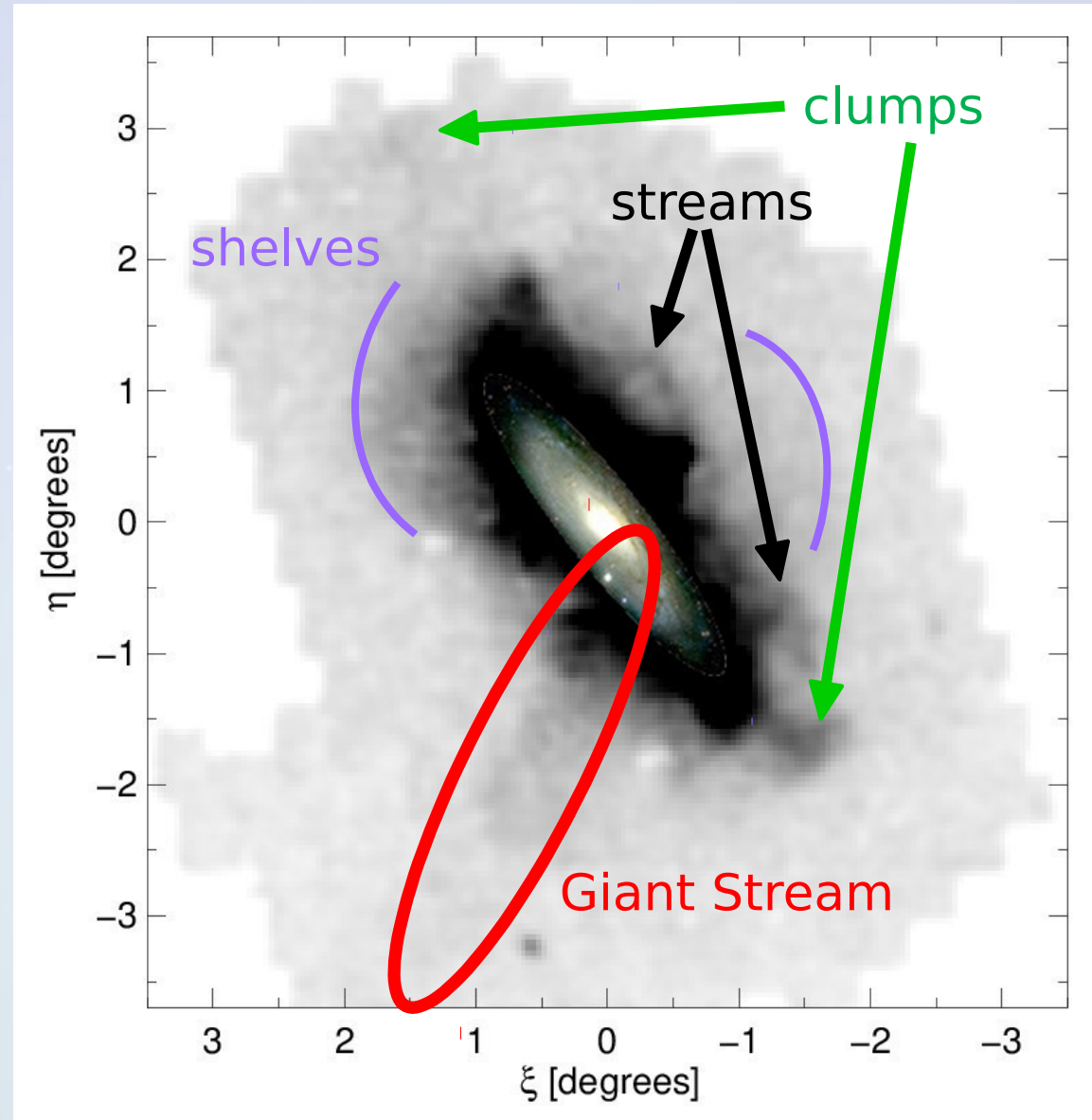


Andromeda's complex mass assembly



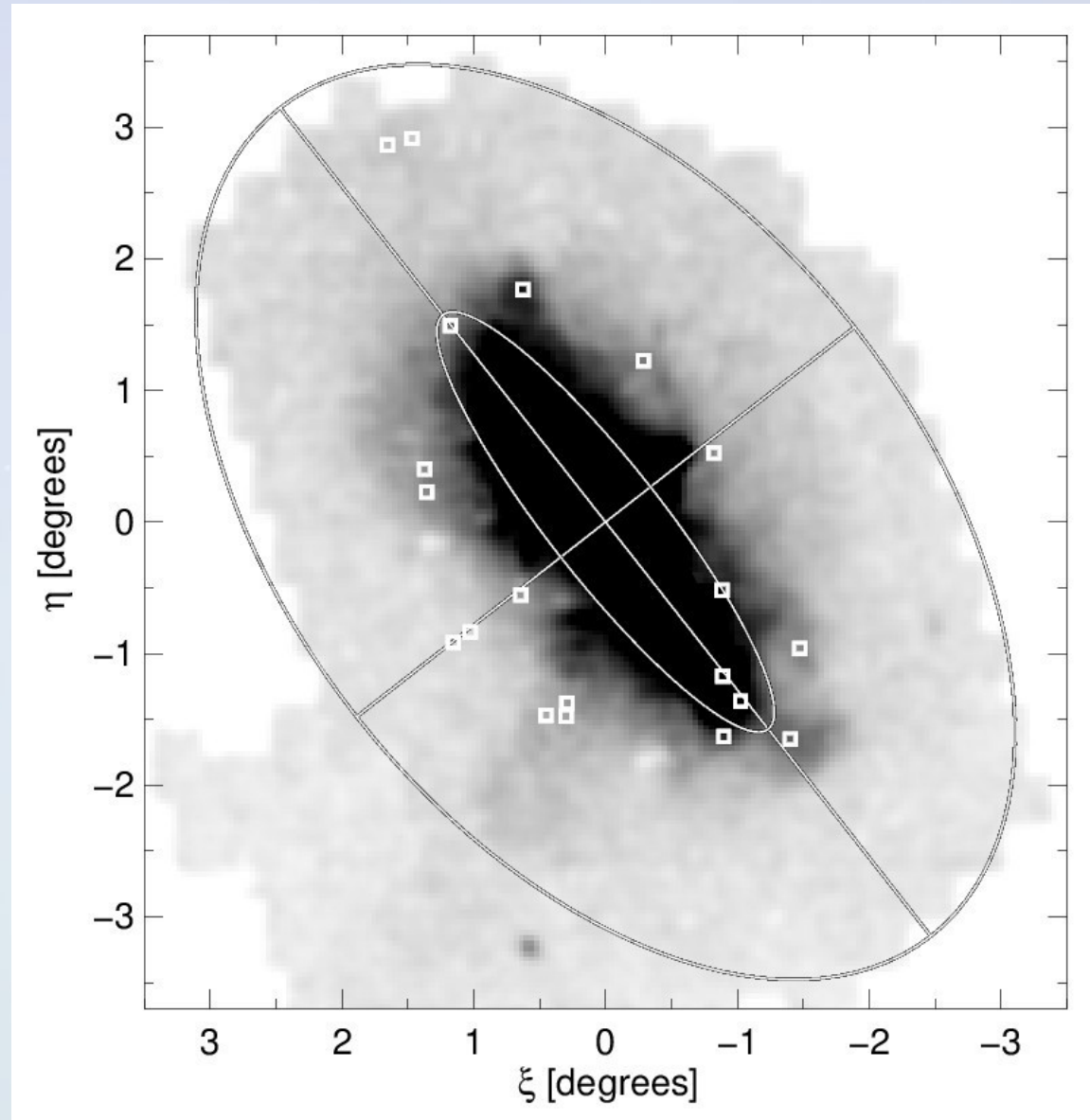
Andromeda's complex mass assembly

- Nature and origin of the substructures?
- Main epochs of star formation?



