The stellar content of I Zw 18: constraints from synthetic color-magnitude diagram modelling

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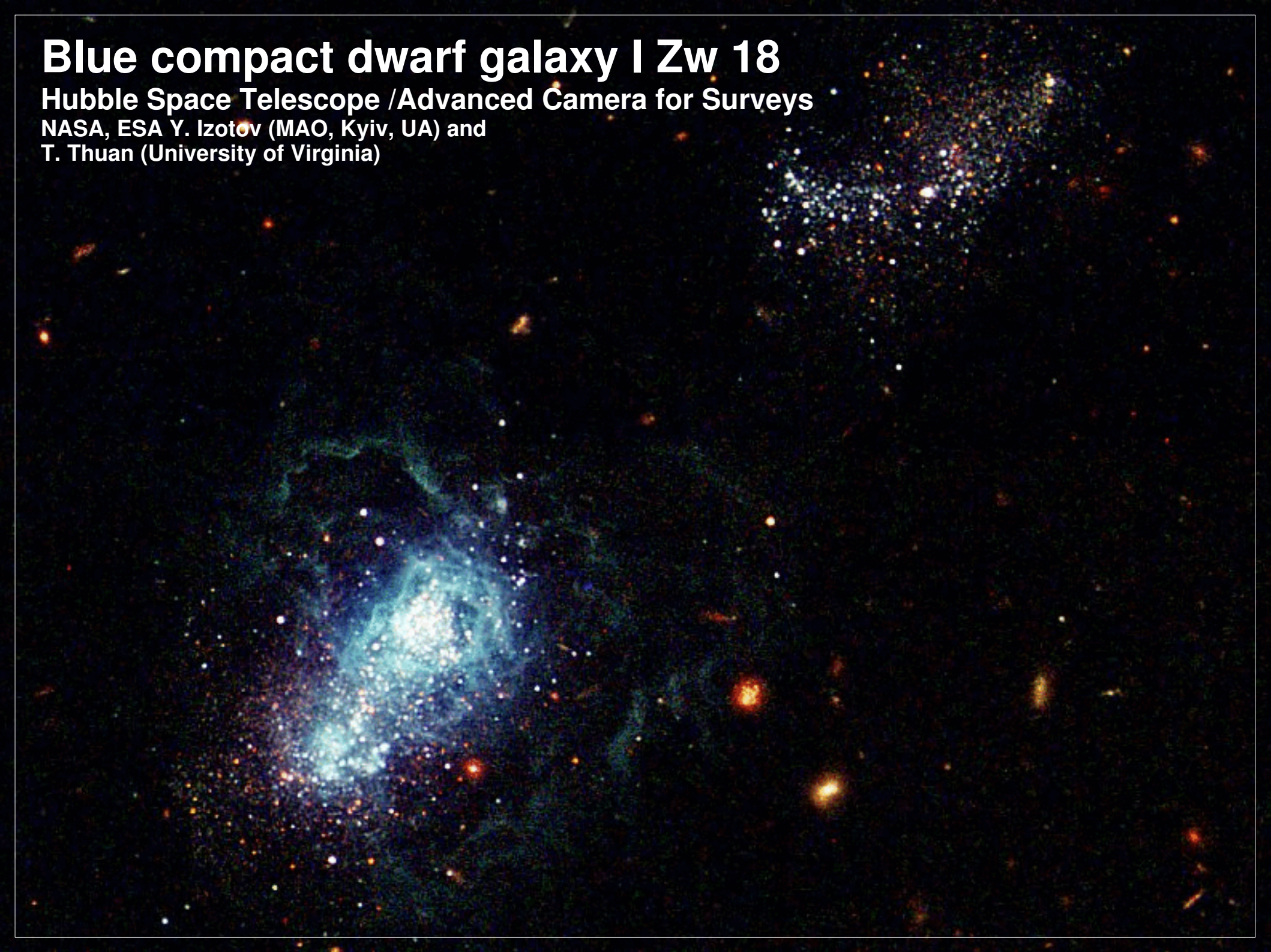
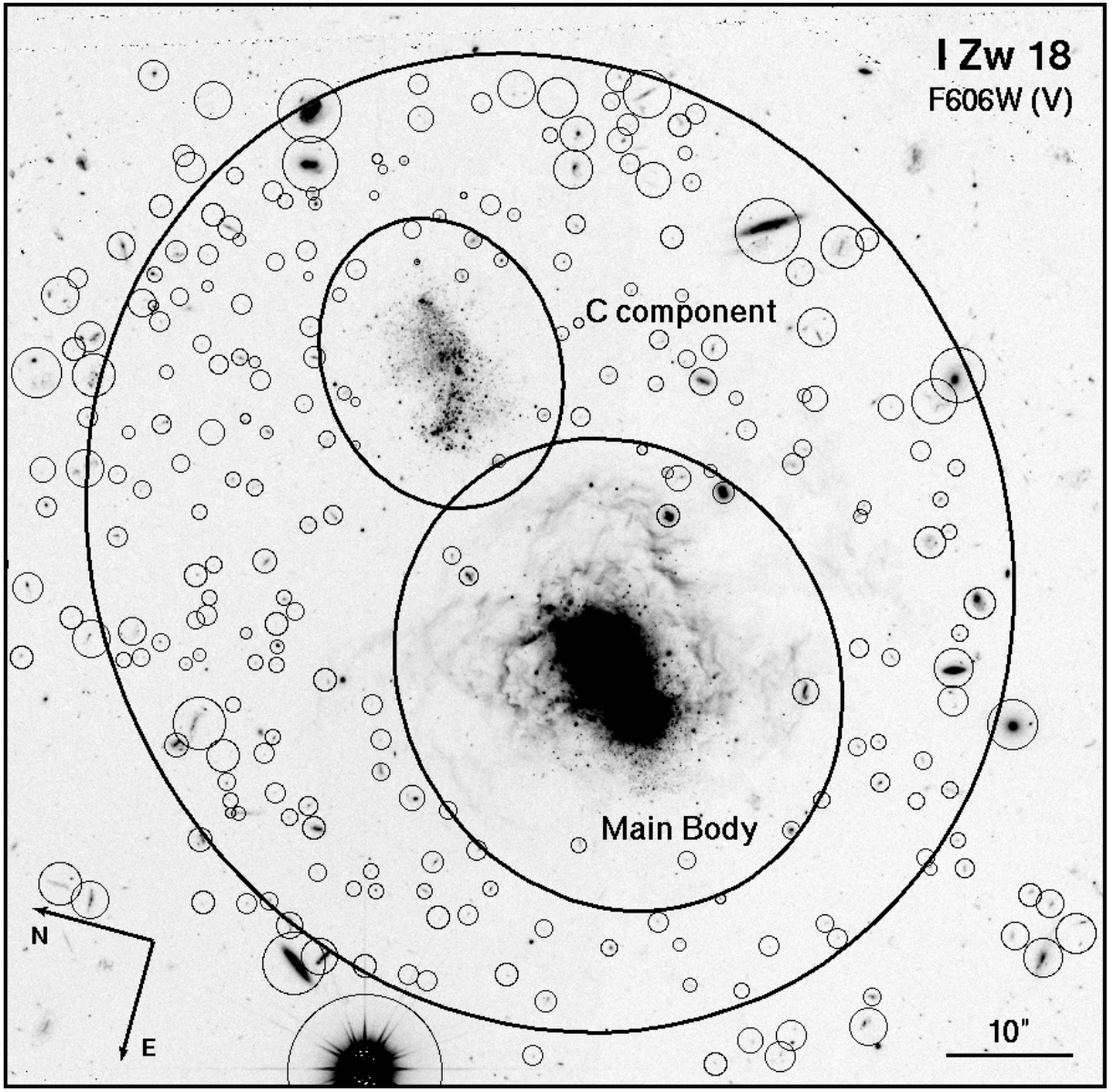

Blue compact dwarf galaxy I Zw 18
Hubble Space Telescope /Advanced Camera for Surveys
NASA, ESA Y. Izotov (MAO, Kyiv, UA) and
T. Thuan (University of Virginia)

HST/ACS image of I Zw 18 in F606W(V) filter
(GO: 10586, PI: Aloisi et al.)



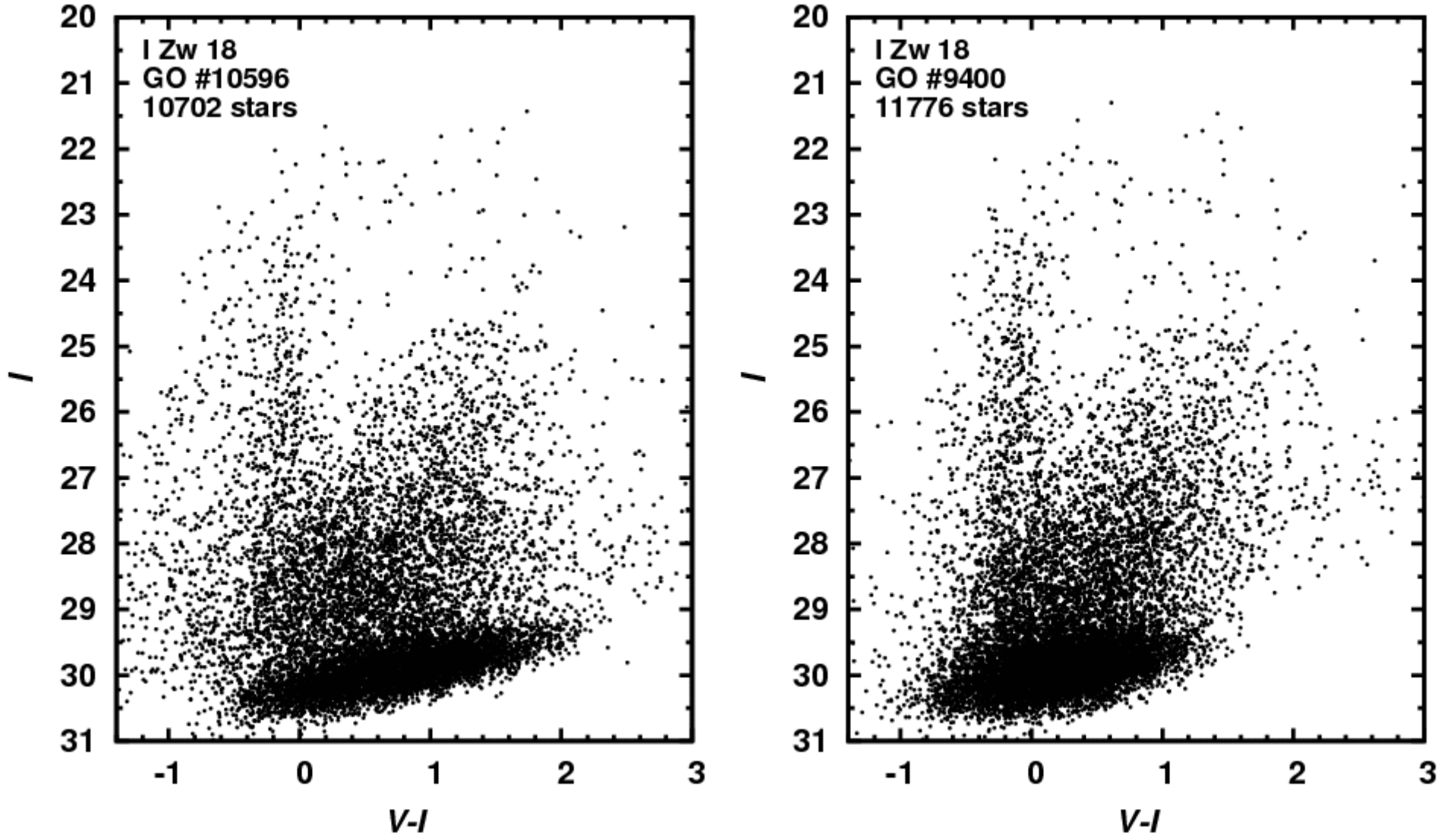
Big ellipse: the region of the photometric analysis

Smaller ellipses: the adopted inner boundaries of the Main Body and the C component

Small circles: diffuse background objects, manually selected and removed from the photometry

