

STELLAR POPULATION
SYNTHESIS MODELS

α -enhanced stellar population models for studying massive galaxies

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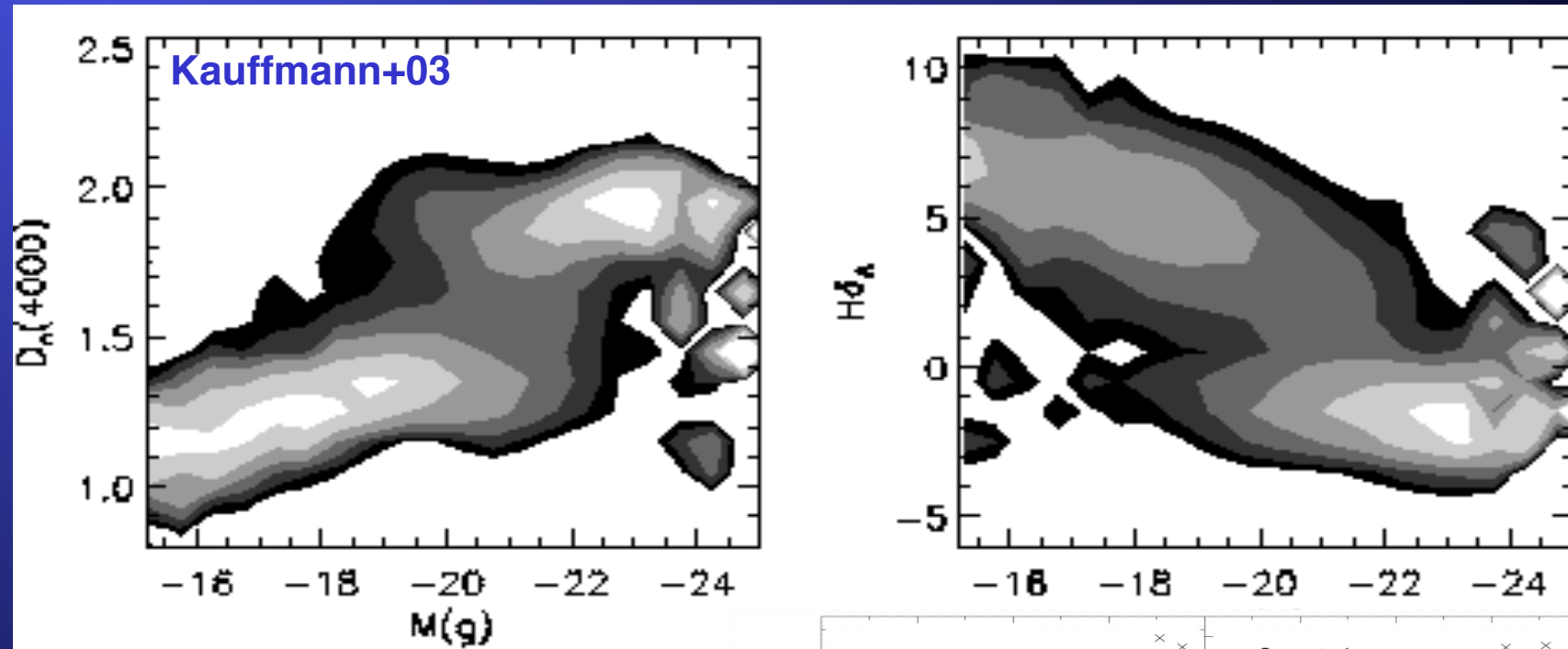
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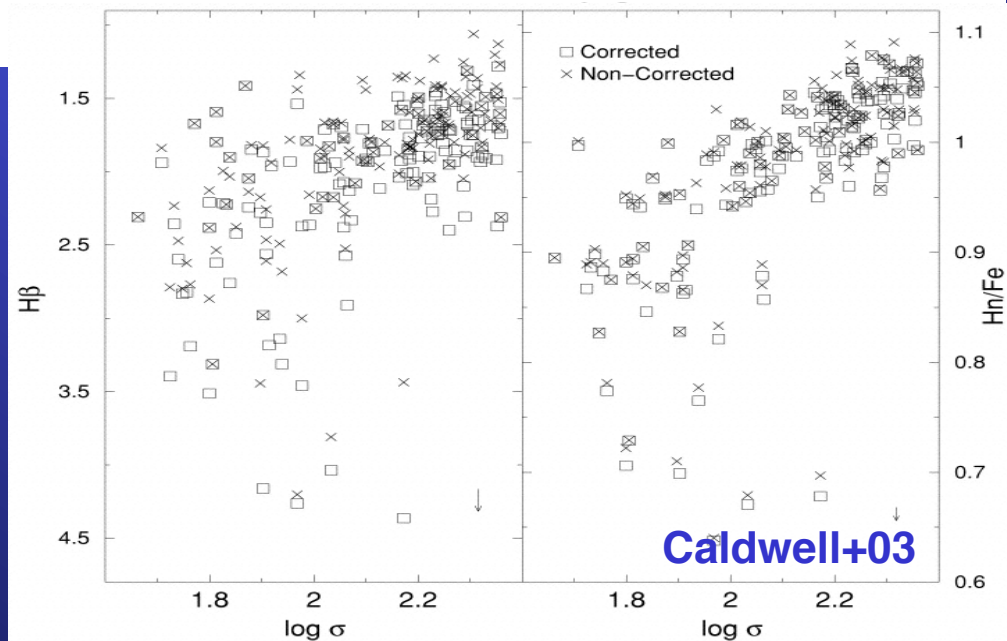
Galaxy Formation

18-22 July 2011, Durham, UK

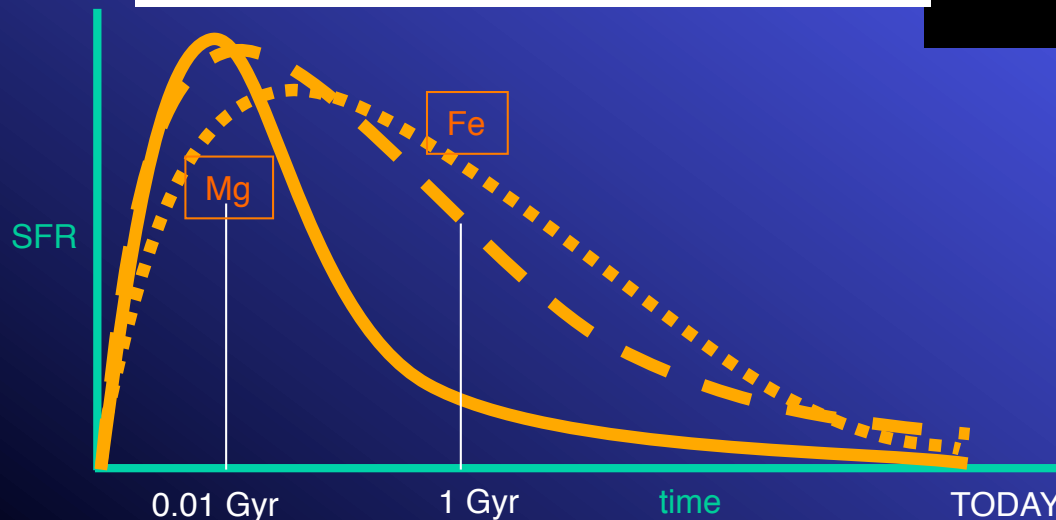
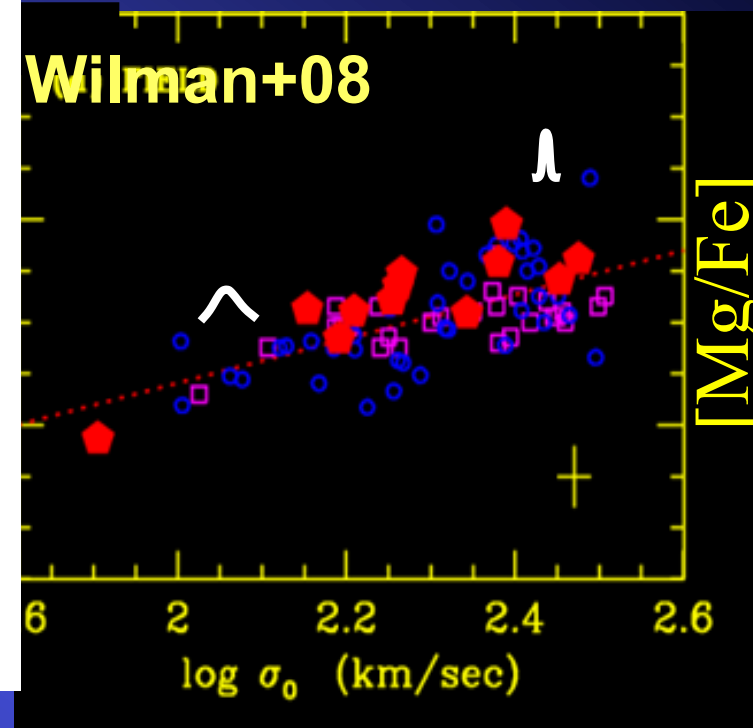
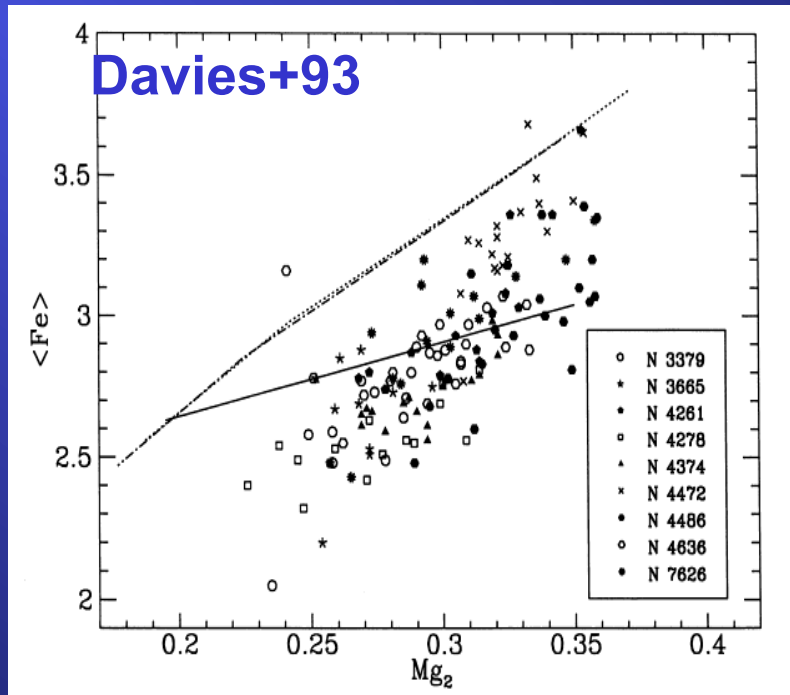
Stellar population properties of massive galaxies



