Star Formation histories and evolution of late-type dwarf galaxies

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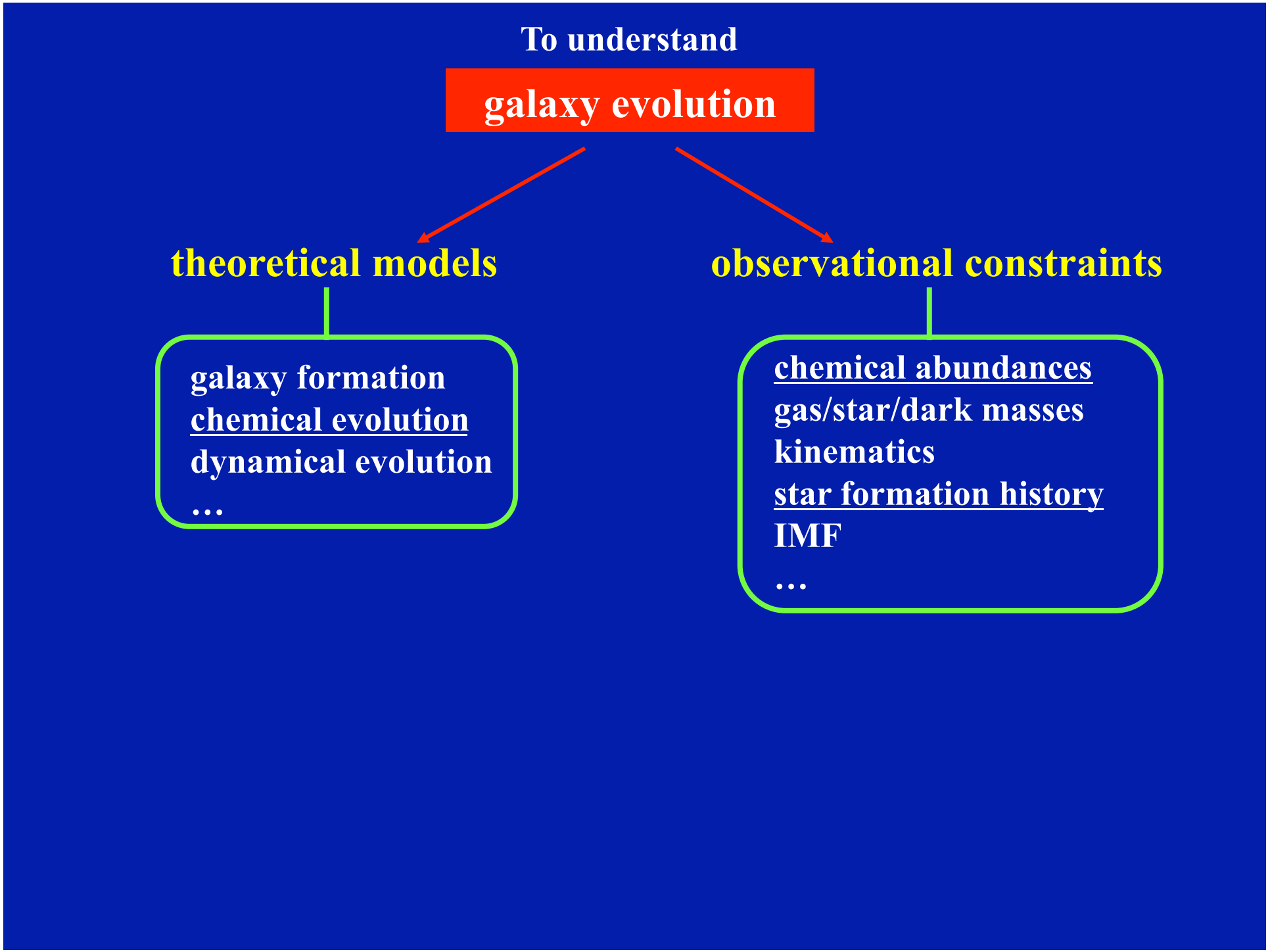
INAF – Osservatorio Astronomico di Bologna

ESO, October 15th 2014


To understand
galaxy evolution
theoretical models
observational constraints
galaxy formation
chemical evolution
dynamical evolution
…
chemical abundances
gas/star/dark masses
kinematics
star formation history
IMF
…

Star formations histories from the CMDs of resolved stellar populations:

the deeper, the tighter, the better

(e.g. Tolstoy, Hill, Tosi 2009, ARAA, and many others)

