Star formation histories of passive cluster galaxies at z~1

Raphaël Gobat
(CEA/Saclay)

with

Ricardo Demarco (UdeC), Piero Rosati (ESO), Emanuele Daddi (CEA),
Chris Lidman (AAO), Alessandro Rettura (UCR), Veronica Strazzullo (NRAO)

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Outline

- Star formation histories from spectrophotometric fitting

  - method and characterization of the SFH

- The z = 0.84 cluster RX J0152.7-1357:

  - SFH variation with environment

  - build-up of the red sequence

- Environmental age gradients in XMMU J2235.3-2557 at z = 1.39

Spectrophotometric modelling

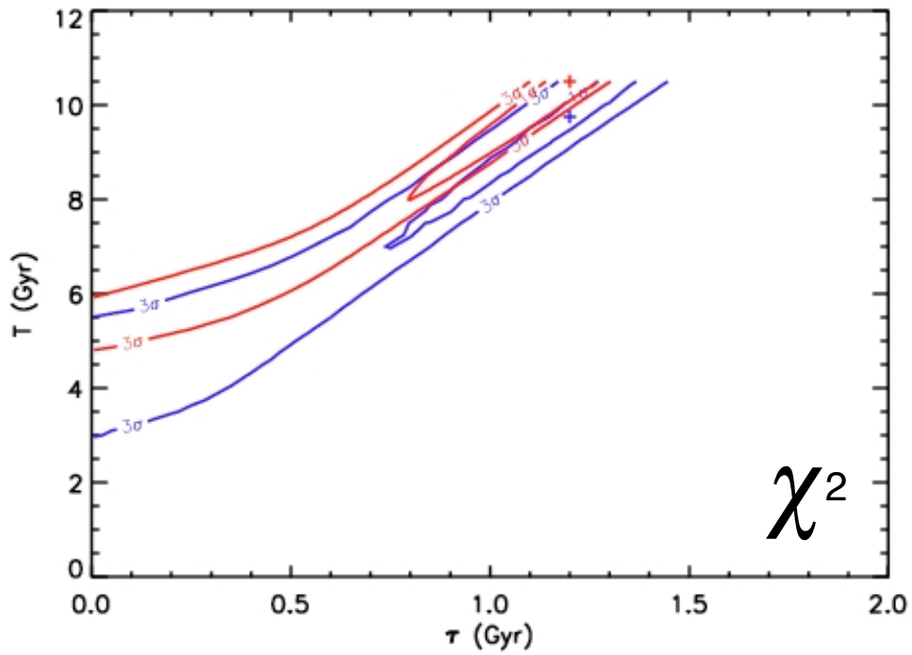
Observed SED
(≥ 4 bands)

model SEDs

CSP models
(T, τ, Z, Av, σv, ...)

model spectra

Observed
spectrum
(S/N ≥ 4)



$M_\star$

t_{SF}

t_{fin}

M/L

Spectrophotometric modelling

Observed SED
(≥ 4 bands)

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CSP models
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$Z_\odot$ 0

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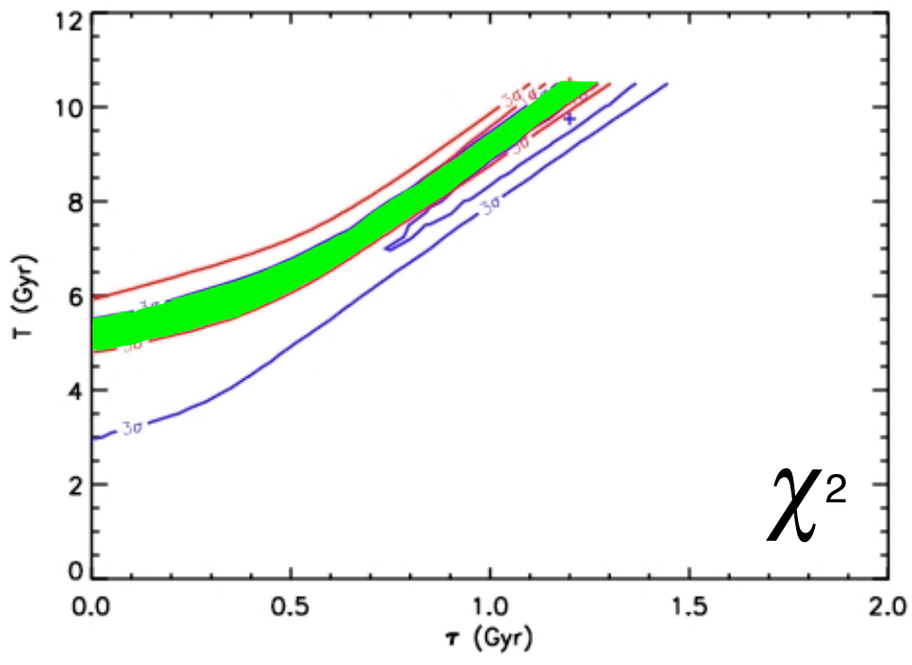

$M_\star$

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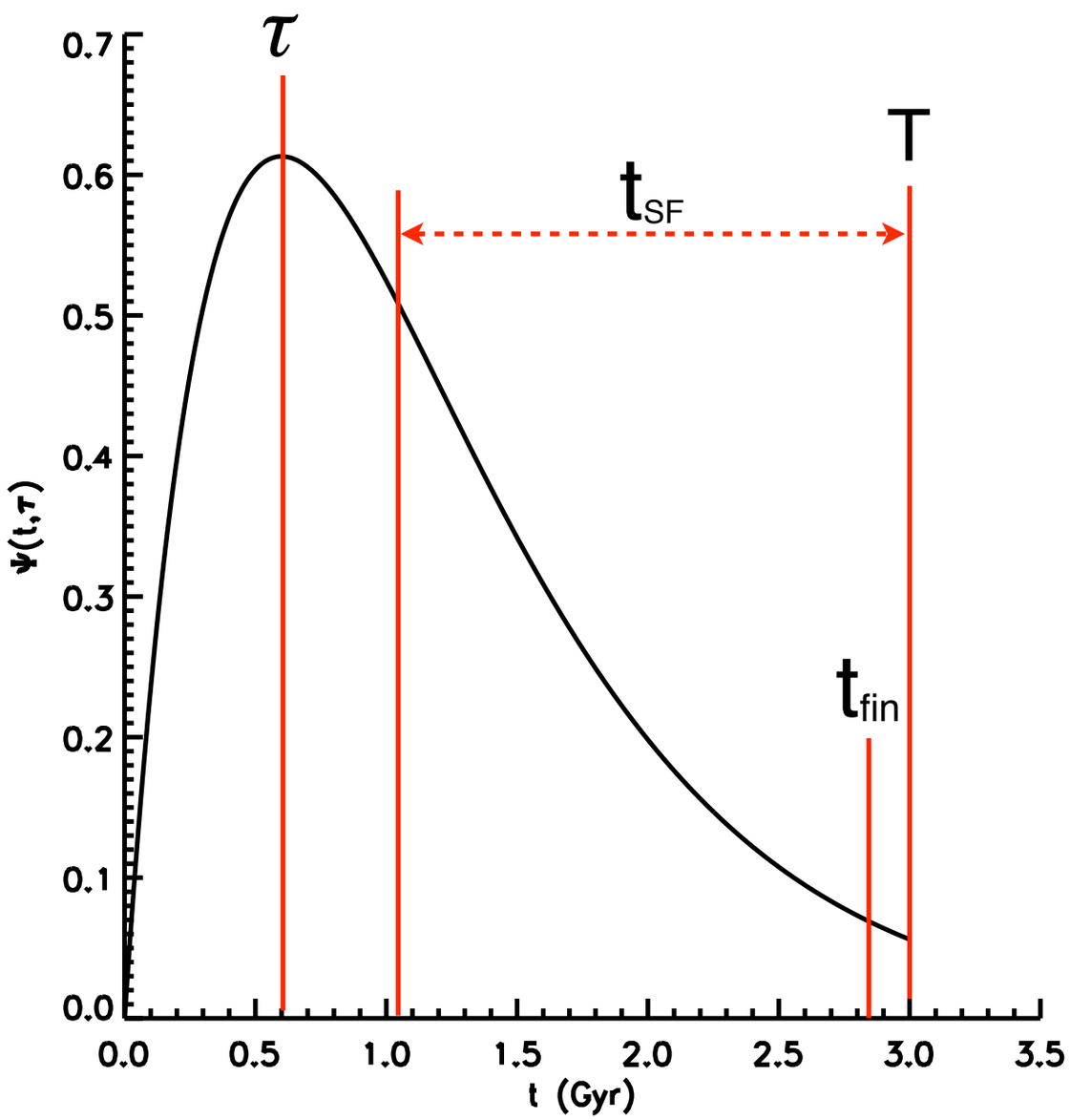
M/L