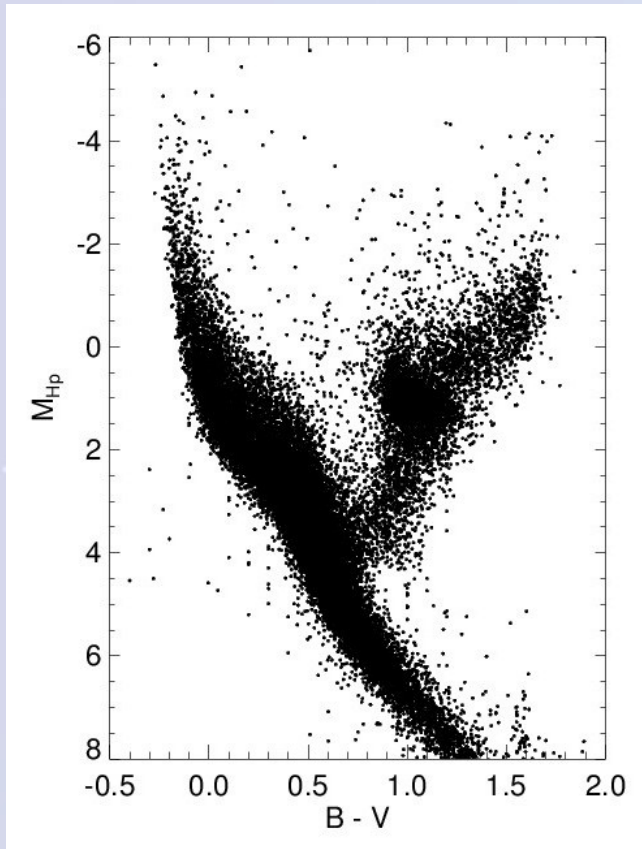
Deep HST survey of the Andromeda galaxy

- 16 fields observed with the *Hubble Space Telescope*
- $13 < R_{\text{proj.}} < 45$ kpc
- Substructures:
 - 14 fields
 - 3 orbits per pointing
- Outer disc:
 - 3 fields
 - 10-13 orbits per pointing