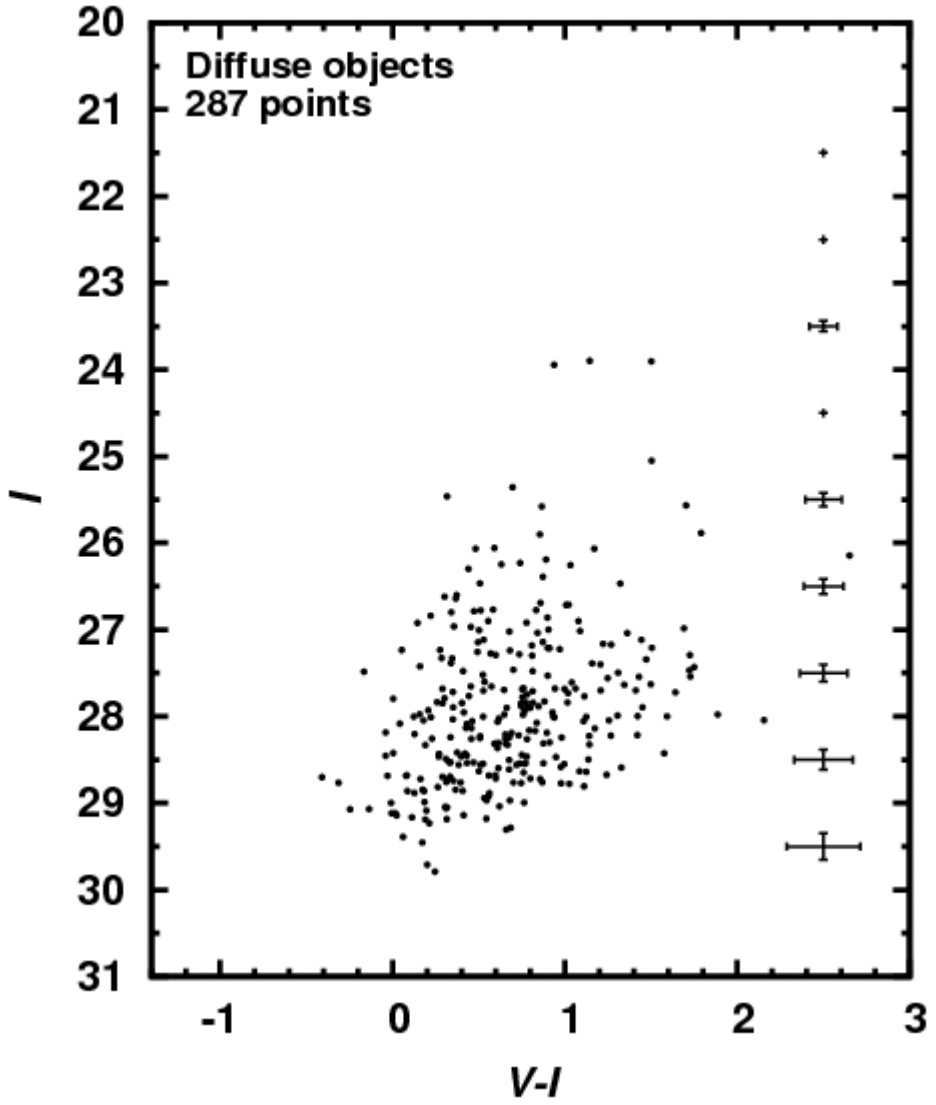
Preliminary photometry

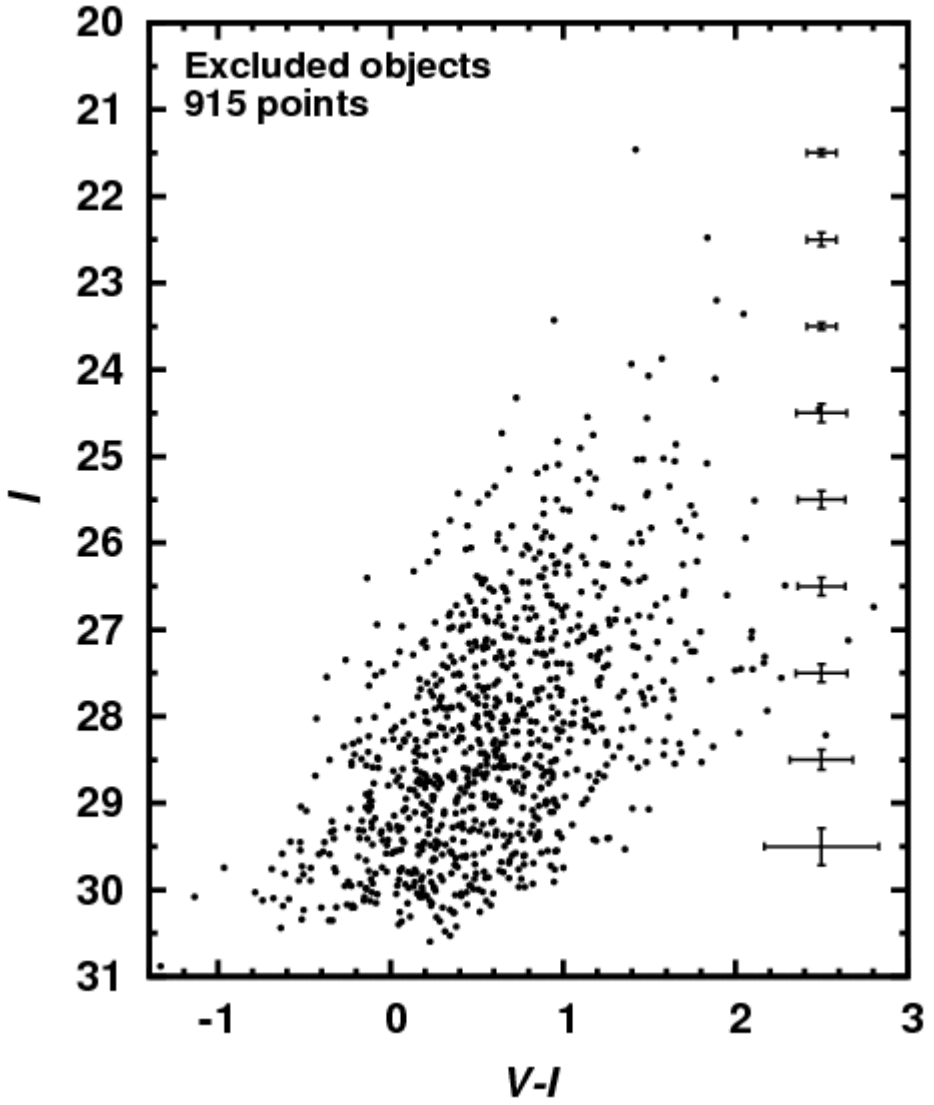
Uncleaned CMDs [*V-I*, *I*] of I Zw 18, obtained using Aloisi et al. (left) and Izotov & Thuan (right) datasets. Apperture corrections applied, magnitudes corrected for the Galactic extinction (A_V=0.101 mag).



Diffuse background sources and false detections

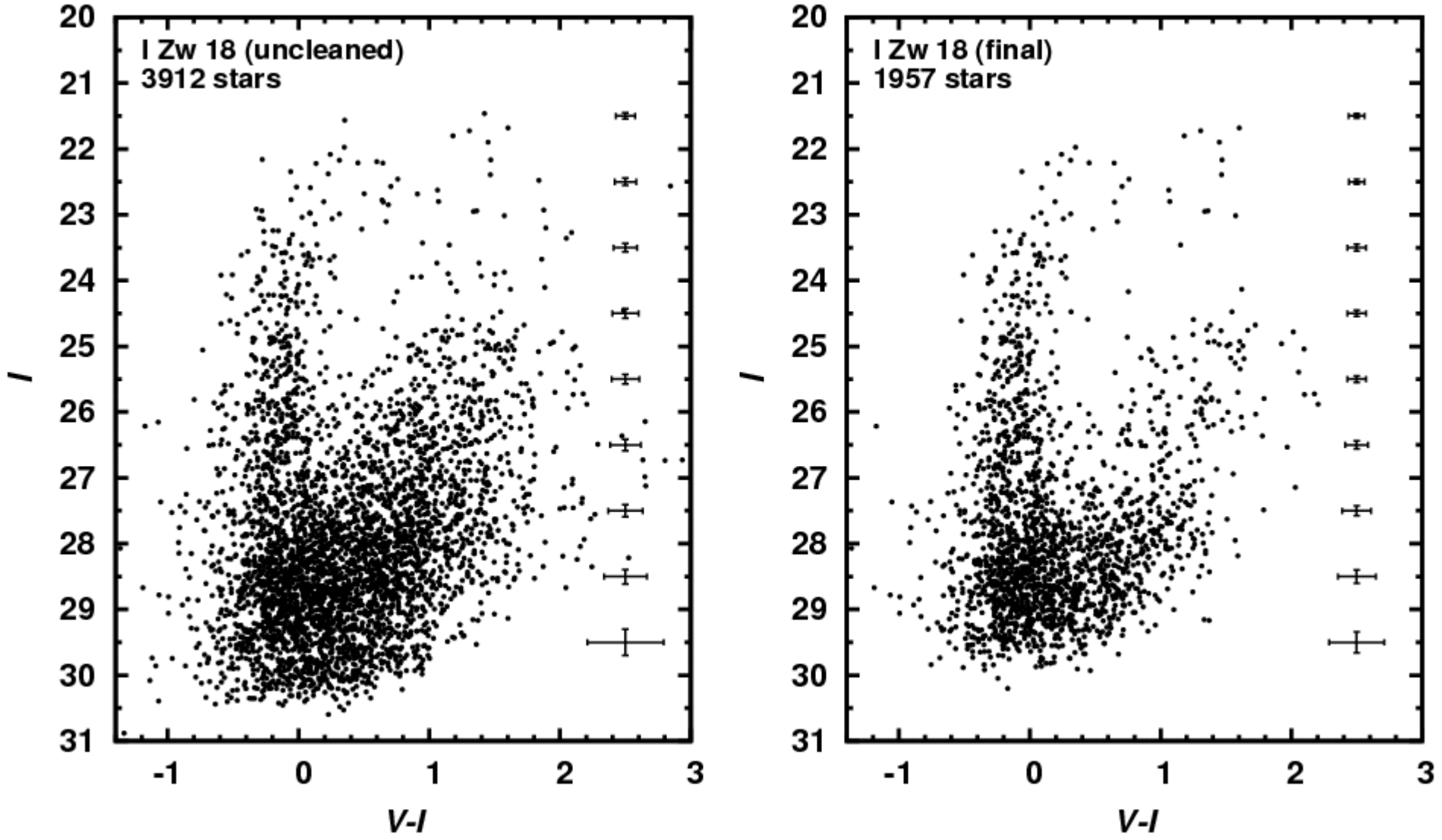
CMDs [*V-I*, *I*] of the diffuse sources manually selected in the inner region of I Zw 18 (left) and the objects found beyond the adopted outer boundary (right).





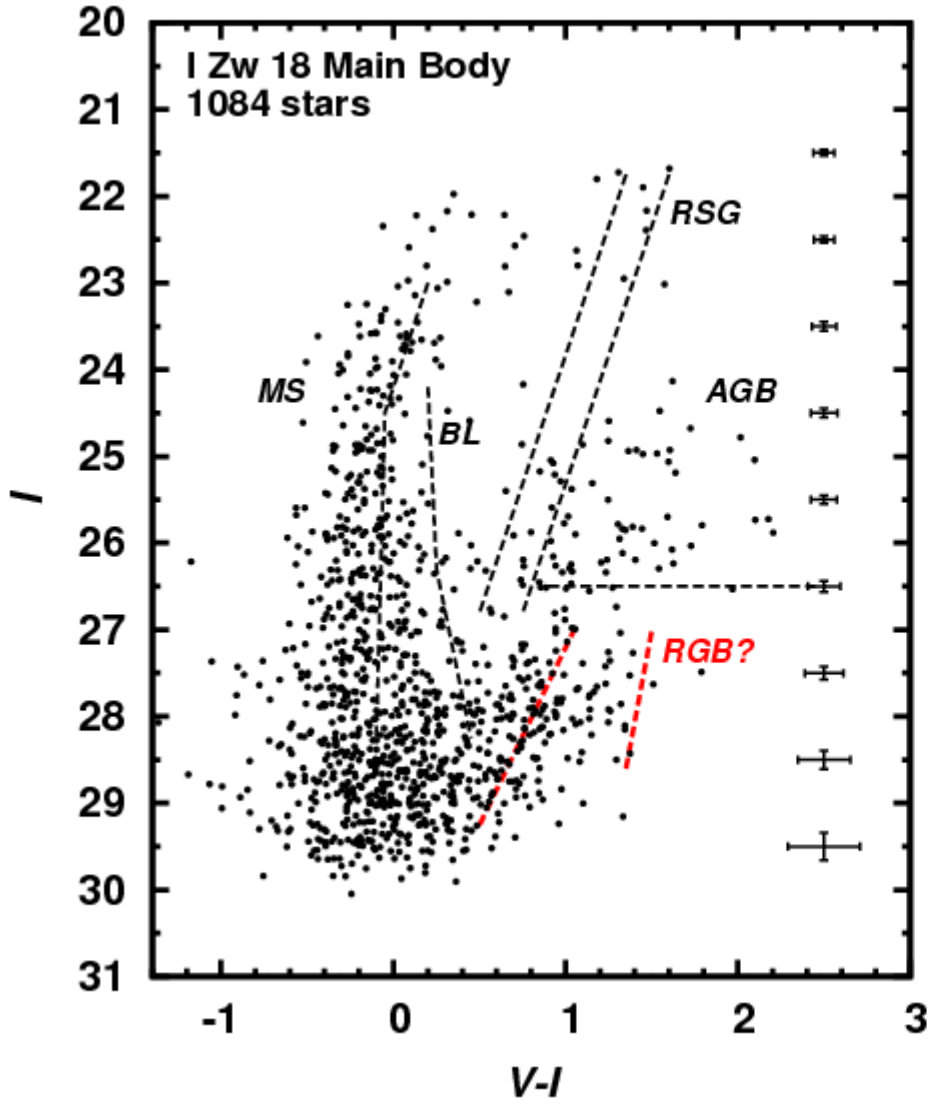
Initial contaminated and final CMDs of I Zw 18