Massive Early-Type Galaxies (ETGs) are generally known to be mainly old, unlike their low-mass counterparts.



Massive galaxies show $[Mg/Fe]>0$



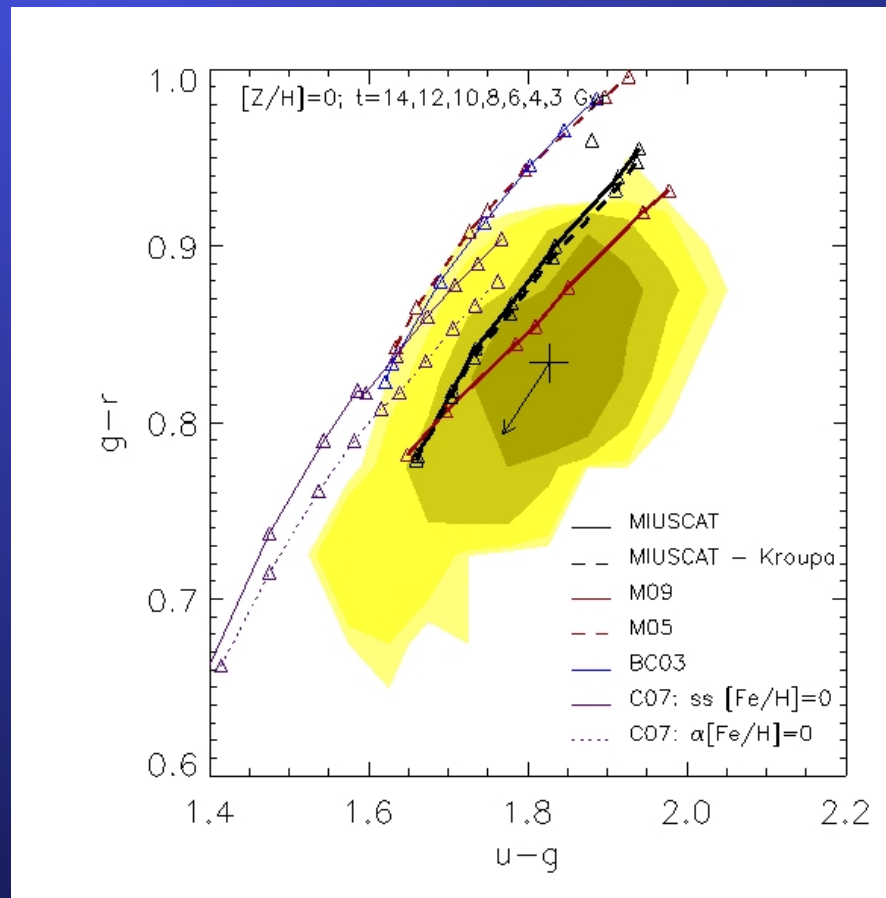
SFR	TIMESCALE
.....	EXTENDED LARGE
-----	INTERMEDIATE INTERMEDIATE
————	VERY EFFICIENT SHORT

$[Mg/Fe]$: how fast the bulk of the stellar populations formed (e.g. Matteucci & Greggio 86)



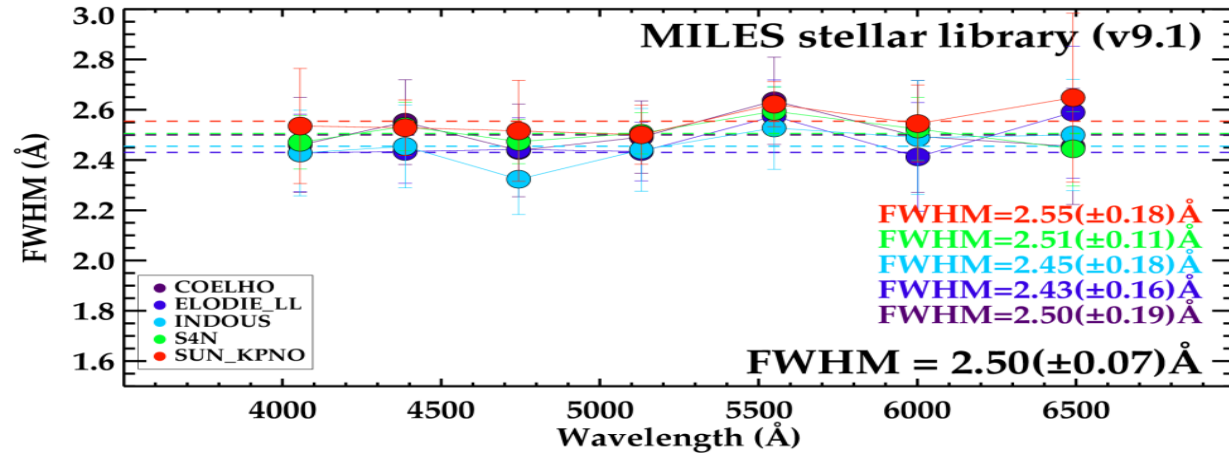
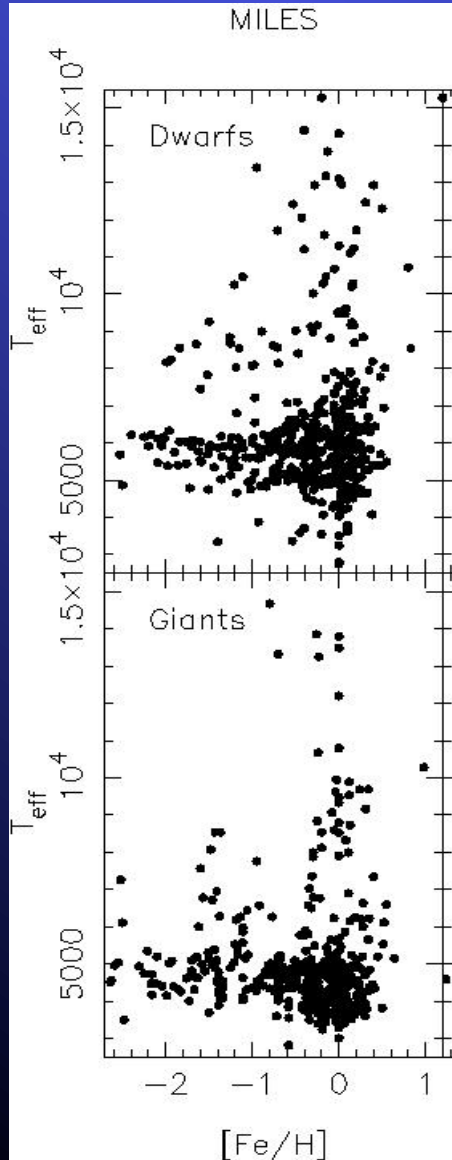
Massive galaxy colours

Luminous Red Galaxy sample from SDSS/DR7 in the nearby Universe: stellar population synthesis models do not match accurately the optical SDSS colours:



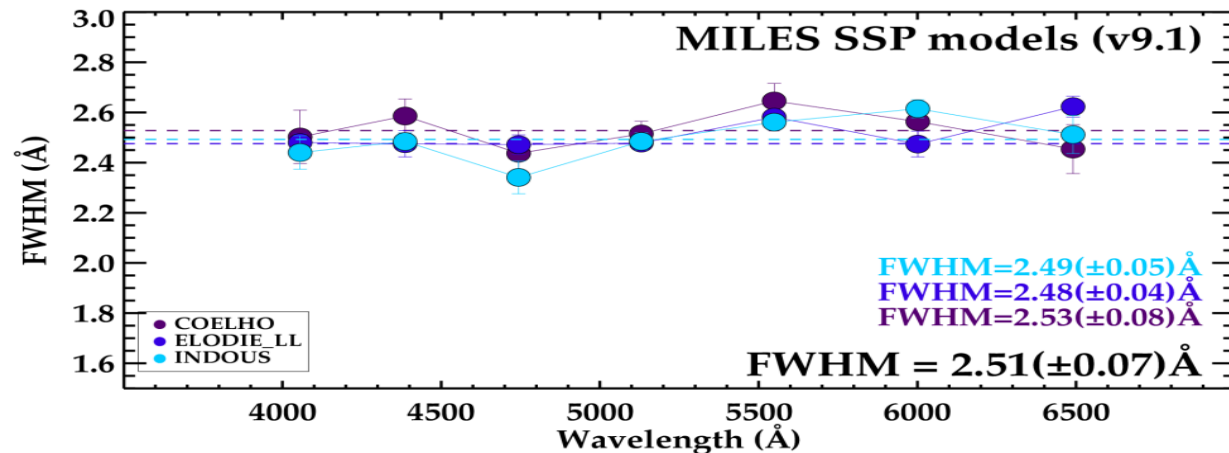


<http://miles.lac.es>



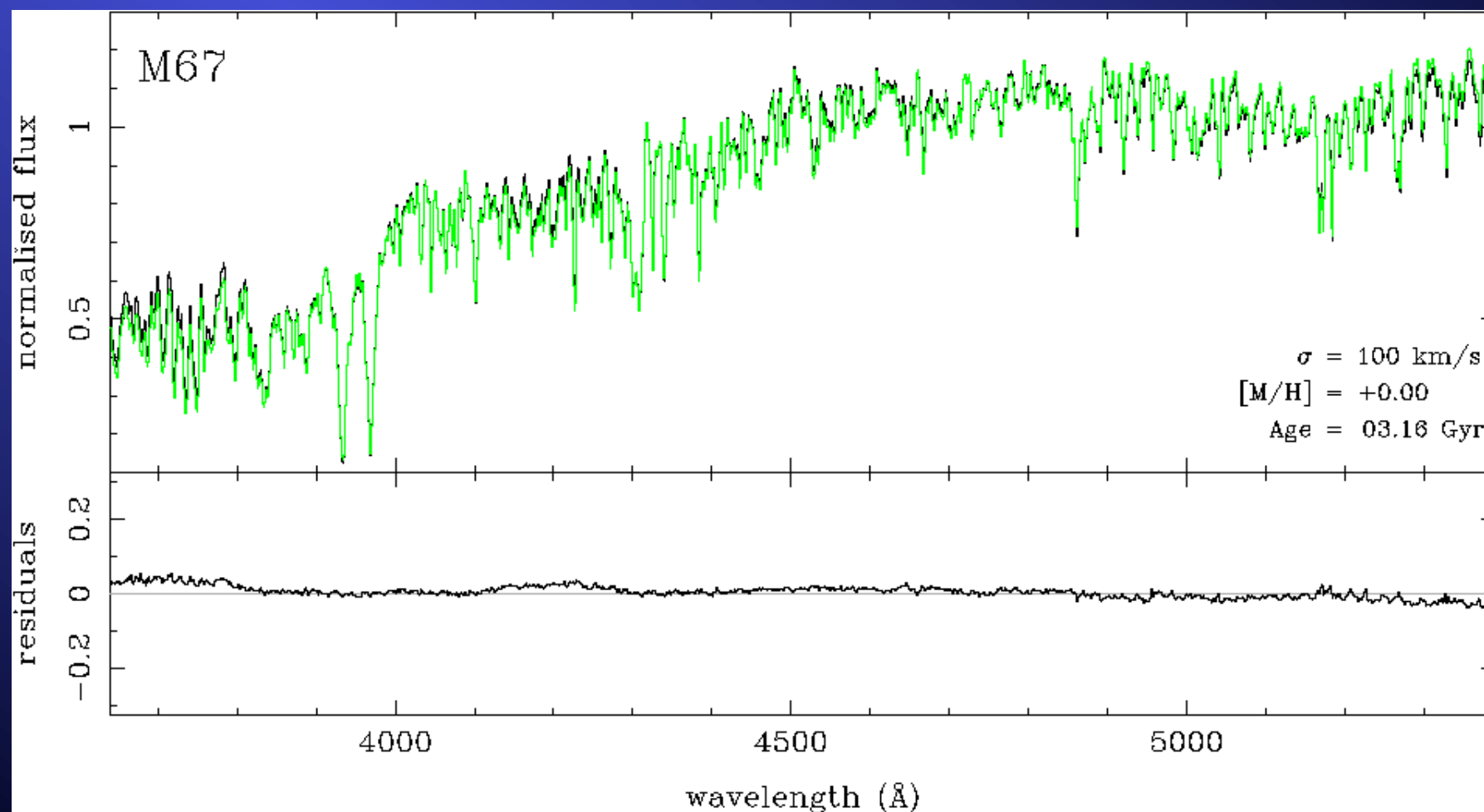
Updated last week!
New version of MILES library
& models