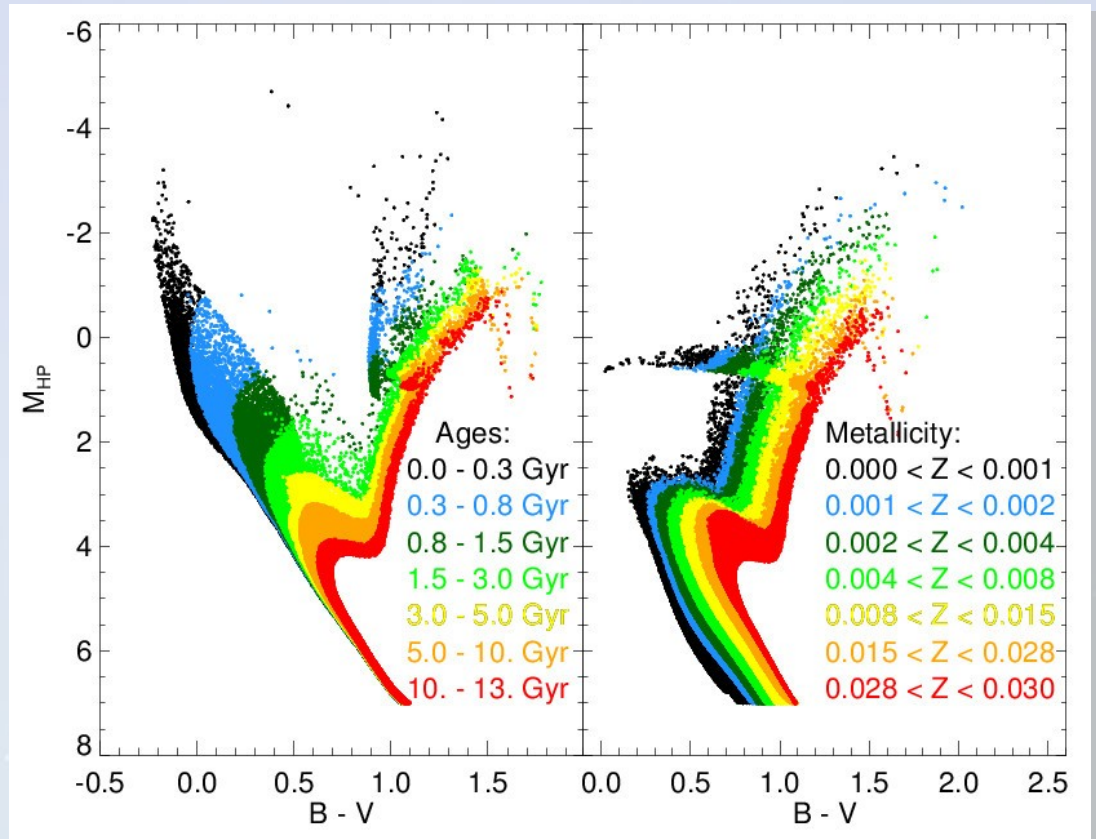


Star formation and chemical enrichment history

Observations



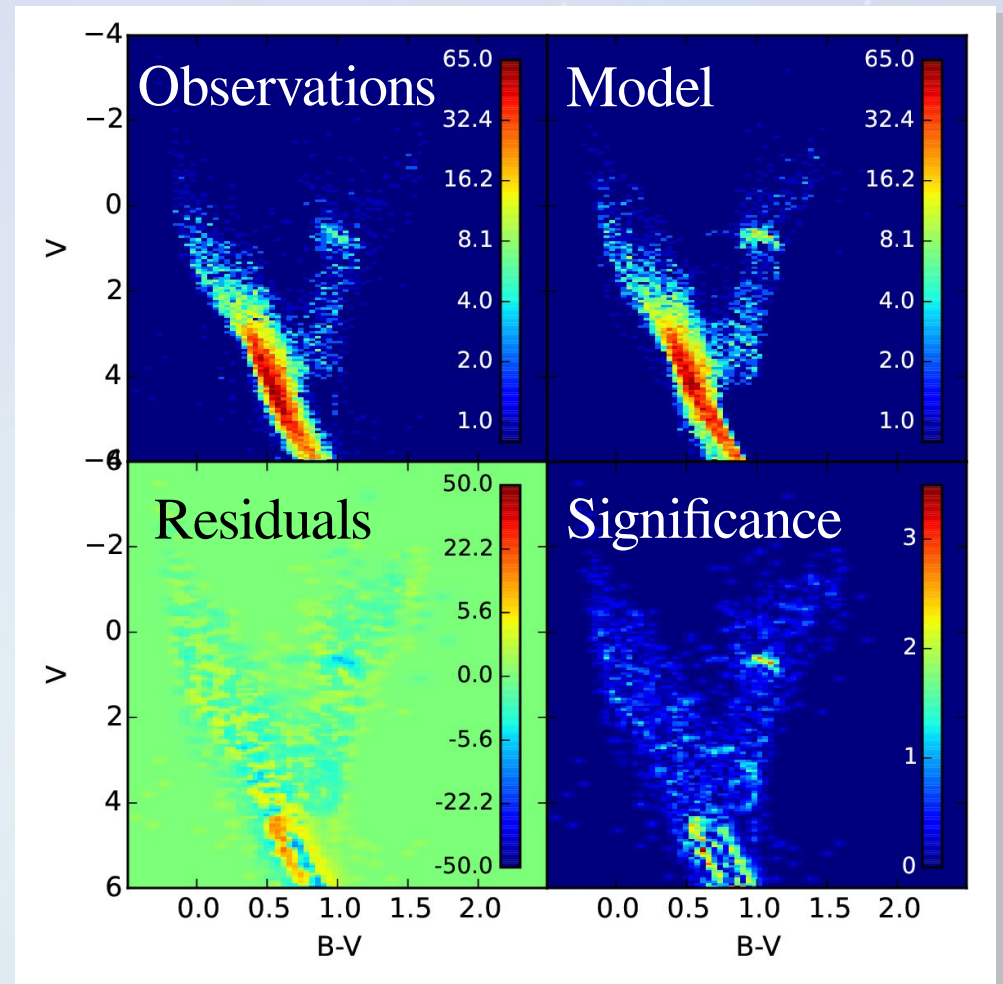
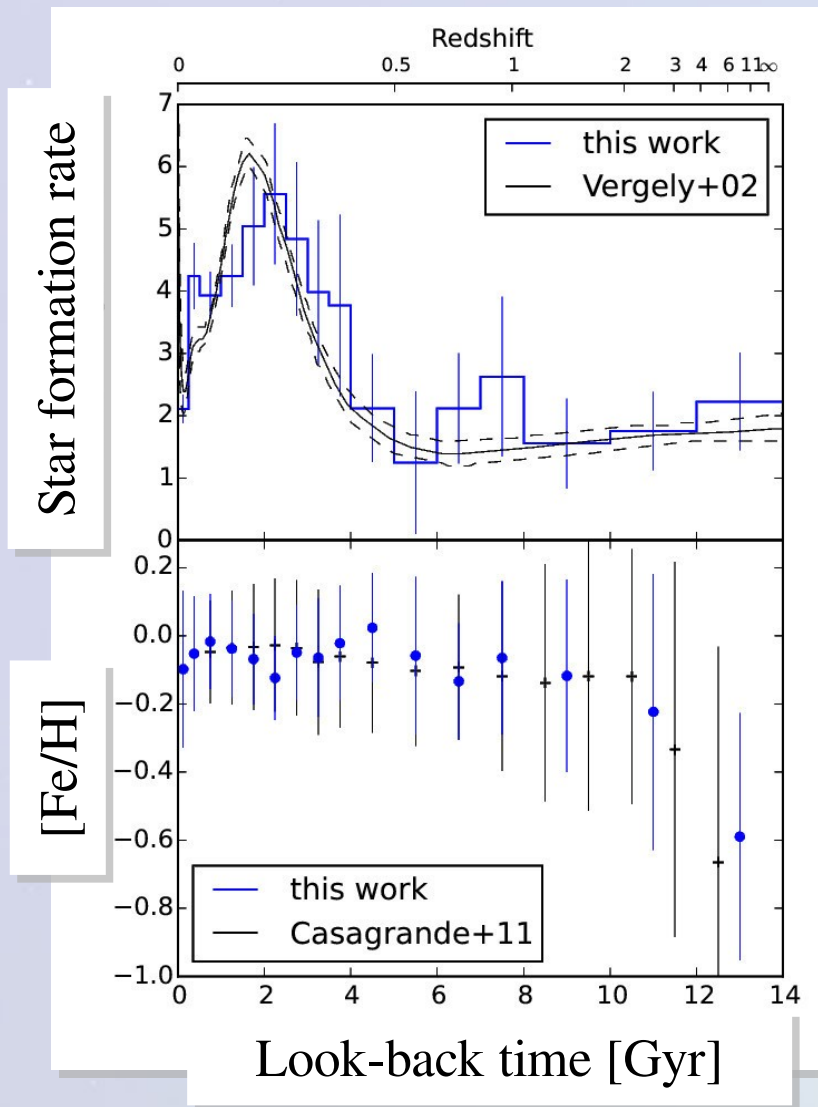
Stellar evolution models



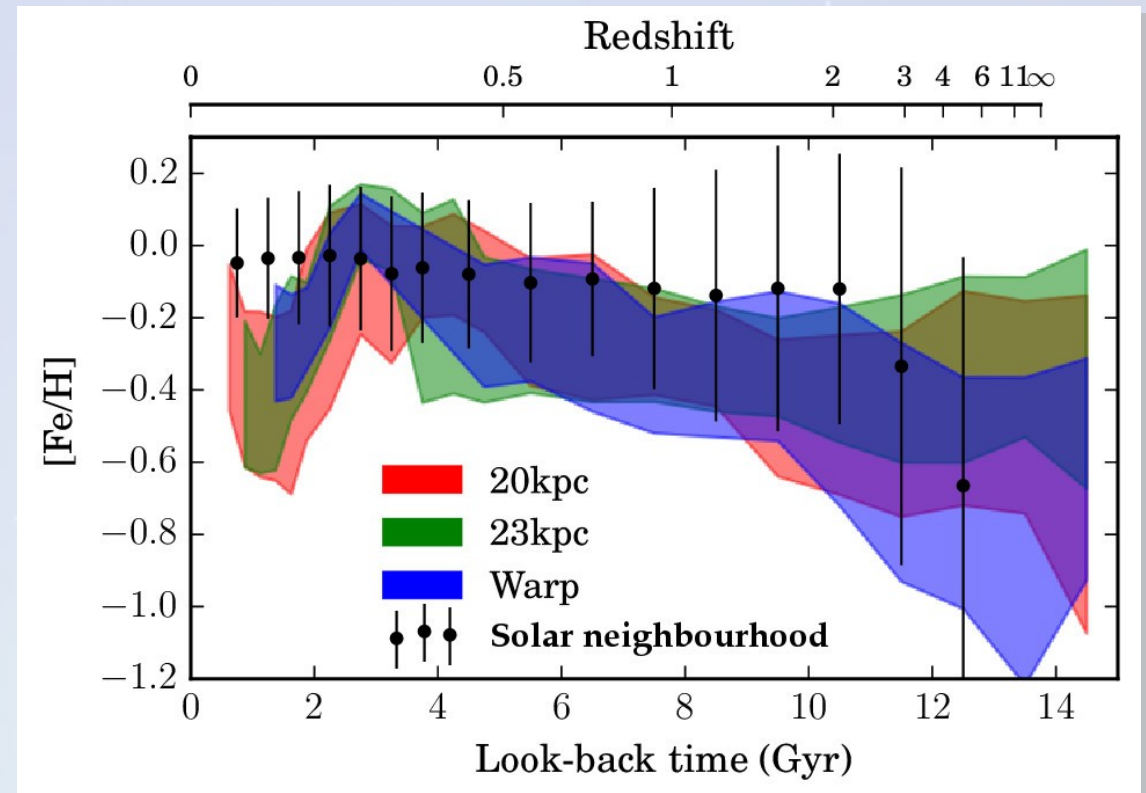
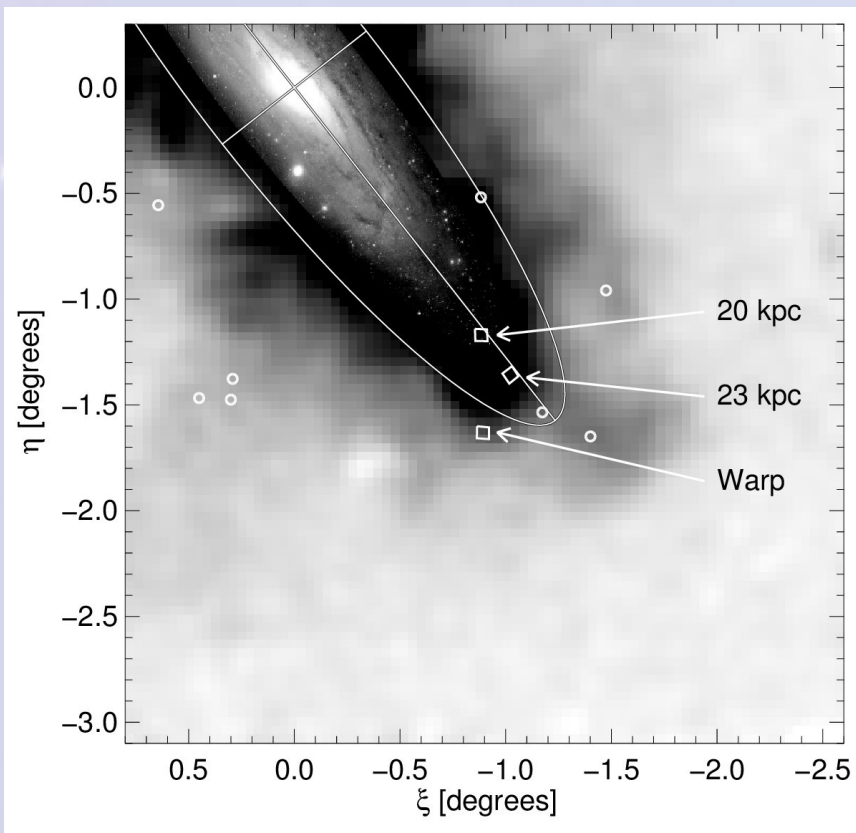
Assumptions:

- fraction and mass ratio of binaries
- initial mass function (IMF)

Star formation and chemical enrichment history



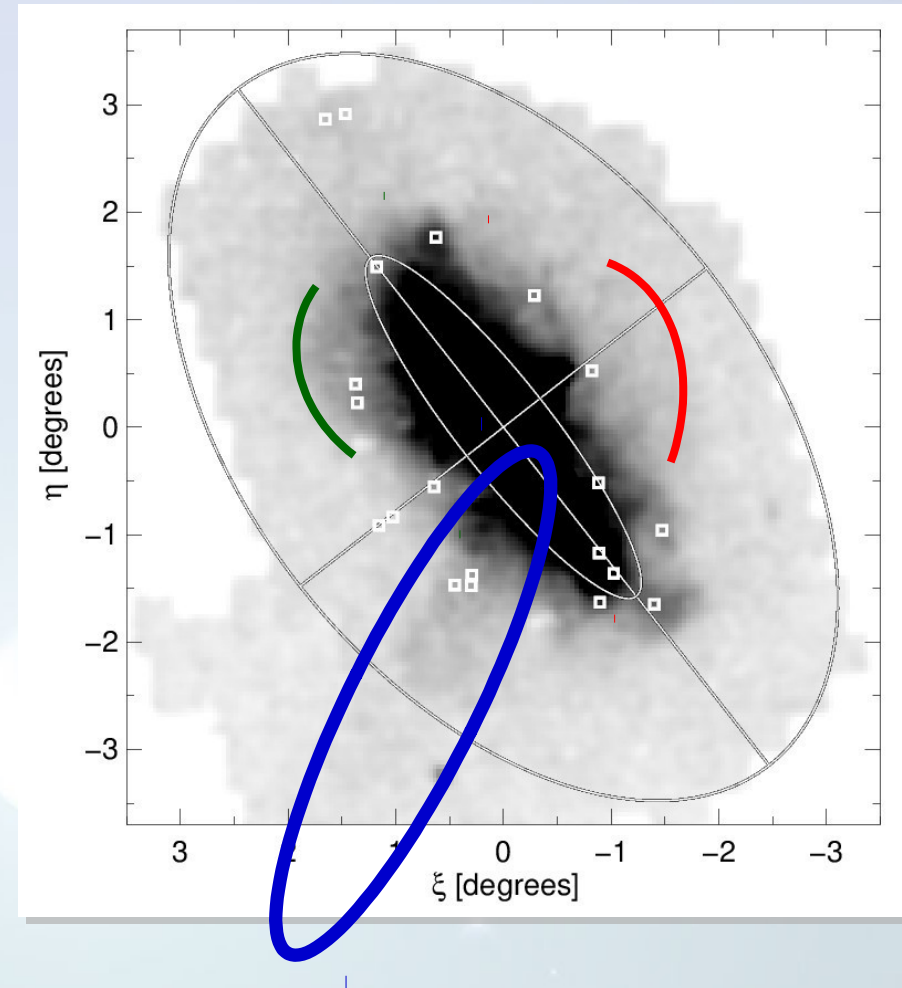
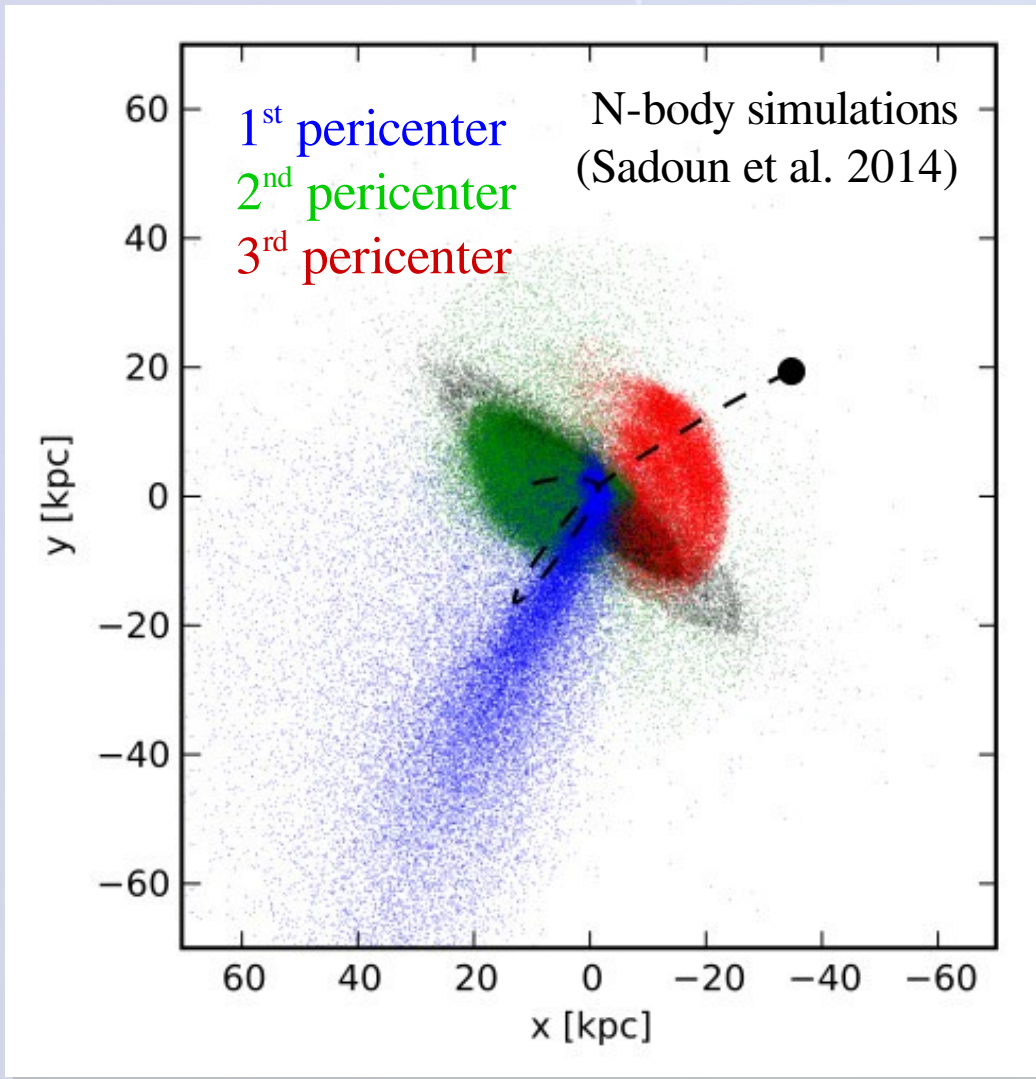
The age-metallicity relation in the outer disc of M31