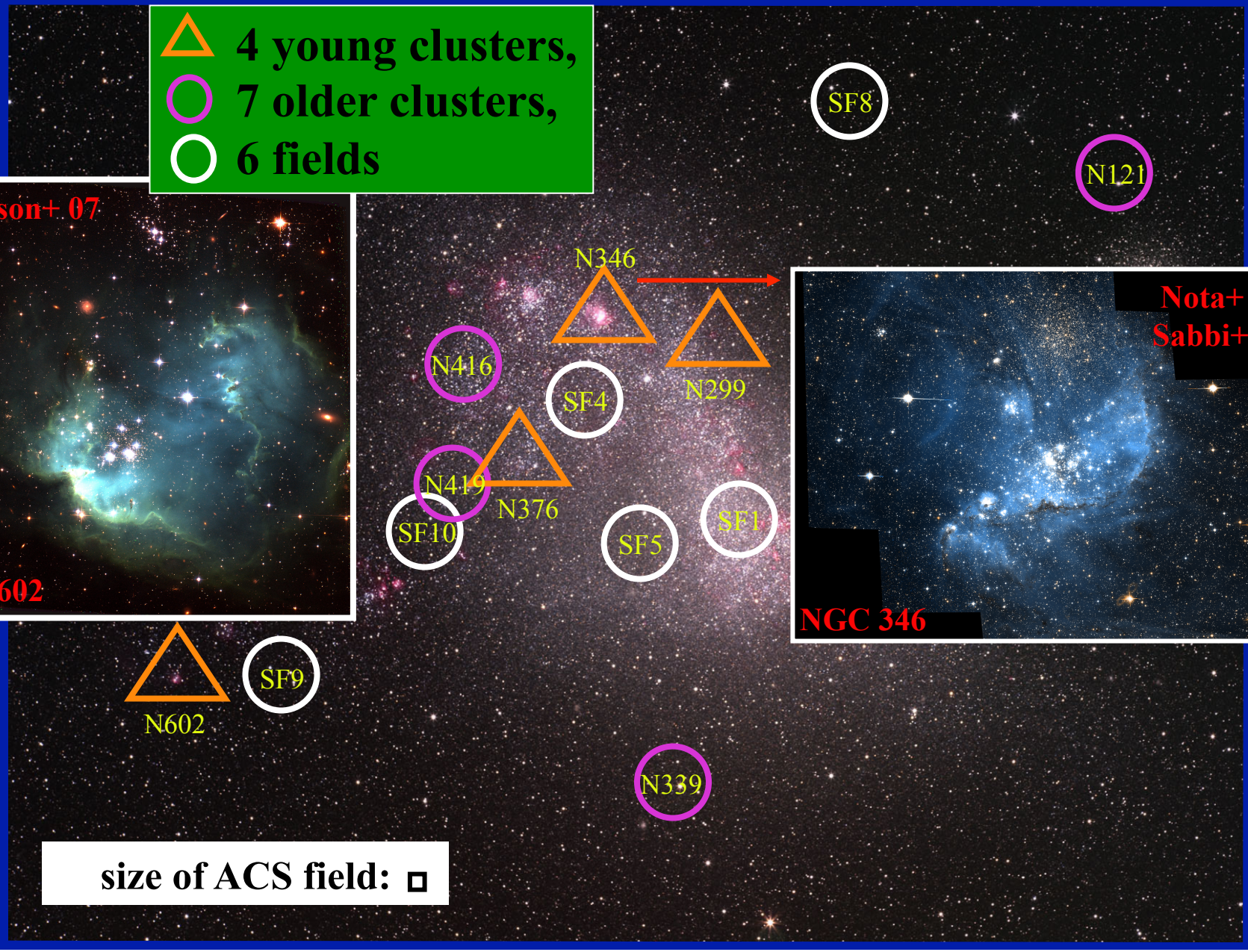
↓

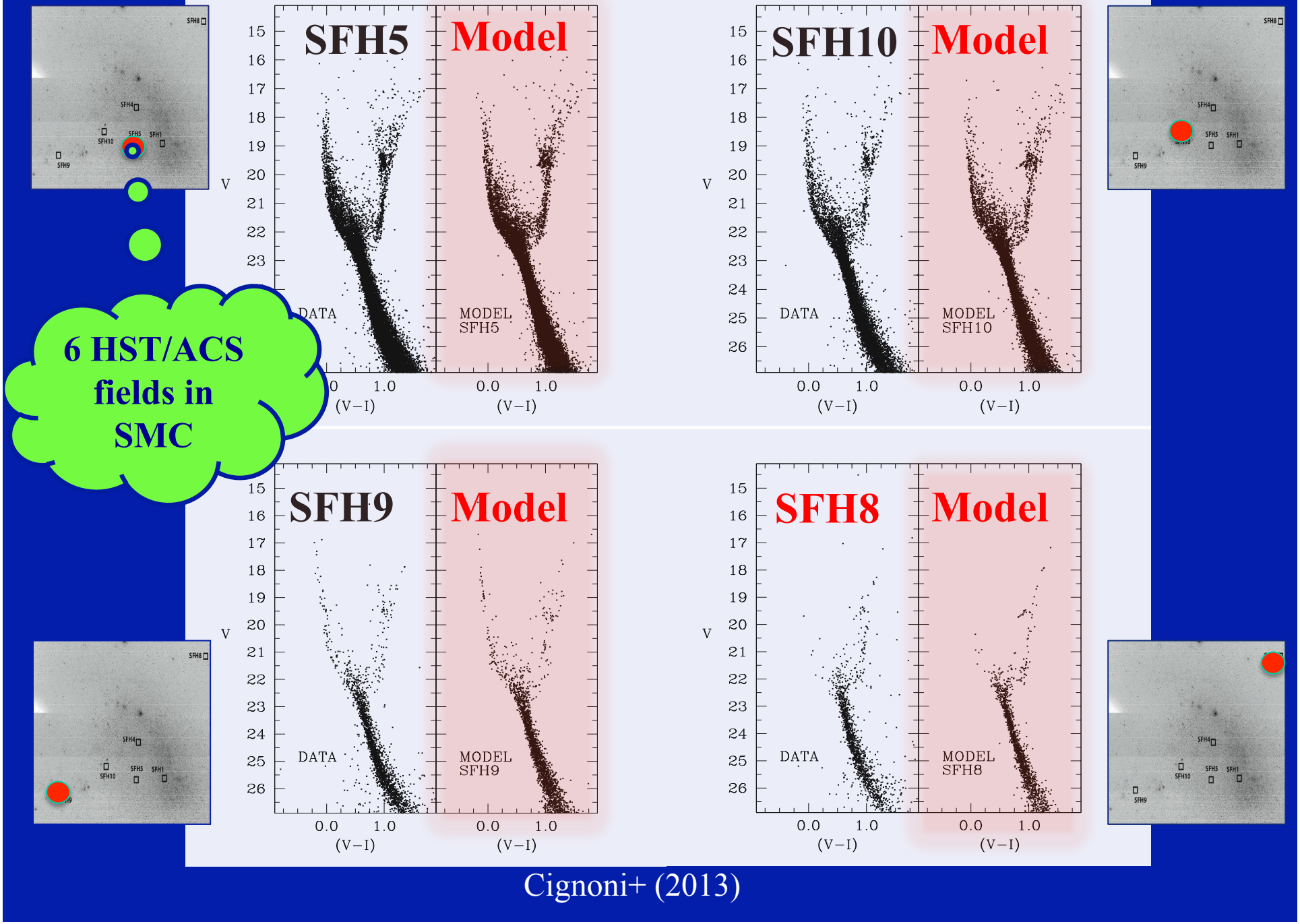
The SMC is the closest dIrr

↓

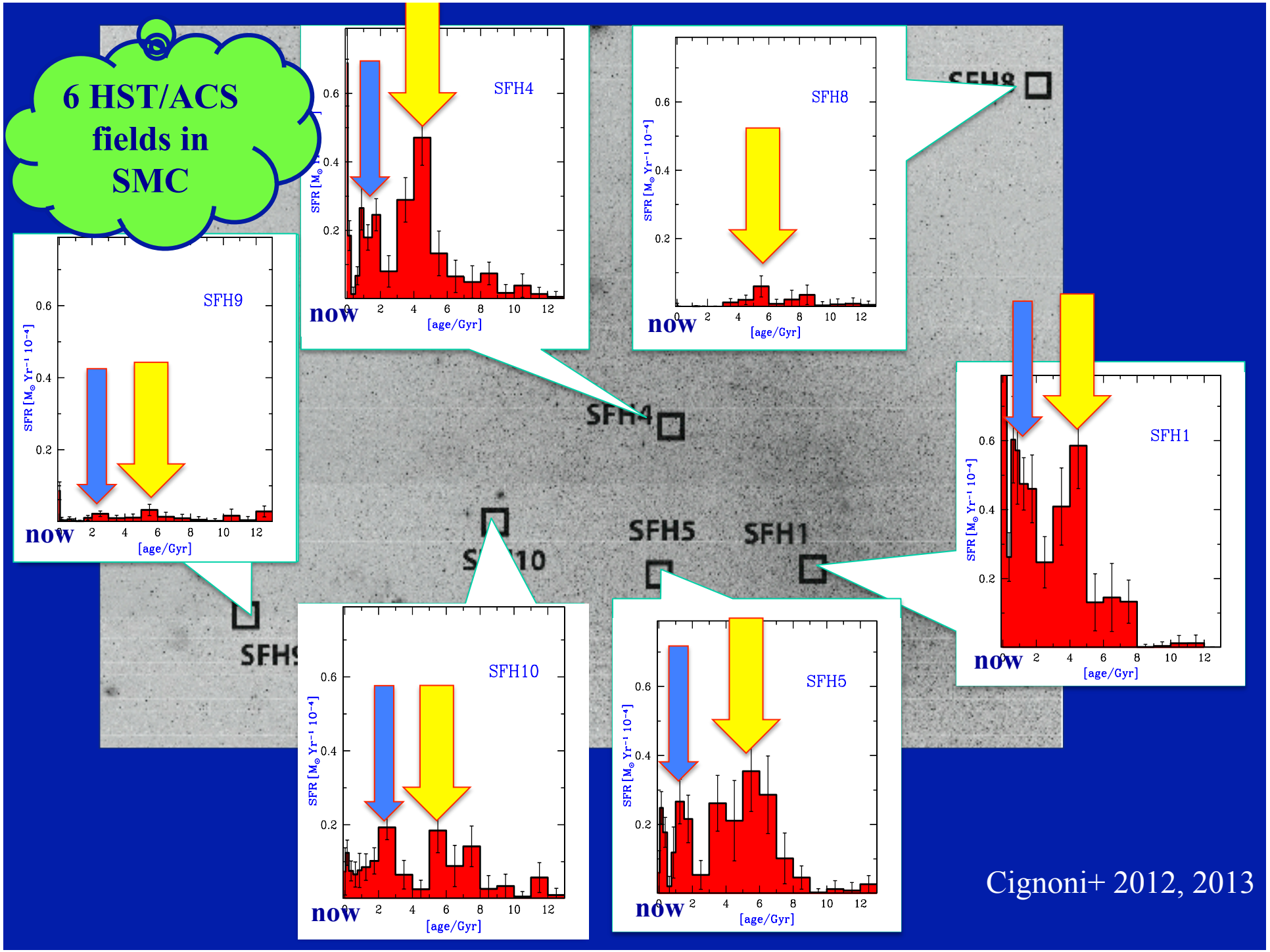
the best target for SFHs of late-type dwarfs

The SMC is the closest dIrr => best benchmark





Cignoni+ (2013)