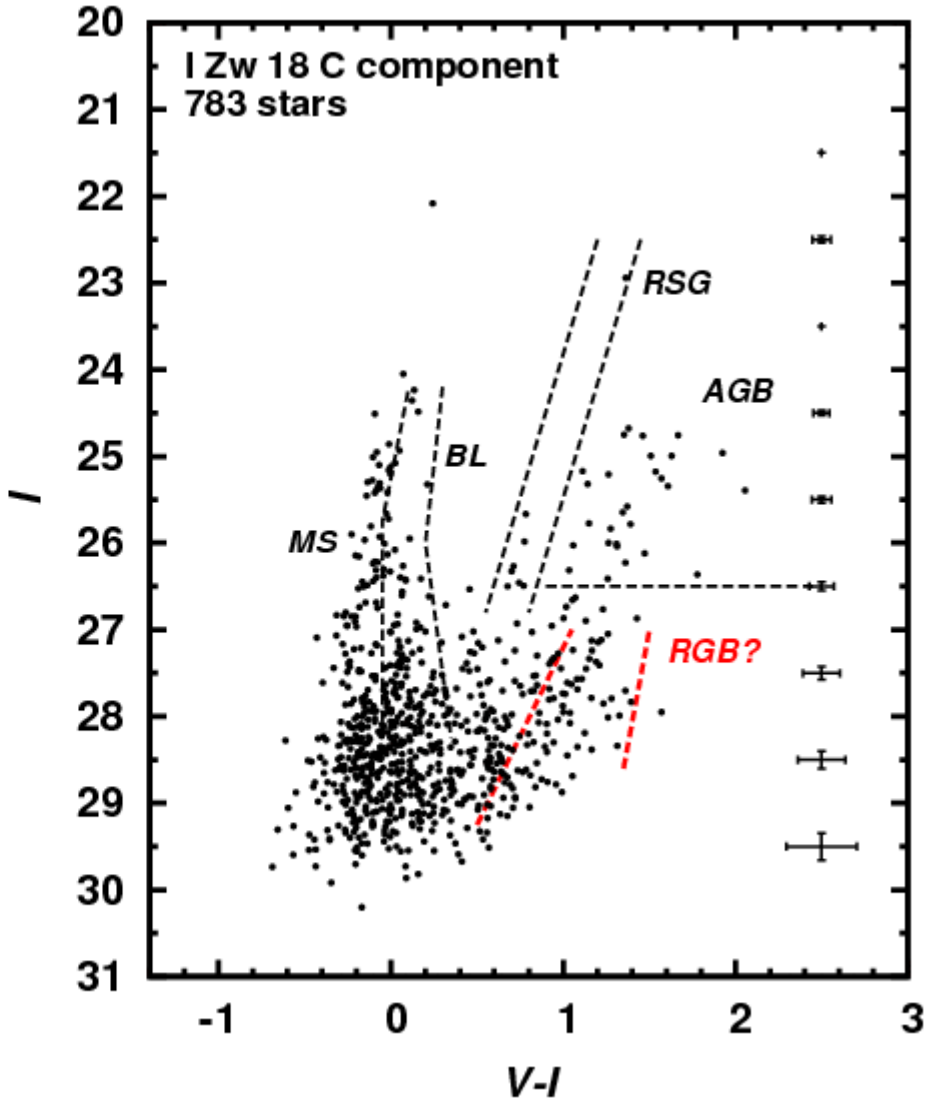
CMD [*V-I*, *I*] of I Zw 18 without the background objects removed and the photometric cuts applied (left) and the final 'clean' CMD (right). Near the half of the detected points disappear after cleaning.

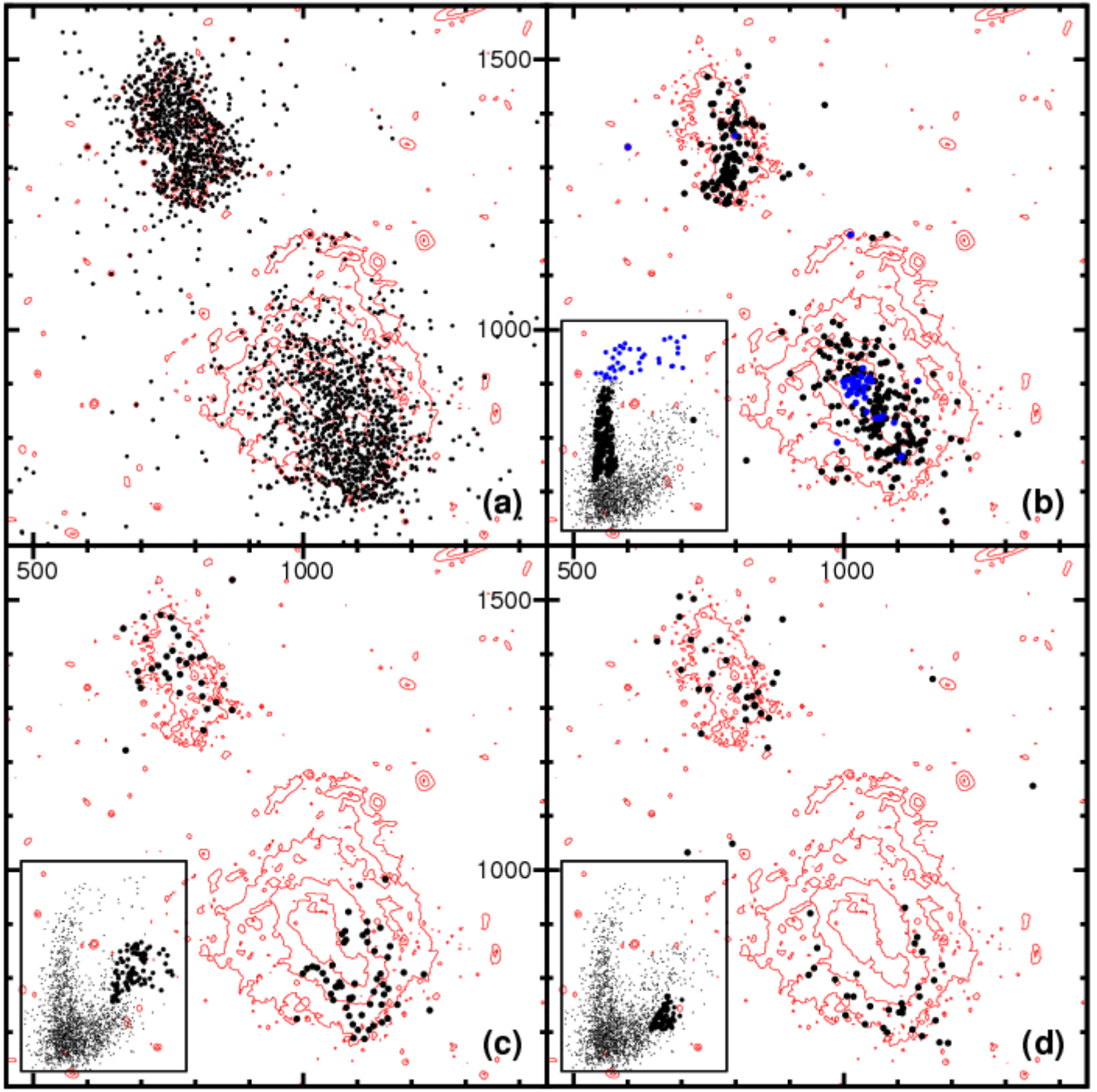


CMDs of the main body and the C component

Main stellar evolutionary sequences are marked with the dotted lines.
Do we see the red giant branch stars here? And where is the TRGB?



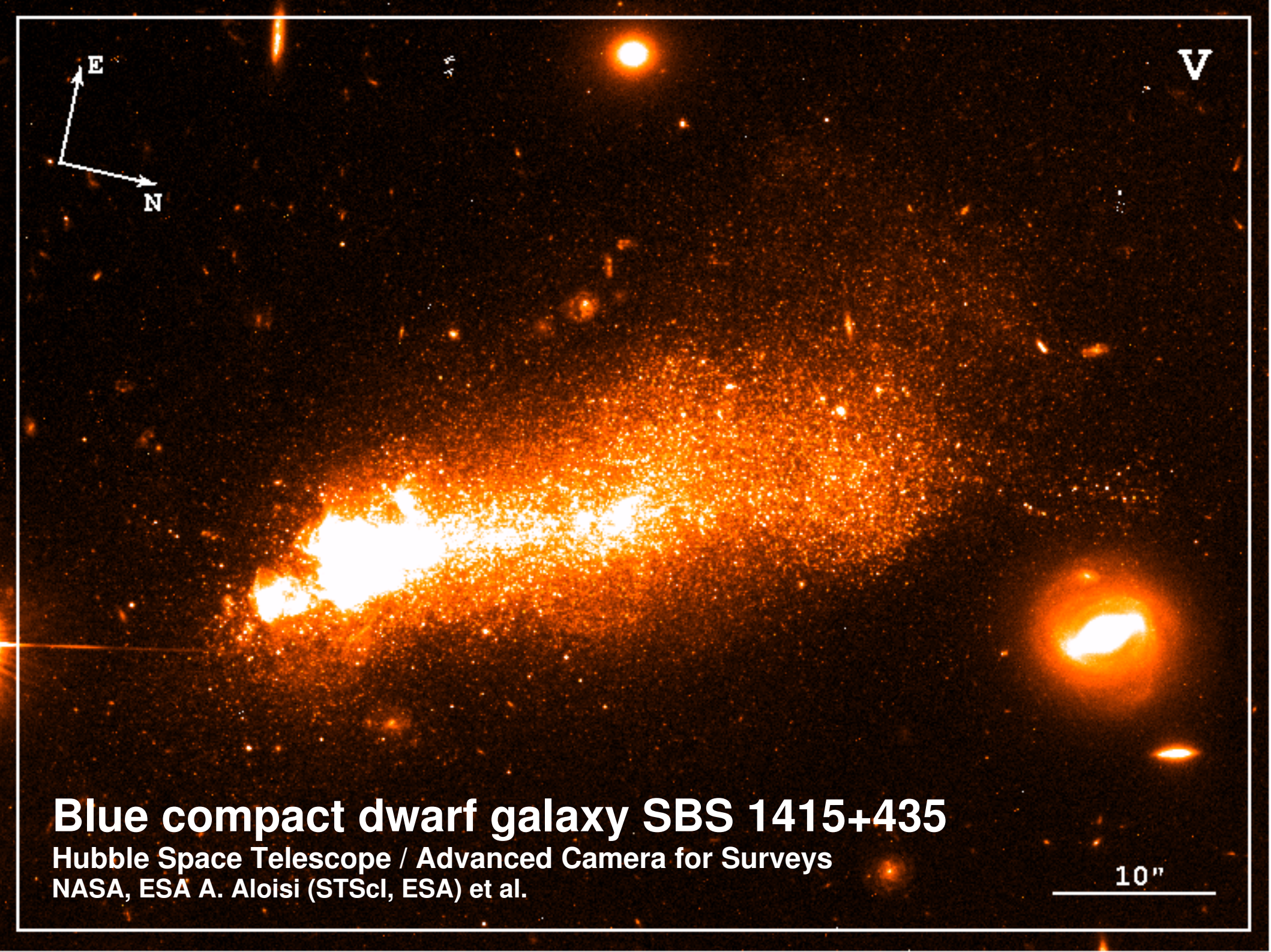




Spatial distributions of stellar populations in I Zw 18

(a) All stars
(b) MS, BL, SG
(c) AGB
(d) RGB?

