

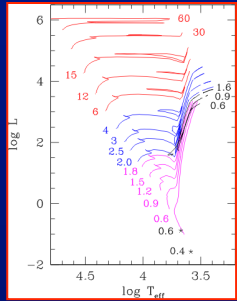
Building up synthetic color-magnitude diagrams

Santi Cassisi

INAF - Astronomical Observatory of Teramo, Italy

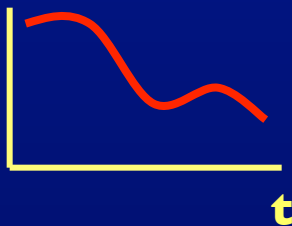
Computing a synthetic CMD

Ingredients



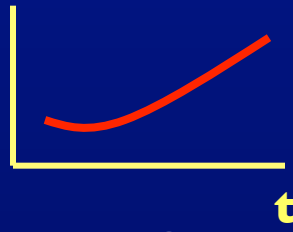
Stellar models

ψ



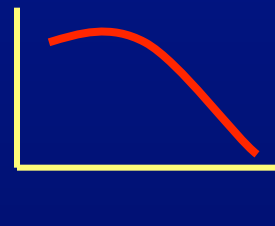
SFR

Z



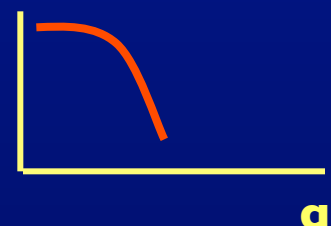
CEL

ϕ



IMF

β



Binaries

Computing method

Montecarlo



Age, metallicity and mass

Interpolation in the stellar evolution library



Luminosity and effective temperature

Bolometric corrections



Magnitudes and colors

Let us start with the simplest case: a Simple Stellar Population

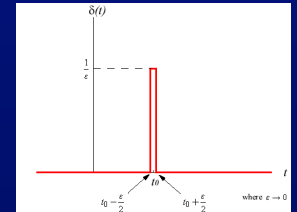
The stars must be coeval



Single star formation burst



Then the SFR function is represented
by a Dirac delta function



The stars must be
chemically homogenous



**All stars were BORN with
the same chemical composition**



The metallicity is constant

Synthetic CMD for a SSP: setting the parameters

let us assume that we want to compute a CMD for a SSP with:

- ✓ Age = 10000Myr
- ✓ $[Fe/H] = -1.3 \rightarrow Z = 0.002$ for an α -enhanced metal mixture
- ✓ He abundance $Y = 0.248$
- ✓ Number of objects in the simulation = 100000
- ✓ Initial mass function: Salpeter power law
- ✓ No binaries
- ✓ Observational plane: ACS@HST photometric system

Synthetic CMD for a SSP: selecting the stellar model library

BaSTI *A Bag of Stellar Tracks and Isochrones...*

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VLM extended scaled solar isochrones have been included

Scaled solar interpolated isochrones and $\eta=0$ models have been included


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INAF - Osservatorio Astronomico di Roma


URL: <http://www.ao-teramo.inaf.it/BASTI>

1 - selecting the metal mixture & He abundance...


Stellar Evolutionary models

 **SCALED SOLAR:**


- canonical
- non-canonical


 **α - ENHANCED:**

- canonical
- non canonical

 **ADDITIONAL MODELS:**

- He enhanced
- CNO/Na extreme
- White Dwarfs

 **Create Query on *BaSTI* DB**

 **WEB TOOL:**

- Isochrones - Tracks
- Luminosity Function
- Synthetic Color - Magnitude Diagrams
- Synthetic HB Generator

2 - selecting the metallicity...

Please choose tracks/isochrones for download from the following list of chemical compositions:

| Z | Y | [Fe/H] | [M/H] | normal | AGB extended |
|---------|--------|--------|-------|---|---|
| 0.00001 | 0.245 | -3.62 | -3.27 | <input type="checkbox"/> $\eta=0.4$ | |
| 0.0001 | 0.245 | -2.62 | -2.27 | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ |
| 0.0003 | 0.245 | -2.14 | -1.79 | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ |
| 0.0006 | 0.246 | -1.84 | -1.49 | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ |
| 0.001 | 0.246 | -1.62 | -1.27 | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ |
| 0.002 | 0.248 | -1.31 | -0.96 | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ |
| 0.004 | 0.251 | -1.01 | -0.66 | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ |
| 0.008 | 0.256 | -0.70 | -0.35 | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ |
| 0.01 | 0.259 | -0.60 | -0.25 | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ |
| 0.0198 | 0.2734 | -0.29 | 0.06 | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ |
| 0.03 | 0.288 | -0.09 | 0.26 | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ |
| 0.04 | 0.303 | 0.05 | 0.40 | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ | <input type="checkbox"/> $\eta=0.2$ <input type="checkbox"/> $\eta=0.4$ |
| 0.05 | 0.316 | 0.16 | 0.51 | <input type="checkbox"/> $\eta=0.4$ | |

3 - selecting the type of models...

You are now in:

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- [Evolutionary models](#)
- [HB models](#)
- [Isochrones](#)

4 - selecting the Photometric system...

3 - selecting the type of models...

You are now in:

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- [Evolutionary models](#)
- [HB models](#)
- [Isochrones](#)

Y= 0.248, Z = 0.002 - Evolutionary models

- [M = 0.50 Mo](#) ■ [M = 0.55 Mo](#) ■ [M = 0.60 Mo](#) ■ [M = 0.70 Mo](#) ■ [M = 0.75 Mo](#)
- [M = 0.78 Mo](#) ■ [M = 0.80 Mo](#) ■ [M = 0.90 Mo](#) ■ [M = 1.00 Mo](#) ■ [M = 1.10 Mo](#)
- [M = 1.20 Mo](#) ■ [M = 1.30 Mo](#) ■ [M = 1.40 Mo](#) ■ [M = 1.50 Mo](#) ■ [M = 1.60 Mo](#)
- [M = 1.70 Mo](#) ■ [M = 1.80 Mo](#) ■ [M = 1.90 Mo](#) ■ [M = 2.00 Mo](#) ■ [M = 2.20 Mo](#)
- [M = 2.40 Mo](#) ■ [M = 2.60 Mo](#) ■ [M = 2.80 Mo](#) ■ [M = 3.00 Mo](#) ■ [M = 3.50 Mo](#)
- [M = 4.00 Mo](#) ■ [M = 4.50 Mo](#) ■ [M = 5.00 Mo](#) ■ [M = 5.50 Mo](#) ■ [M = 6.00 Mo](#)
- [M = 6.50 Mo](#) ■ [M = 7.00 Mo](#) ■ [M = 7.50 Mo](#) ■ [M = 8.00 Mo](#) ■ [M = 8.50 Mo](#)
- [M = 9.00 Mo](#) ■ [M = 9.50 Mo](#) ■ [M = 10.00 Mo](#)

Download all tracks (as a single .tar.gz file)

[UBVRIJKL bands](#) [ACS HST bands](#)

[Stroemgren bands](#) [Sloan bands](#)

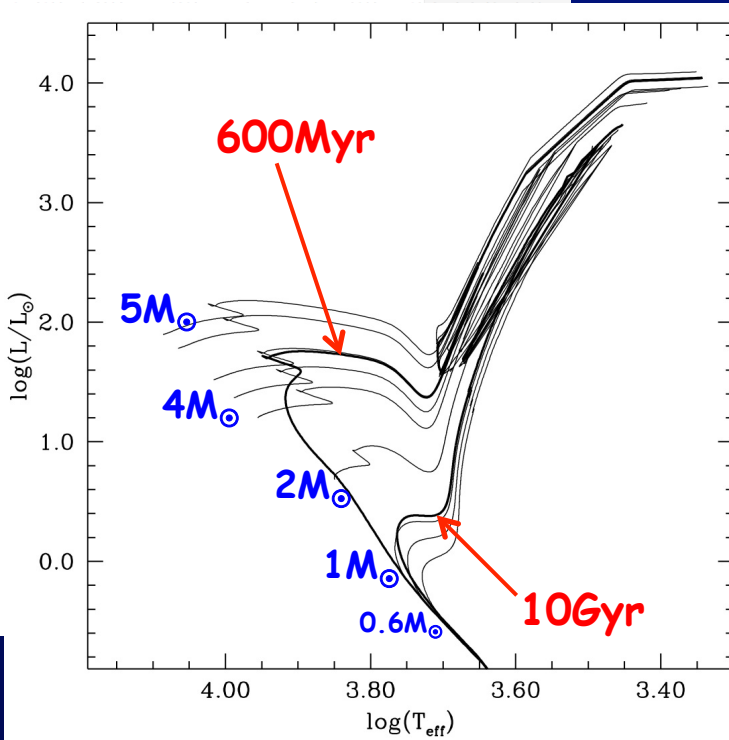
[Walraven bands](#) [WFC2 HST bands](#)