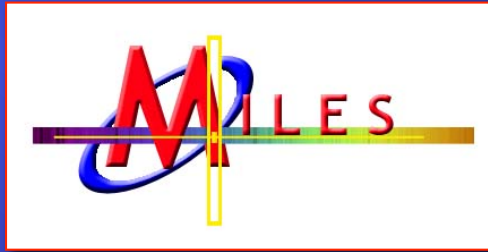
Falcón-Barroso+11 arXiv:
 1107.2303



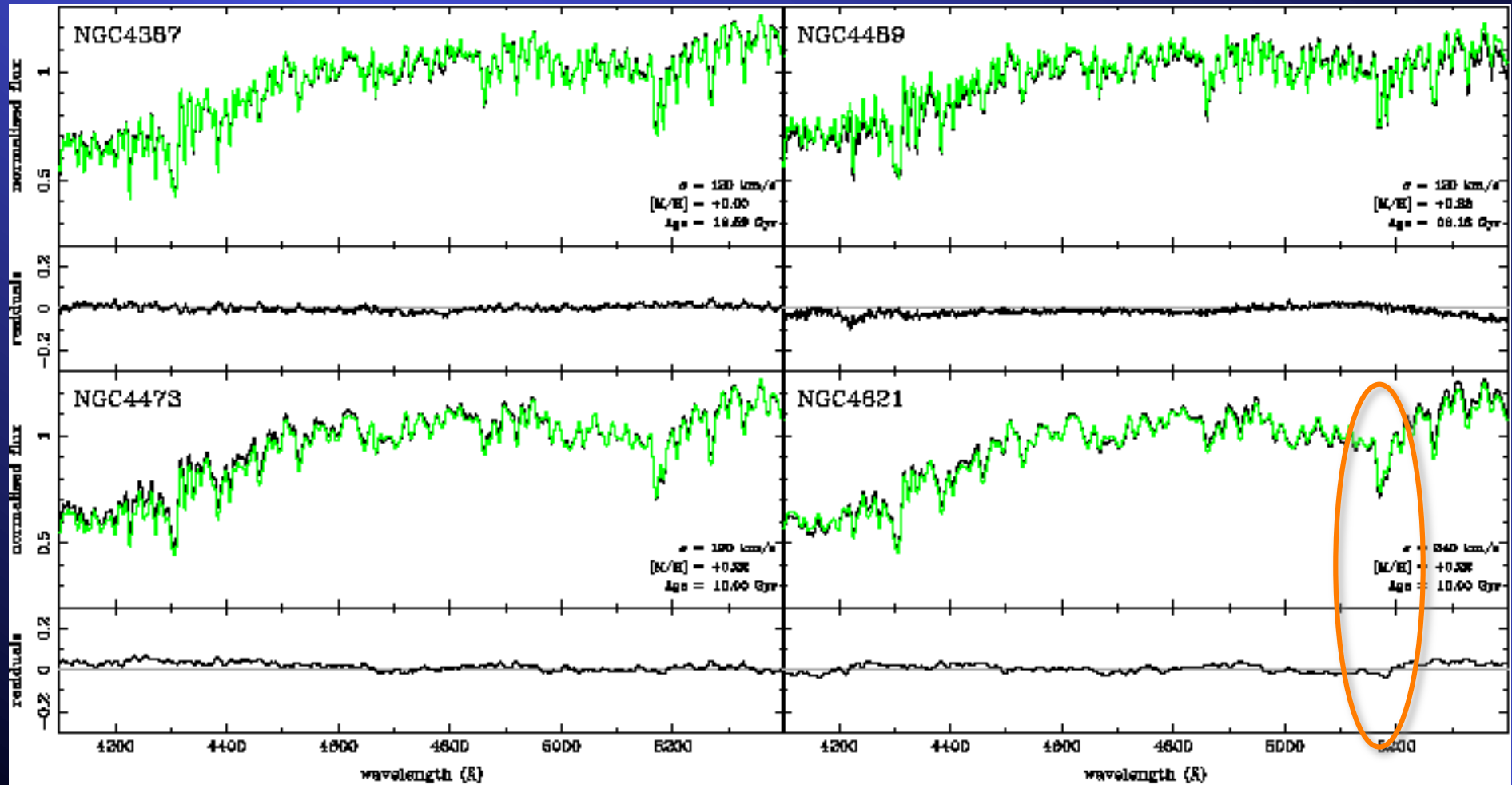


stellar population synthesis models





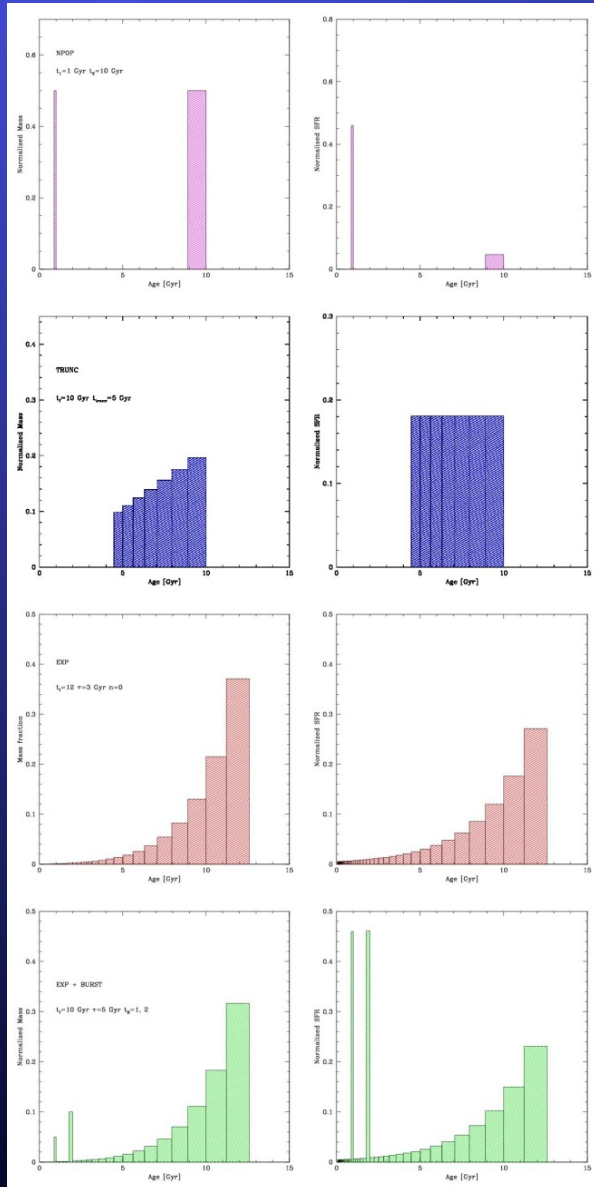
stellar population synthesis models



Computing integrated spectra for a parametric SFH:

ΔM

SFR



N BURST

$t_1 \Delta m_1 Z_1$

$t_2 \Delta m_2 Z_2$

.....

TRUNCATED

$t_{form} t_{trunc} Z_1$

EXP

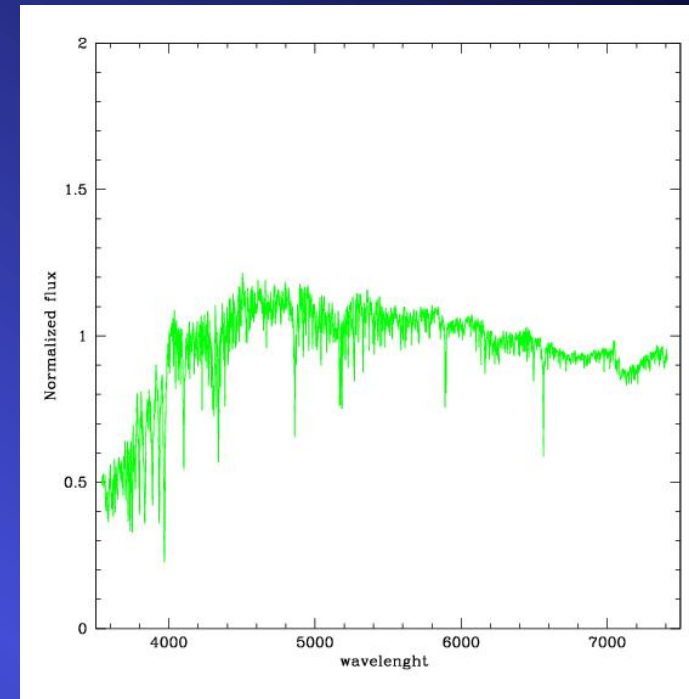
$$SFR(t) = \left(\frac{t_{form} - t}{t_{form}} \right)^n \exp\left(-\frac{t_{form} - t}{\tau}\right)$$

t_{form}, τ, n, Z

EXP + BURST

t_{form}, τ, n, Z

$t_1 \Delta m_1 Z_1 \dots$

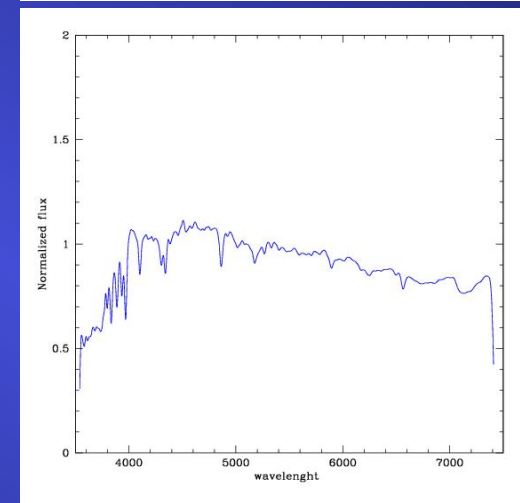
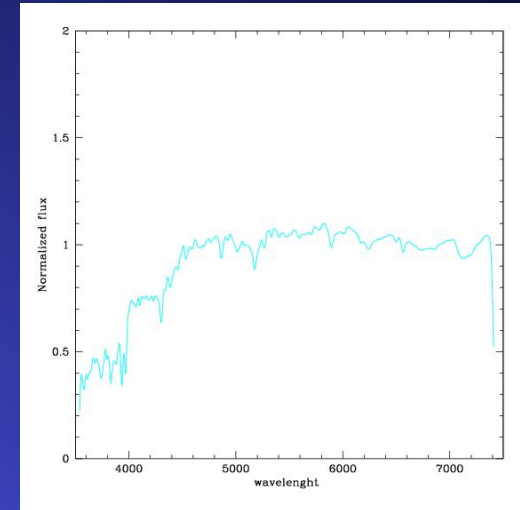
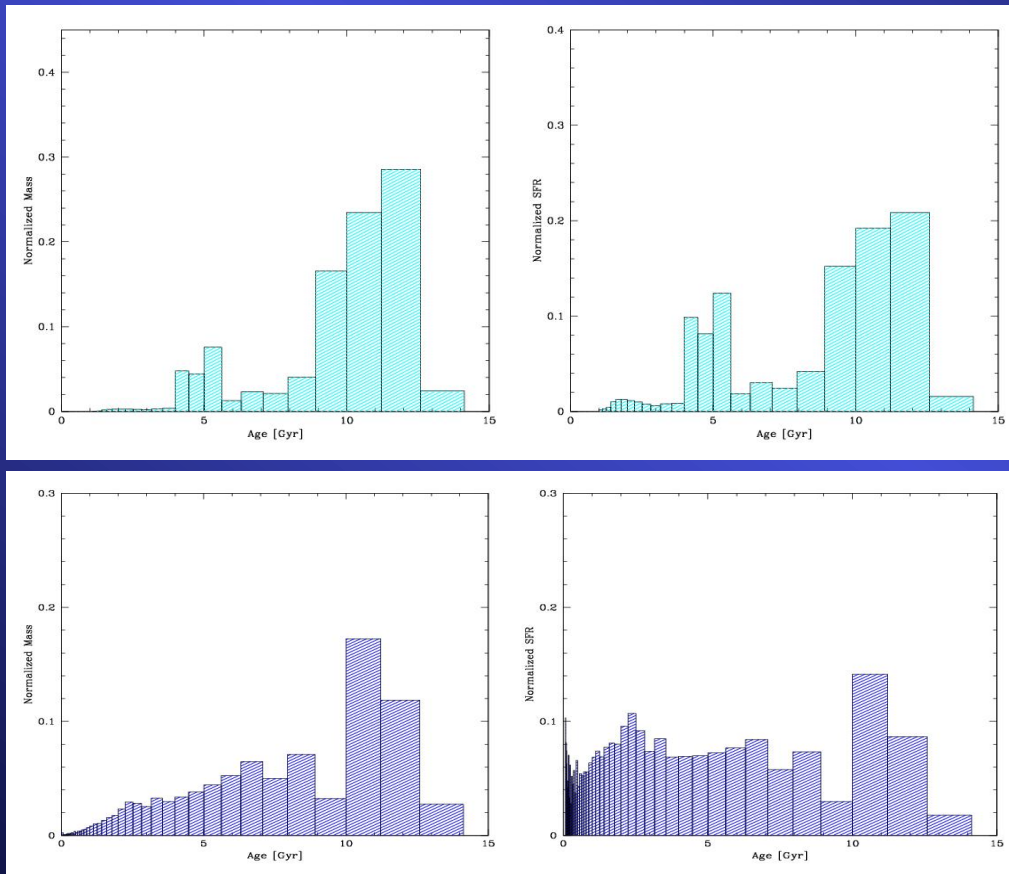