Characterizing the star formation history

delayed, exponentially declining SFH: $\Psi(t,\tau) = \frac{t}{\tau^2} e^{-\frac{t}{\tau}}$



Star formation weighted age:

$$t_{SF}(T,\tau) = \frac{\int_0^T (T-t)\Psi(t,\tau)dt}{\int_0^T \Psi(t,\tau)dt}$$

Final formation time:

$$M^\star(t_{fin}) = 0.99 \times M^\star(T)$$

RX J0152.7-1357

(Demarco et al., in prep.)

(Blakeslee et al. 2006)

$z = 0.84$

5-band photometry:

r_{625}, i_{775}, z_{850} (HST/ACS)
J, K_s (NTT/SofI)

VLT/FORS2 spectroscopy:

134 members ($\overline{S/N} \sim 7$)

76 passive:

r_{625}-$K_s > 2.3$
EW([OII]) ≥ -5Å

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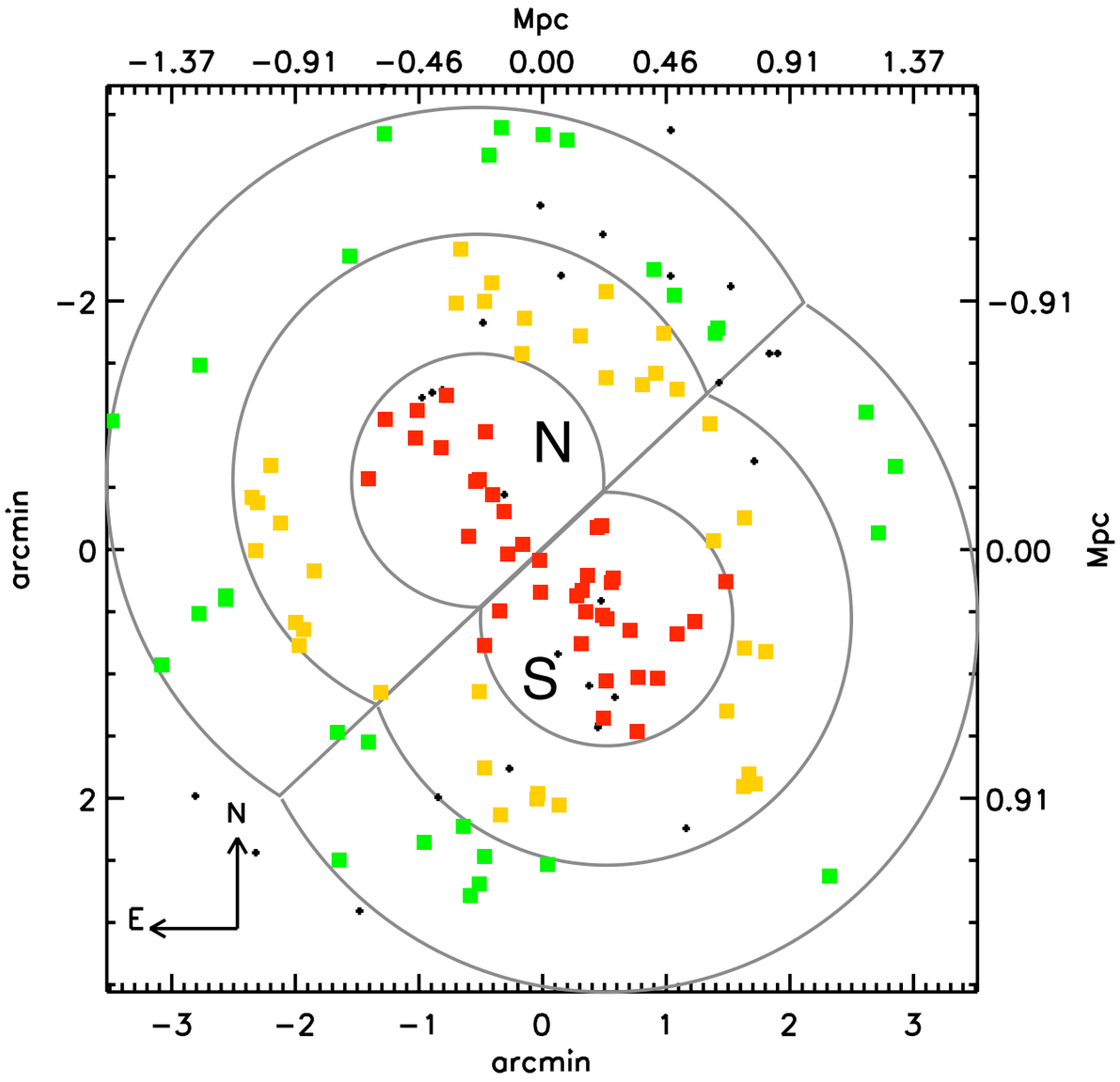
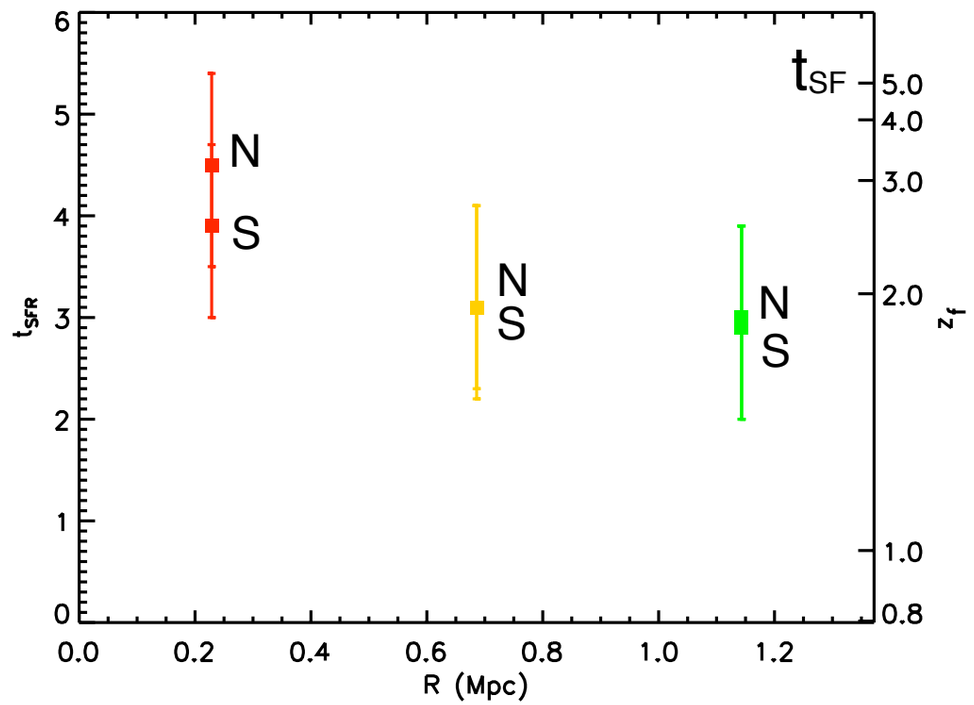
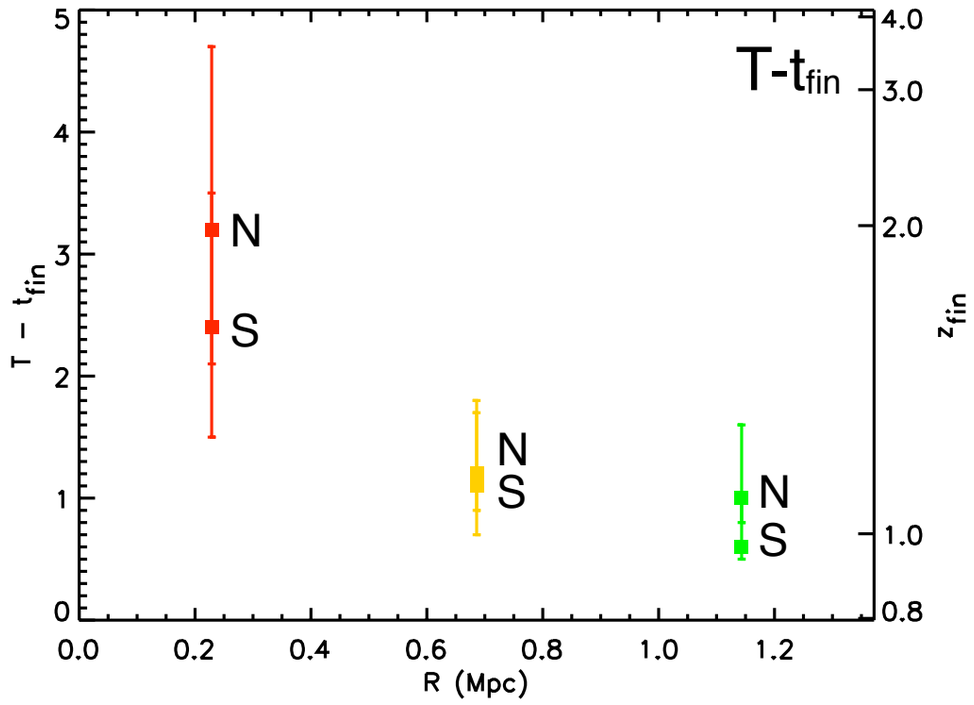
SFH as a function of environment