[WFC3 HST bands](#) [WFC3-IR HST bands](#)

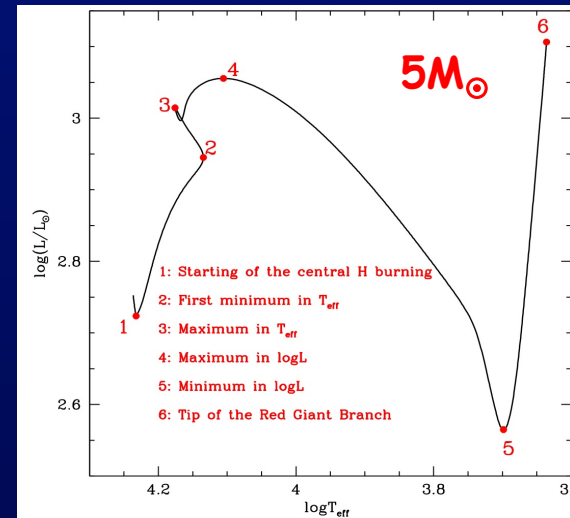
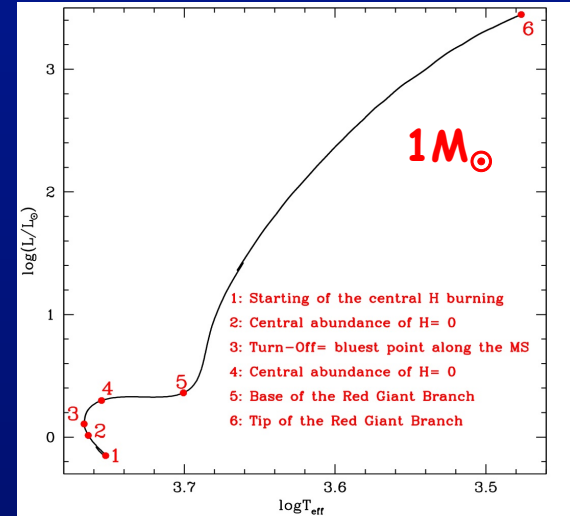
4 - selecting the Photometric system...


```
# Evol. track by Pietrinferni - Cassisi - Salaris - Castelli 2008 :: Standard Model
# Alpha-enhanced model & transformations for ACS (Castelli 2008)
# Np= 1190 [M/H]=-0.963 Z= 0.0020 Y= 0.248 Mass= 1.000 normalized: 20 12 2014
```

| # | log(age) | (M/Mo) | log(L/Lo) | logTe | F435W | F475W | F555W | F606W | F625W | F775W | F814W |
|----------------|--------------|---------|-----------|--------|--------|--------|--------|--------|--------|--------|-------|
| -9.00000000000 | 1.0000000000 | 0.18235 | 3.82844 | 4.7031 | 4.5760 | 4.3633 | 4.2445 | 4.1187 | 3.8701 | 3.8453 | |
| 7.16377092359 | 1.0000000000 | 0.18274 | 3.82845 | 4.7021 | 4.5750 | 4.3624 | 4.2435 | 4.1177 | 3.8691 | 3.8443 | |
| 7.46480091925 | 1.0000000000 | 0.18313 | 3.82845 | 4.7011 | 4.5740 | 4.3614 | 4.2425 | 4.1167 | 3.8681 | 3.8433 | |
| 7.64089217831 | 1.0000000000 | 0.18352 | 3.82845 | 4.7001 | 4.5730 | 4.3604 | 4.2415 | 4.1157 | 3.8672 | 3.8423 | |
| 7.76583091492 | 1.0000000000 | 0.18392 | 3.82845 | 4.6991 | 4.5720 | 4.3594 | 4.2405 | 4.1147 | 3.8662 | 3.8414 | |
| 7.86274092793 | 1.0000000000 | 0.18431 | 3.82845 | 4.6981 | 4.5710 | 4.3584 | 4.2395 | 4.1137 | 3.8652 | 3.8404 | |
| 7.94192217397 | 1.0000000000 | 0.18470 | 3.82845 | 4.6971 | 4.5700 | 4.3574 | 4.2385 | 4.1127 | 3.8642 | 3.8394 | |
| 8.00886896360 | 1.0000000000 | 0.18509 | 3.82846 | 4.6961 | 4.5690 | 4.3564 | 4.2375 | 4.1118 | 3.8632 | 3.8384 | |
| 8.06686091058 | 1.0000000000 | 0.18548 | 3.82846 | 4.6951 | 4.5680 | 4.3554 | 4.2365 | 4.1108 | 3.8623 | 3.8374 | |
| 8.11801343303 | 1.0000000000 | 0.18593 | 3.82846 | 4.6939 | 4.5668 | 4.3542 | 4.2354 | 4.1096 | 3.8611 | 3.8363 | |
| 8.16377092359 | 1.0000000000 | 0.18677 | 3.82849 | 4.6917 | 4.5646 | 4.3521 | 4.2333 | 4.1076 | 3.8591 | 3.8343 | |
| 8.20516308075 | 1.0000000000 | 0.18760 | 3.82852 | 4.6895 | 4.5624 | 4.3500 | 4.2312 | 4.1055 | 3.8571 | 3.8323 | |
| 8.24295216964 | 1.0000000000 | 0.18844 | 3.82855 | 4.6872 | 4.5602 | 4.3478 | 4.2291 | 4.1034 | 3.8551 | 3.8303 | |
| 8.27771427590 | 1.0000000000 | 0.18927 | 3.82859 | 4.6850 | 4.5580 | 4.3457 | 4.2270 | 4.1013 | 3.8531 | 3.8283 | |
| 8.30989895927 | 1.0000000000 | 0.19009 | 3.82862 | 4.6828 | 4.5559 | 4.3436 | 4.2249 | 4.0993 | 3.8511 | 3.8264 | |
| 8.33986218265 | 1.0000000000 | | | | | | | | | | |
| 8.36789090625 | 1.0000000000 | | | | | | | | | | |
| 8.39421984497 | 1.0000000000 | | | | | | | | | | |
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| 8.80722360008 | 1.0000000000 | | | | | | | | | | |
| 8.81698343737 | 1.0000000000 | | | | | | | | | | |
| 8.82652875527 | 1.0000000000 | | | | | | | | | | |
| 8.83586878153 | 1.0000000000 | | | | | | | | | | |
| 8.84501216097 | 1.0000000000 | | | | | | | | | | |
| 8.85396700362 | 1.0000000000 | | | | | | | | | | |
| 8.86274092793 | 1.0000000000 | | | | | | | | | | |



The key points along the evolutionary track



```
=====
0.5000 0050z203y248aes.nor_acs_hst
0.5500 0055z203y248aes.nor_acs_hst
0.6000 0060z203y248aes.nor_acs_hst
0.7000 0070z203y248aes.nor_acs_hst
0.7500 0075z203y248aes.nor_acs_hst
0.8000 0080z203y248aes.nor_acs_hst
0.9000 0090z203y248aes.nor_acs_hst
1.0000 0100z203y248aes.nor_acs_hst
1.1000 0110z203y248aes.nor_acs_hst
1.2000 0120z203y248aes.nor_acs_hst
1.3000 0130z203y248aes.nor_acs_hst
1.4000 0140z203y248aes.nor_acs_hst
1.5000 0150z203y248aes.nor_acs_hst
=====
```

```
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0.4890 0489m08z203y248aes.nor_acs_hst
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0.4950 0495m08z203y248aes.nor_acs_hst
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0.5100 0510m08z203y248aes.nor_acs_hst
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0.6100 0610m08z203y248aes.nor_acs_hst
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0.7200 0720m08z203y248aes.nor_acs_hst
0.7400 0740m08z203y248aes.nor_acs_hst
0.7600 0760m08z203y248aes.nor_acs_hst
0.7800 0780m08z203y248aes.nor_acs_hst
0.8000 0800m08z203y248aes.nor_acs_hst
```