<http://miles.iac.es>



Integrated spectra for user-defined SFH

- Example of SFH for massive galaxies in hydrodynamical simulations (MASCLET code, Quilis 04)



- Up to 100 SFHs computed in one query
- Chemical evolution allowed

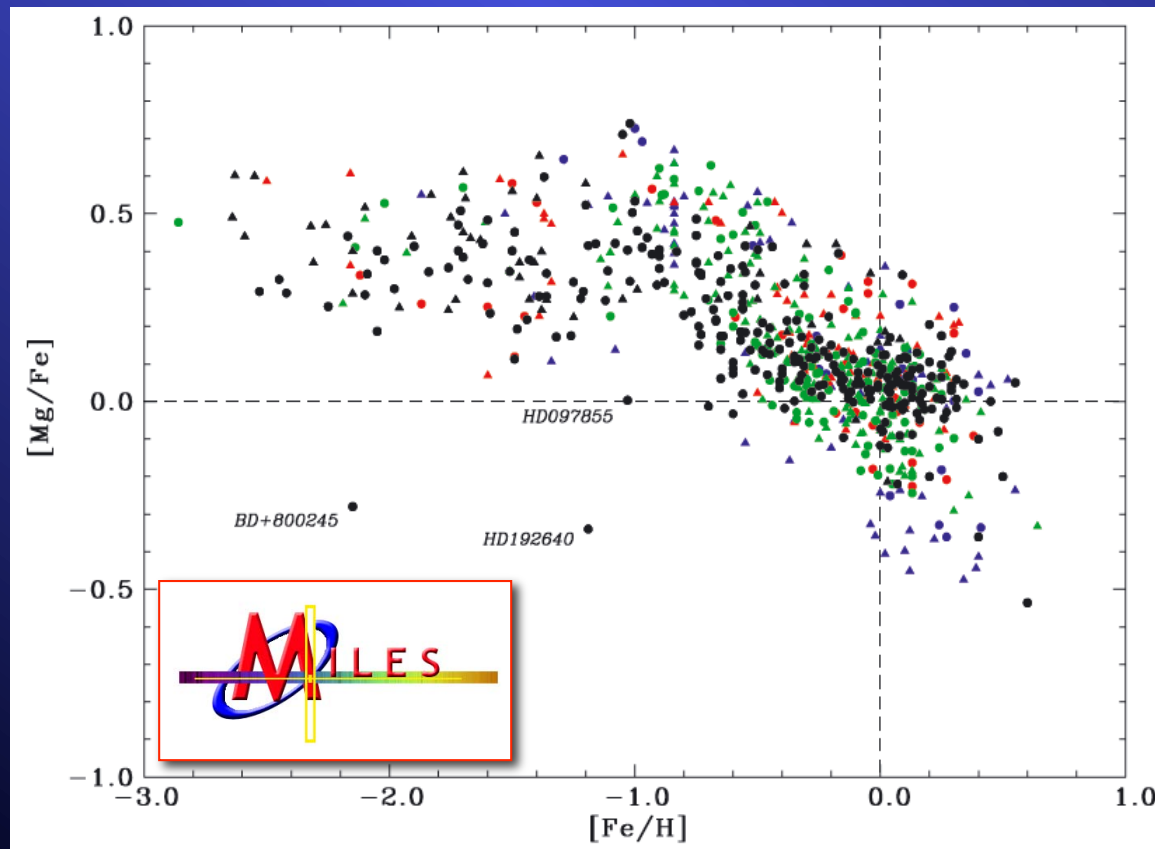
<http://miles.iac.es>



α -enhanced models

Base models:

Scaled-solar isochrones + MILES spectra
(s-s @ solar metallicity; α @ low metallicity)



Milone+11

Scaled-solar models:

Scaled-solar
Isochrones
+
Scaled-solar
MILES spectra

α -enhanced models:

α -enhanced
isochrones
+
 α -enhanced
MILES spectra



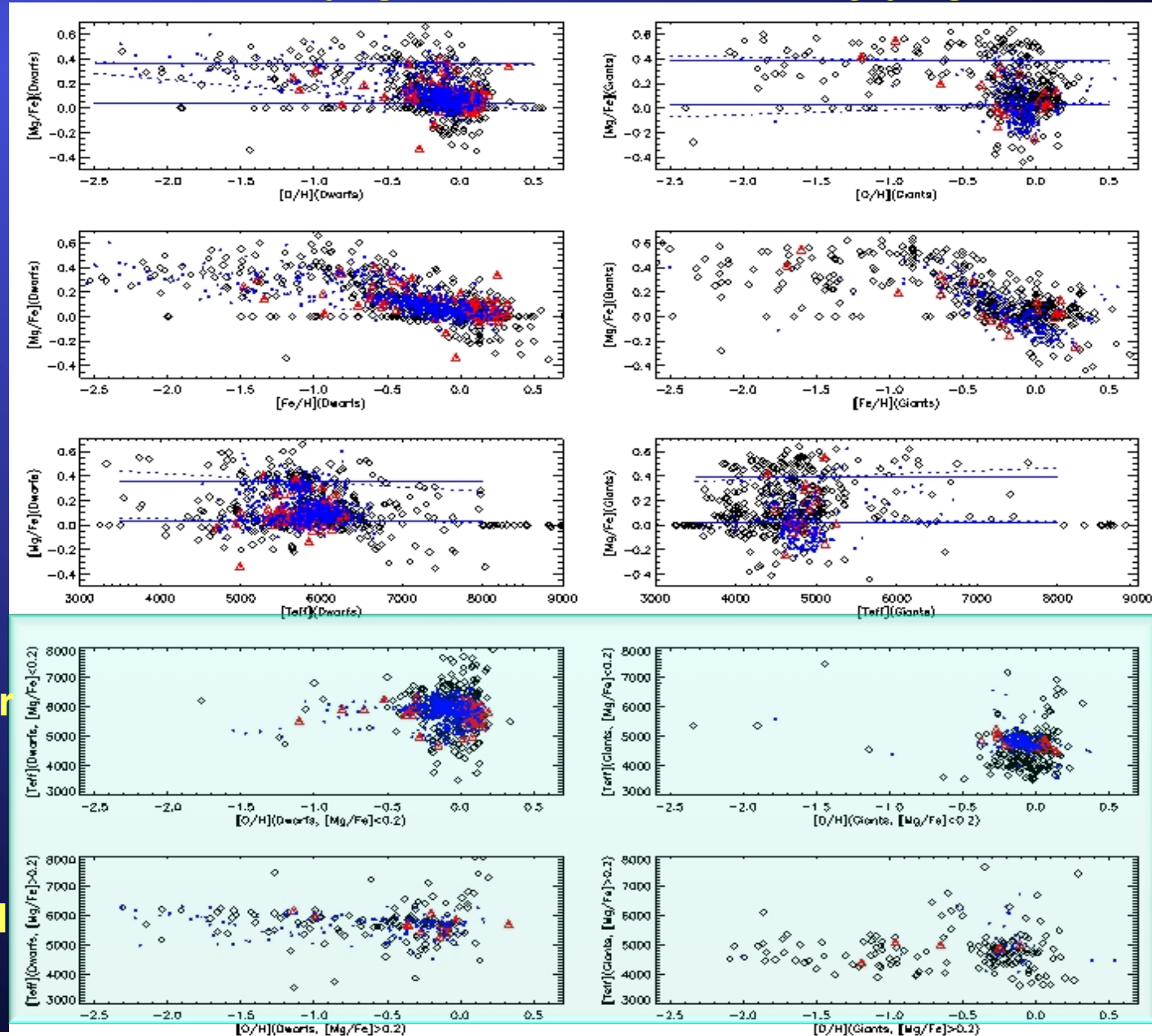


coverage: model reliability

Dwarfs

Giants

Converting
[Fe/H]
to
[O/H] ~ [Z/H]