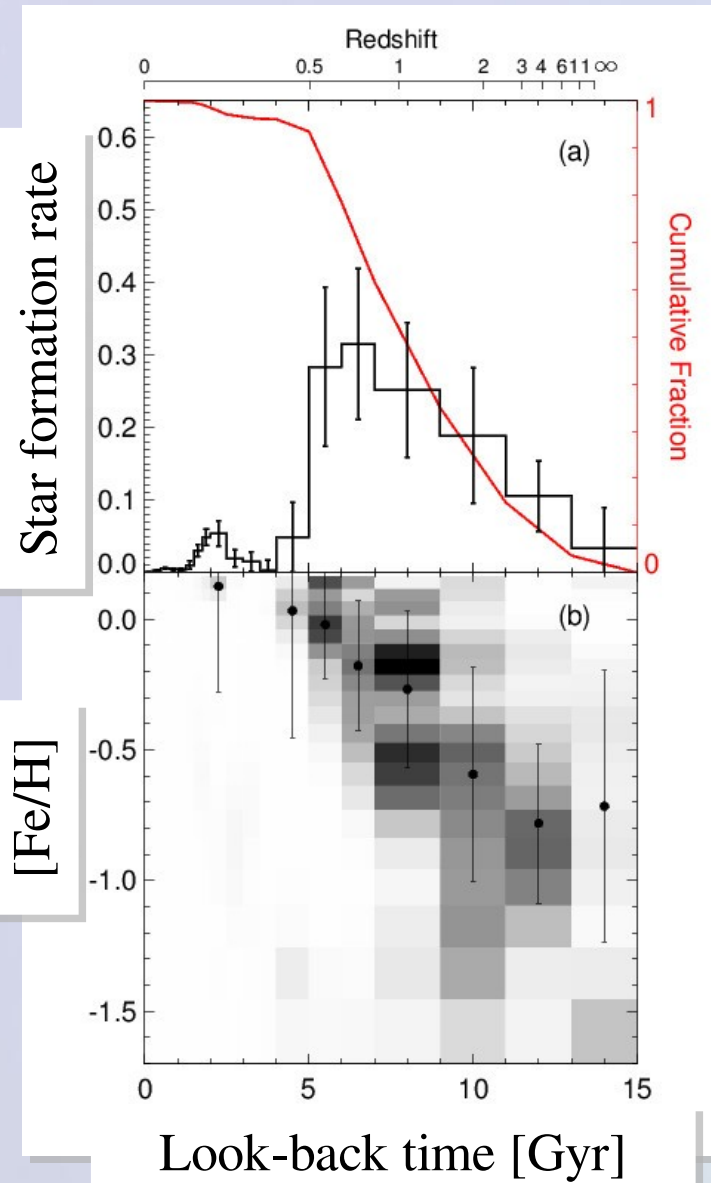
(Bernard et al. 2015b)

- AMR in the outer disc of M31 significantly steeper than in the Milky Way
- Little/no radial migrations in M31?

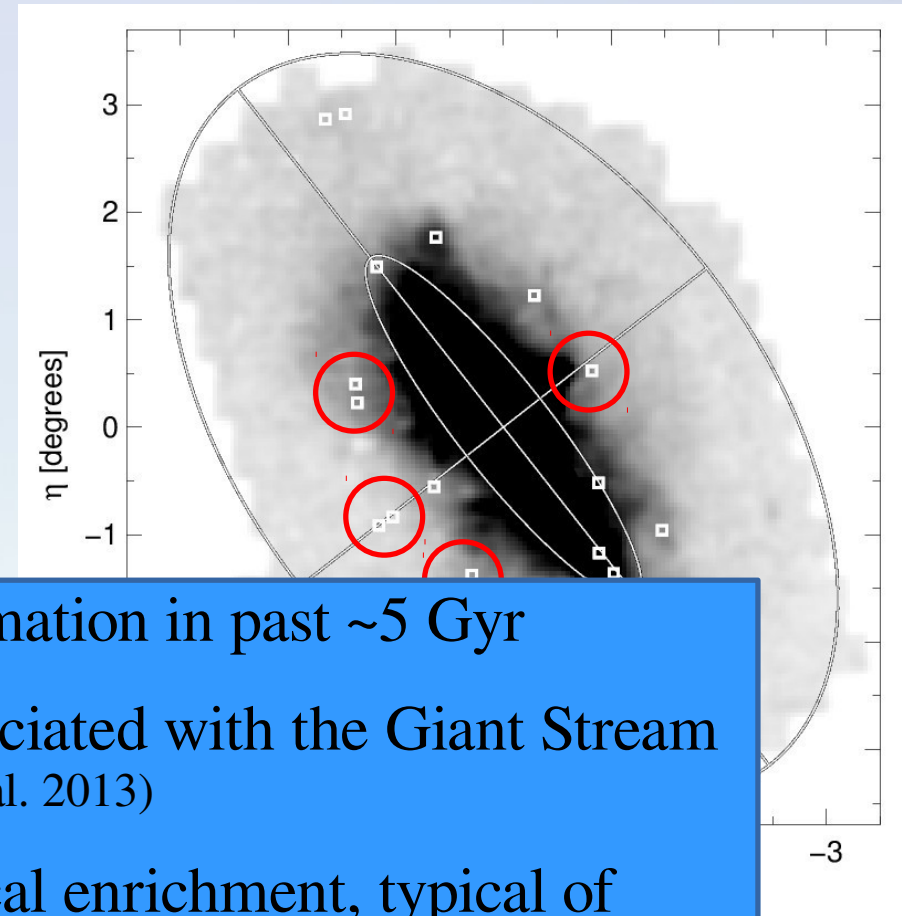
Nature and origin of the substructures (I)