Building the stellar model library

```

MASSES: 0.5000 FILENAMES: 0050z203y248aes.nor_acs_hst
MASSES: 0.5500 FILENAMES: 0055z203y248aes.nor_acs_hst
MASSES: 0.6000 FILENAMES: 0060z203y248aes.nor_acs_hst
MASSES: 0.7000 FILENAMES: 0070z203y248aes.nor_acs_hst
MASSES: 0.7500 FILENAMES: 0075z203y248aes.nor_acs_hst
MASSES: 0.8000 FILENAMES: 0080z203y248aes.nor_acs_hst
MASSES: 0.9000 FILENAMES: 0090z203y248aes.nor_acs_hst
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MASSES: 1.1000 FILENAMES: 0110z203y248aes.nor_acs_hst
MASSES: 1.2000 FILENAMES: 0120z203y248aes.nor_acs_hst
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MASSES: 1.4000 FILENAMES: 0140z203y248aes.nor_acs_hst
MASSES: 1.5000 FILENAMES: 0150z203y248aes.nor_acs_hst

READING NOW ... 0050z203y248aes.nor_acs_hst
READING NOW ... 0055z203y248aes.nor_acs_hst
READING NOW ... 0060z203y248aes.nor_acs_hst
READING NOW ... 0070z203y248aes.nor_acs_hst
READING NOW ... 0075z203y248aes.nor_acs_hst
READING NOW ... 0080z203y248aes.nor_acs_hst
READING NOW ... 0090z203y248aes.nor_acs_hst
READING NOW ... 0100z203y248aes.nor_acs_hst
READING NOW ... 0110z203y248aes.nor_acs_hst
READING NOW ... 0120z203y248aes.nor_acs_hst
READING NOW ... 0130z203y248aes.nor_acs_hst
READING NOW ... 0140z203y248aes.nor_acs_hst
READING NOW ... 0150z203y248aes.nor_acs_hst

SYNTESYS AVAILABLE IN THE RANGE 1583.8 - 17046.6 MYRS

```

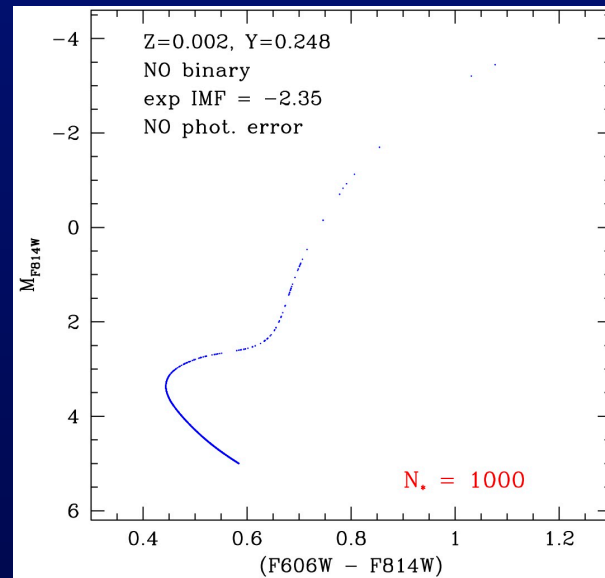
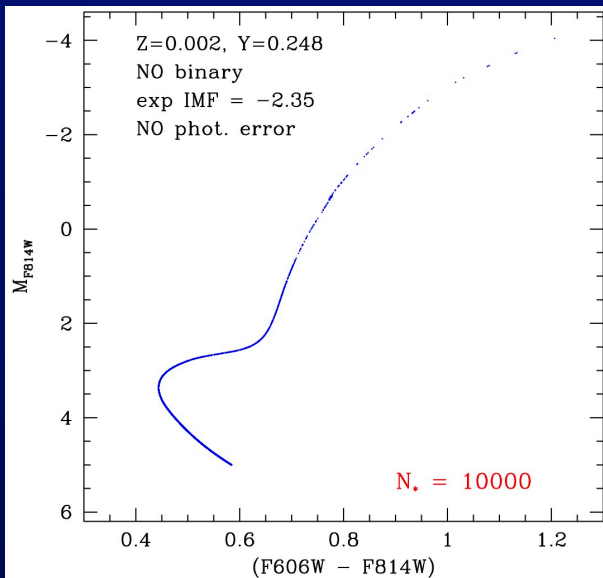
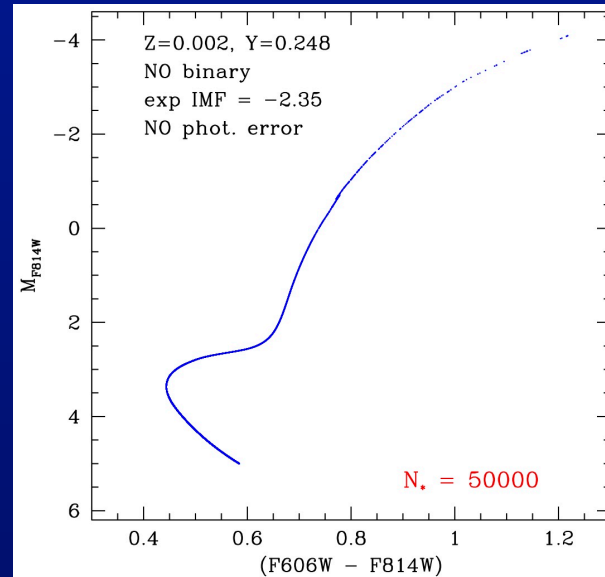
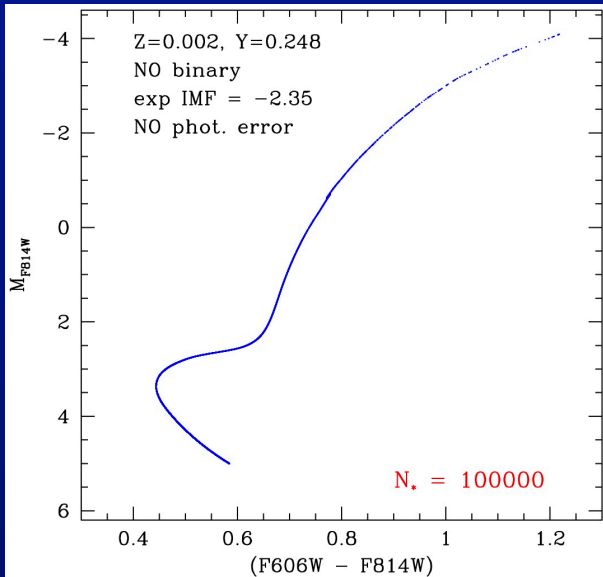
DATA FOR THE INITIALIZATION OF THE SYNTETHIC CMD

Number of STAR AGE
N.BINARY N.of CROWDED ExpMF VLIM QSPREAD <M_HB> SIGMAMHB BINfL
N.of error point (m-M)
V1 ERRV1 ER RBV1
V2 ERRV2