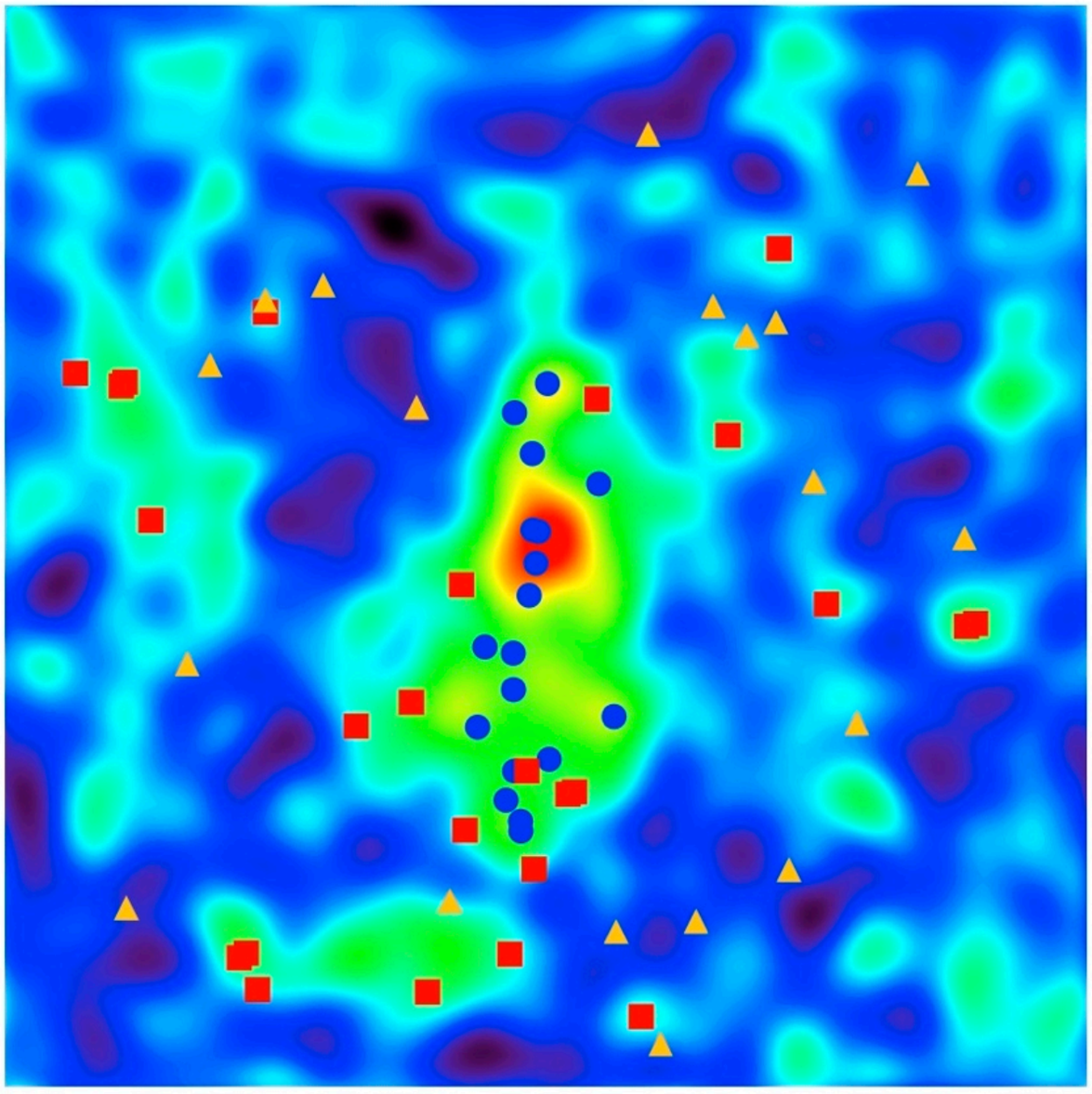
t_{SF} ~ 4.8(4.1) - 1.7(1.1)R(Mpc) Gyr

T - t_{fin} ~ 2.6 - 1.7R(Mpc) Gyr

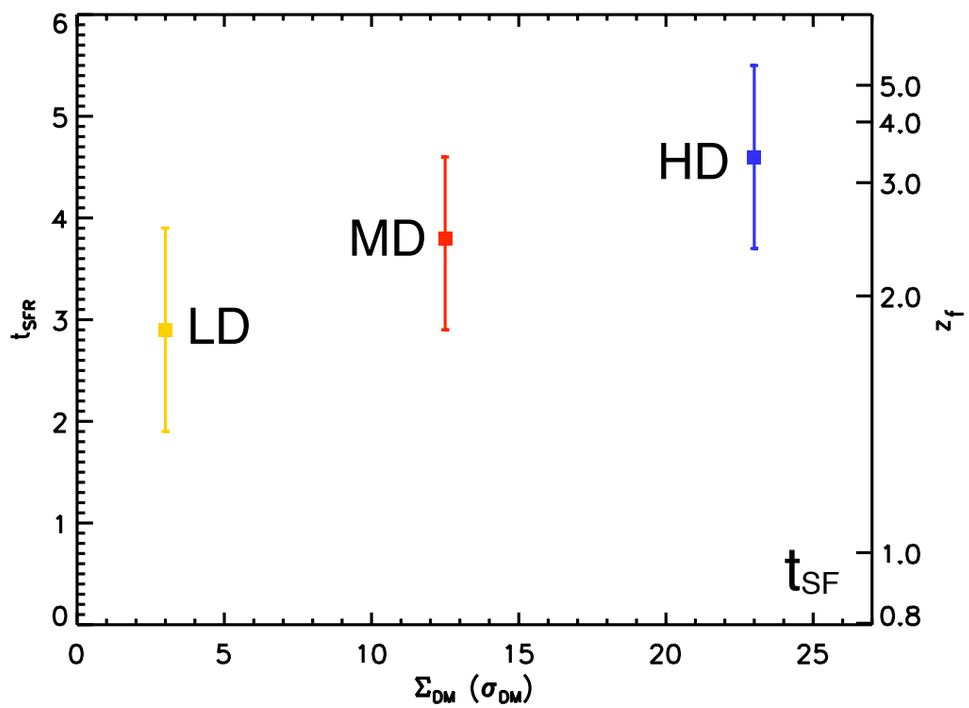


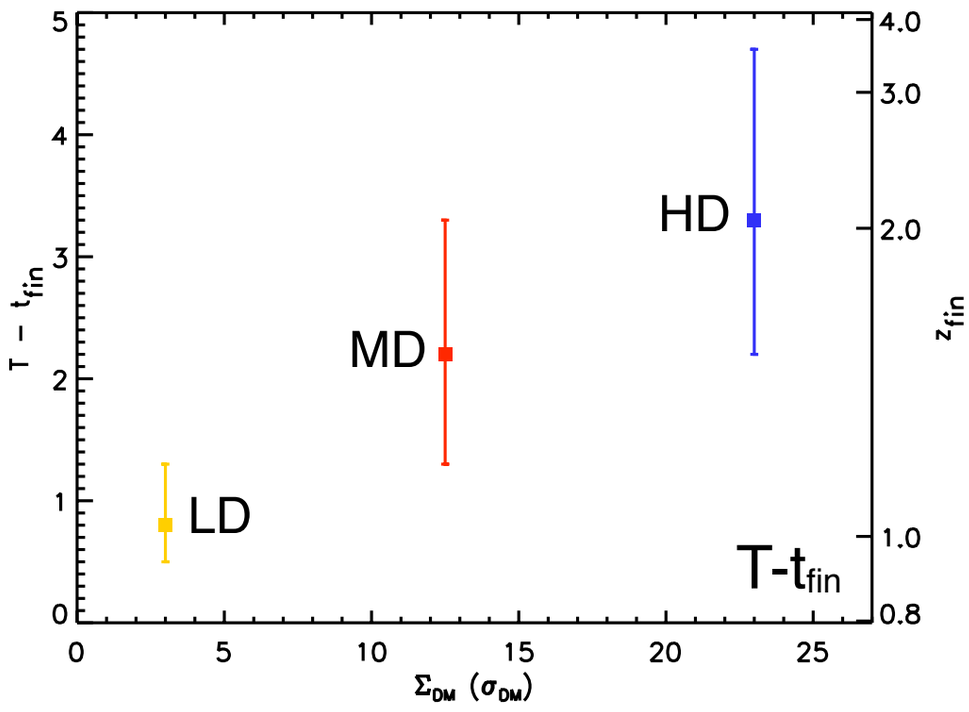
➡ strong radial age gradient

SFH as a function of DM density



(Jee et al. 2005)