Q.: Is the data 'deep' enough for registration of the RGB stars in the outer parts? Where is the 'halo'?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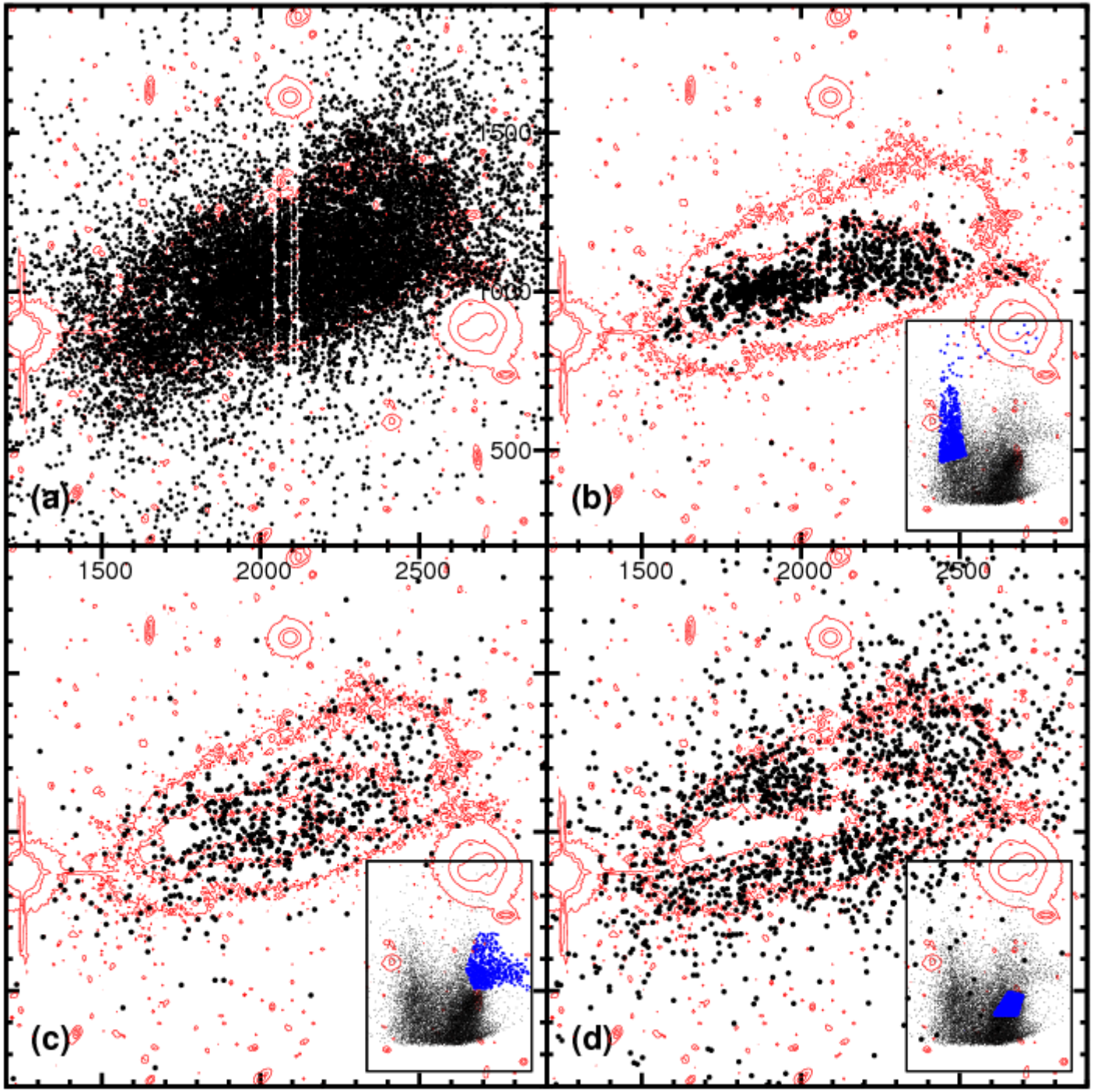
Blue compact dwarf galaxy SBS 1415+435
Hubble Space Telescope / Advanced Camera for Surveys
NASA, ESA A. Aloisi (STScI, ESA) et al.
10"



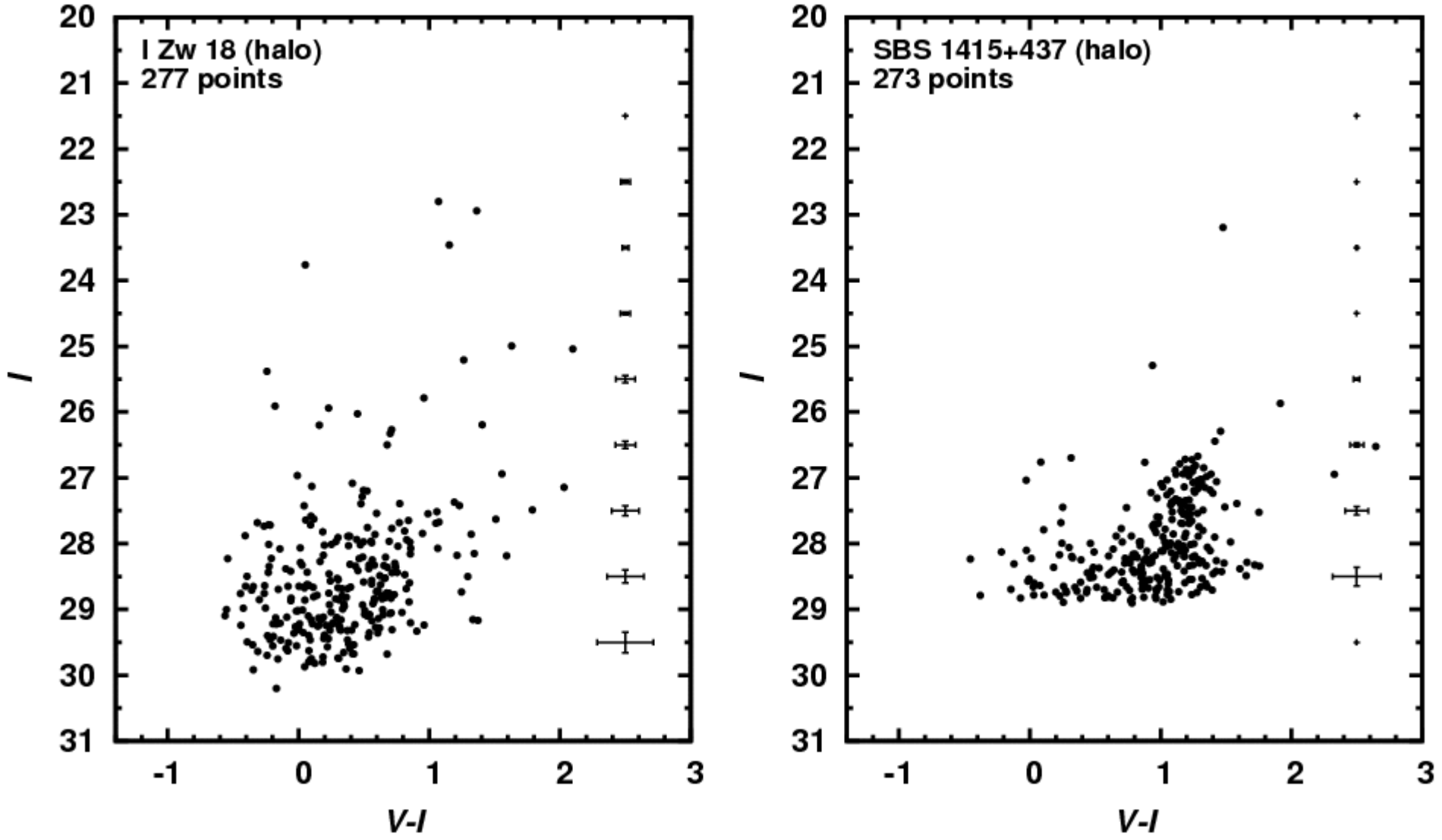
Spatial distributions of stellar populations in SBS 1415+437

(a) All stars
(b) MS, BL, SG
(c) AGB
(d) RGB

RGB stars occupy the largest area (though their distribution quite inhomogeneous)

'Halo' populations of I Zw 18 and SBS 1415+437

The number of points on the CMD of SBS 1415+437 (right) is scaled to the statistic of I Zw 18 (left). RGB for SBS 1415+437 is easily recognizable, but not for the I Zw 18 CMD.



Synthetic color-magnitude modelling. Ingredients.

1. Isochrone library: *Marigo et al. (2008)* with *log(t)*=6.5-10.2 and $\Delta log(t)$=0.01, Z=0.0004-0.001.

2. Initial mass function (IMF): α=-2.35 (*Salpeter (1955)*) with $M_{min}=0.07\ M_{\odot}$ and $M_{max}=120.0\ M_{\odot}$, $<M>=0.25\ M_{\odot}$.

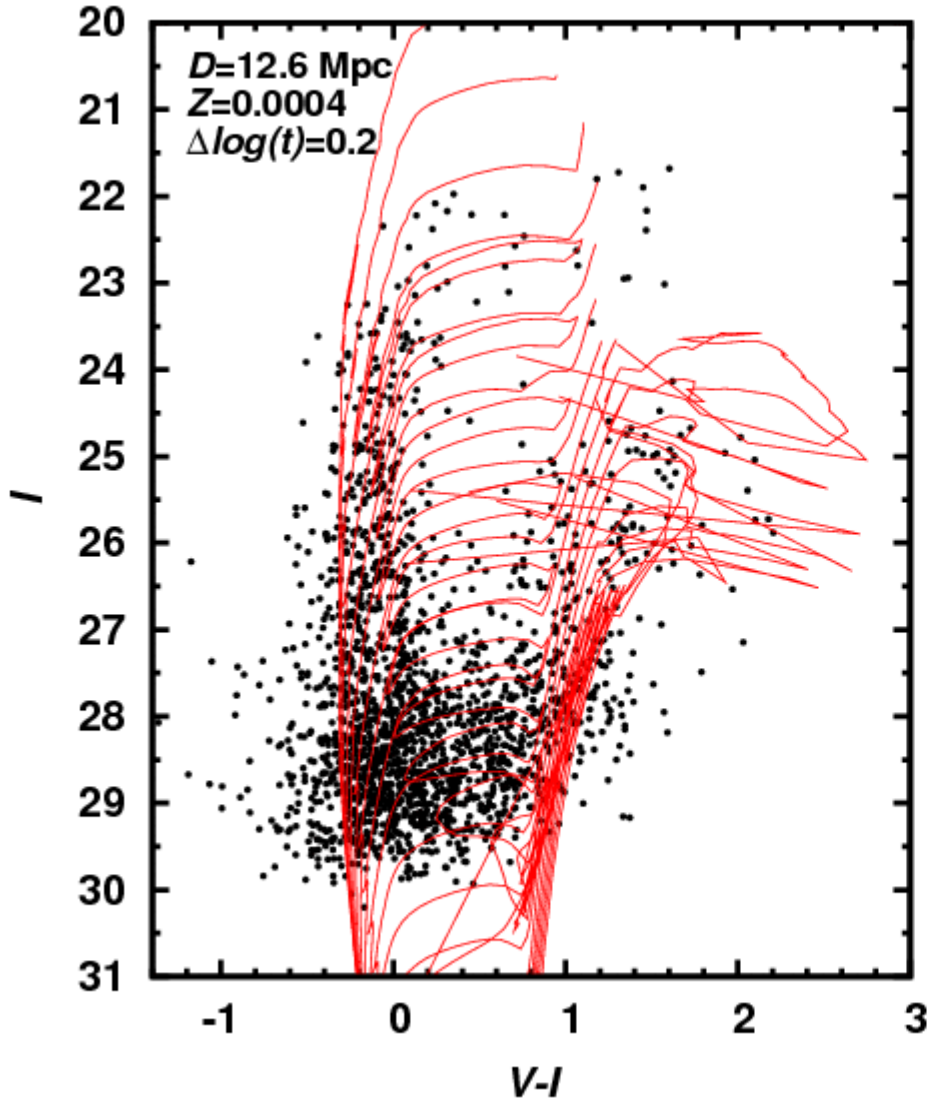
3. Binary fraction: β=0-0.3, flat IMF (q=0.5).

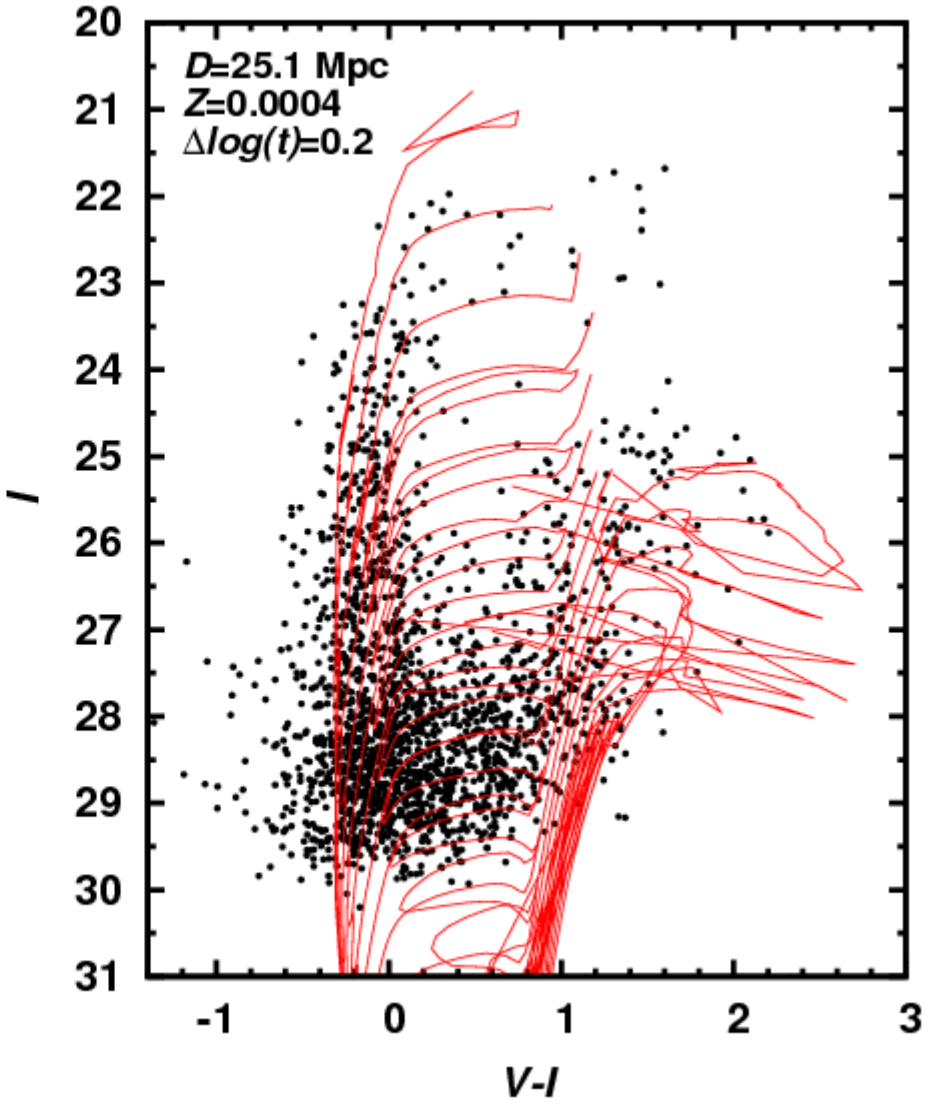
4. Simulating the observational conditions: artificial star tests (AST), recipes from *Aparicio & Gallart (1995), Gallart et al. (1996)*.