6 HST/ACS fields in SMC
SFH4
SFH8
SFH9
SFH1
SFH10
SFH5
SFR [M⊙ Yr⁻¹ 10⁻⁴]
[age/Gyr]
now
Cignoni+ 2012, 2013

Completion Status

Deep: To be completed in P93 or following

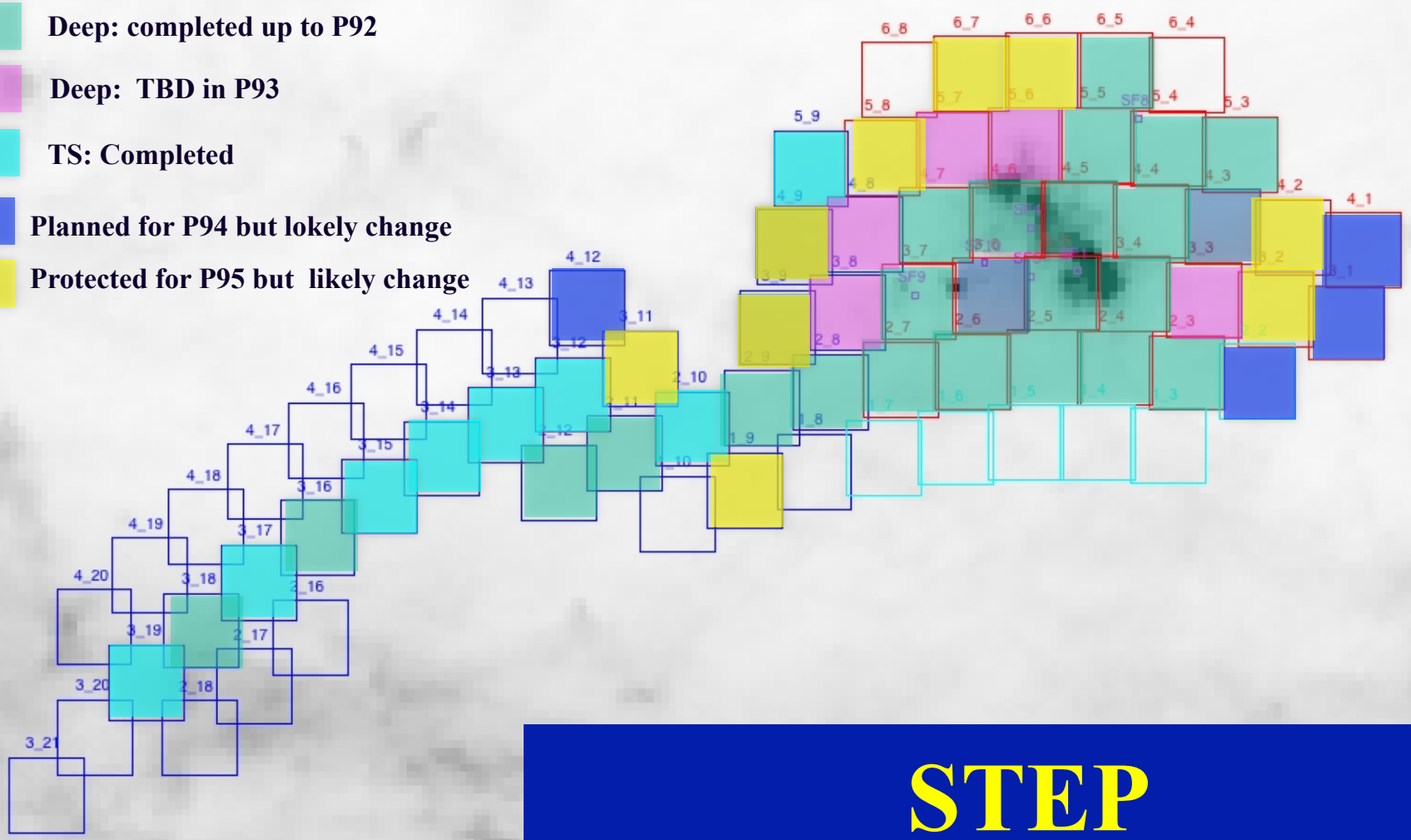
Deep: completed up to P92

Deep: TBD in P93

TS: Completed

Planned for P94 but lokely change

Protected for P95 but likely change

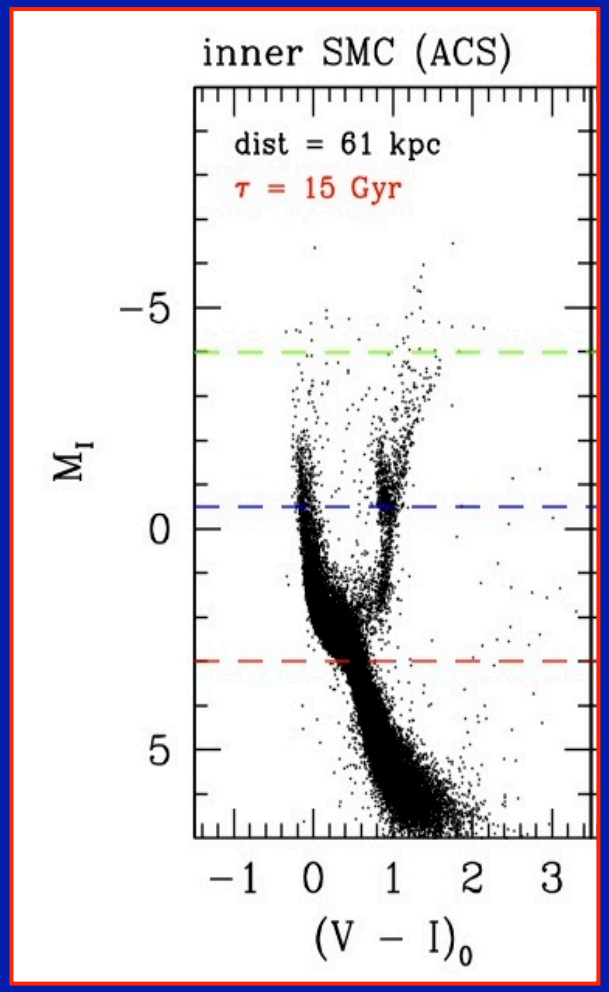


STEP

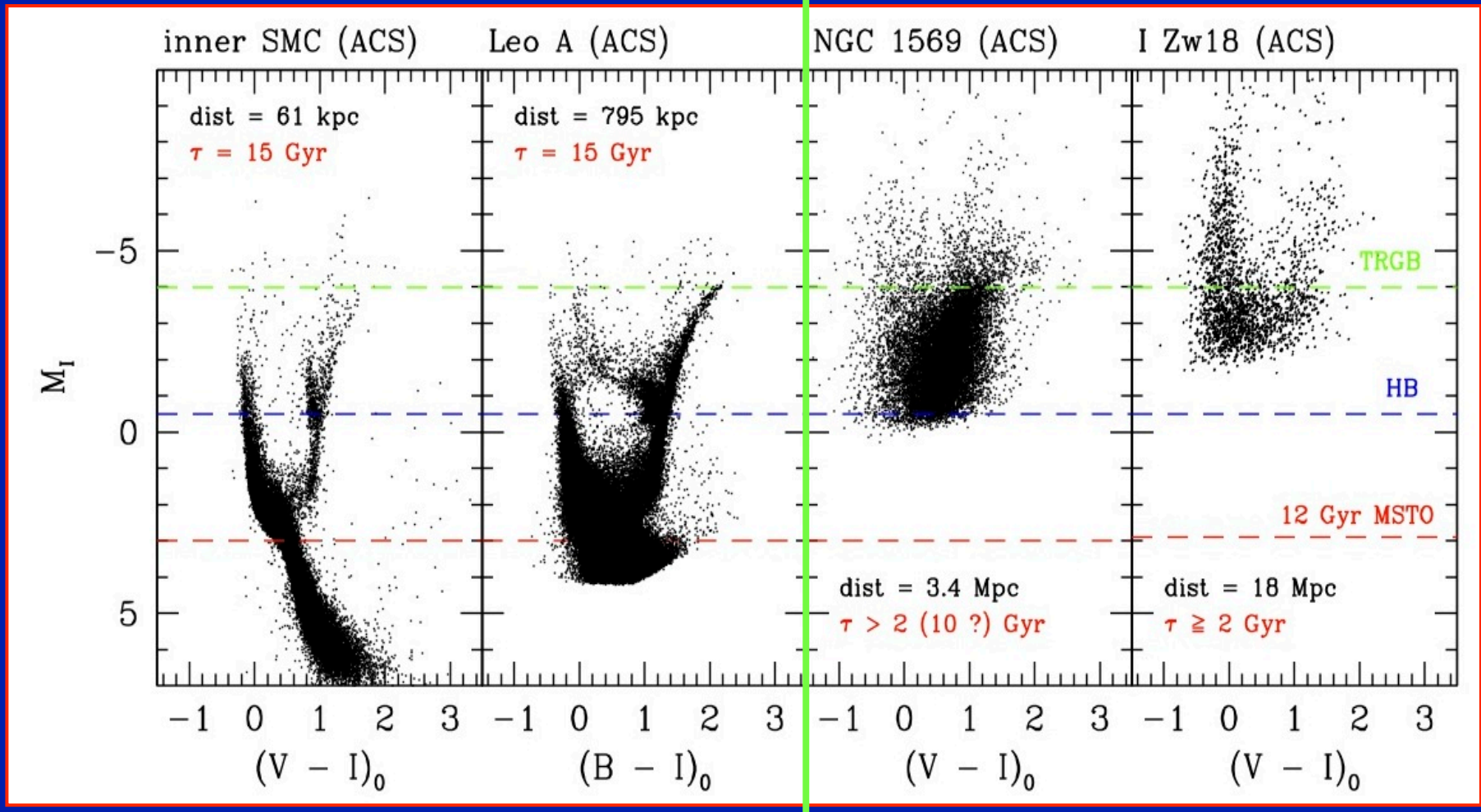
VST survey of SMC and Bridge

(see V. Ripepi's poster 39)

Effect of distance on star resolution
➡ on reachable lookback times / stellar ages



Effect of distance on star resolution
→ on reachable lookback times / stellar ages



Local Group ↔ Local Universe

the Local Group and beyond

LG galaxies are not representative of all existing types: ellipticals and BCDs (i.e. the most and the least evolved ones) are not present here

SFHs must be studied also outside the LG

ACS :
VI H_α

NGC 4449

4 Mpc

Strong starburst Irr, streams ? satellite accretion ?