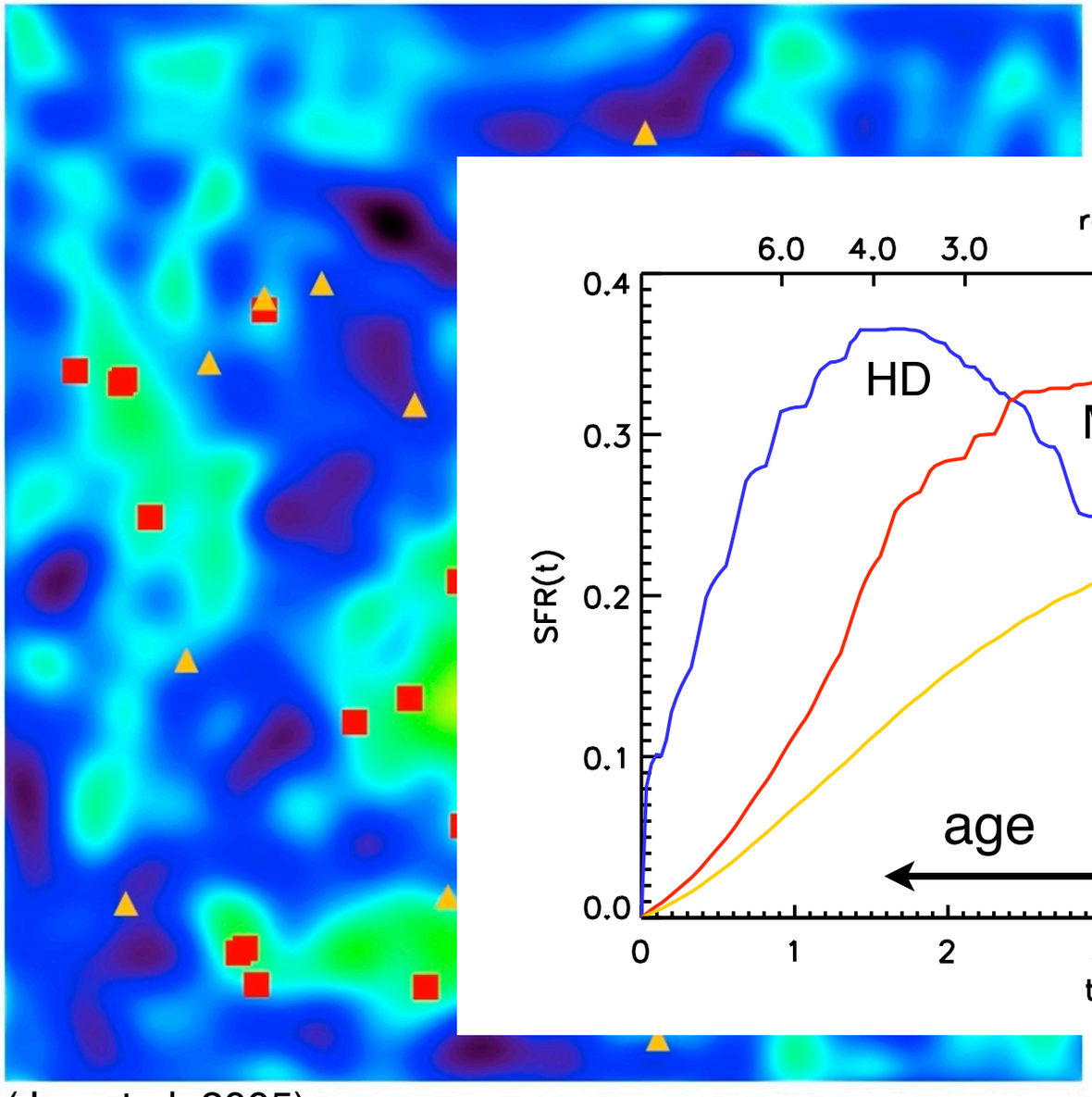




$$t_{SF} = 2.7 - 0.1\Sigma_{DM}\ \mathrm{Gyr}$$

$$T - t_{fin} = 0.5 - 0.1\Sigma_{DM}\ \mathrm{Gyr}$$