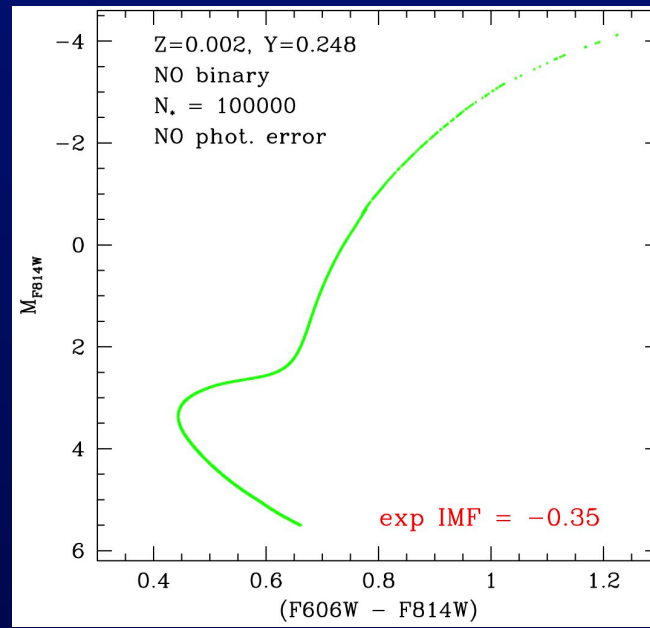
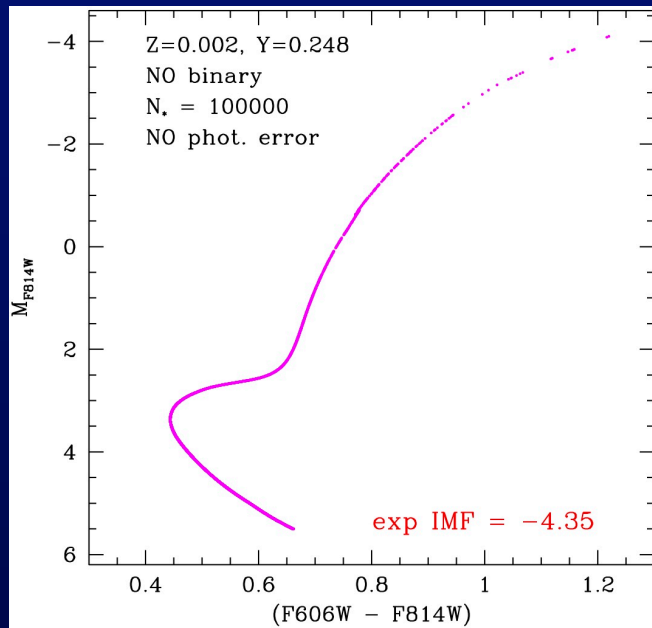
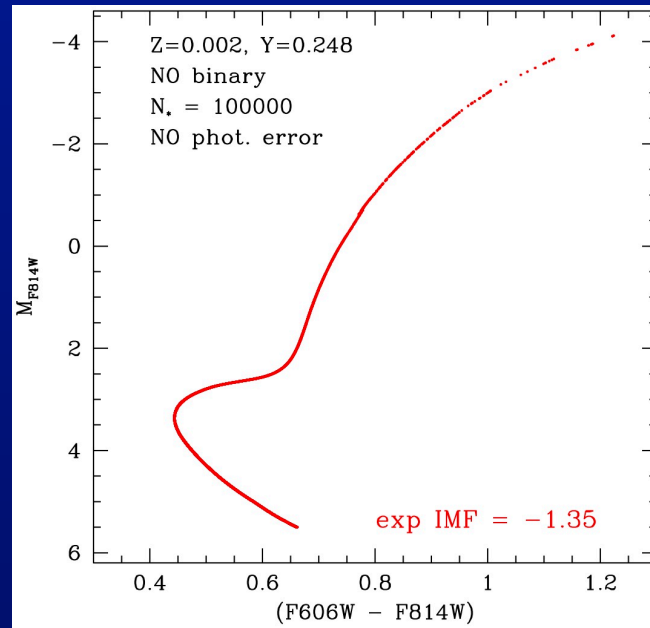
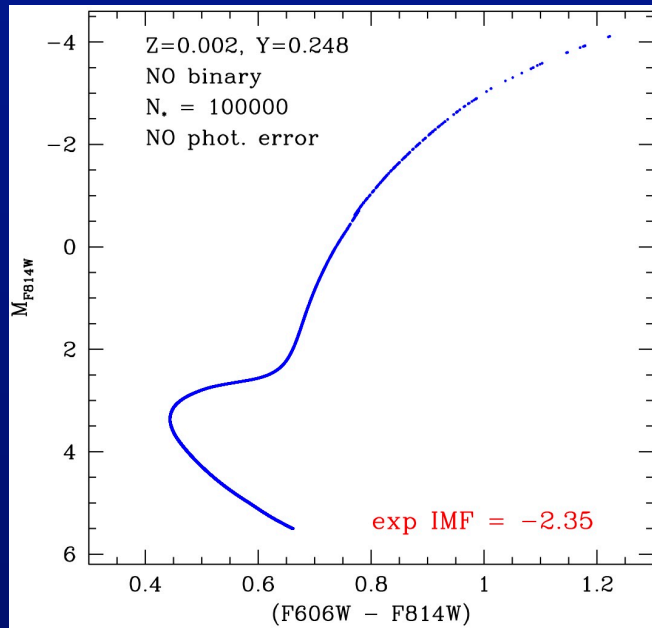
100000 10000

00.0 00.0 2.35 5.00 0.0000 0.600 0.010 0.250
1 0.0
-4.000 0.000 0.000
-3.000 0.000 0.000
-2.000 0.000 0.000
-1.000 0.000 0.000
0.000 0.000 0.000
2.000 0.000 0.000
4.000 0.000 0.000
5.000 0.000 0.000

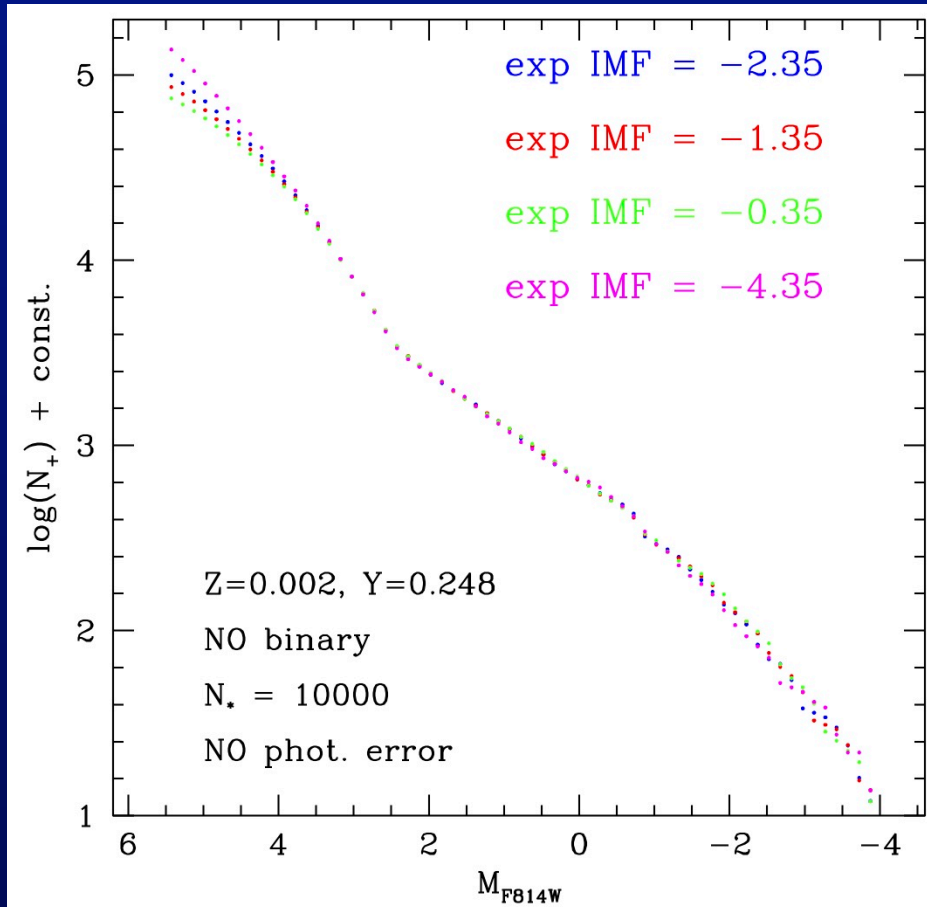
The effect of Statistical Sampling



The effect of the Initial Mass Function

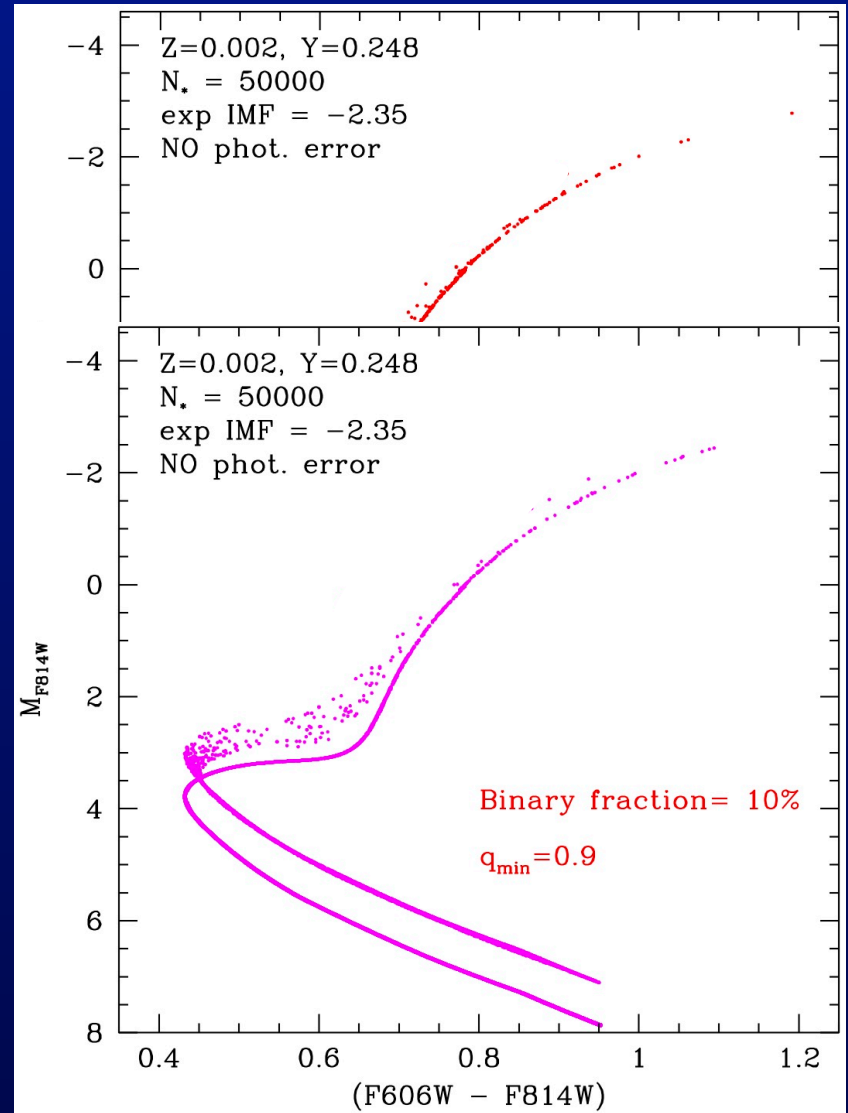
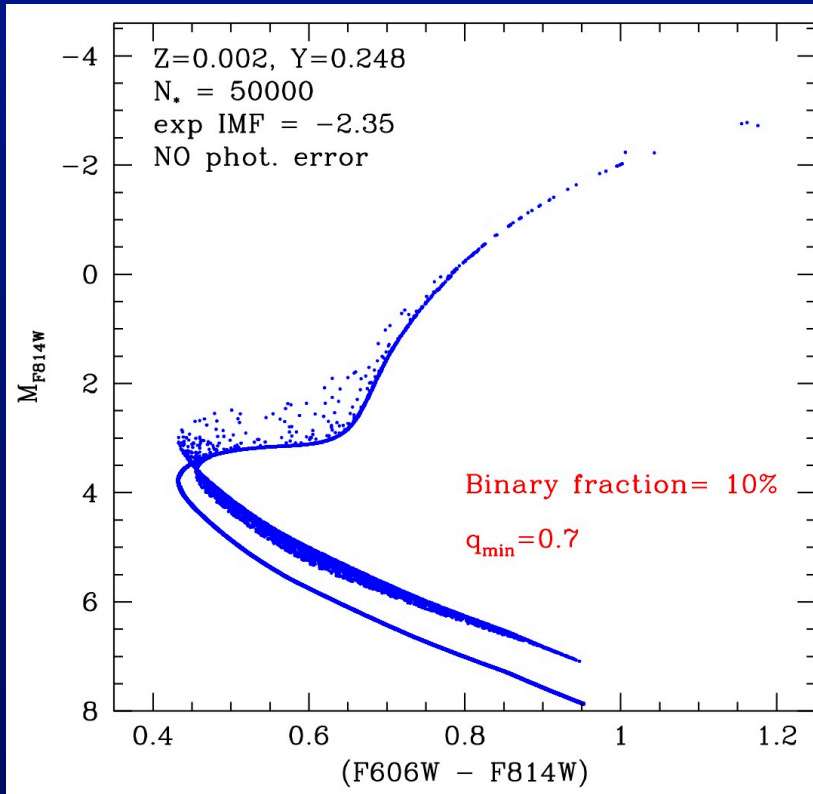