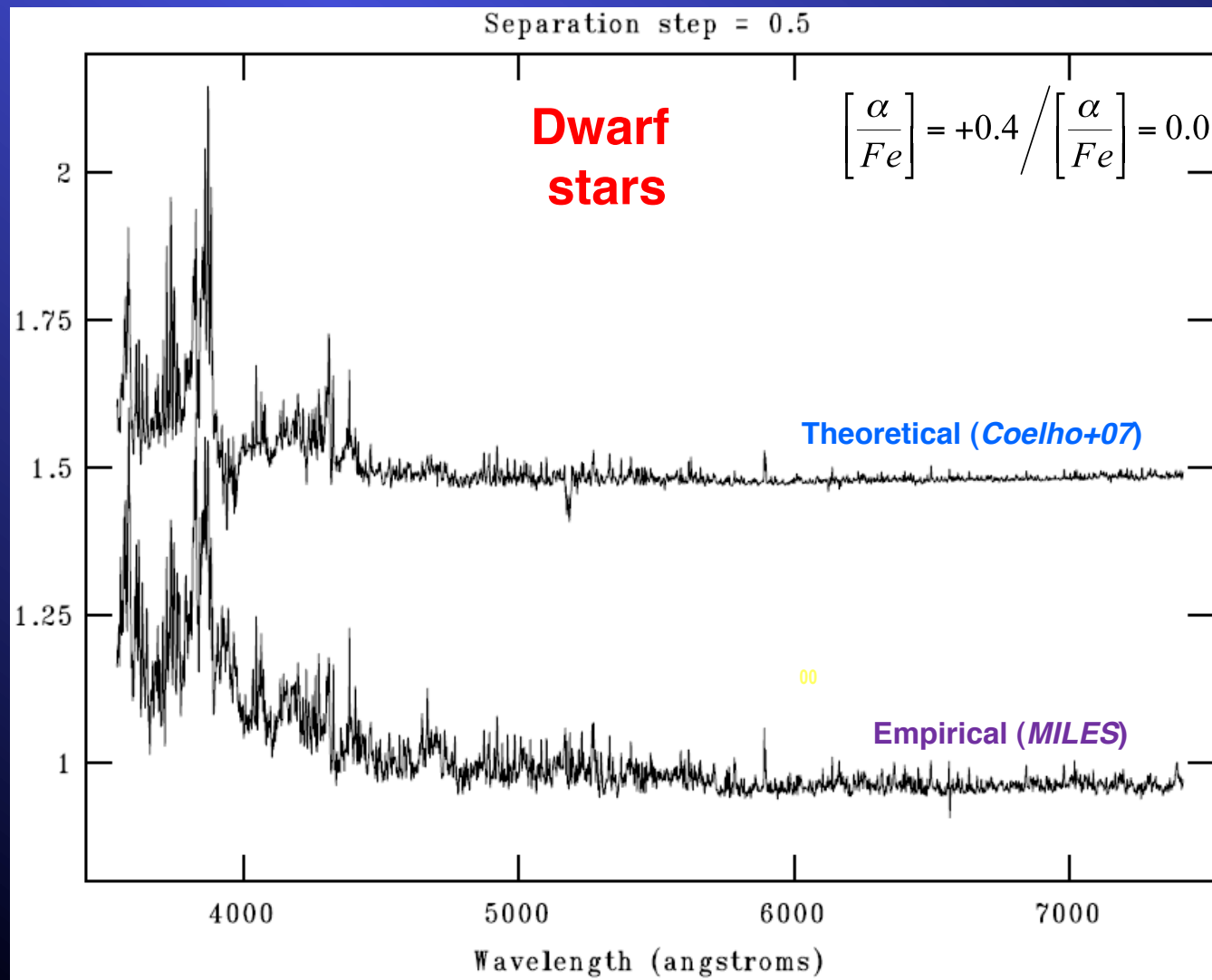


Scaled-solar

α -enhanced



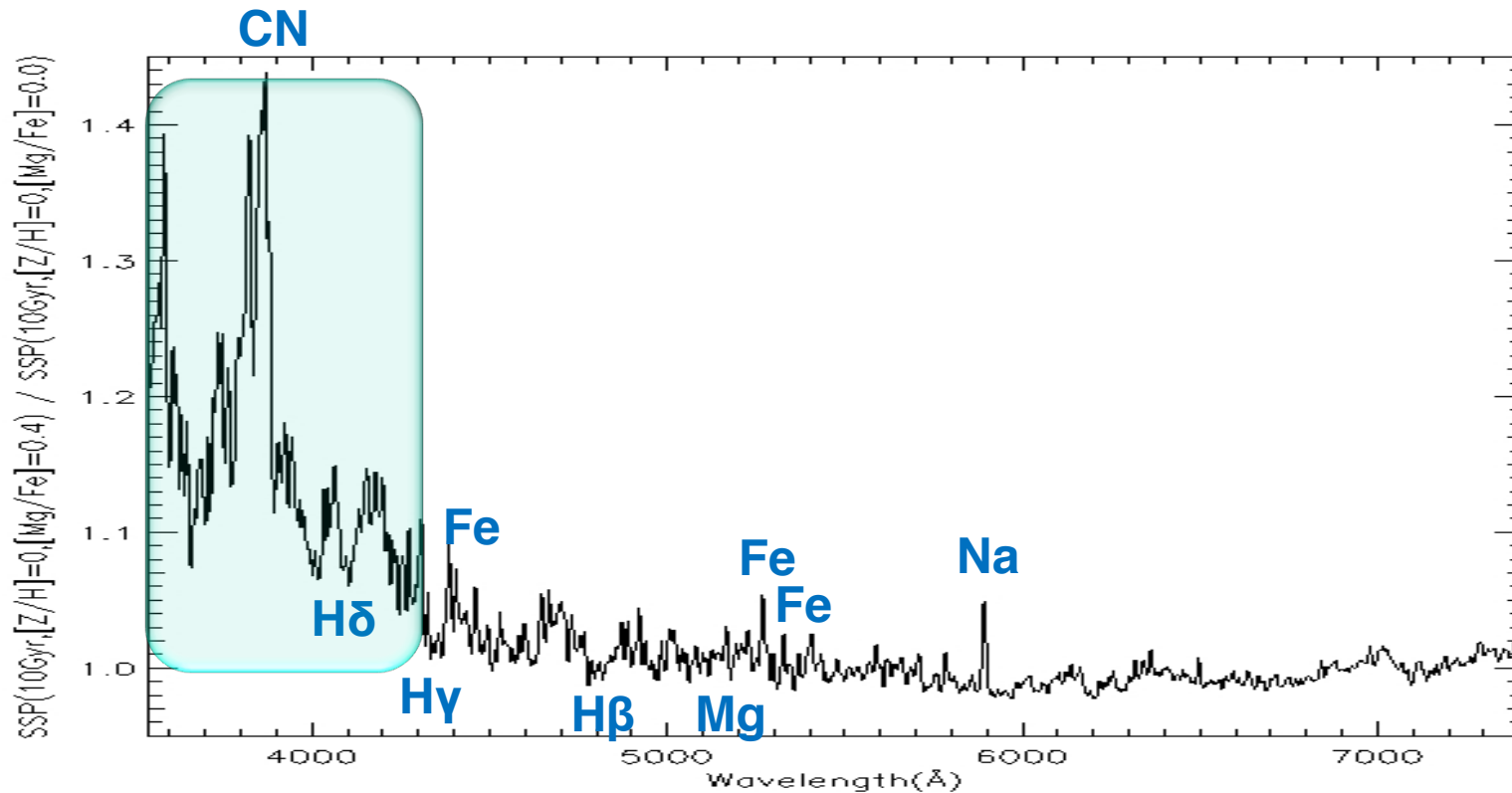
Ratios of enhanced / solar star spectra



**Teff=5500K,
Log(g)=4.0,
[Z/H]=0.0)**

Preliminary SSP SEDs

SSP(α -enhanced) / SSP(scaled-solar)



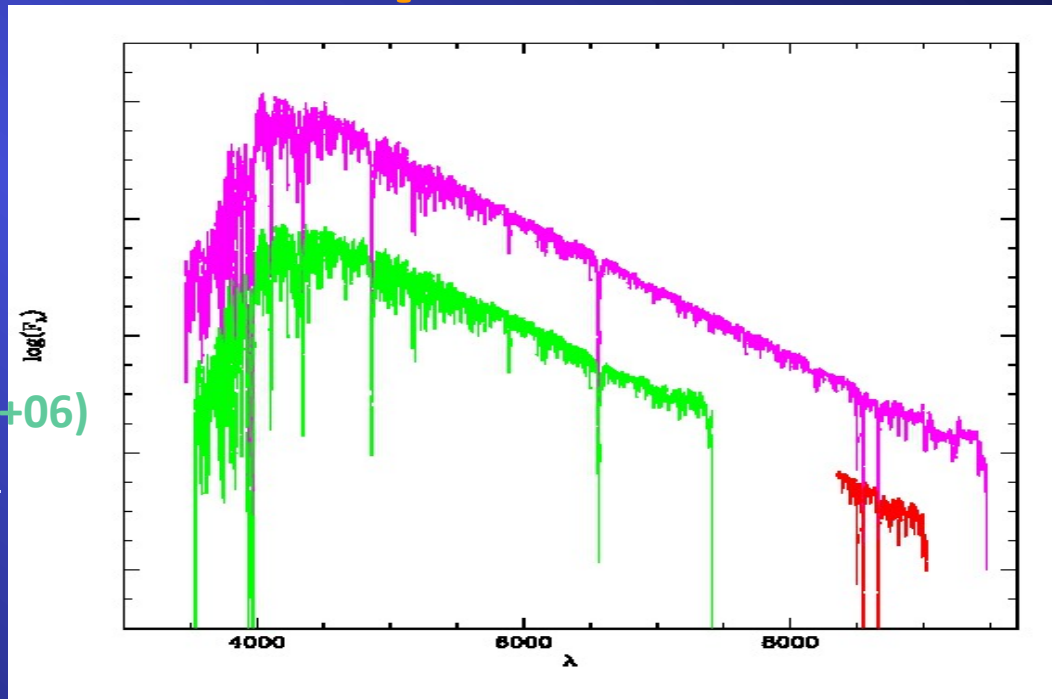
[Mg/Fe]-enhancement affects mainly the blue part of the spectrum:

$$(u-g)\alpha = (u-g)_{ss} - 0.2 \text{ mag} \quad (\text{for } \alpha=0.4)$$

$$(g-r)\alpha = (g-r)_{ss} - 0.05 \text{ mag} \quad (\text{for } \alpha=0.4)$$

MIUSCAT composite stellar library

MILES:
985 stars,
3535-7429 Å
(Sánchez-Blázquez+06)
<http://miles.iac.es>



CaT:
706 stars,
8348-9020 Å
(Cenarro+03)
<http://miles.iac.es>

INDO-US: (Valdes+04):
1273 stars, 3460-9464 Å; good stellar parameter coverage
not well flux calibrated, gaps in the spectra, telluric absorption