SFH as a function of DM density



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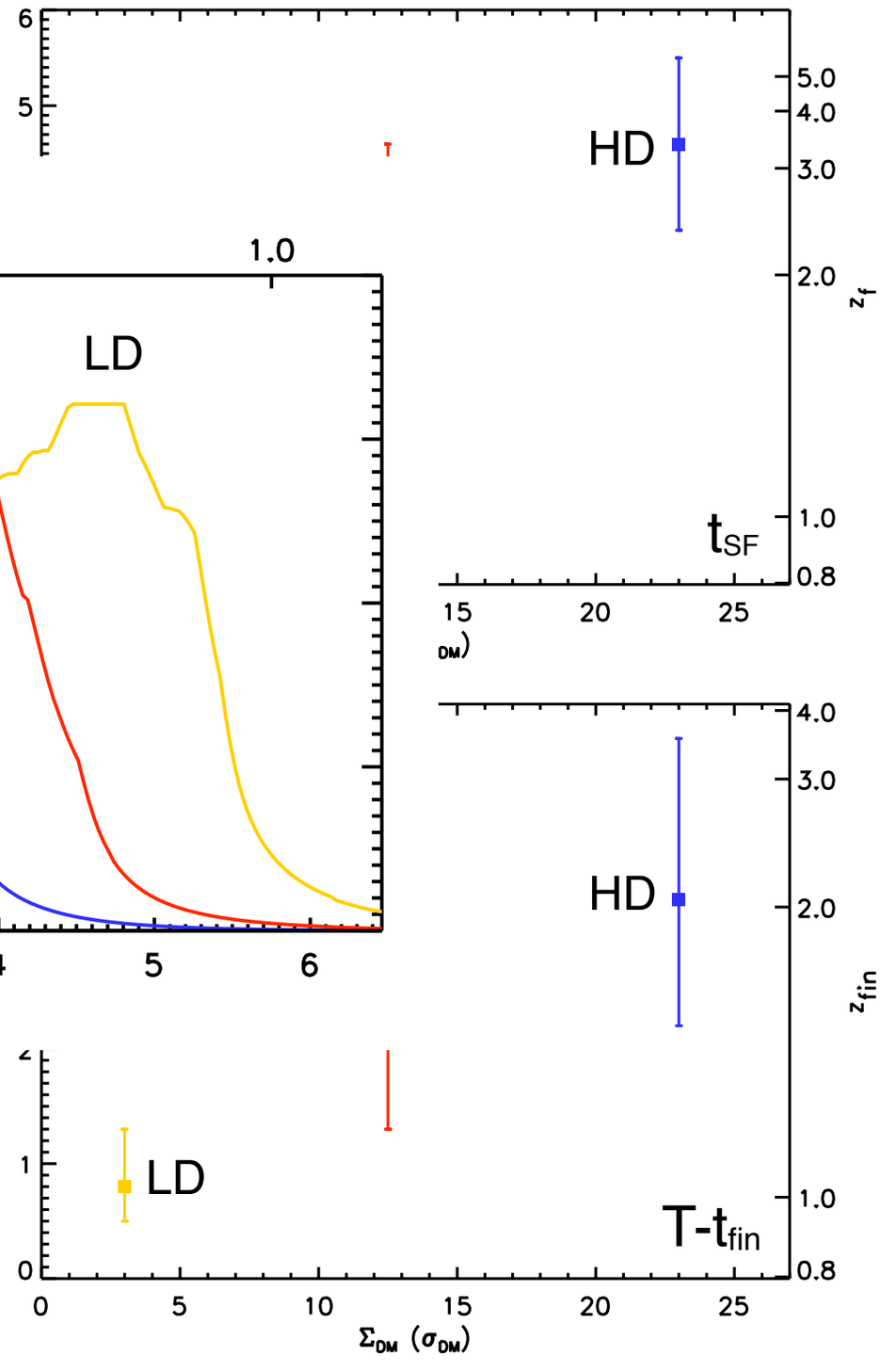
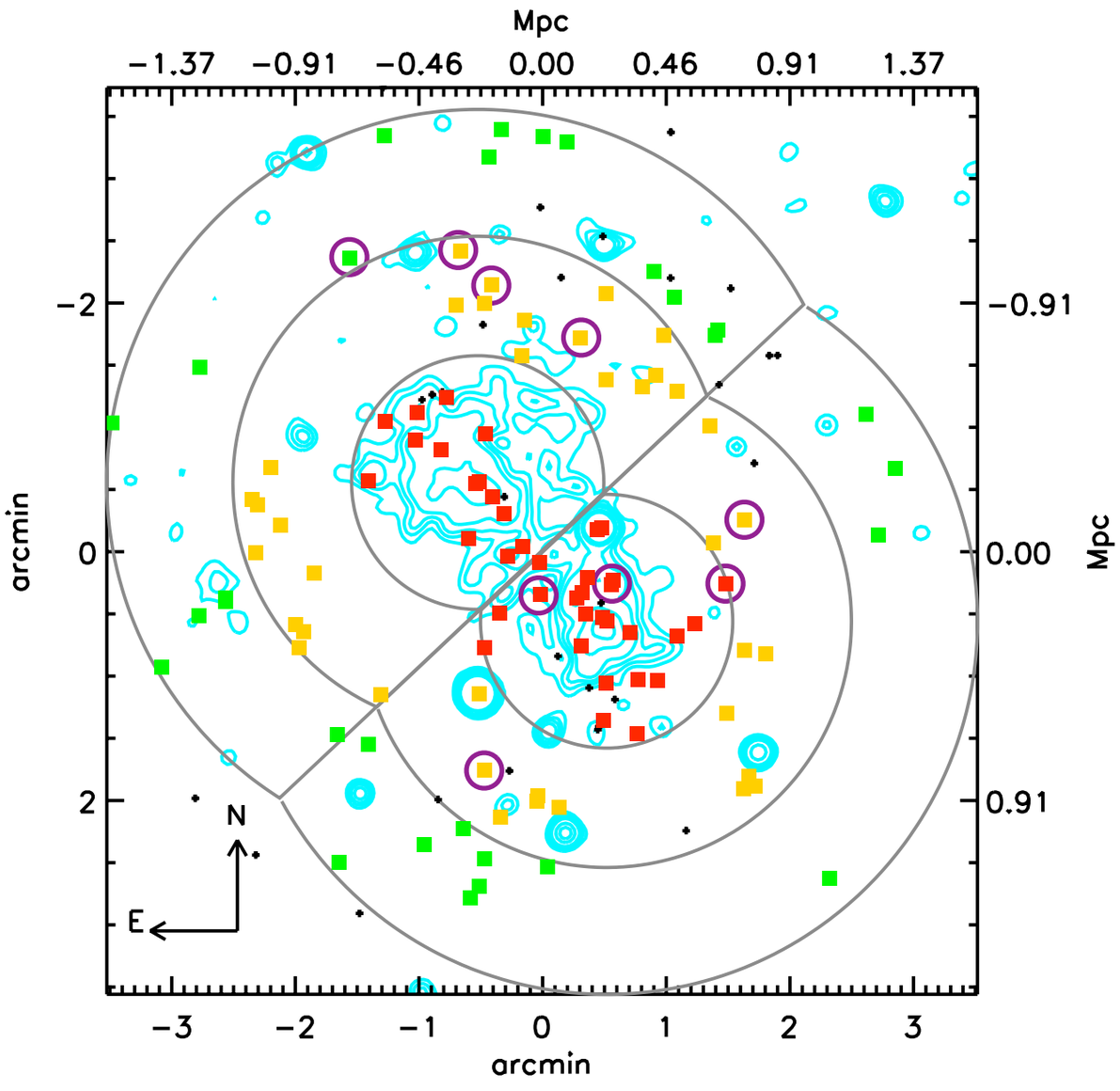