Progenitor of the Giant Stellar Stream



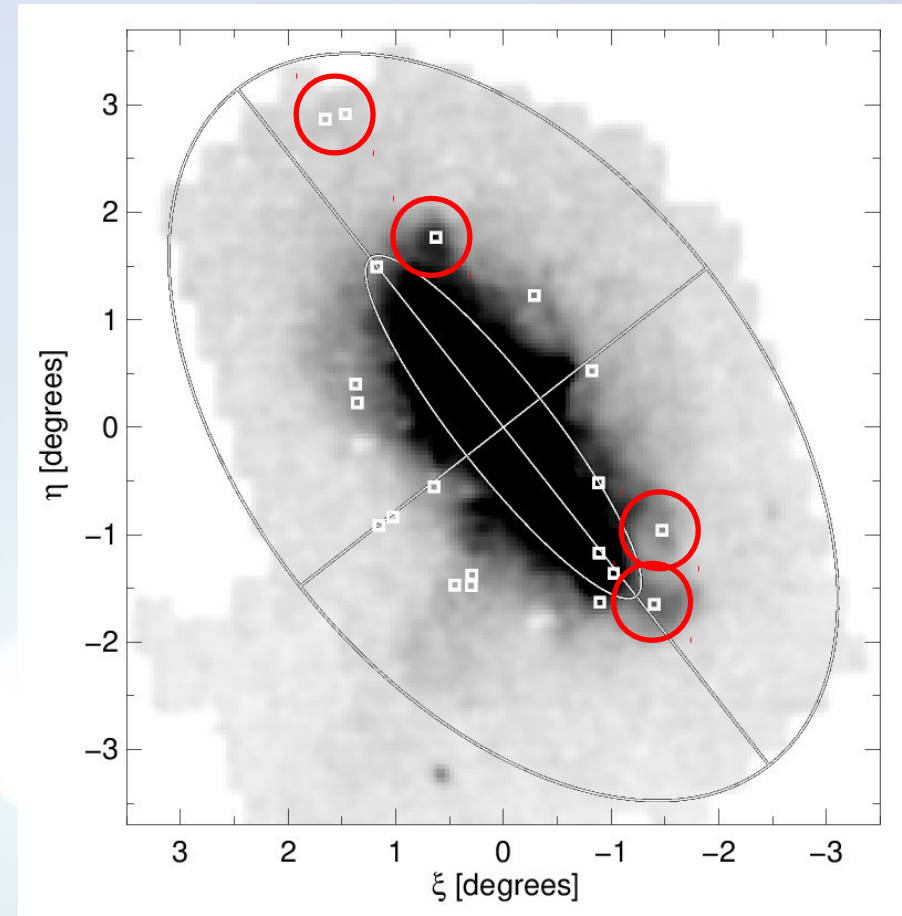
(Bernard et al. 2015a)



- no star formation in past ~ 5 Gyr
- no gas associated with the Giant Stream (e.g. Lewis et al. 2013)
- fast chemical enrichment, typical of galactic spheroids and elliptical galaxies (e.g. Sagittarius: Siegel et al. 2007)

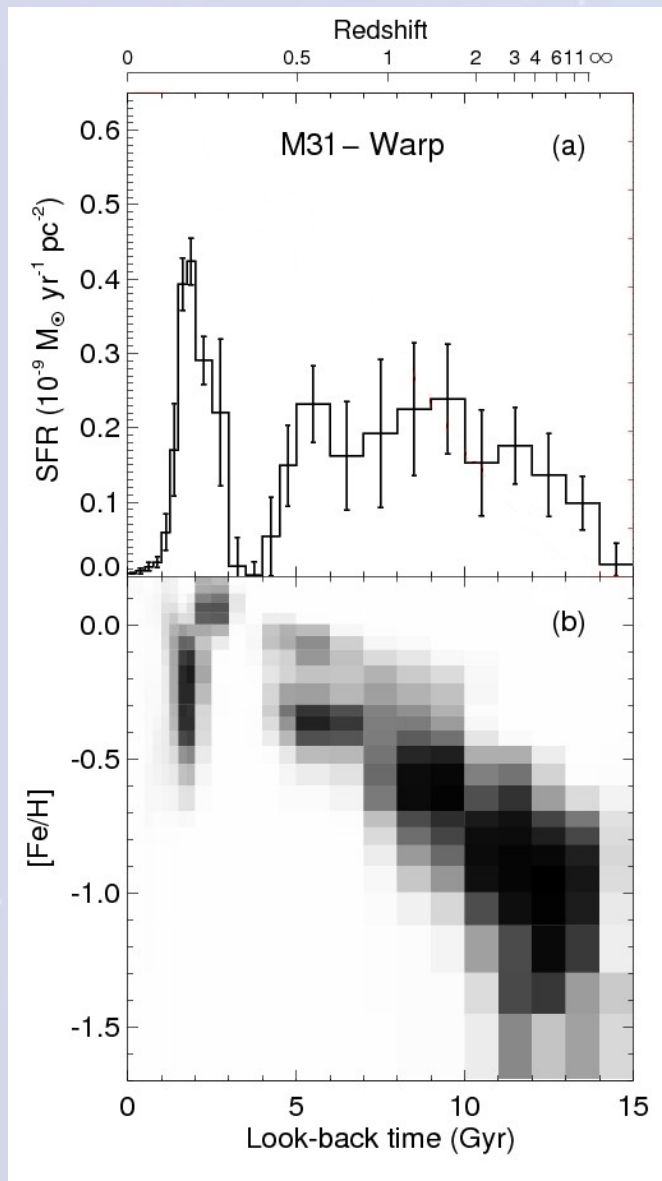
Nature and origin of the substructures (II)

- fields dominated by material from the thin disc
- not remnants of accreted galaxies
- kinematics evidence of heated disc stars in the halo (Dorman et al. 2013)
- disc kinematics out to $R \sim 70$ kpc (Ibata et al. 2005)

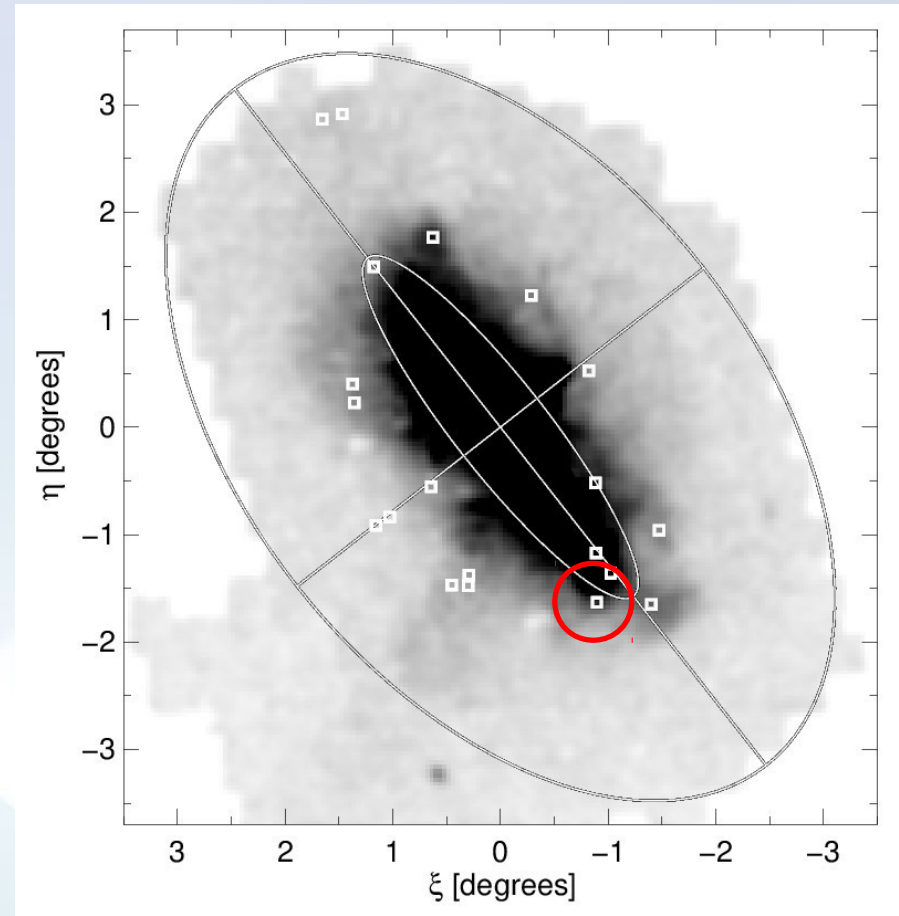


(Bernard et al. 2015a)