Annibali+ 08, 11, 12

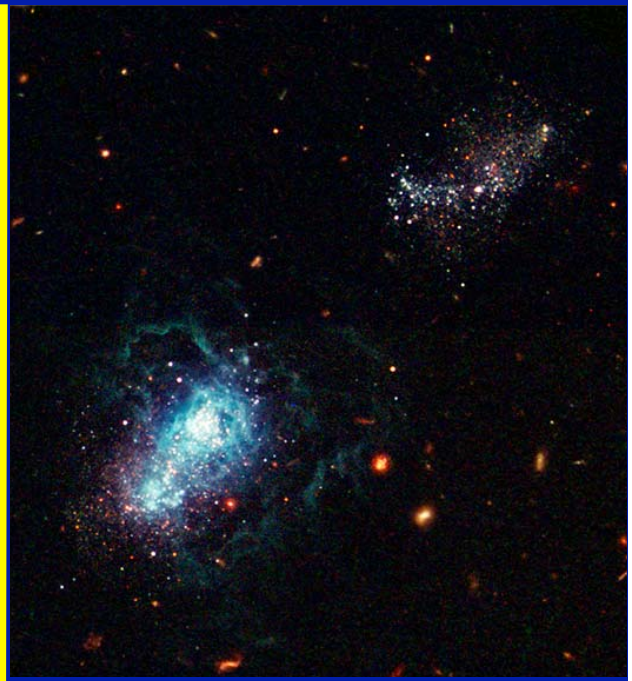
WFPC2 + NICMOS :
UBVIJH

NGC 1705

5 Mpc

Strong starburst BCD, evidence of galactic winds

Annibali+ 03, 09



WFPC2 + ACS :
BVI

IZw18

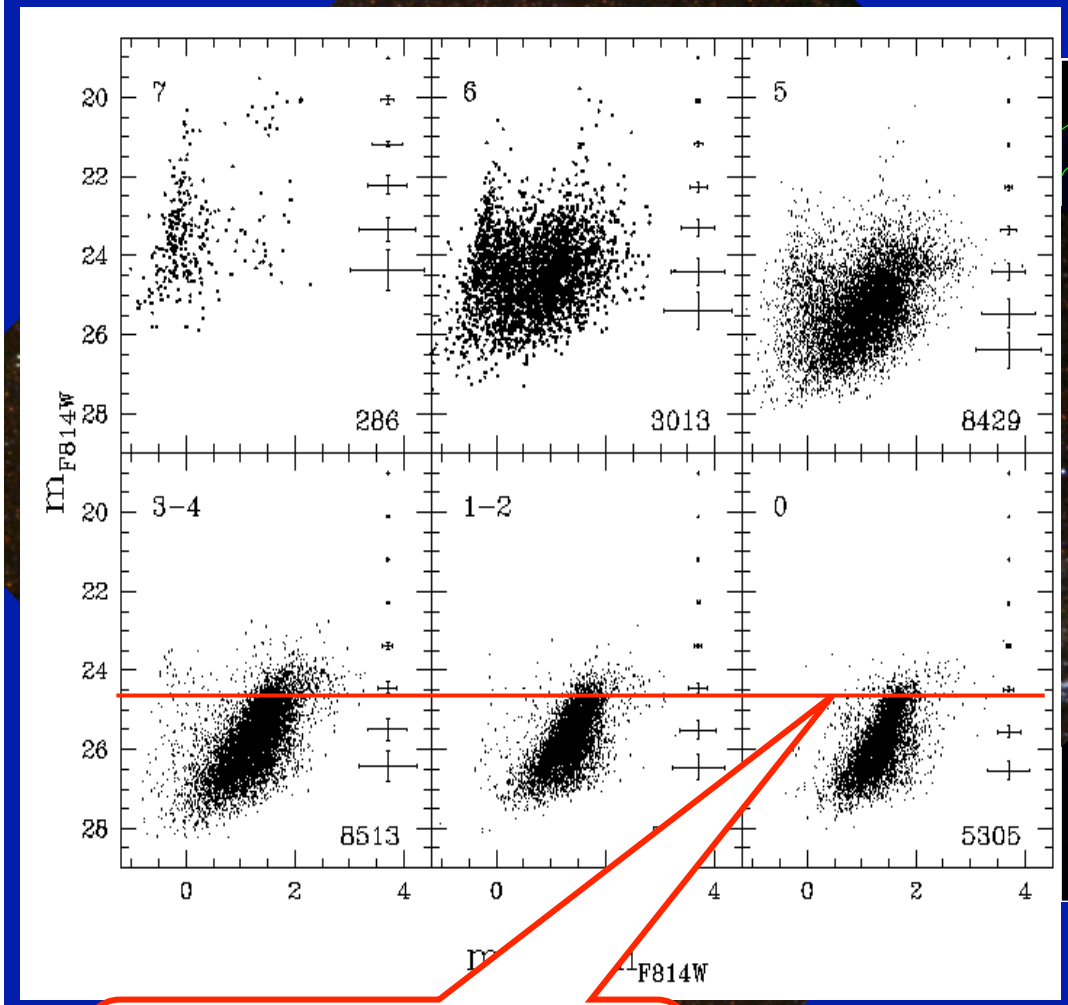
18 Mpc

Most metal poor BCD, winds ? satellite or gas accretion ?

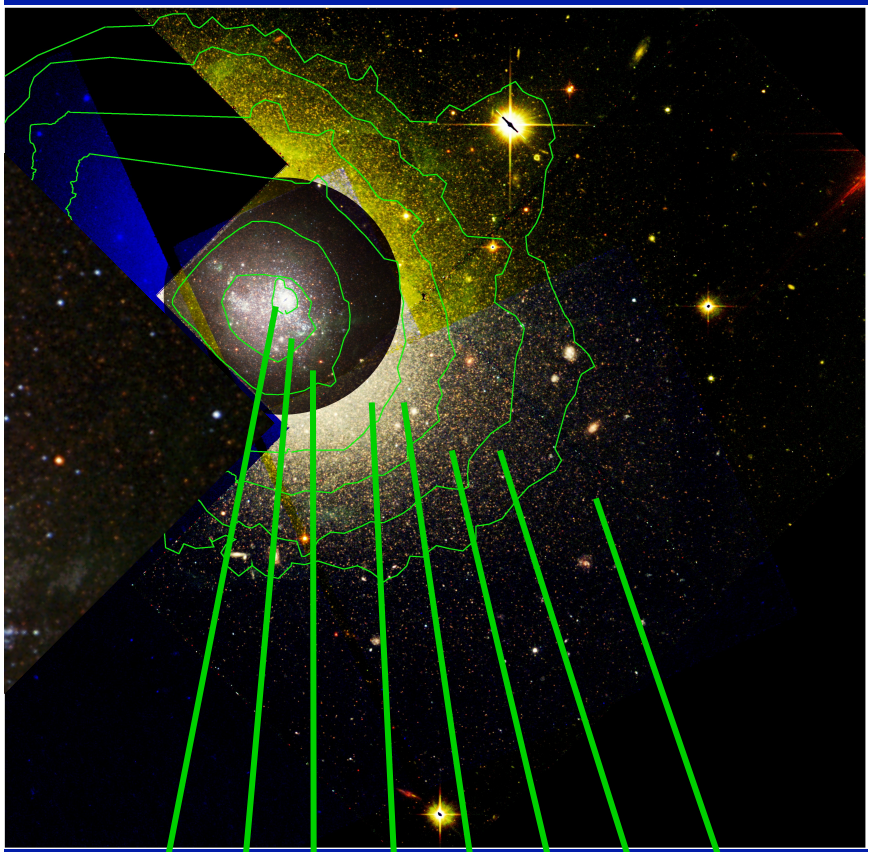
Annibali+ 13

Different regions in BCD NGC 1705: "old" results

Tosi+ 01



T-RGB very well defined
=> $(m\text{-}M)_0$ = 28.54 ± 0.26
=> D = 5.1 ± 0.6 Mpc



7 6 5 4 3 2 1 0

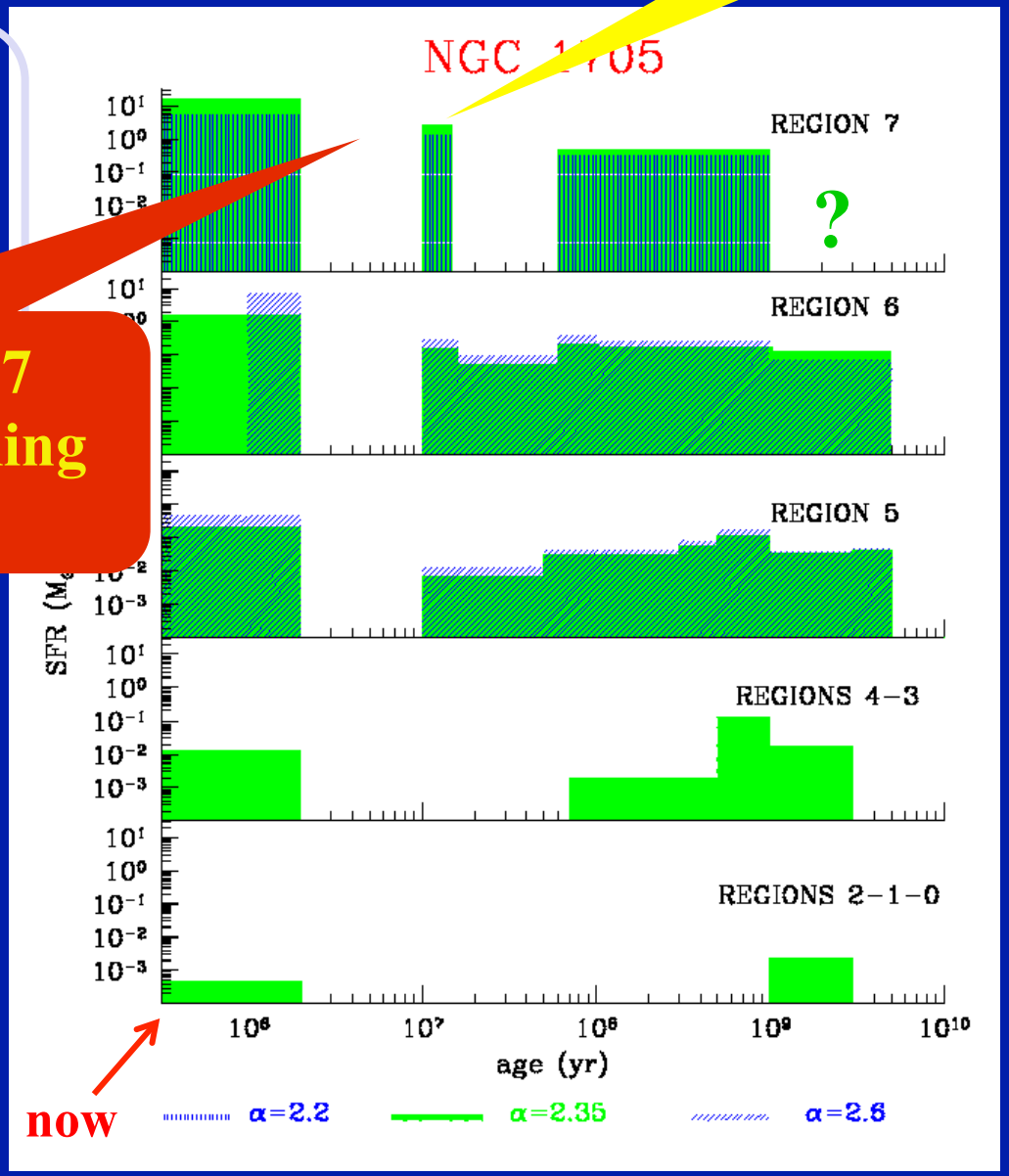
NGC1705: a post-starburst BCD already back to SF activity; gasps and not bursts

1) Some SF 5 - 1 Gyr ago
2) Some SF 1 - 0.02 Gyr ago
3) Strong central SF 17 - 10 Myr ago
4) No SF anywhere 10 - 3 Myr ago
5) Strong SF everywhere 3-0 M

quiescent phase only 6-7 Myr long => rapid cooling or triggered SF ?