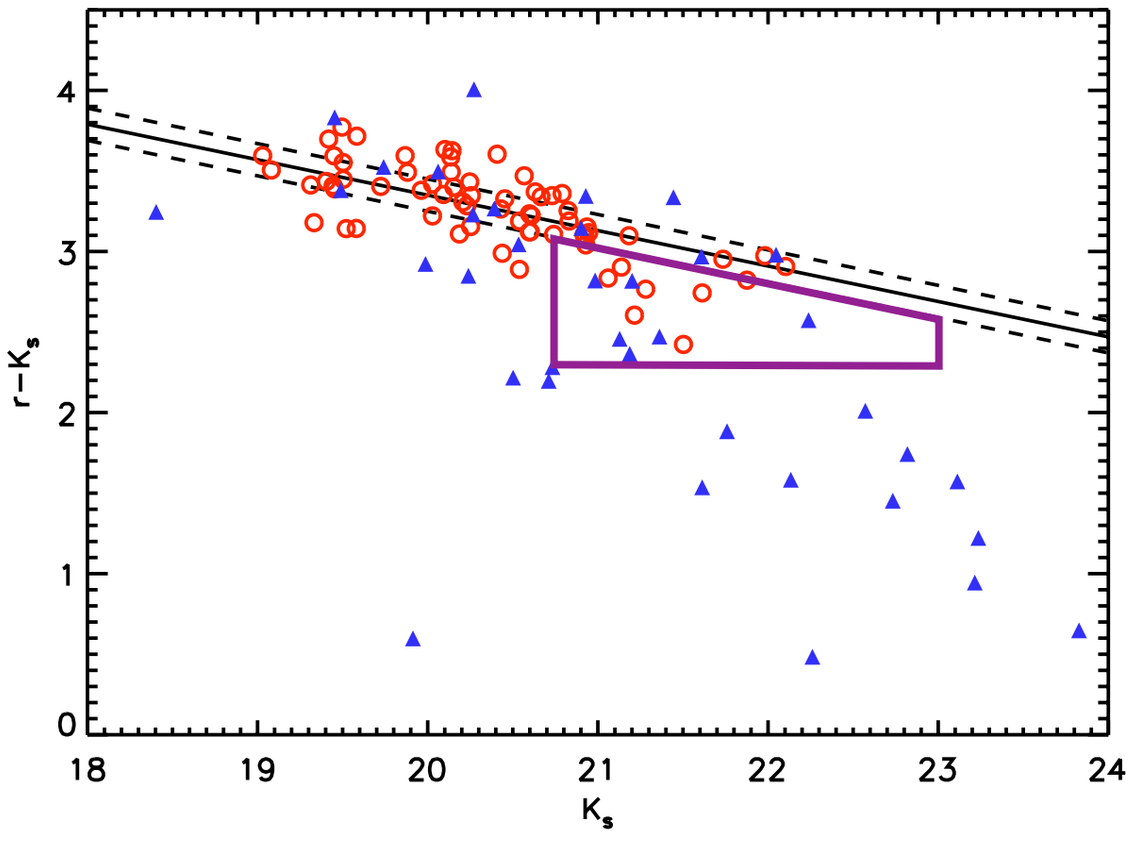
$t_{SF} = 2.7 - 0.1\Sigma_{DM}$ Gyr

$T - t_{fin} = 0.5 - 0.1\Sigma_{DM}$ Gyr

➡ shorter SFH in high density regions

Faint blue ETGs





x-ray emission (Chandra)