The Luminosity Function: IMF effects

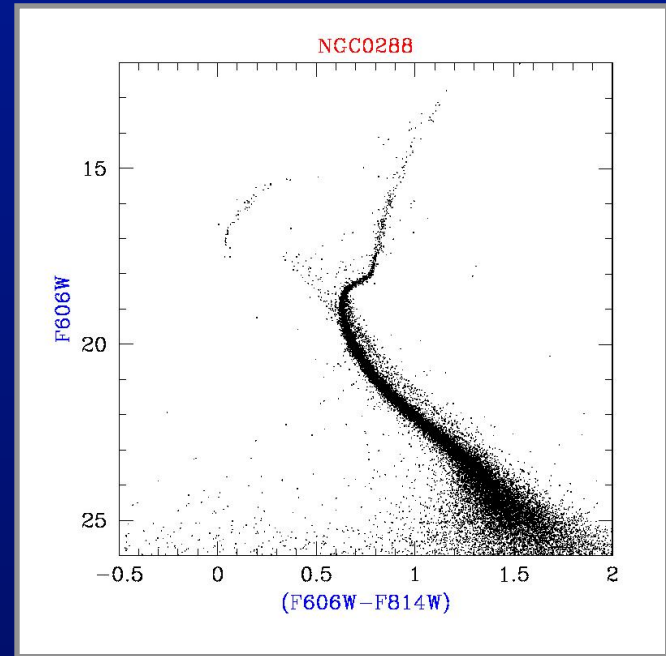


$$\frac{dN}{dm} \propto m^\alpha$$

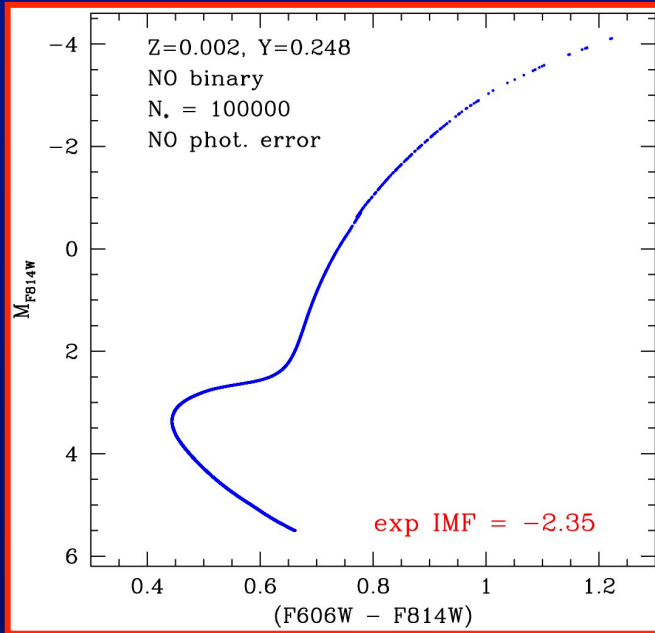
The presence of binary



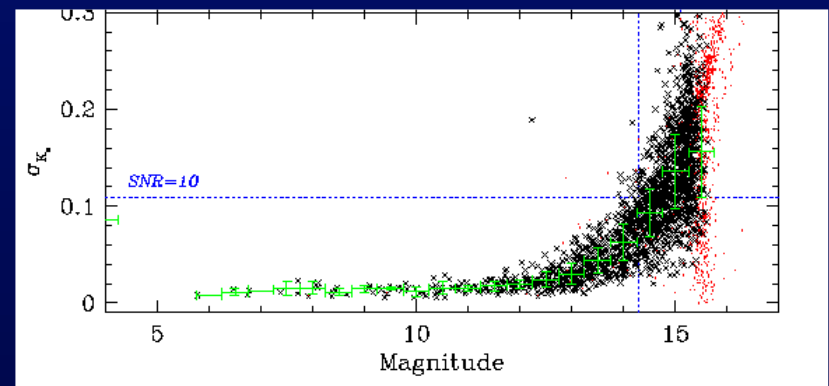
Real CMD



Theoretical CMD

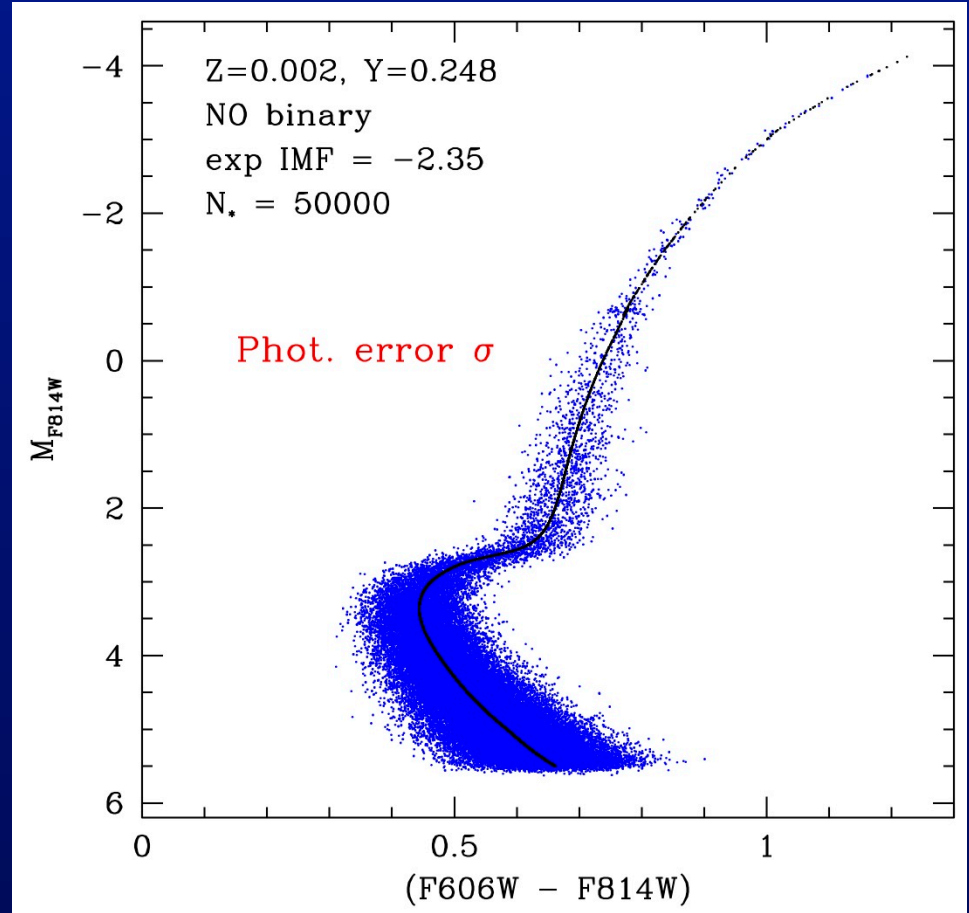


Photometric errors



Simulating the photometric errors...