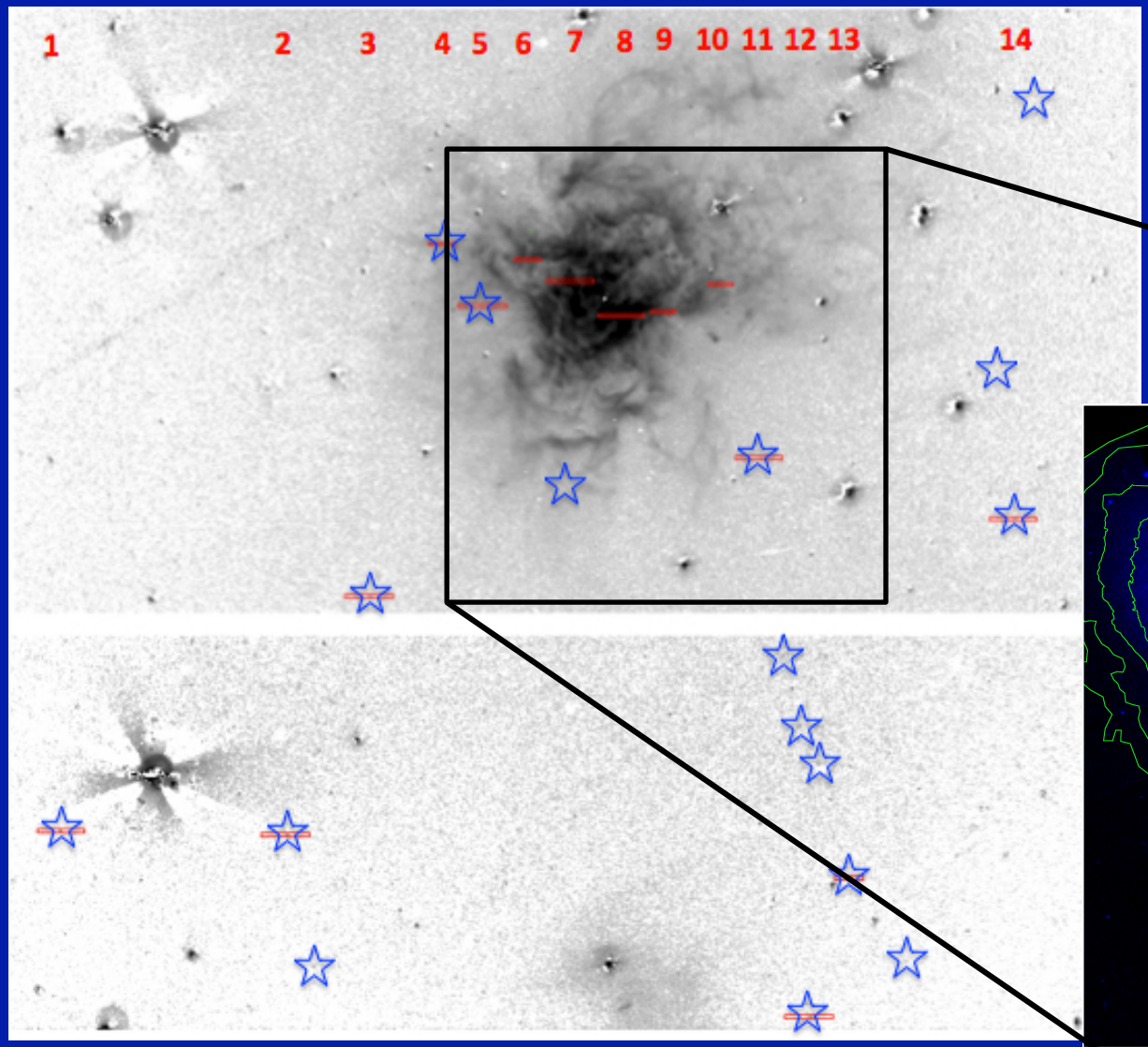
Annibali+ 03 and 09

wind source



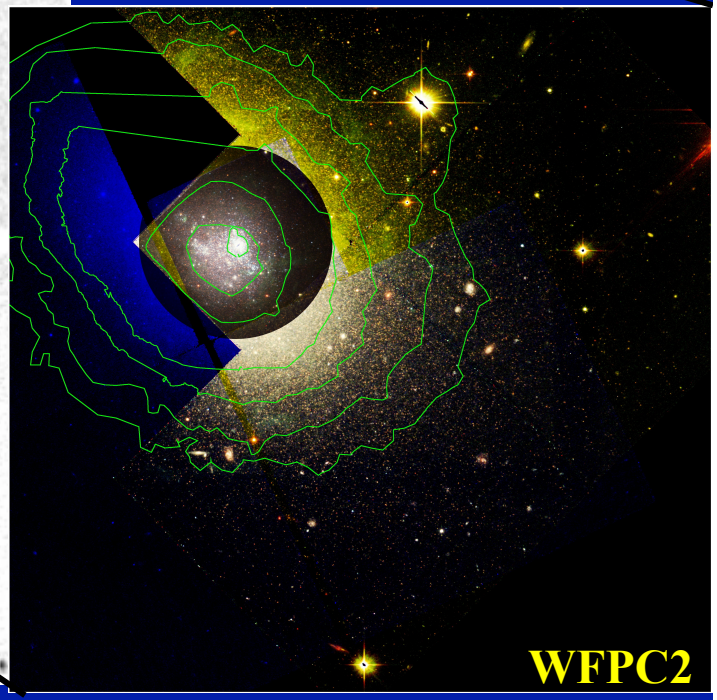
VLT FORS2 to study PNe and H II regions in NGC1705 (work in progress)

Continuum-subtracted [OIII] image of NGC 1705 (FOV ~ 6.5' x 5.8')

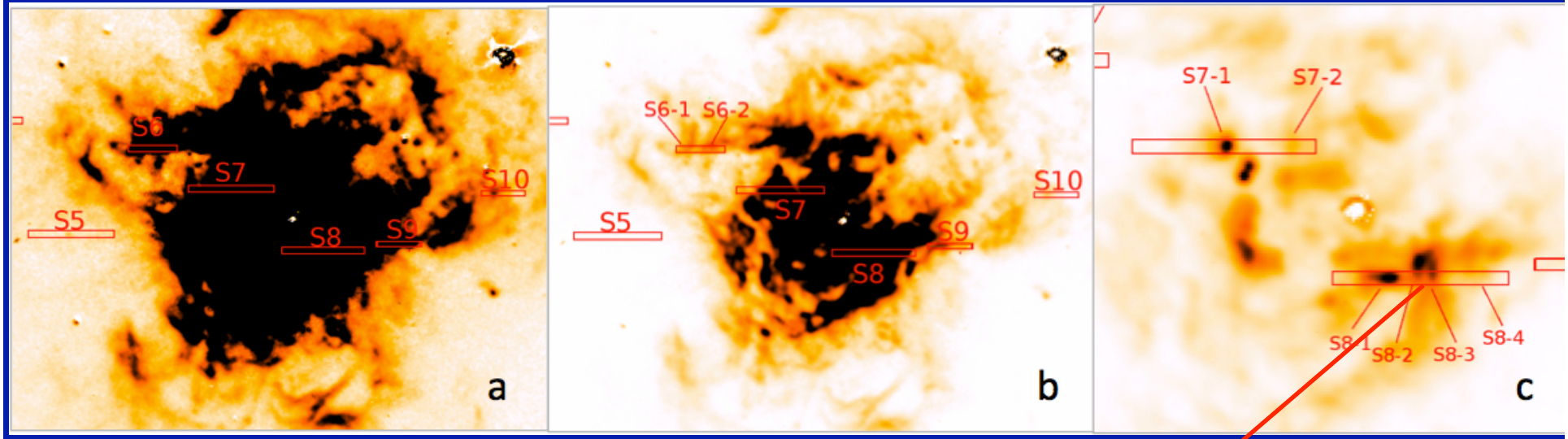


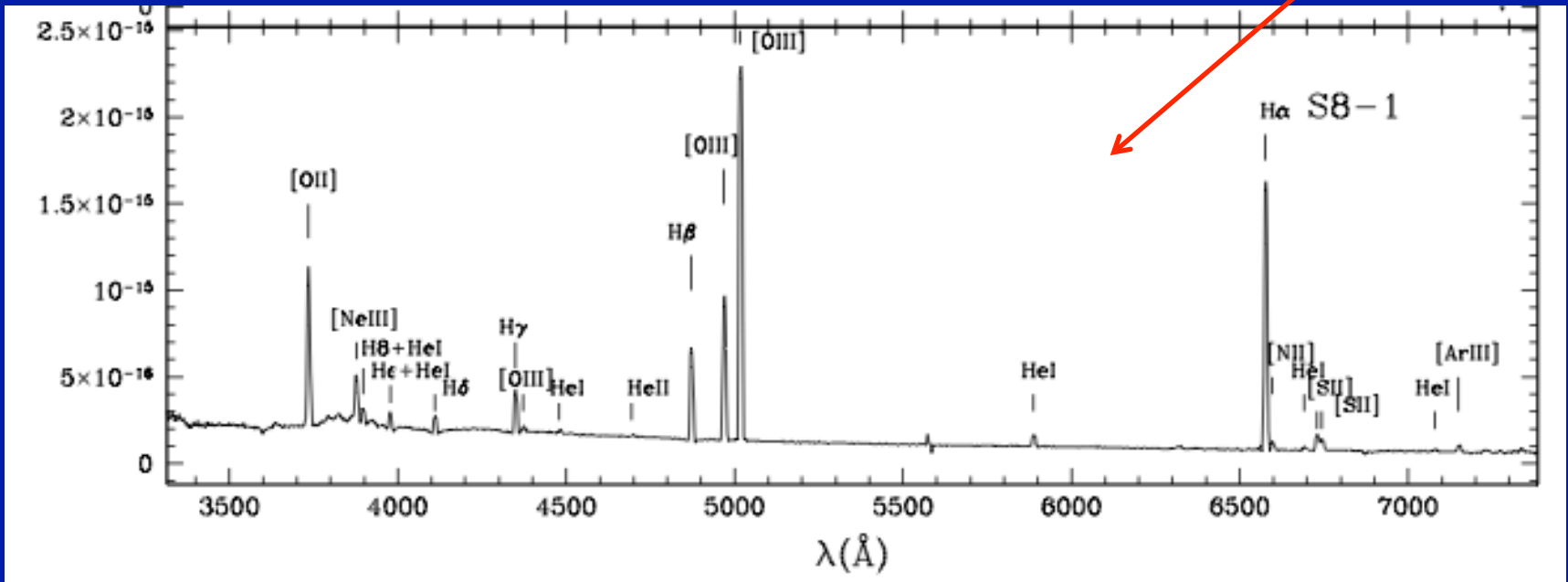
PN candidates (17)

MXU slits
(9 PN cand + H II reg
+ gas philaments)



H II regions and gas philaments in NGC 1705





Preliminary HII region abundances (Annibali+ in prep)

<12 + log(N/H)> =6.71 [N/H]* = -1.15
<12 + log(O/H)> =8.00 [O/H]* = -0.76
<12 + log(Ne/H)> =7.47 [Ne/H] = -0.46
<12 + log(S/H)> =6.42 [S/H]* = -0.74
<12 + log(Ar/H)> =5.80 [Ar/H] = -0.60

*(Solar values from Caffau et al. 2010)

Hints for **spatial gradients**
(O abundance is ~0.3 dex lower in the periphery than in the central regions).