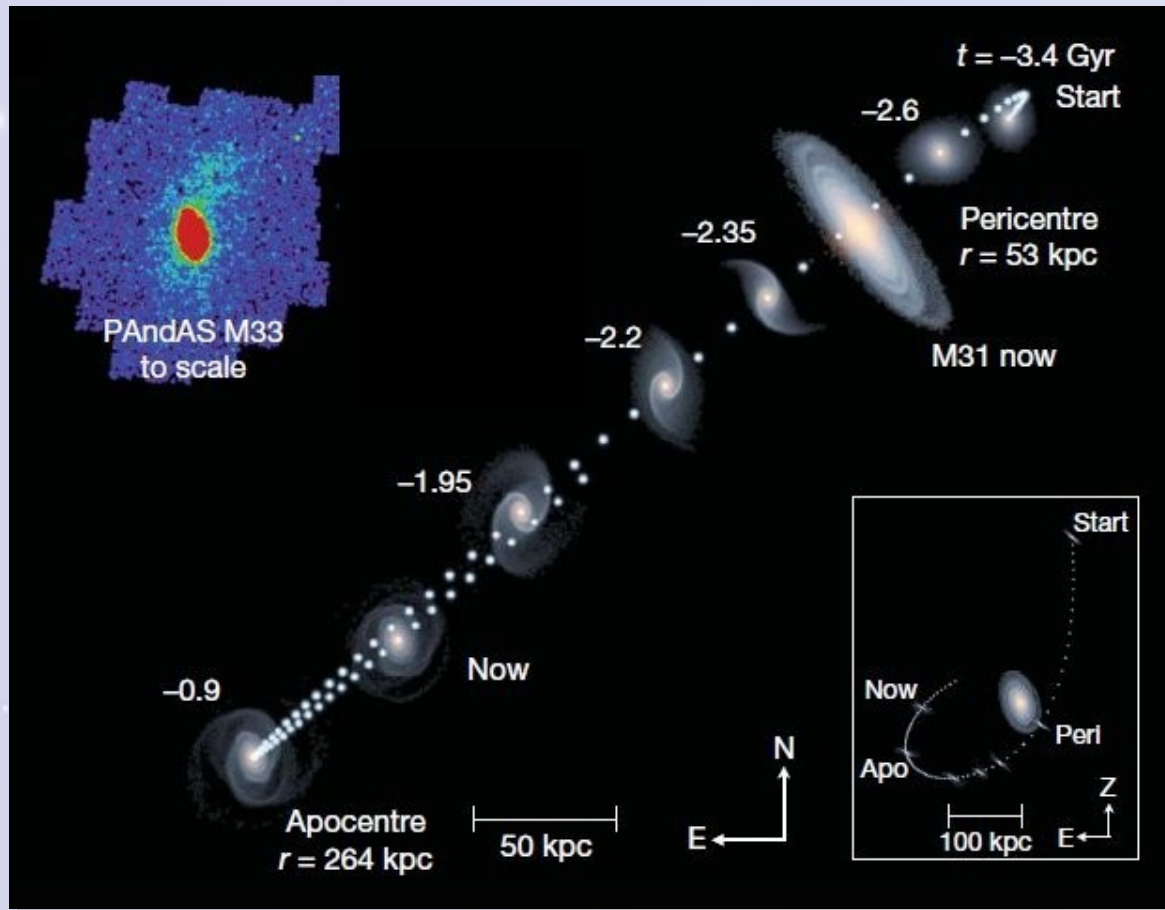
A disc-wide star formation burst 2 Gyr ago



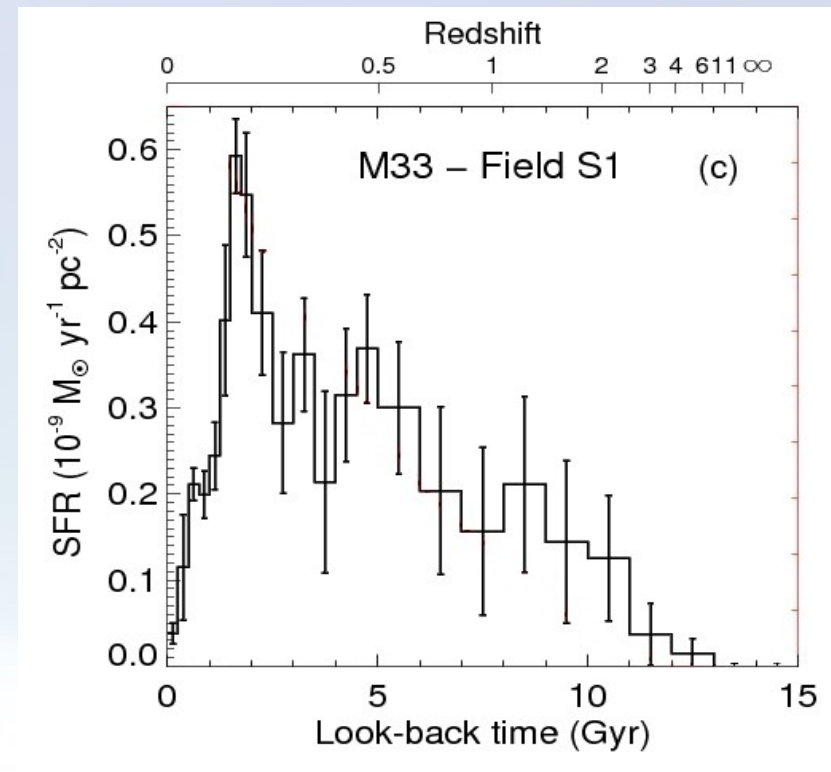
(Bernard et al. 2012)



M31-M33 interaction ~2.5 Gyr ago



(McConnachie et al. 2009)

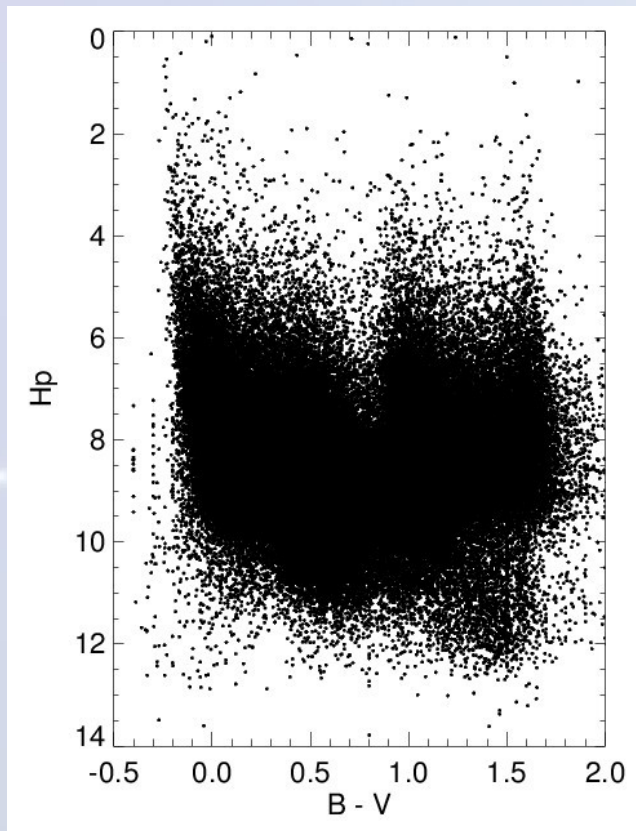


(Bernard et al. 2012;
Williams et al. 2009;
Barker et al. 2009)