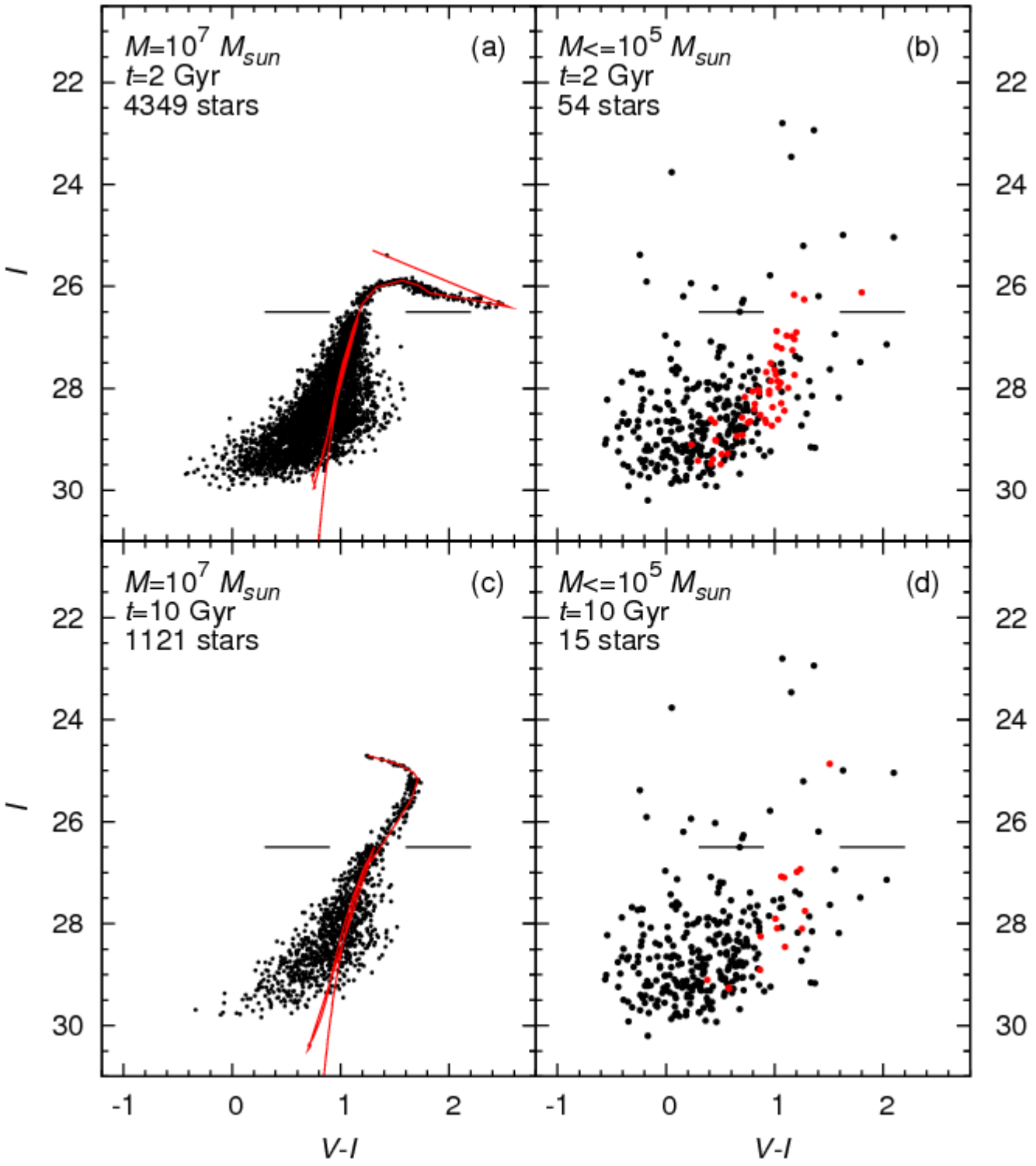
5. Star-formation history (SFH) recovering: recipes from *Dolphin (2002)*, *Harris & Zaritsky (2001),* minimization algorithm based on the downhill simplex method, uncertainties determined by Monte-Carlo tests.

Theoretical isochrones and the observed CMD

Isochrones superposed on the CMD of I Zw 18 for both distance moduli (m-M)=30.5 and 32.0 are near equally good at reproducing the observed distributions of stars.





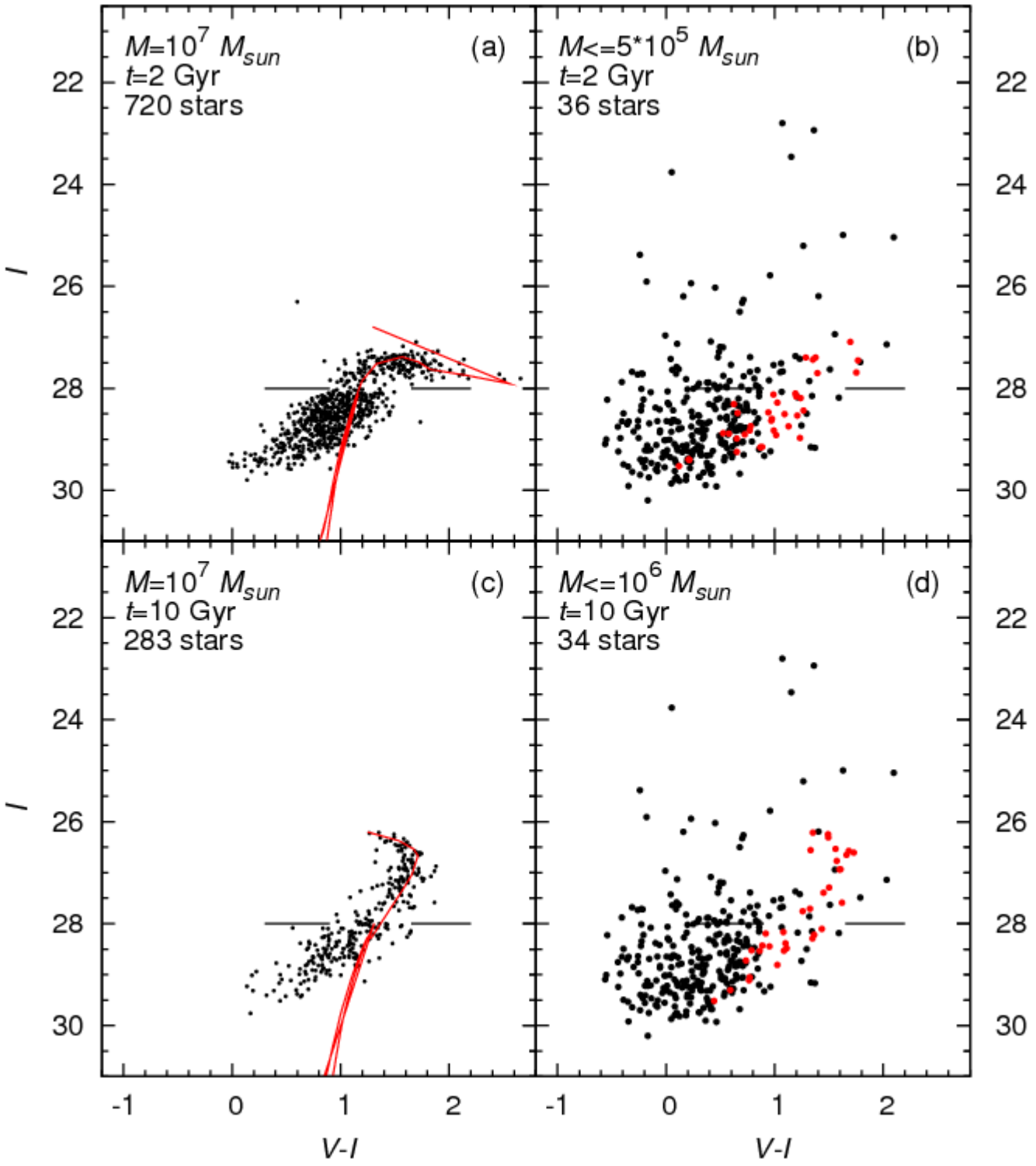


Searching the halo at *D*=12.6 Mpc

Synthetic CMDs of the 'artificial haloes' for a given distance, ages and total masses;

(b),(d): black points – observed distribution; red points – modelled;

For *D*=12.6 Mpc the data is well deep enough to permit the 'halo' registration if it is present.