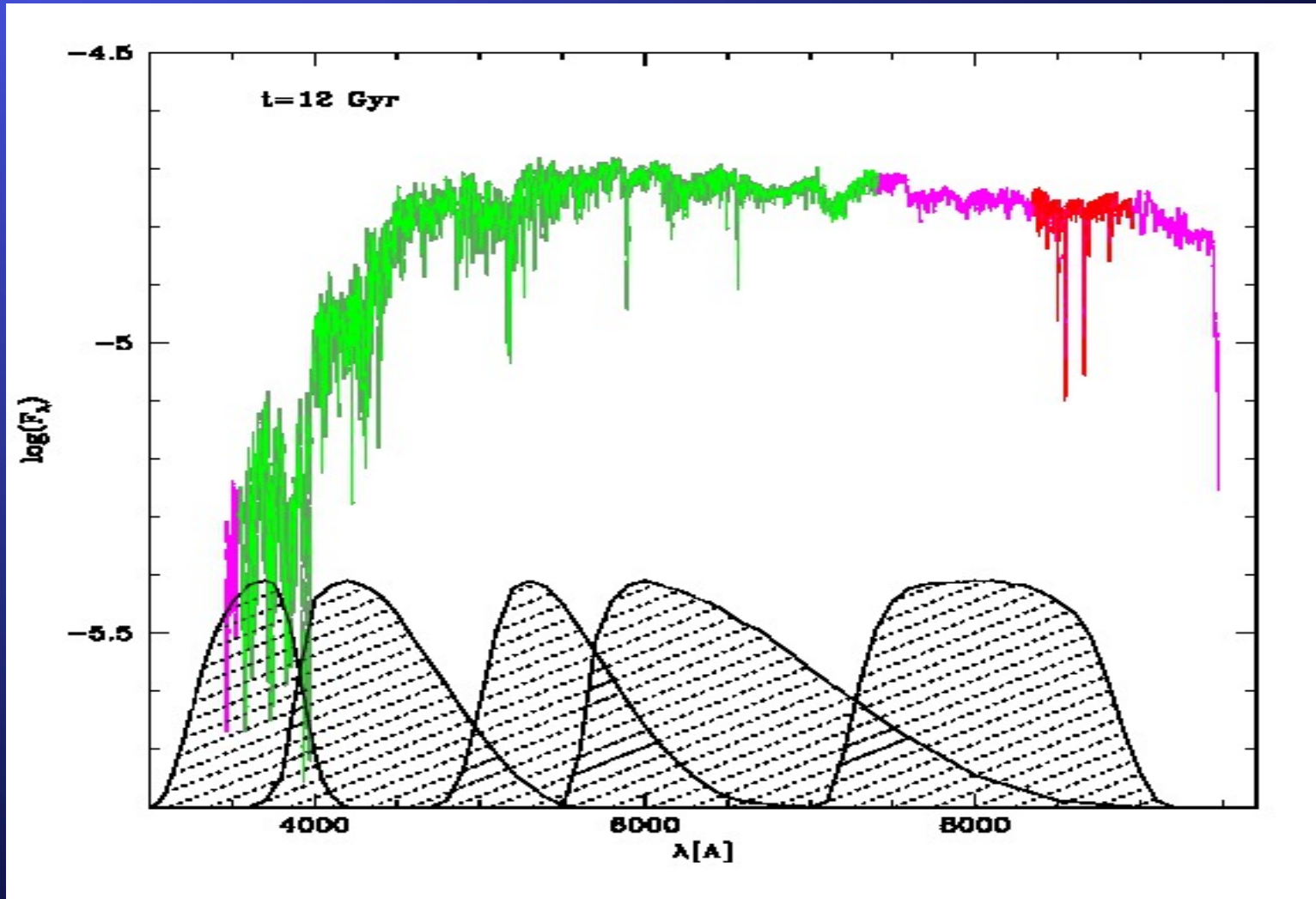
537 useful stars

228/204 stars in common with MILES/CaT

238 no matches → MILES and CaT stars have been interpolated

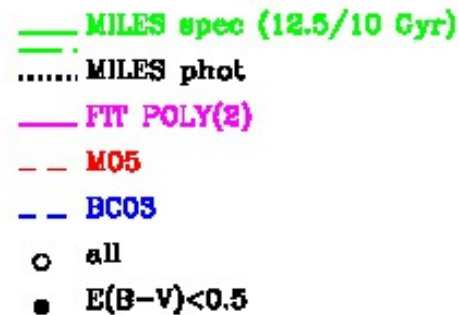
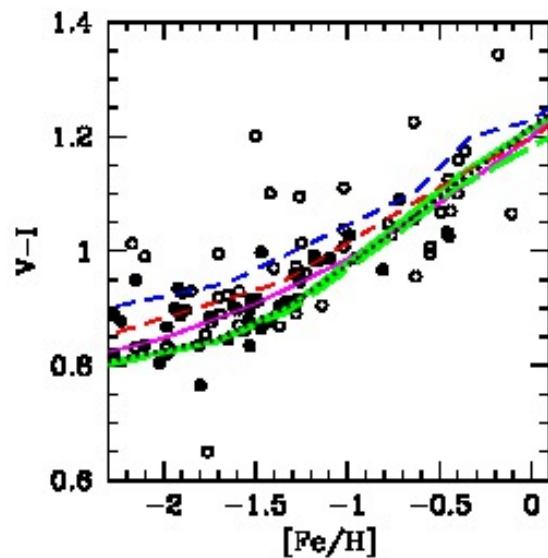
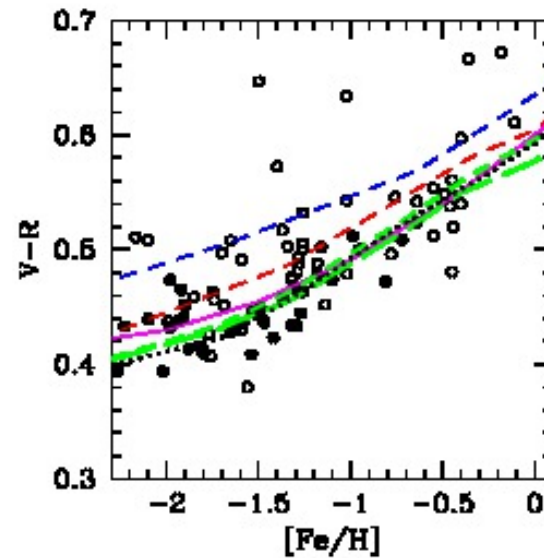
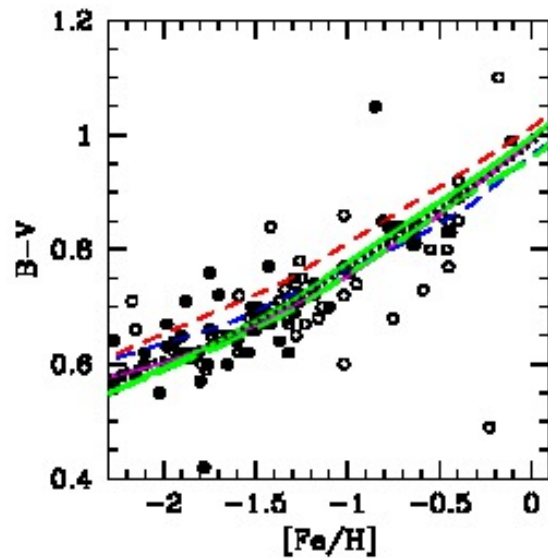