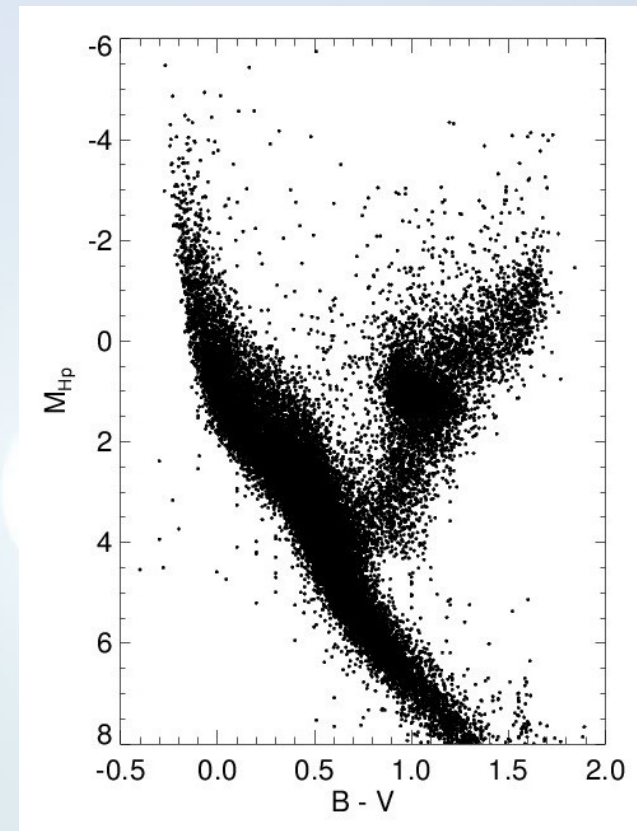
Star formation history of the Milky Way

- Color-magnitude diagram of the solar neighbourhood from *Hipparcos*

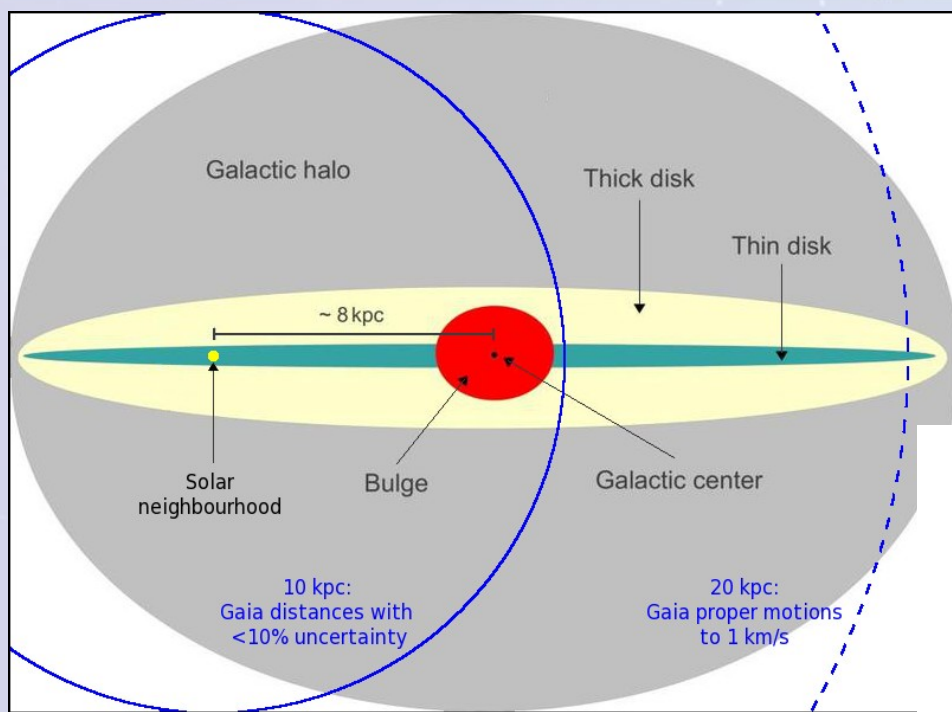
Without distances



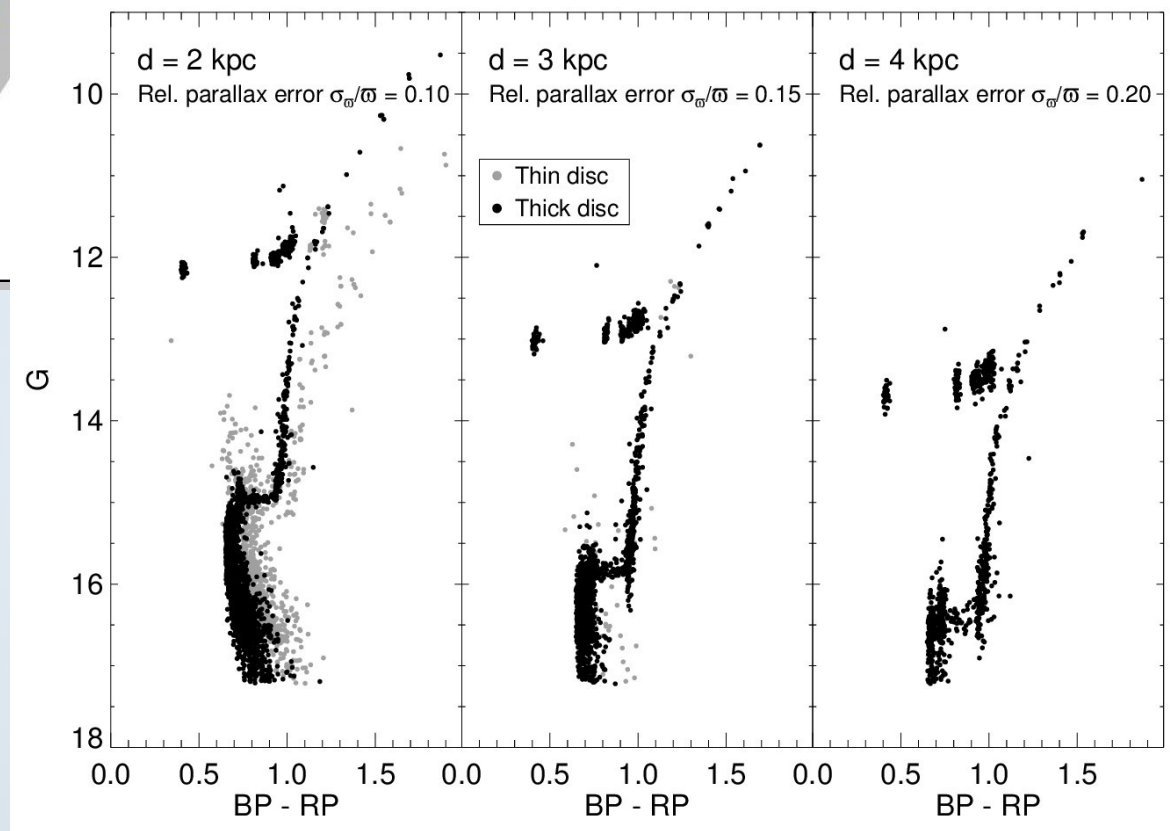
With individual distances



Gaia's reach



Gaia Universe Model Snapshot
(Robin et al. 2012), with
uncertainties modeled from
in-orbit commissioning



Summary

- Age-metallicity relation (AMR) of M31 disc different from Milky Way's
- Stream AMR consistent with a dwarf elliptical progenitor
- Disc-like fields: AMR/dynamics suggest material disrupted from thin disc
- 2 Gyr old burst is global phenomenon, possibly due to pericentric passage of M33 ~2.5 Gyr ago

→ possibility to apply this method to the Milky Way components and substructures thanks to *Gaia* parallaxes