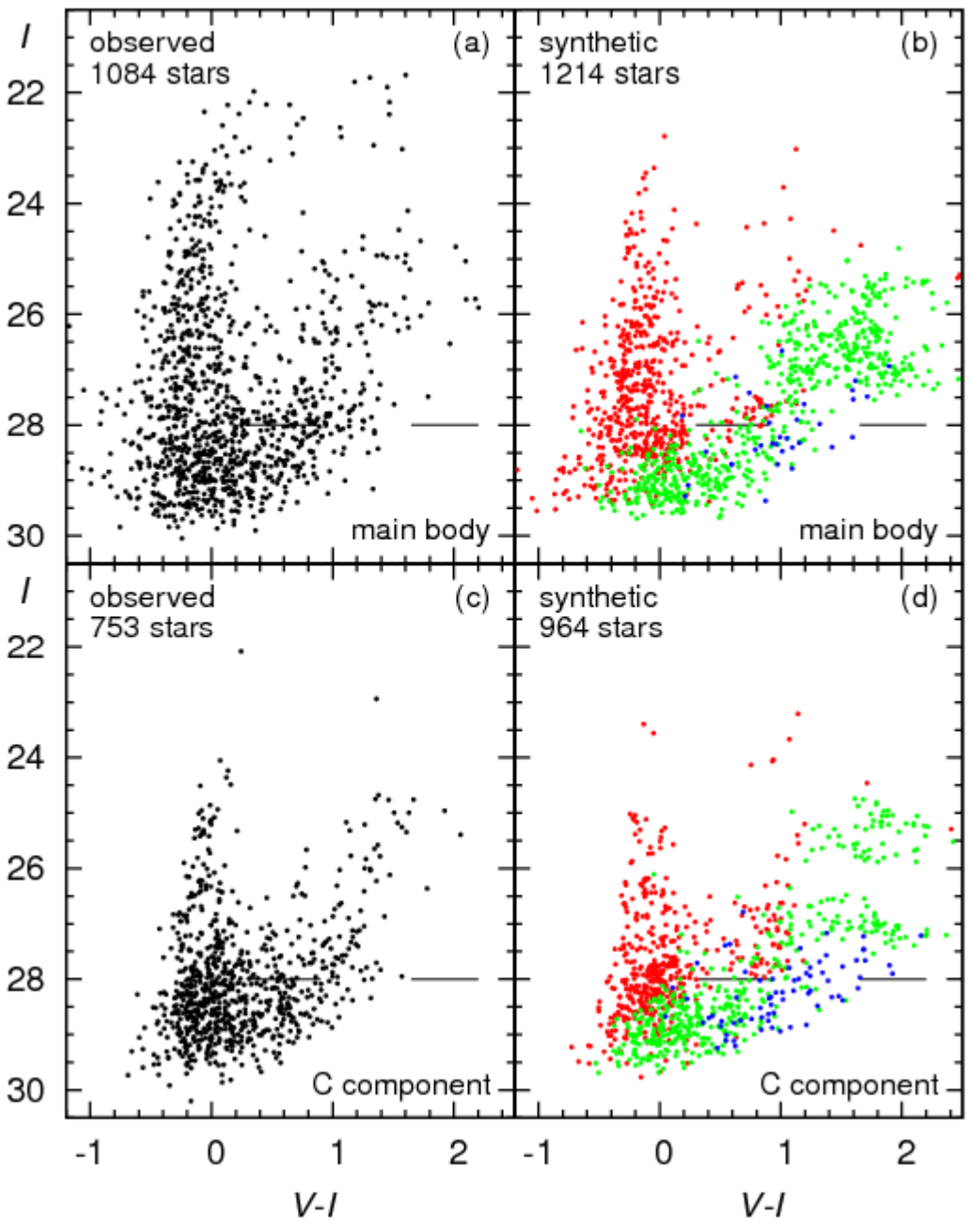
Searching the halo at *D*=25.0 Mpc

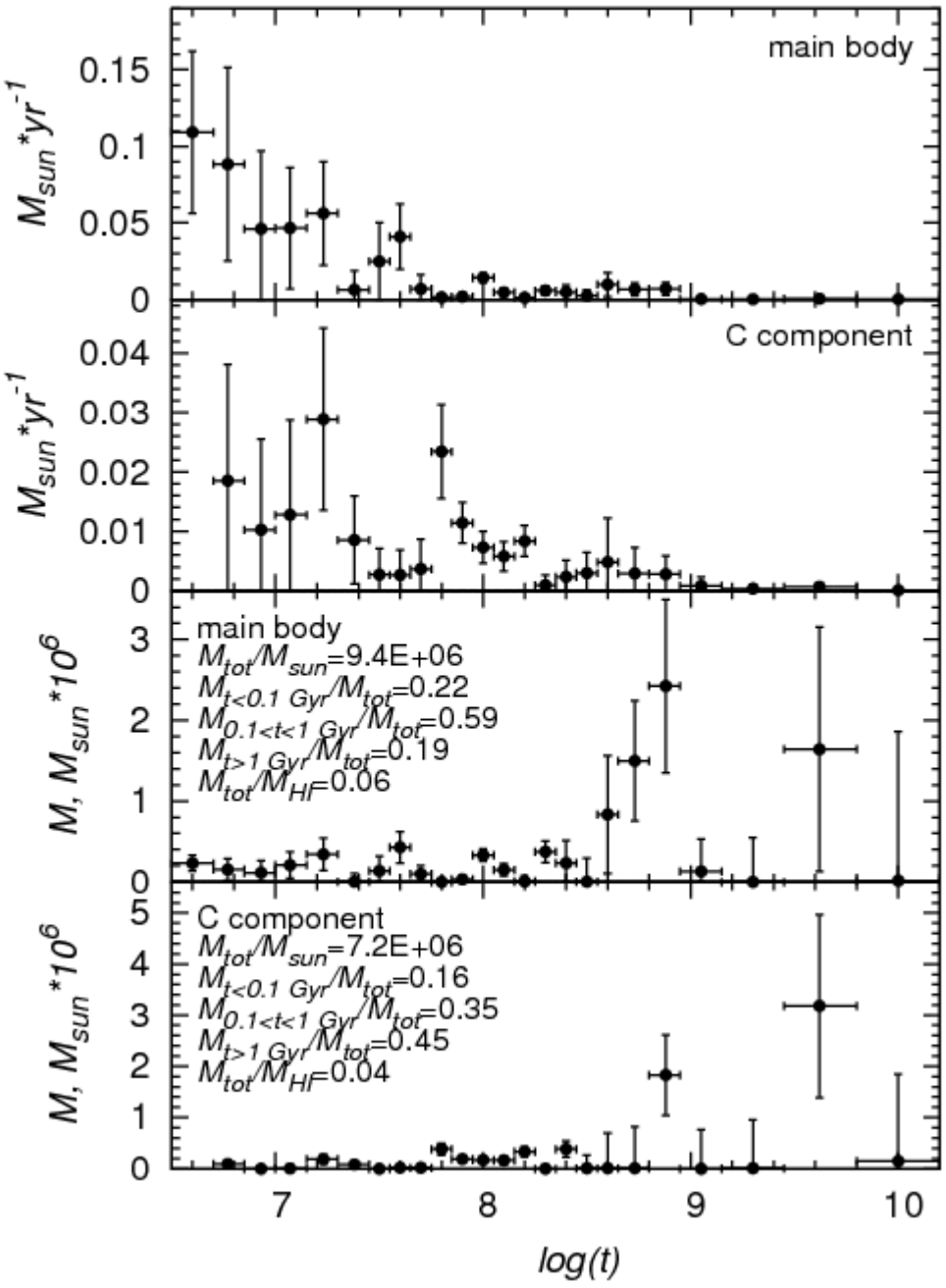
Synthetic CMDs of the 'artificial haloes' for a given distance, ages and total masses;

(b),(d): black points – observed distribution; red points – modelled;

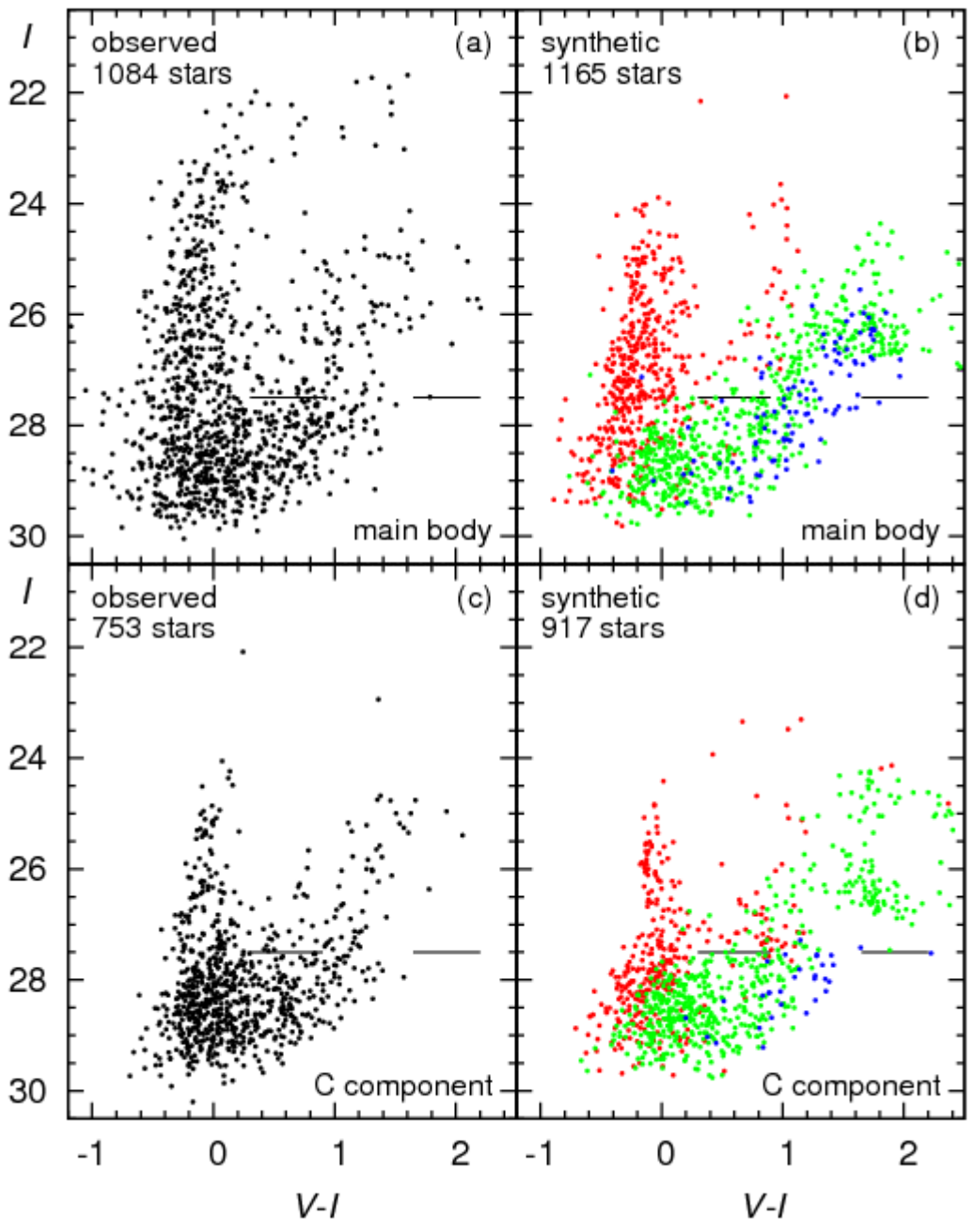
For *D*=25.0 Mpc the data is still deep enough to permit the 'halo' registration (if its stellar mass >$10^{6\text{-}7}$ $M_\odot$).

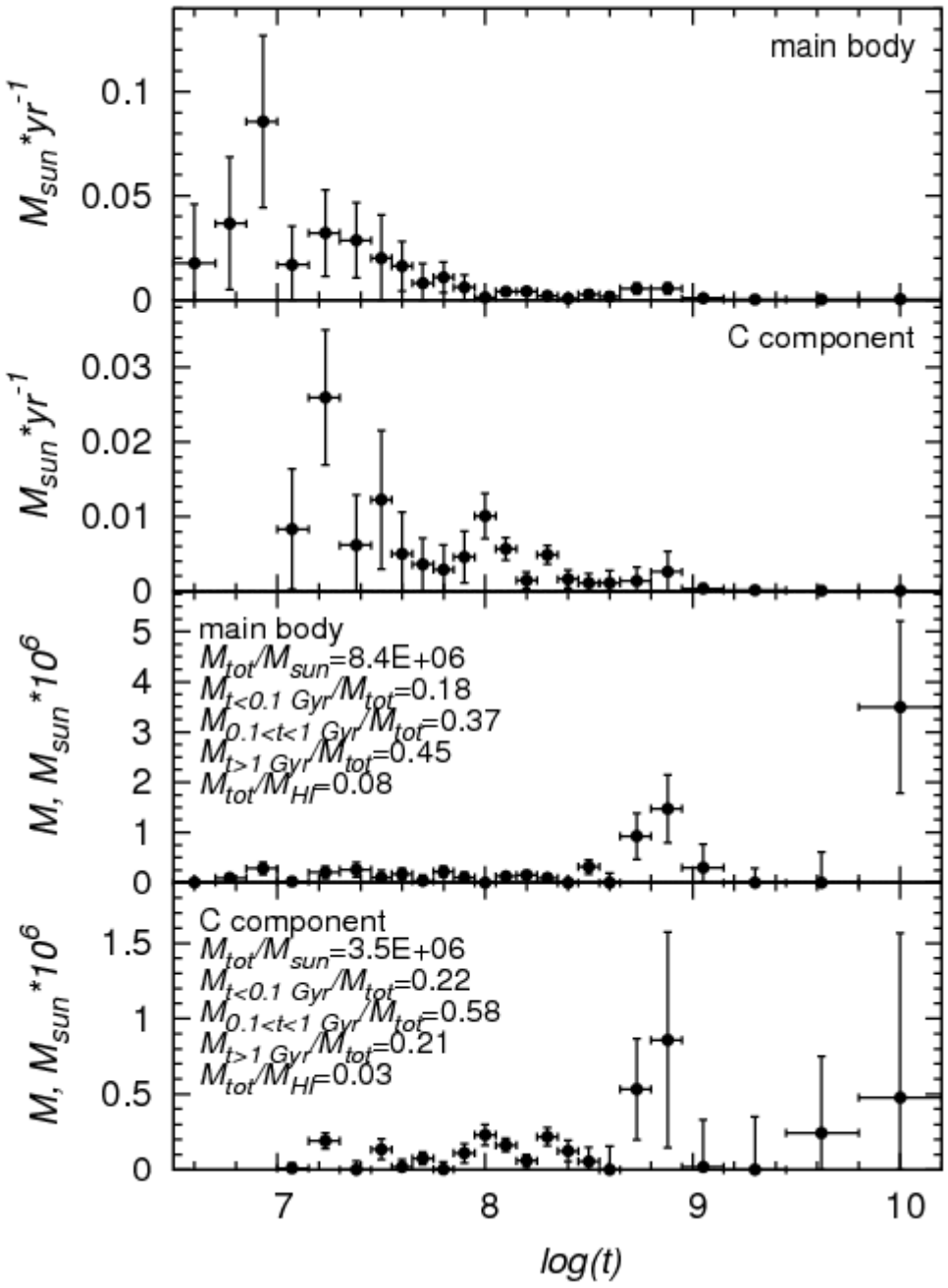
Star-formation history of the main body and the C component of I Zw 18 at *D*=25.0 Mpc