Preliminary HII region abundances

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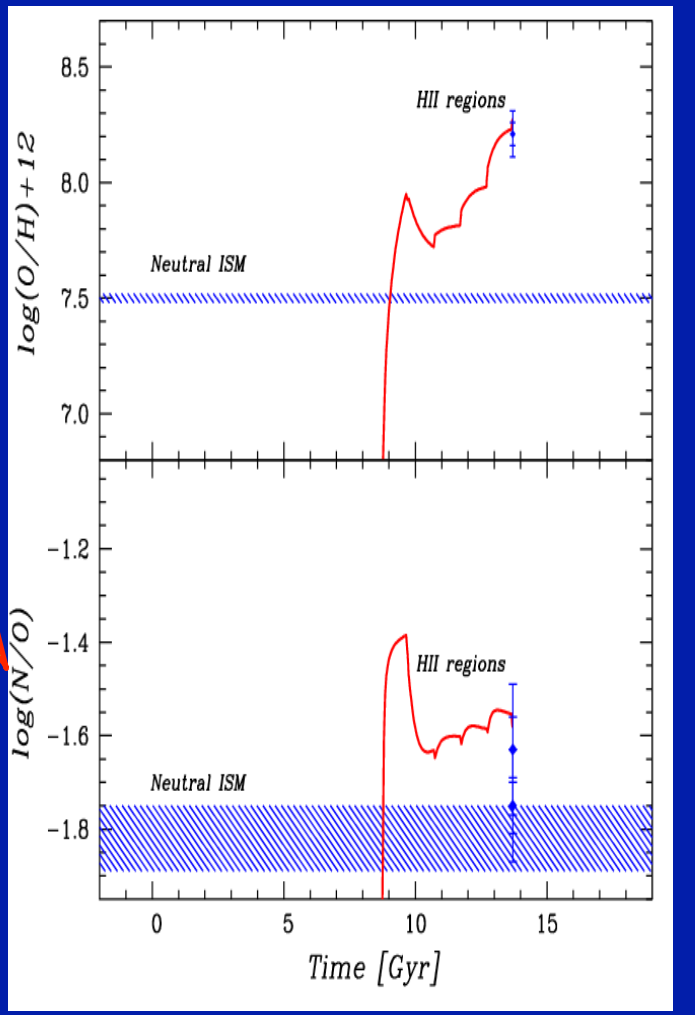
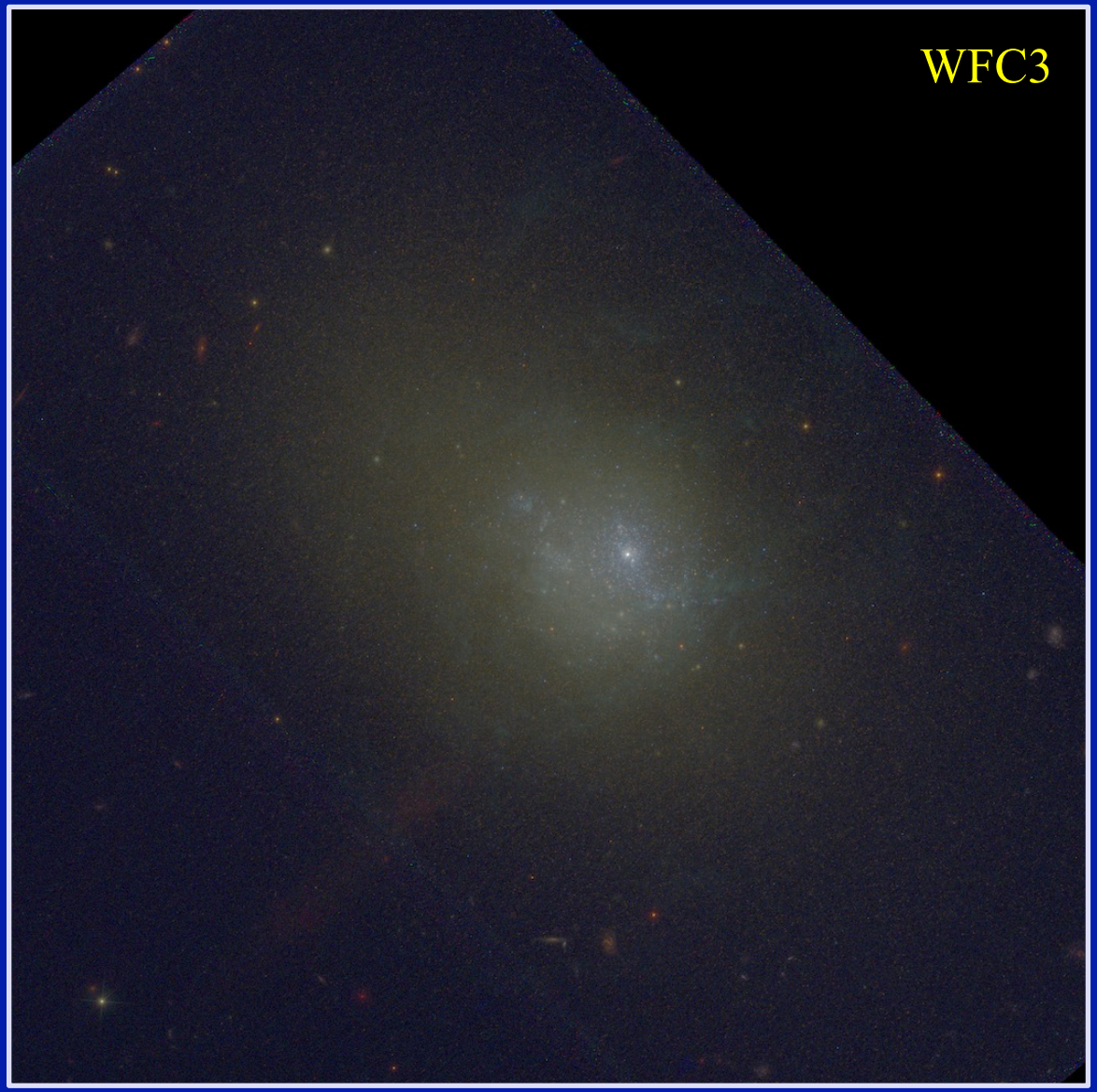
*(Solar values from Caffa

Hints f
(
pe gions).

We'll use these values to compute new chemical evolution models of NGC 1705, improving what we did in Romano+ (06)

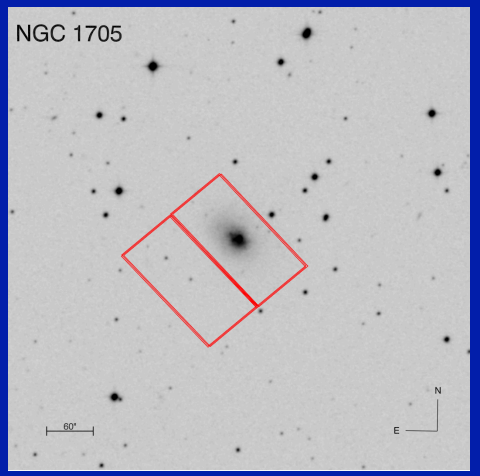


NGC 1705 in UV: next study



Composite image: NUV+U (blue), B+V (green), I (red)

Legacy ExtraGalactic LEGUS Ultraviolet Survey



Legacy ExtraGalactic LEGUS Ultraviolet Survey

https://legus.stsci.edu
Calzetti+ 2014, AJ in press

(154 primary + 154 parallel orbits)

Cycle 21 HST Treasury Program – PI D. Calzetti

to study SF and its relation with galactic environment in nearby galaxies, from individual stars scales to kpc–size

50 galaxies, in the range 3.5-12 Mpc, in 126 pointings (63 primary);