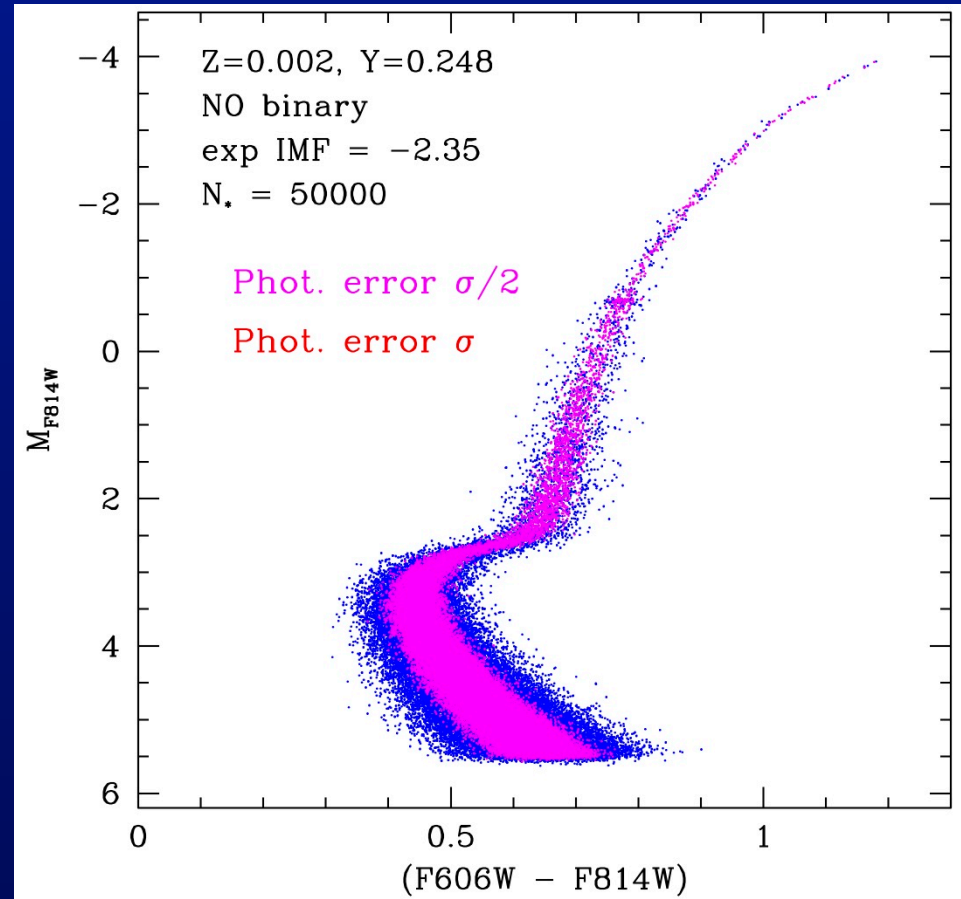
| 50000 | 10000 | | | | | | |
|--------|-------|-------|------|--------|-------|-------|-------|
| 0.0 | 00.0 | 2.35 | 5.50 | 0.0000 | 0.600 | 0.010 | 0.150 |
| 9 | 0.0 | | | | | | |
| -4.000 | 0.001 | 0.001 | | | | | |
| -3.000 | 0.006 | 0.008 | | | | | |
| -2.000 | 0.008 | 0.011 | | | | | |
| -1.000 | 0.010 | 0.014 | | | | | |
| 0.000 | 0.020 | 0.028 | | | | | |
| 2.000 | 0.025 | 0.035 | | | | | |
| 4.000 | 0.030 | 0.042 | | | | | |
| 5.000 | 0.040 | 0.056 | | | | | |
| 6.000 | 0.050 | 0.071 | | | | | |



please remember the lecture by [Monelli](#) for a discussion on how to retrieve the "true" observational errors that have to be taken into account....

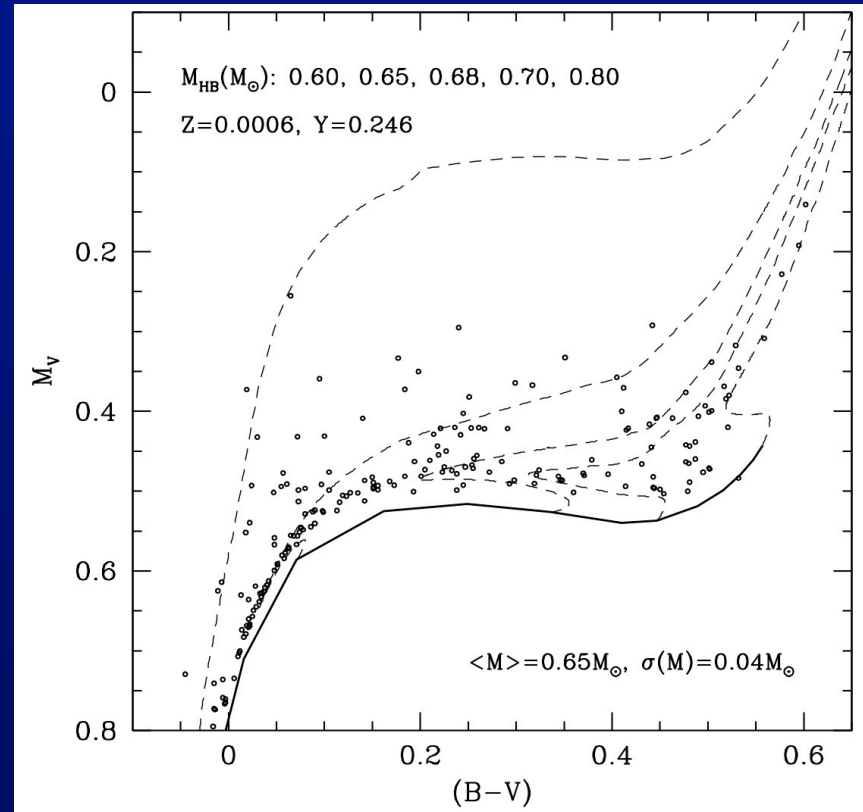
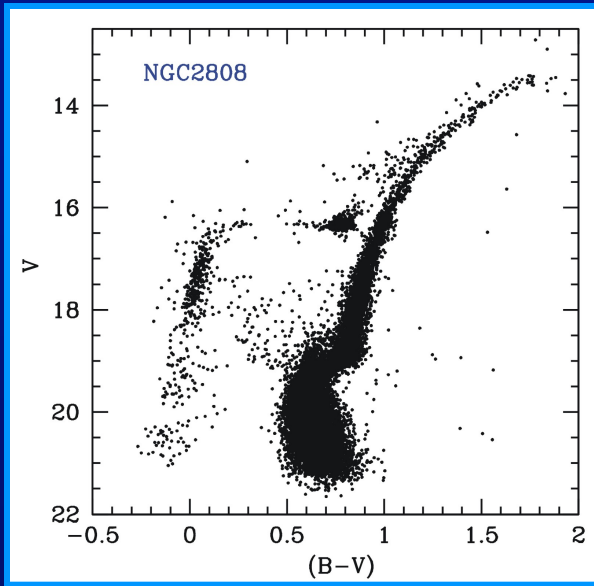
Simulating the photometric errors...

| 50000 | 10000 | | | | | | |
|--------|-------|-------|------|--------|-------|-------|-------|
| 0.0 | 00.0 | 2.35 | 5.50 | 0.0000 | 0.600 | 0.010 | 0.150 |
| 9 | 0.0 | | | | | | |
| -4.000 | 0.001 | 0.001 | | | | | |
| -3.000 | 0.006 | 0.008 | | | | | |
| -2.000 | 0.008 | 0.011 | | | | | |
| -1.000 | 0.010 | 0.014 | | | | | |
| 0.000 | 0.020 | 0.028 | | | | | |
| 2.000 | 0.025 | 0.035 | | | | | |
| 4.000 | 0.030 | 0.042 | | | | | |
| 5.000 | 0.040 | 0.056 | | | | | |
| 6.000 | 0.050 | 0.071 | | | | | |