t_{SF} = 2.9 ± 1 Gyr

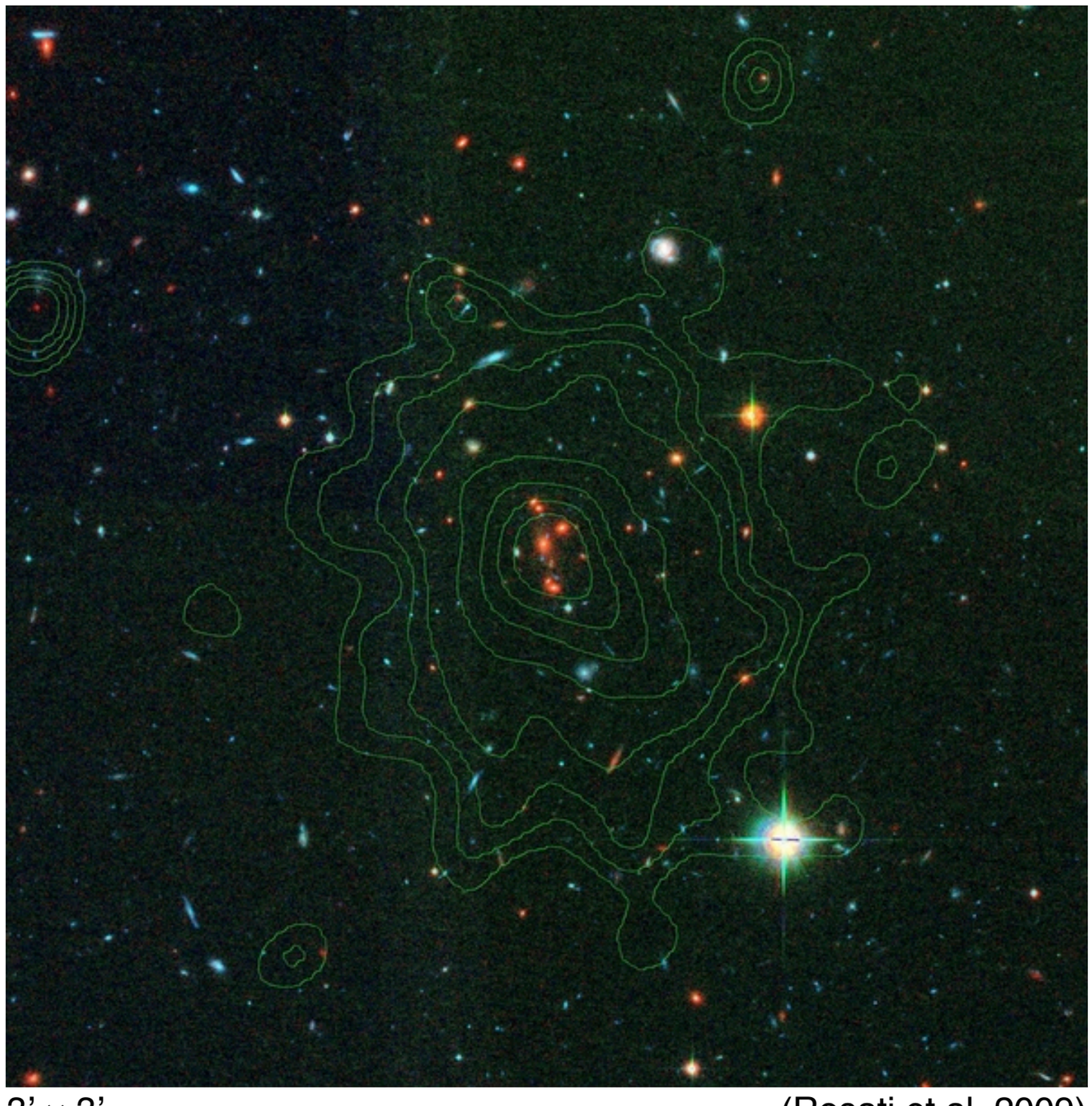
T - t_{fin} = 0.7 ± 0.3 Gyr

but the crossing time is **t_{cr} ~ 0.8 Gyr**

➡ no direct interaction with the dense ICM

XMMU J2235.3-2557

(Rosati et al., 2009)



3’ × 3’ (Rosati et al. 2009)

z = 1.39

4-band photometry:

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J, K_s (VLT/ISAAC)

VLT/FORS2 spectroscopy:

28 members

16 passive:

$K_s < 23$
EW([OII]) ≥ -5Å

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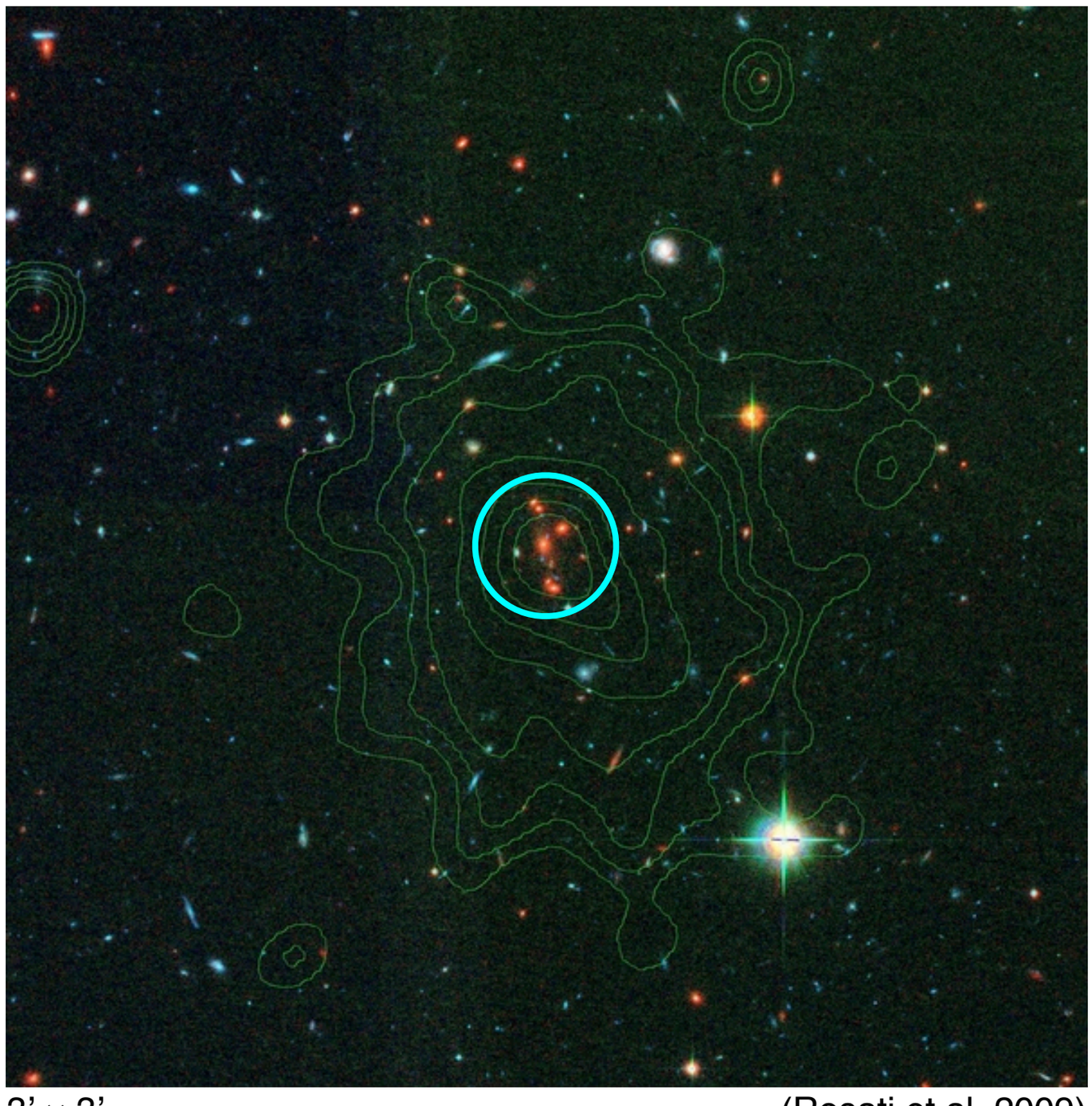