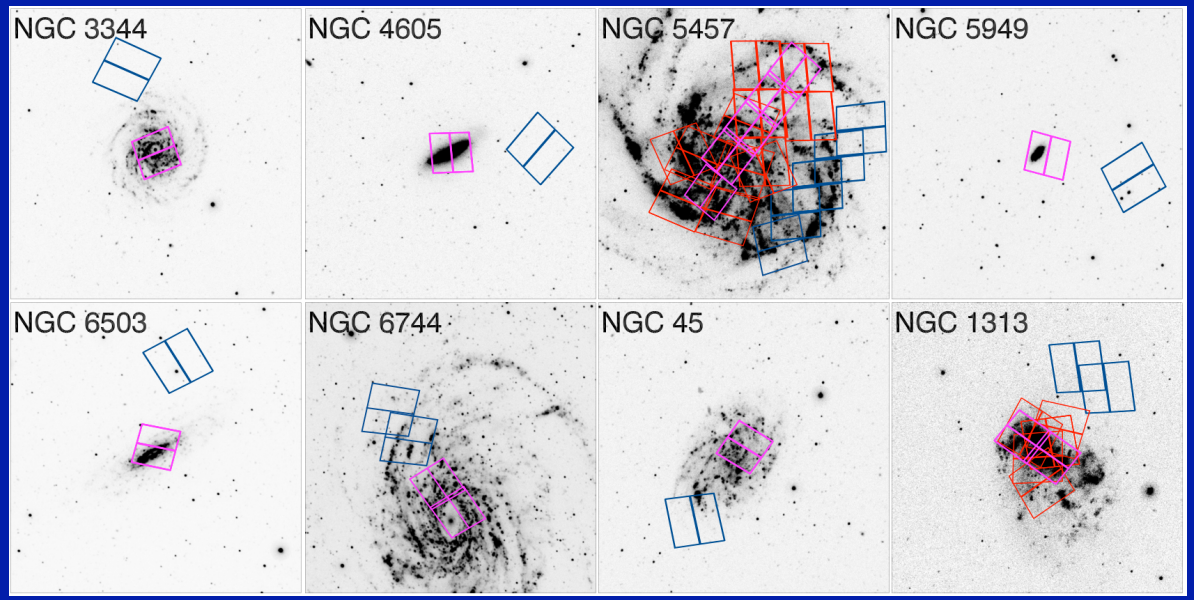
100% completed in Sept.14

Primary: WFC3/NUV,U,B, V,I (5 bands)

Parallel: ACS/B,V,I

Leverage the HST Archive as much as possible

LEGUS footprint=magenta
LEGUS parallels=blue
Archival data=red



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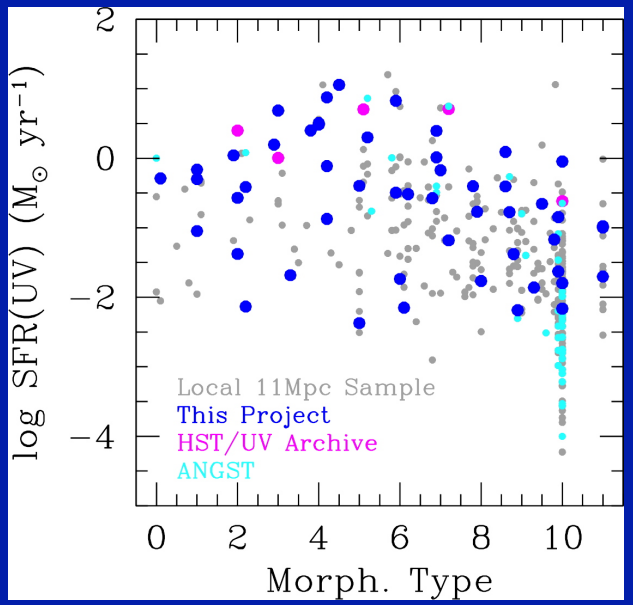
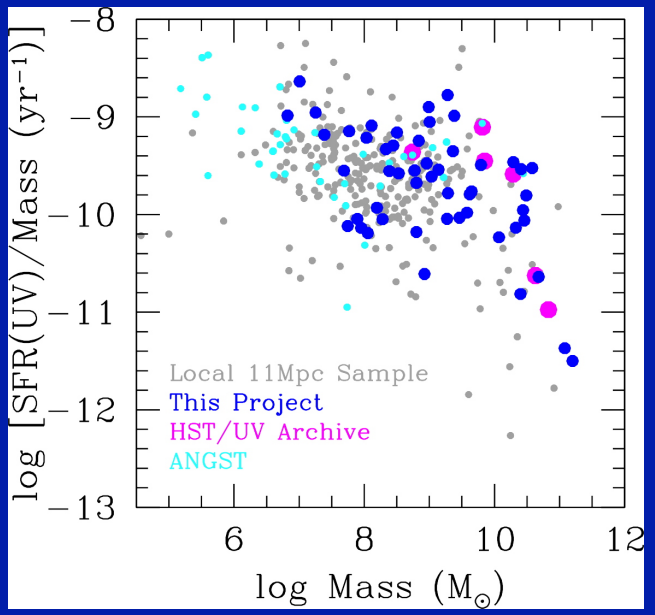
LEGUS

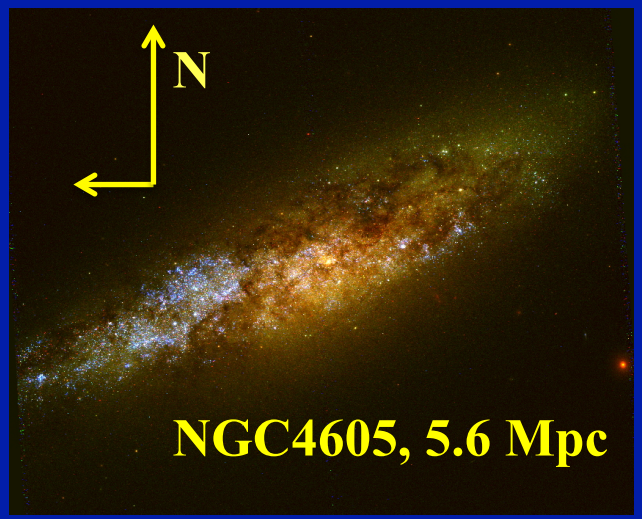
Ultraviolet Survey

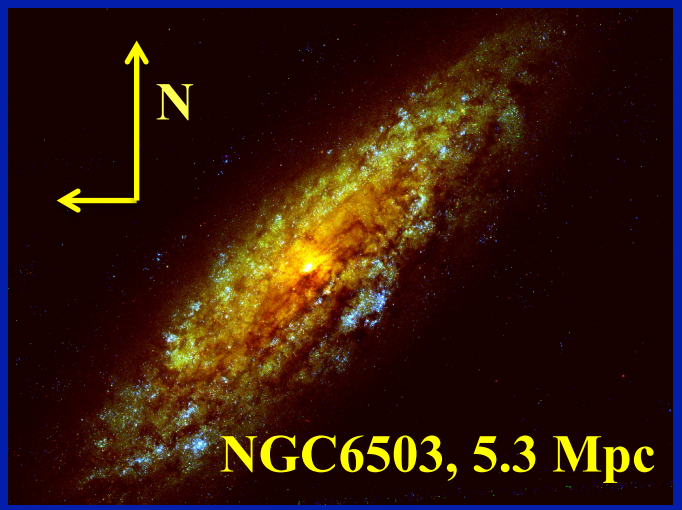
The Sample

Full range of basic properties (morphology, sSFR, SFR, mass, interaction type, presence/absence of bars, etc.) found in the local Universe, < 12 Mpc.



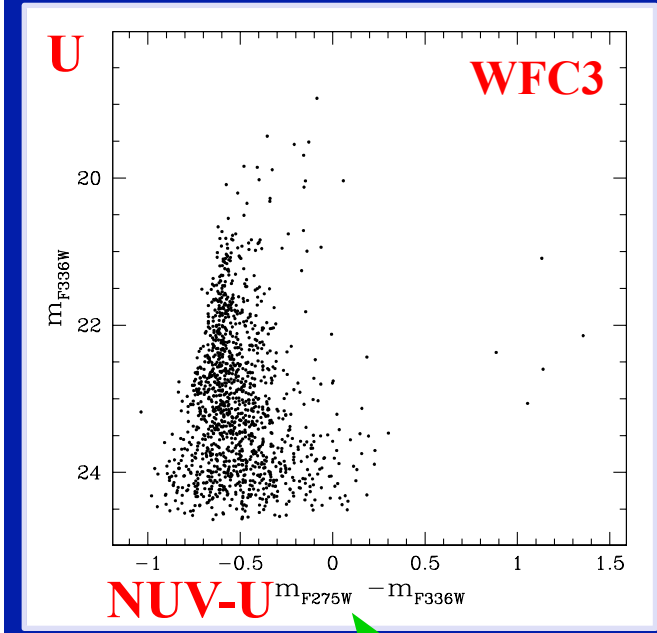


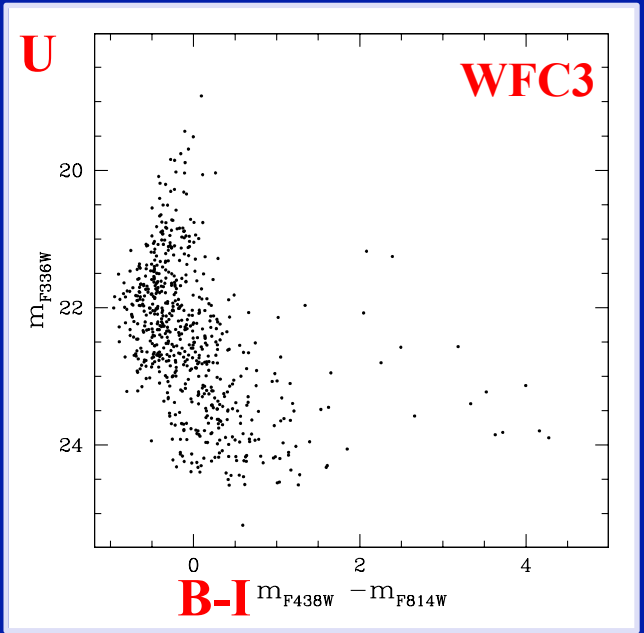




Color-composites: NUV (blue), B (green), and I (red)