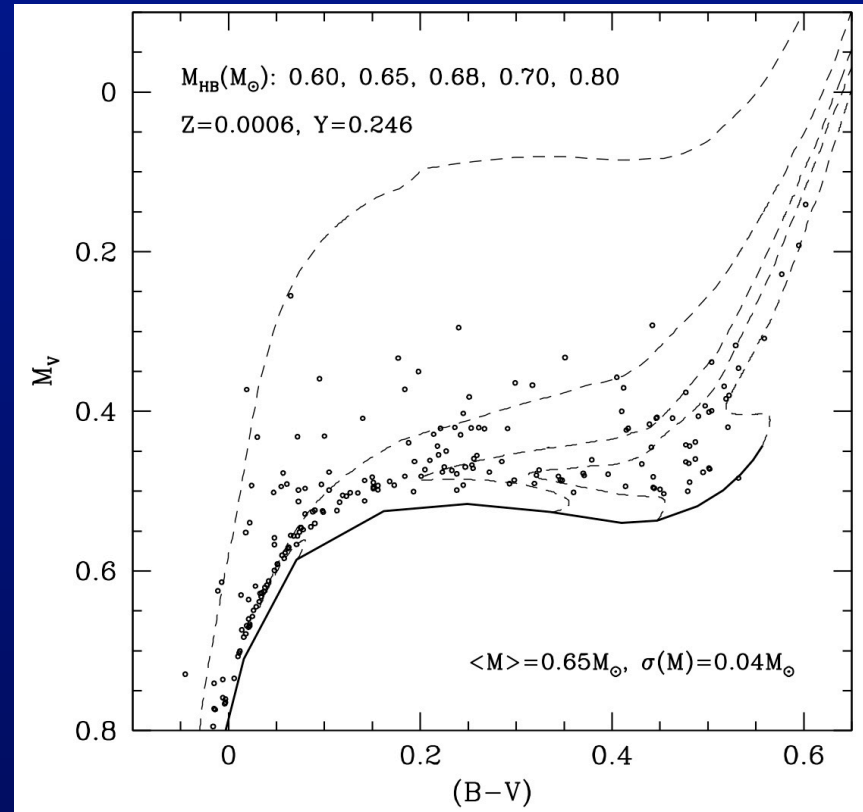
please remember the lecture by [Monelli](#) for a discussion on how to retrieve the “true” observational errors that have to be taken into account....

Simulating the HB stage...



Simulating the HB stage...

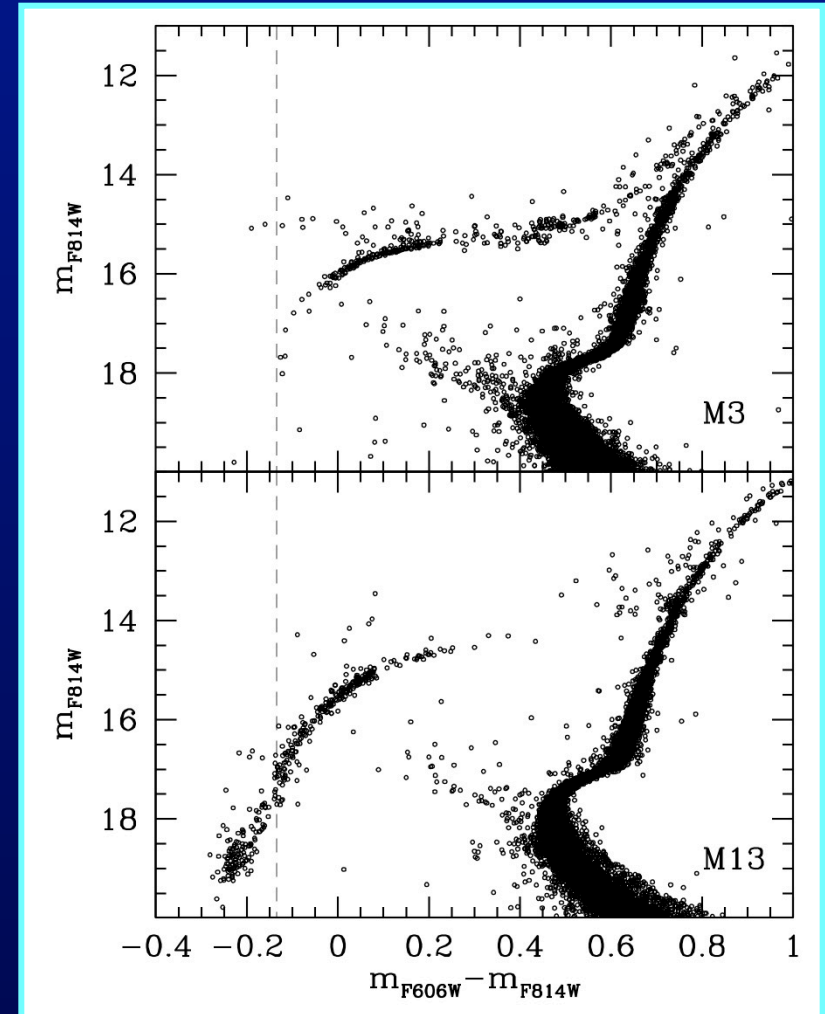
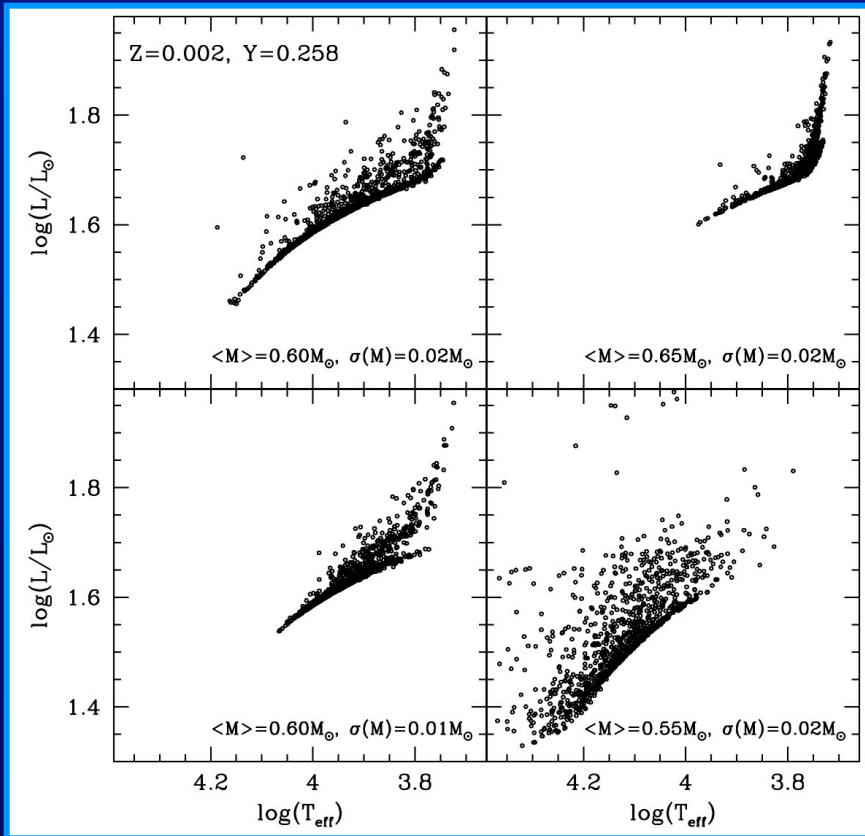
| 13 | 4 | 320 | 1190 | 7 | 35 | 900 | 7 |
|--------|--------------------------------|-----|------|---|----|-----|---|
| 0.5000 | 0050z203y248aes.nor_acs_hst | | | | | | |
| 0.5500 | 0055z203y248aes.nor_acs_hst | | | | | | |
| 0.6000 | 0060z203y248aes.nor_acs_hst | | | | | | |
| 0.7000 | 0070z203y248aes.nor_acs_hst | | | | | | |
| 0.7500 | 0075z203y248aes.nor_acs_hst | | | | | | |
| 0.8000 | 0080z203y248aes.nor_acs_hst | | | | | | |
| 0.9000 | 0090z203y248aes.nor_acs_hst | | | | | | |
| 1.0000 | 0100z203y248aes.nor_acs_hst | | | | | | |
| 1.1000 | 0110z203y248aes.nor_acs_hst | | | | | | |
| 1.2000 | 0120z203y248aes.nor_acs_hst | | | | | | |
| 1.3000 | 0130z203y248aes.nor_acs_hst | | | | | | |
| 1.4000 | 0140z203y248aes.nor_acs_hst | | | | | | |
| 1.5000 | 0150z203y248aes.nor_acs_hst | | | | | | |
| 0.4885 | 0488m08z203y248aes.nor_acs_hst | | | | | | |
| 0.4890 | 0489m08z203y248aes.nor_acs_hst | | | | | | |
| 0.4900 | 0490m08z203y248aes.nor_acs_hst | | | | | | |
| 0.4950 | 0495m08z203y248aes.nor_acs_hst | | | | | | |
| 0.5000 | 0500m08z203y248aes.nor_acs_hst | | | | | | |
| 0.5050 | 0505m08z203y248aes.nor_acs_hst | | | | | | |
| 0.5100 | 0510m08z203y248aes.nor_acs_hst | | | | | | |
| 0.5150 | 0515m08z203y248aes.nor_acs_hst | | | | | | |
| 0.5200 | 0520m08z203y248aes.nor_acs_hst | | | | | | |
| 0.5250 | 0525m08z203y248aes.nor_acs_hst | | | | | | |
| 0.5300 | 0530m08z203y248aes.nor_acs_hst | | | | | | |
| 0.5350 | 0535m08z203y248aes.nor_acs_hst | | | | | | |
| 0.5400 | 0540m08z203y248aes.nor_acs_hst | | | | | | |
| 0.5450 | 0545m08z203y248aes.nor_acs_hst | | | | | | |
| 0.5500 | 0550m08z203y248aes.nor_acs_hst | | | | | | |
| 0.5600 | 0560m08z203y248aes.nor_acs_hst | | | | | | |
| 0.5700 | 0570m08z203y248aes.nor_acs_hst | | | | | | |
| 0.5800 | 0580m08z203y248aes.nor_acs_hst | | | | | | |
| 0.5900 | 0590m08z203y248aes.nor_acs_hst | | | | | | |
| 0.6000 | 0600m08z203y248aes.nor_acs_hst | | | | | | |
| 0.6100 | 0610m08z203y248aes.nor_acs_hst | | | | | | |
| 0.6200 | 0620m08z203y248aes.nor_acs_hst | | | | | | |
| 0.6300 | 0630m08z203y248aes.nor_acs_hst | | | | | | |
| 0.6400 | 0640m08z203y248aes.nor_acs_hst | | | | | | |
| 0.6500 | 0650m08z203y248aes.nor_acs_hst | | | | | | |
| 0.6600 | 0660m08z203y248aes.nor_acs_hst | | | | | | |
| 0.6700 | 0670m08z203y248aes.nor_acs_hst | | | | | | |
| 0.6800 | 0680m08z203y248aes.nor_acs_hst | | | | | | |
| 0.6900 | 0690m08z203y248aes.nor_acs_hst | | | | | | |
| 0.7000 | 0700m08z203y248aes.nor_acs_hst | | | | | | |
| 0.7200 | 0720m08z203y248aes.nor_acs_hst | | | | | | |
| 0.7400 | 0740m08z203y248aes.nor_acs_hst | | | | | | |
| 0.7600 | 0760m08z203y248aes.nor_acs_hst | | | | | | |
| 0.7800 | 0780m08z203y248aes.nor_acs_hst | | | | | | |
| 0.8000 | 0800m08z203y248aes.nor_acs_hst | | | | | | |