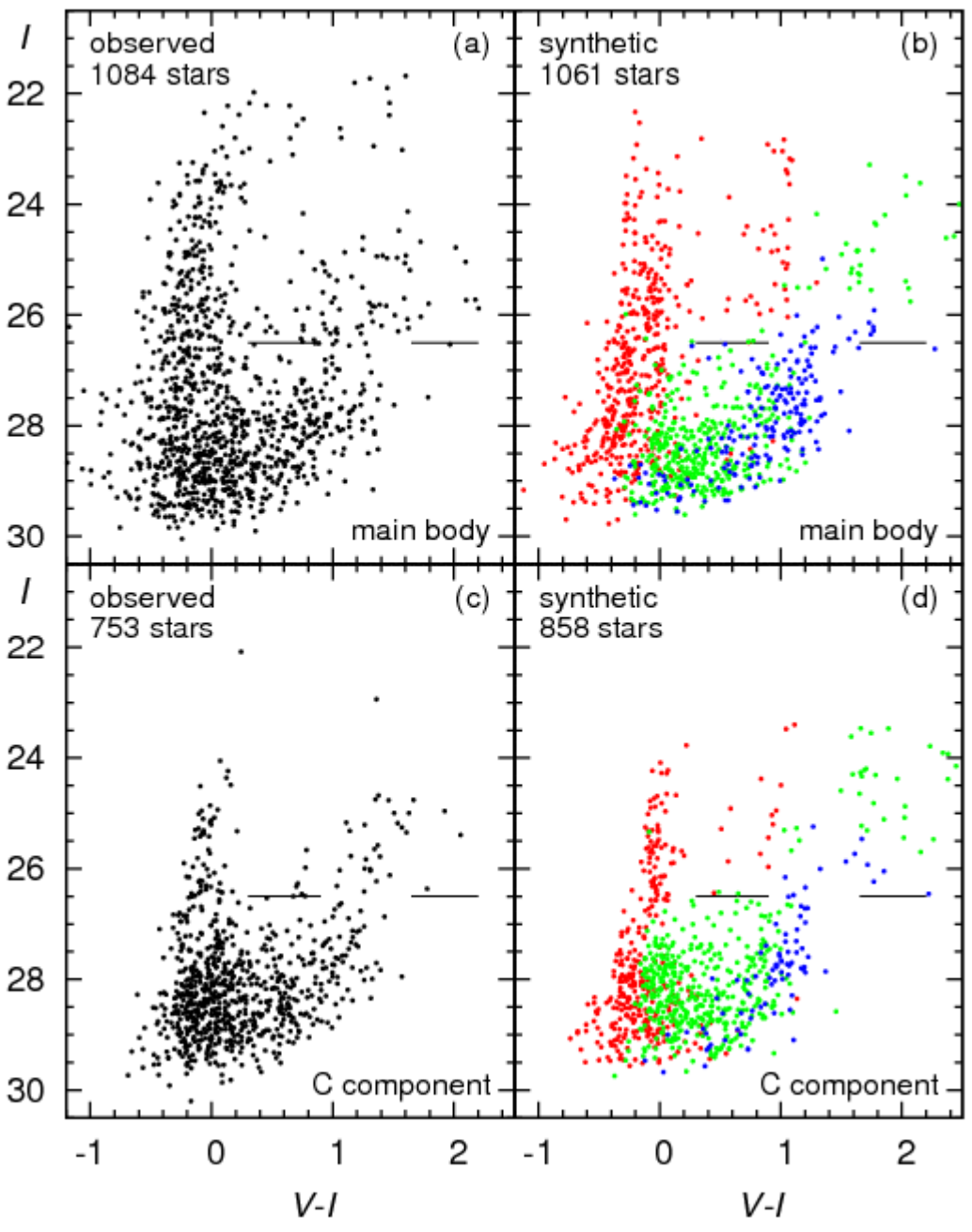


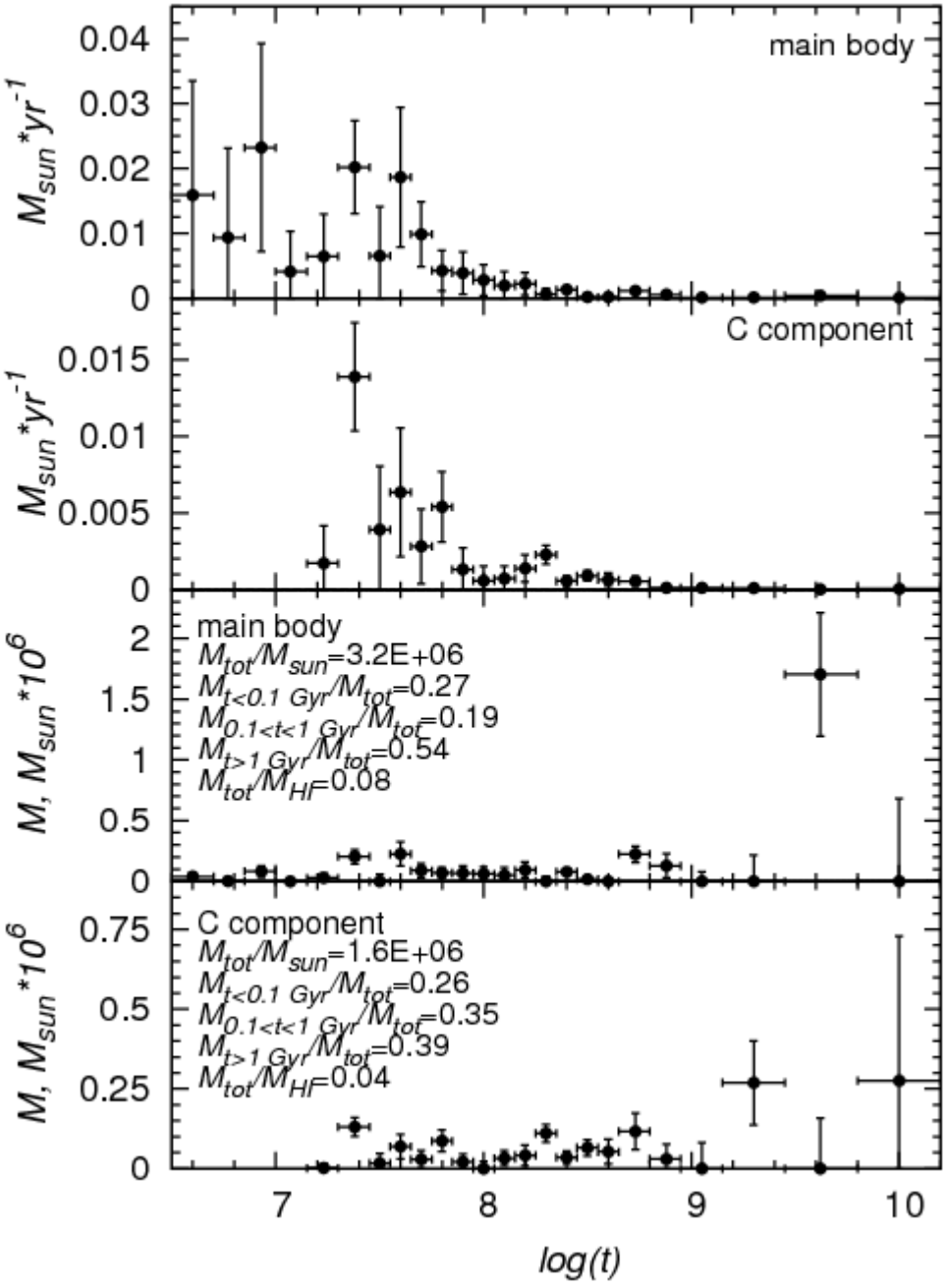
Star-formation history of the main body and the C component of I Zw 18 at *D*=20.0 Mpc