NGC 1705 in UV: next study





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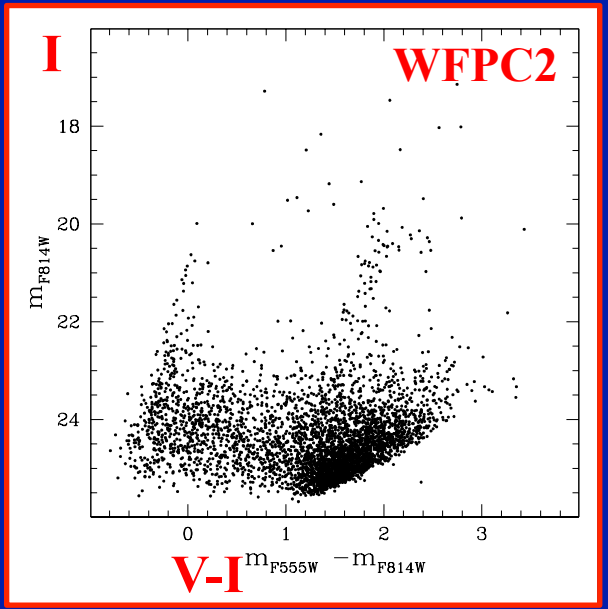
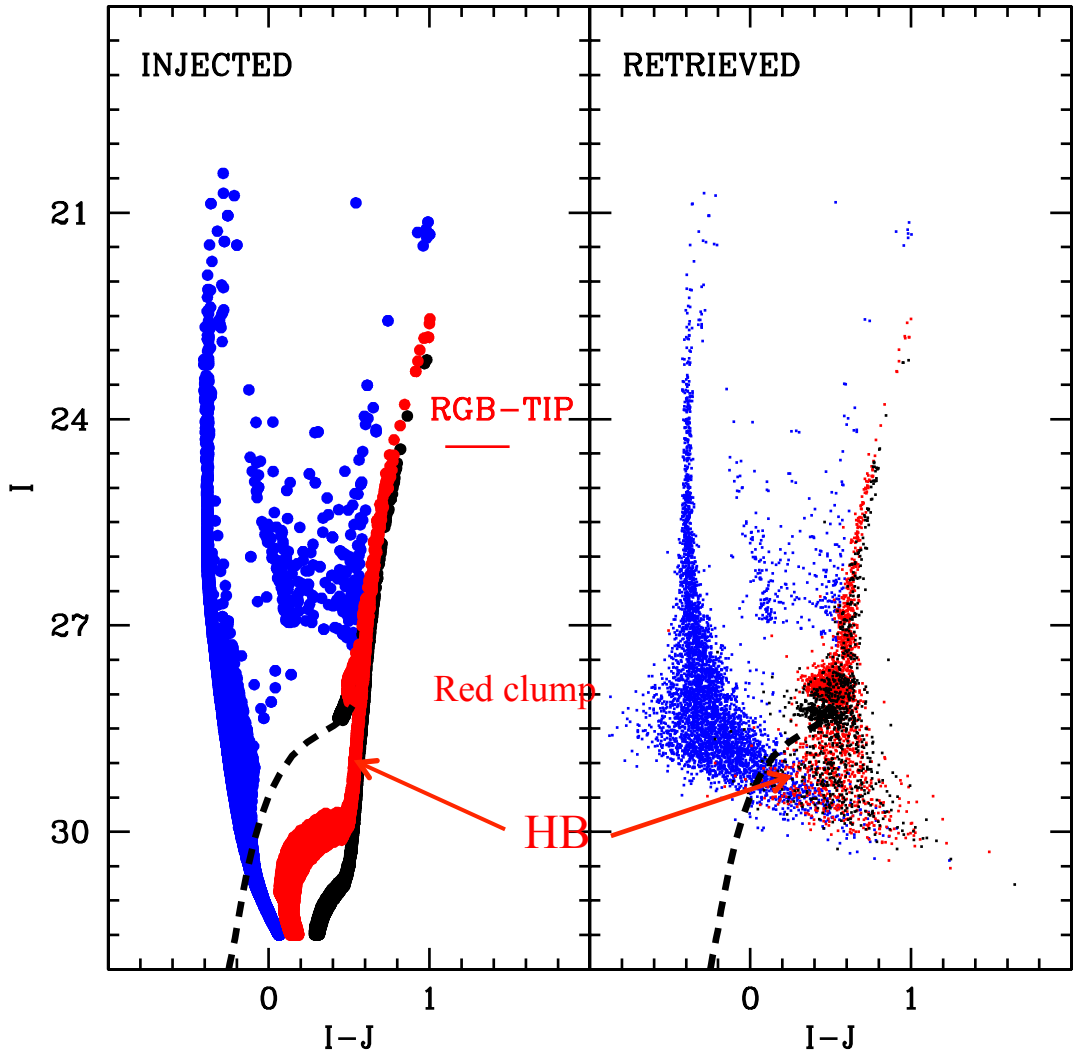
LEGUS

Ultraviolet Survey

We can study the recent SF activity in much better detail. Not the old, red stars.



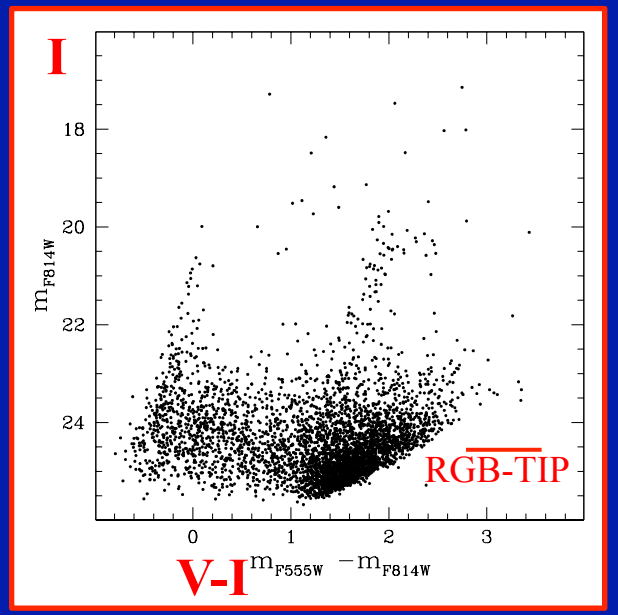
NGC 1705 in NIR: the future with E-ELT



courtesy G. Fiorentino

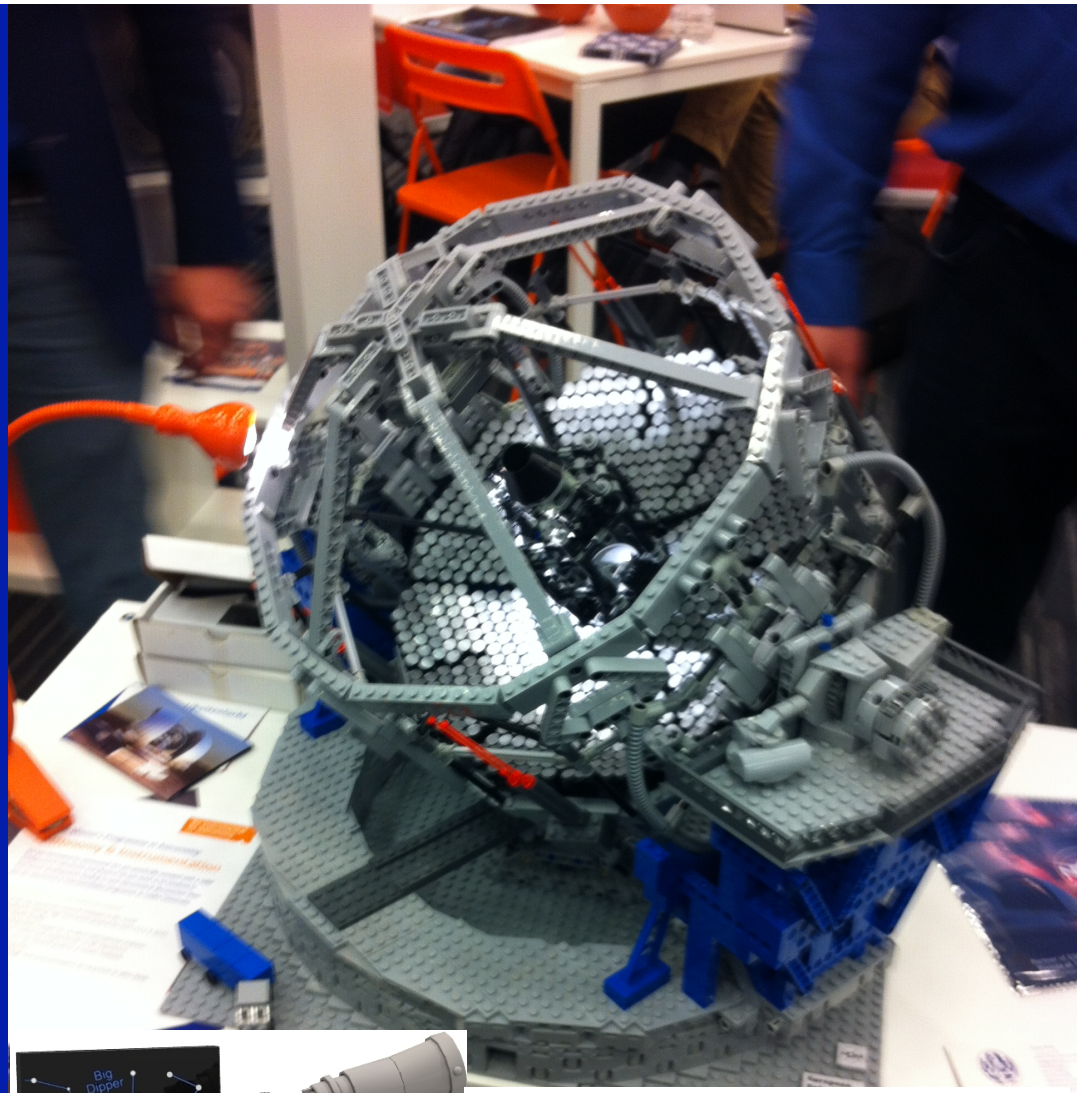
INJECTED: theoretical CMD assuming reasonable SFH normalized to bright blue plume observed with HST.
RETRIEVED: the injected CMD convolved with Micado +Maory simulations

We plan to resolve stars as old as 10 Gyr



LEGUS, LEGO and E-ELT

Thank you



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LEGUS

Ultraviolet Survey