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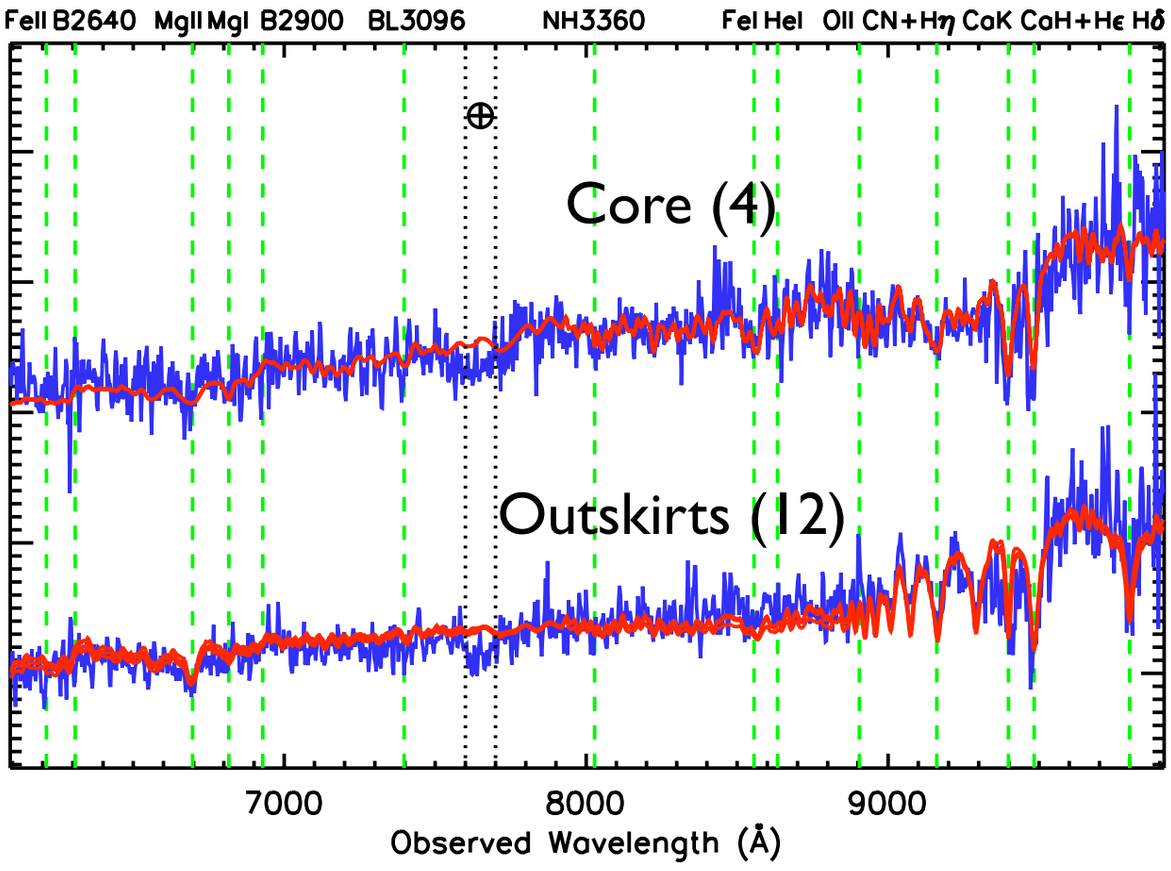

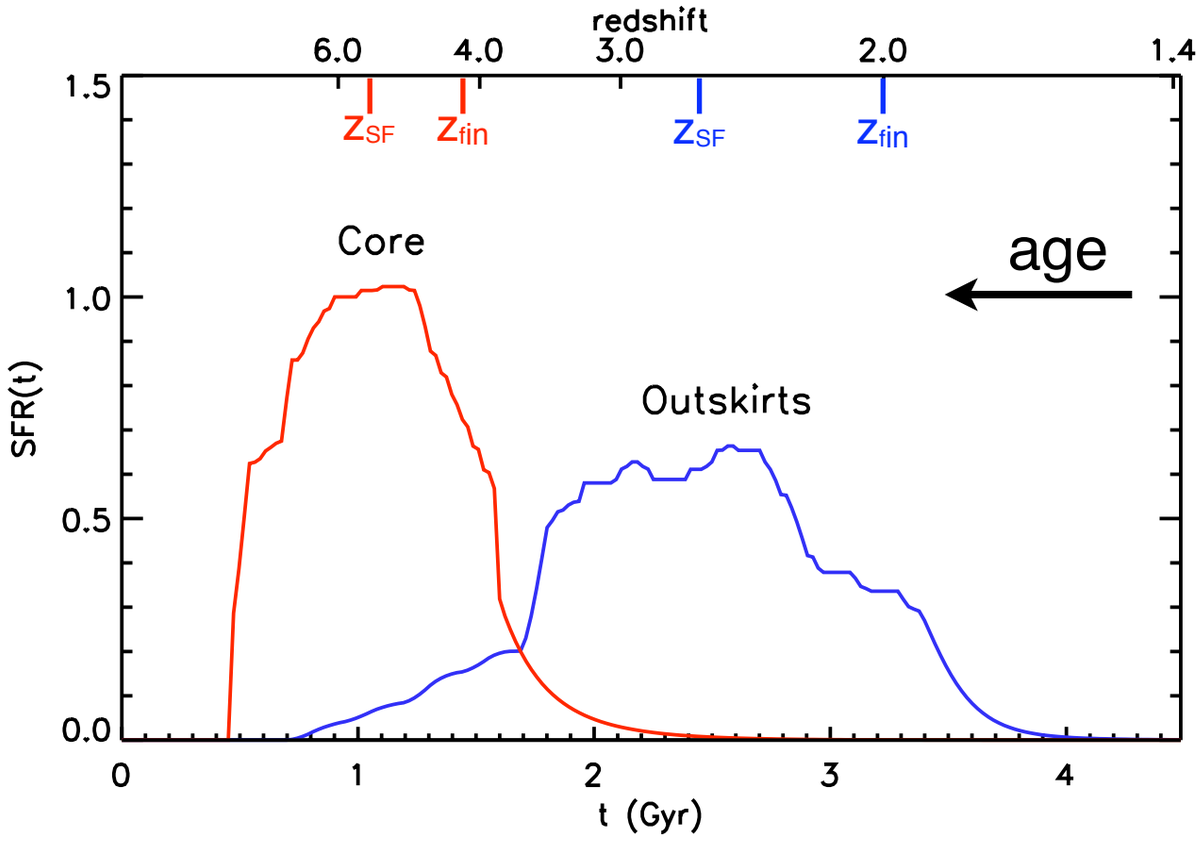

Core: $t_{SF} \sim 3.4$ Gyr , T - $t_{fin} \sim$ 3.0 Gyr, $\bar{R} \sim 0.03$ Mpc

Outskirts: $t_{SF} \sim 2.1$ Gyr , T - $t_{fin} \sim 1.2$ Gyr, $\bar{R} \sim 0.6$ Mpc

➡ steep(er) radial age gradient

Conclusions

- strong environmental age gradients:
  - core ETGs formed at $z > 3$: short SFH
  - outskirts are ~ 1.5 Gyr younger: protracted SFH
  - RS is populated by an infalling galaxy population
  - no direct interaction with the dense ICM
- larger age difference than between field and cluster at $z \sim 1$

- steeper age gradient at higher z ?
- cluster-cluster variation ($\Delta t_{SF} \sim 1$ Gyr, $\Delta(U\text{-}B)_{z=1.4} \sim 0.15$)