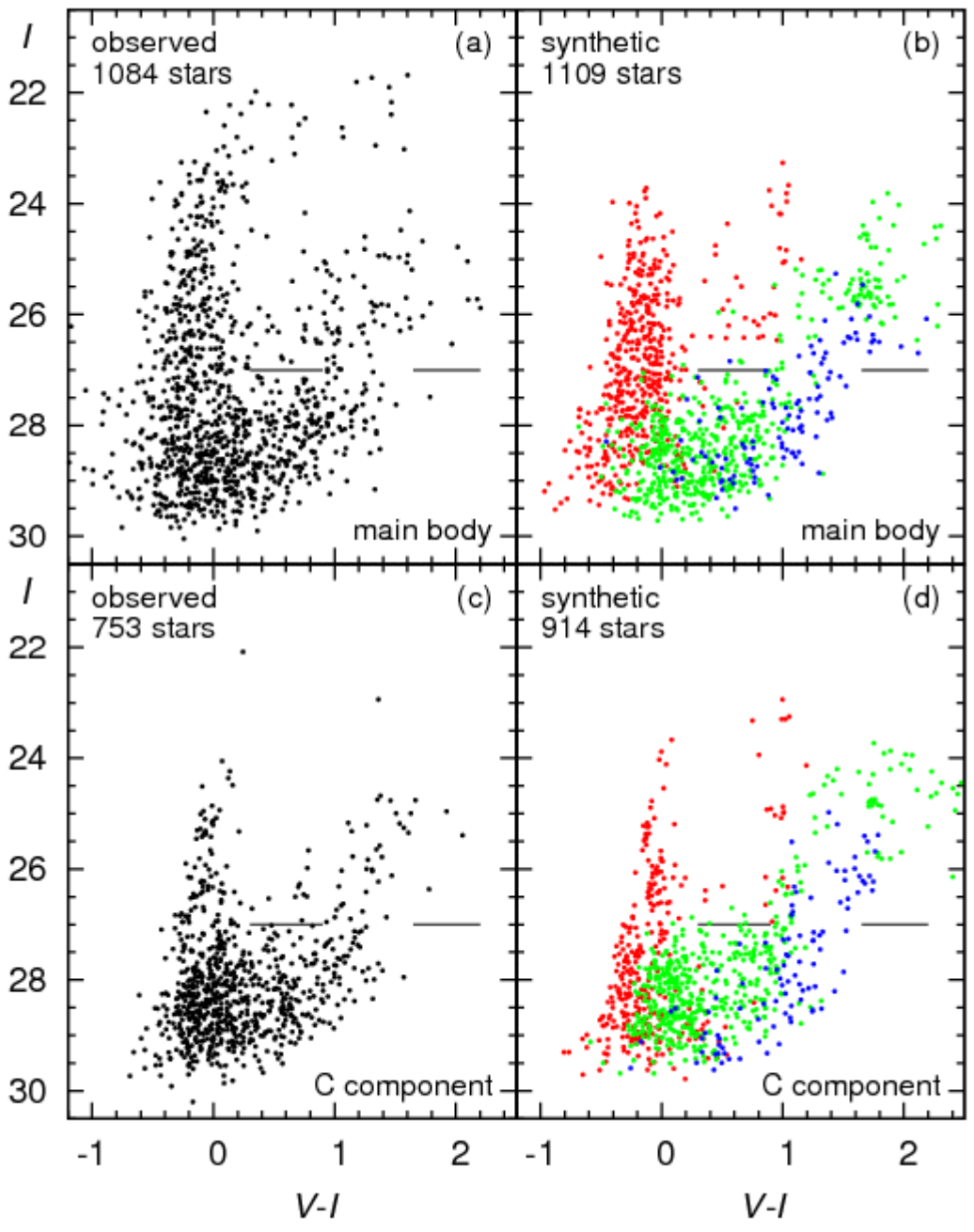


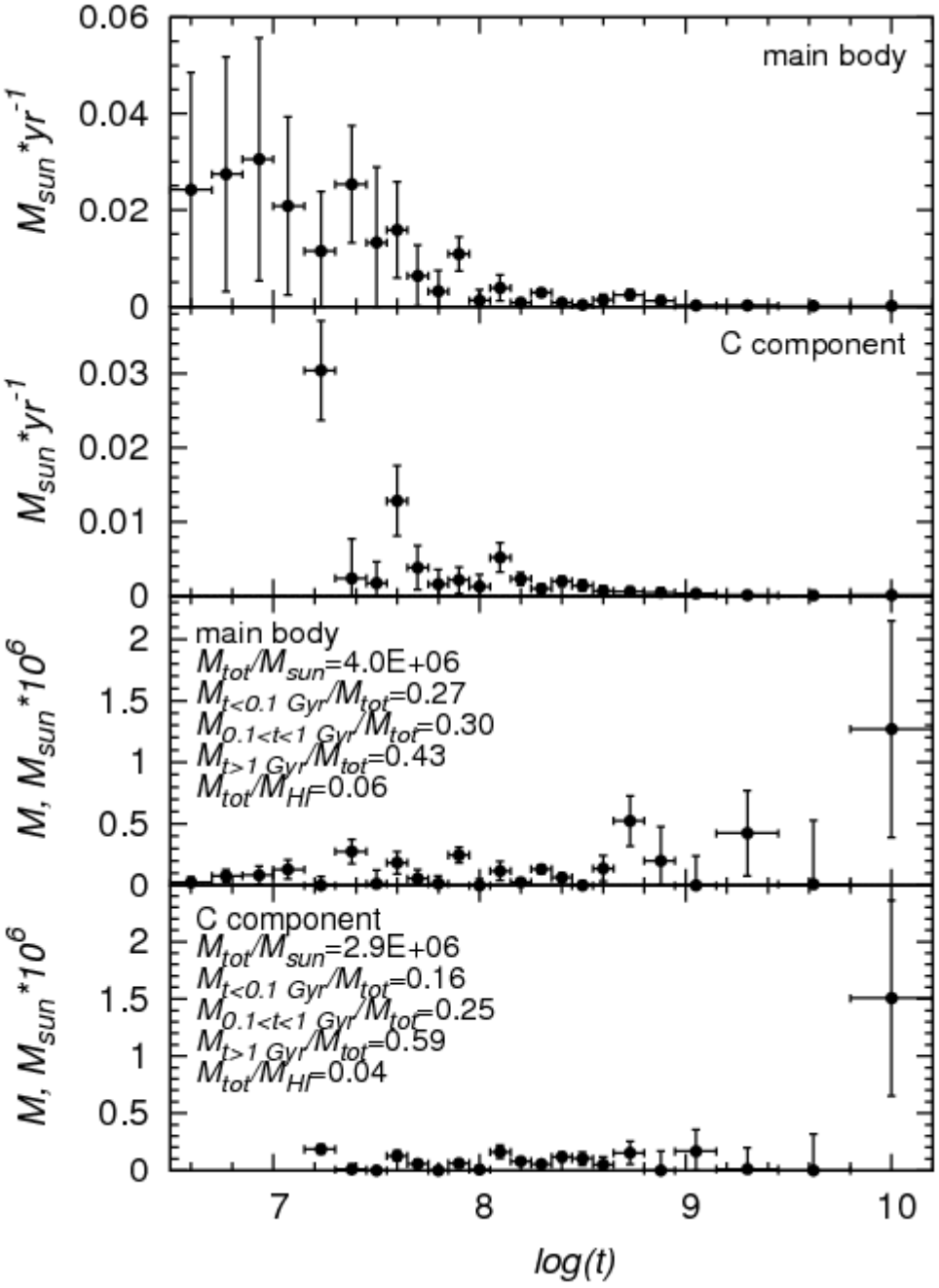
Star-formation history of the main body and the C component of I Zw 18 at D=12.6 Mpc



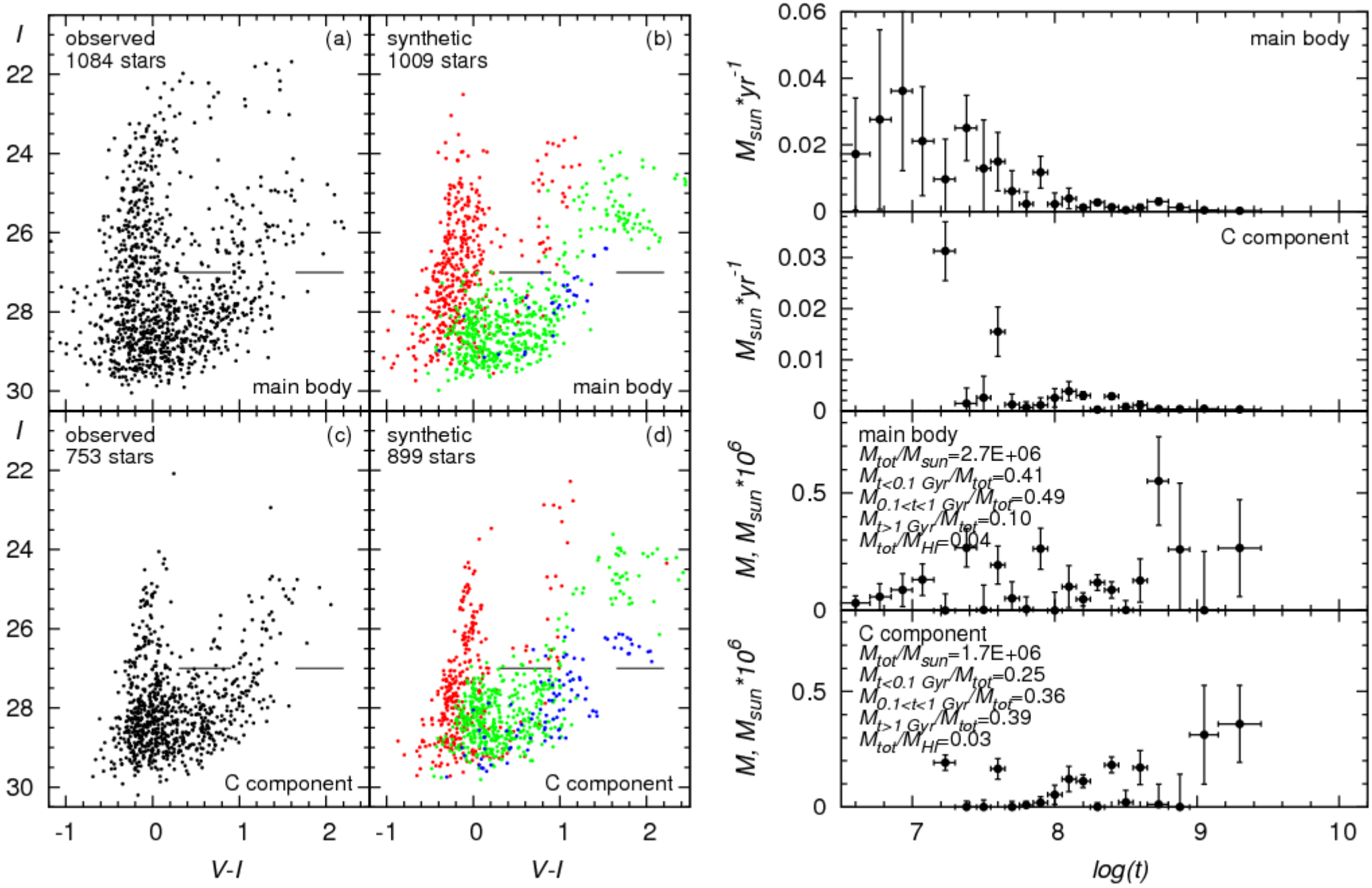


Star-formation history of the main body and the C component of I Zw 18 at D=16.0 Mpc

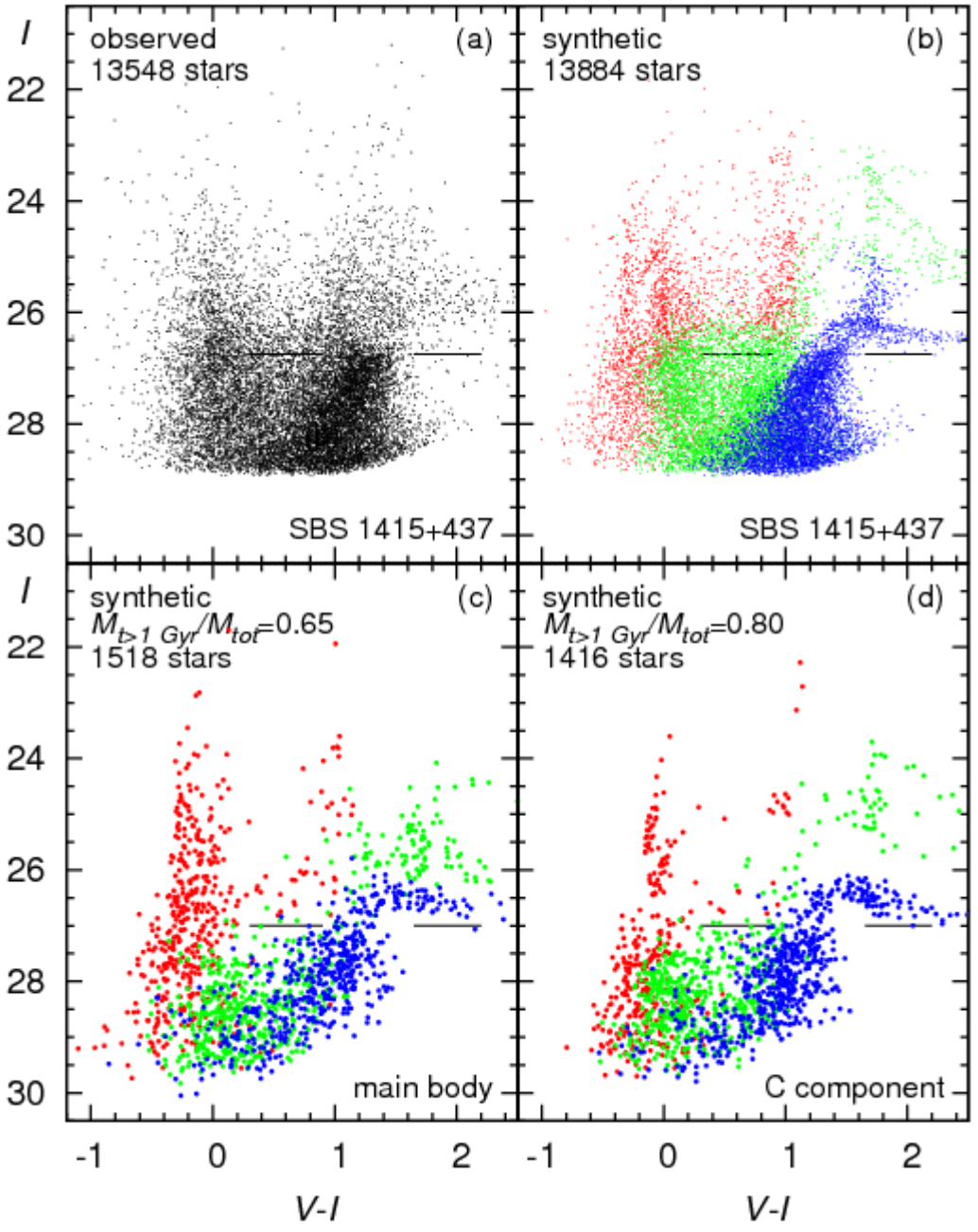


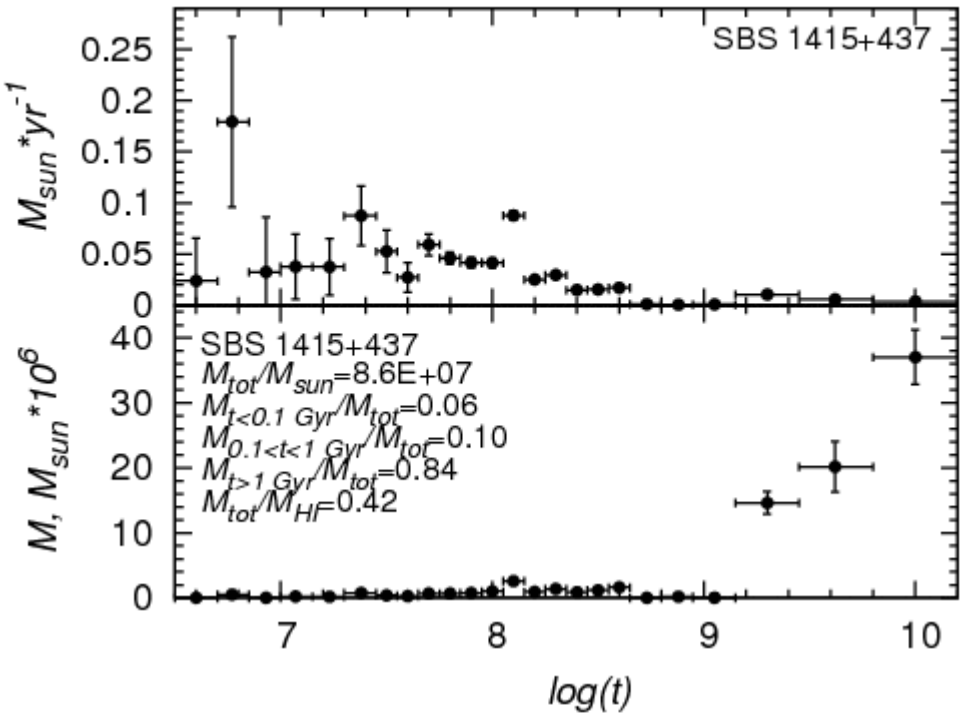


Star-formation history of the main body and the C component at D=16.0 Mpc and t_{SFH}<2 Gyr



Comparison with SBS 1415+437





The mass fraction of old stars (age>1 Gyr) for I Zw 18 (c,d) is chosen similar to SBS 1415+437.

Conclusions

1. The available data is well deep enough to detect the extended halo of the red giant branch stars in I Zw 18, but it is either absent or has very low mass (M<~10^5 $M_\odot$).

2. The distance to the galaxy is 16.0 Mpc or less, the models with the higher values show bad agreement with the observed CMDs.

3. The minimum age of the red giant branch stars in I Zw 18 is ~2 Gyr, the upper limit is uncertain due to the very poor statistics and large photometric errors.

4. The mass fraction of the old stars in I Zw 18 with ages more than 1 Gyr can be as high as ~0.5. The stars-to-gas mass ratio M^*/M(HI) can be 0.1 or less.

Thank you
for attention