MIUSCAT models



UBVRI colours can now be measured

Synthetic colors vs observations: MW GC



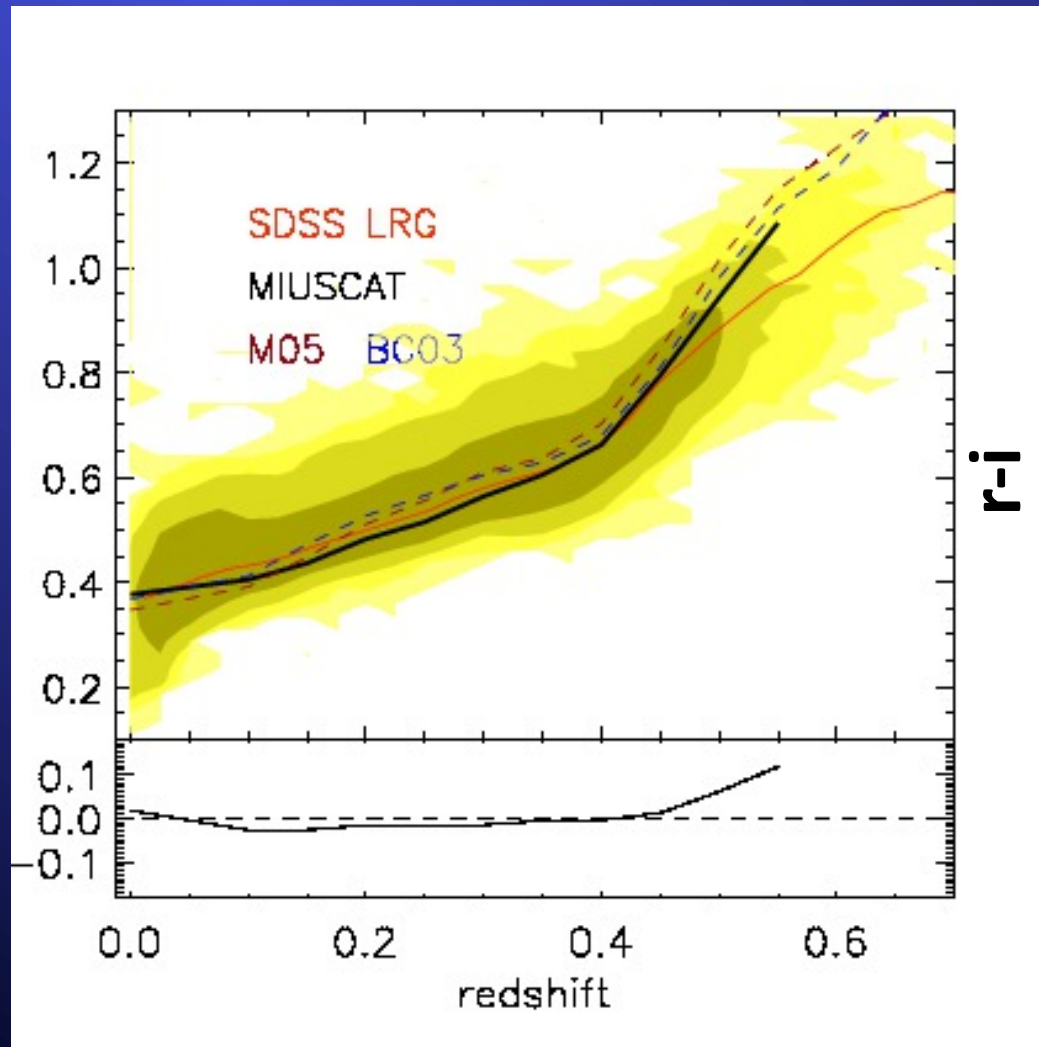
MW GCs (Harris 96):
UBVRI colors,
 $E(B-V)$, $[Fe/H]$
for 150 clusters

MIUSCAT models
provide better
match than those
based on
theoretical
stellar libraries



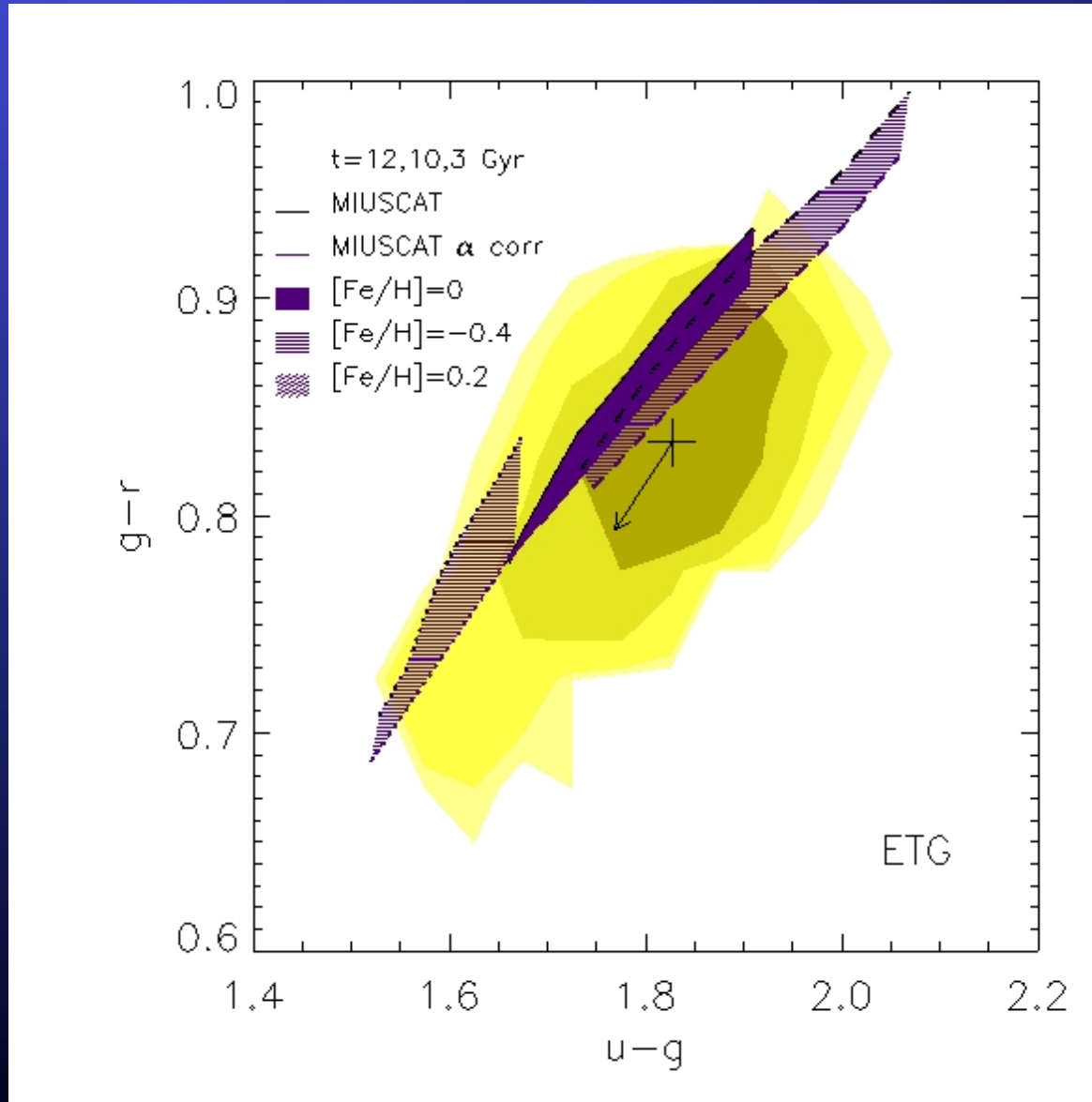
LRG color evolution

Luminous Red Galaxy sample from SDSS/DR7 for $z < 0.6$



LRG colors are consistent with a passive evolution model (SSP) assuming $z_f=5$, solar metallicity and Kroupa IMF

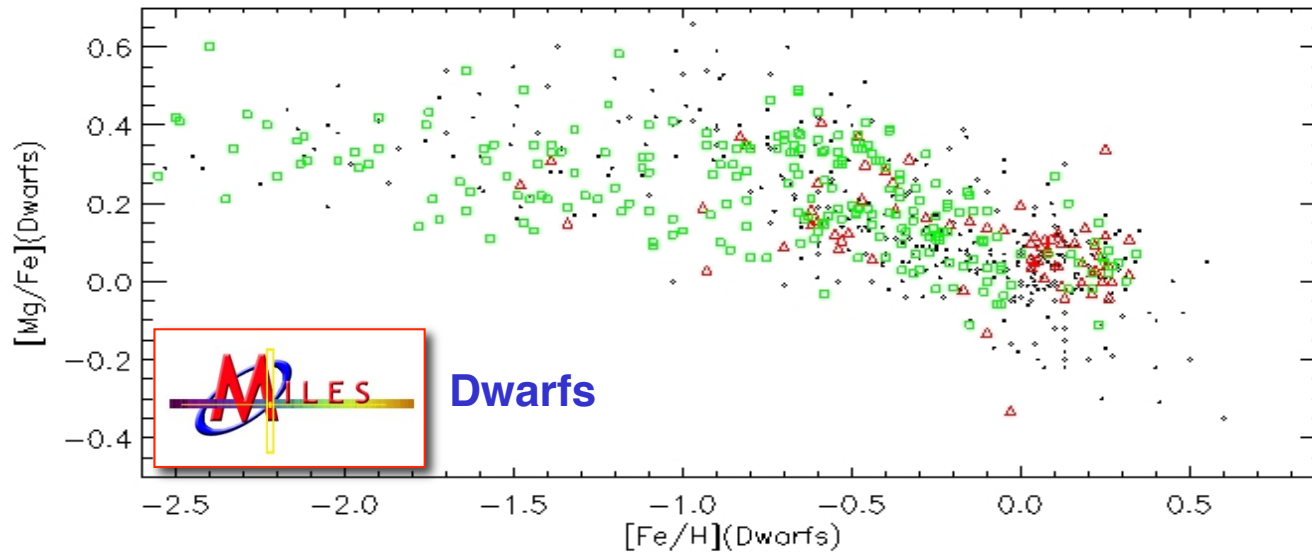
α -enhanced SSP colours



α -enhanced
SSP models
fit better

nearby LRG
colours from
the SDSS

Next step: Expanding [Mg/Fe] coverage



Current sample

Newly observed

Next run