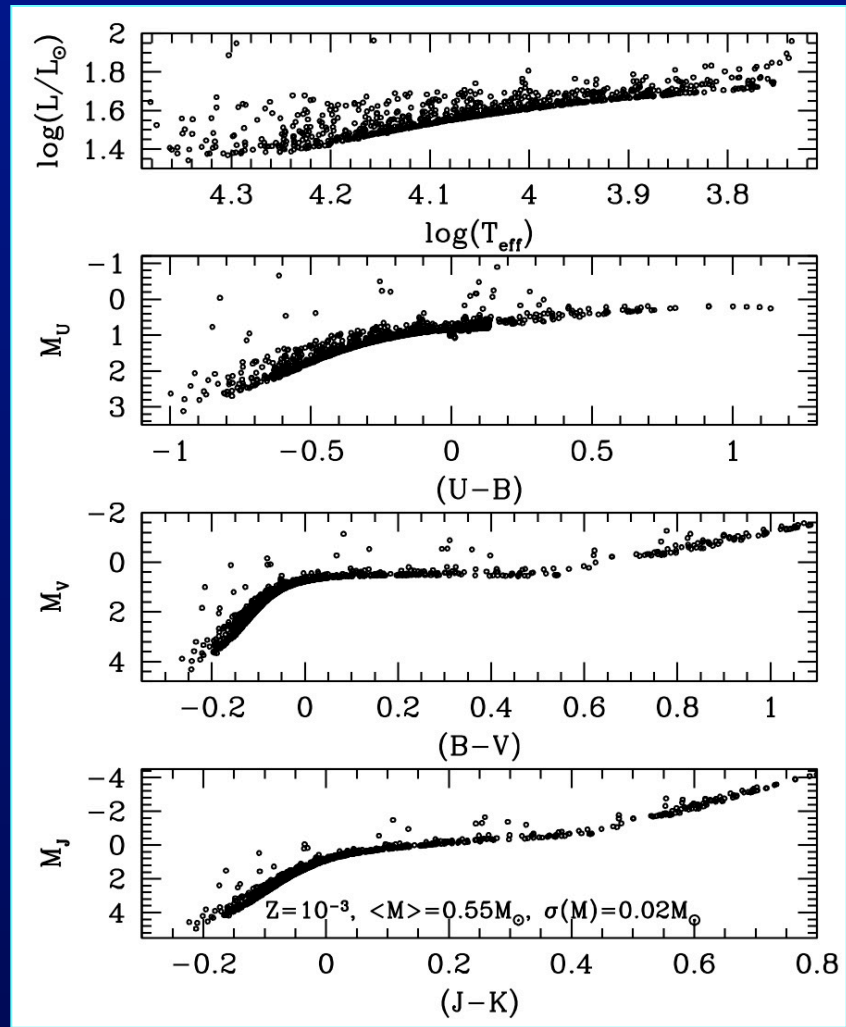


Average Mass on the HB: $\langle M \rangle$

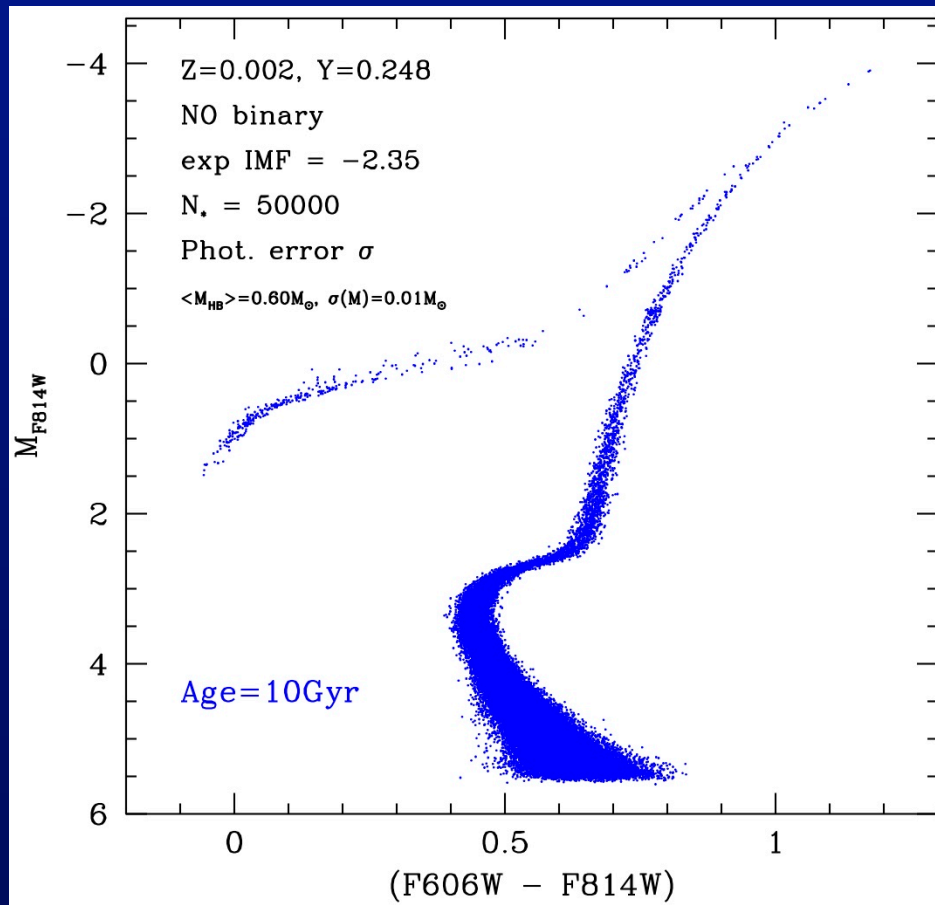
Mass dispersion along the HB: $\sigma(M)$

how do they affect the HB distribution?

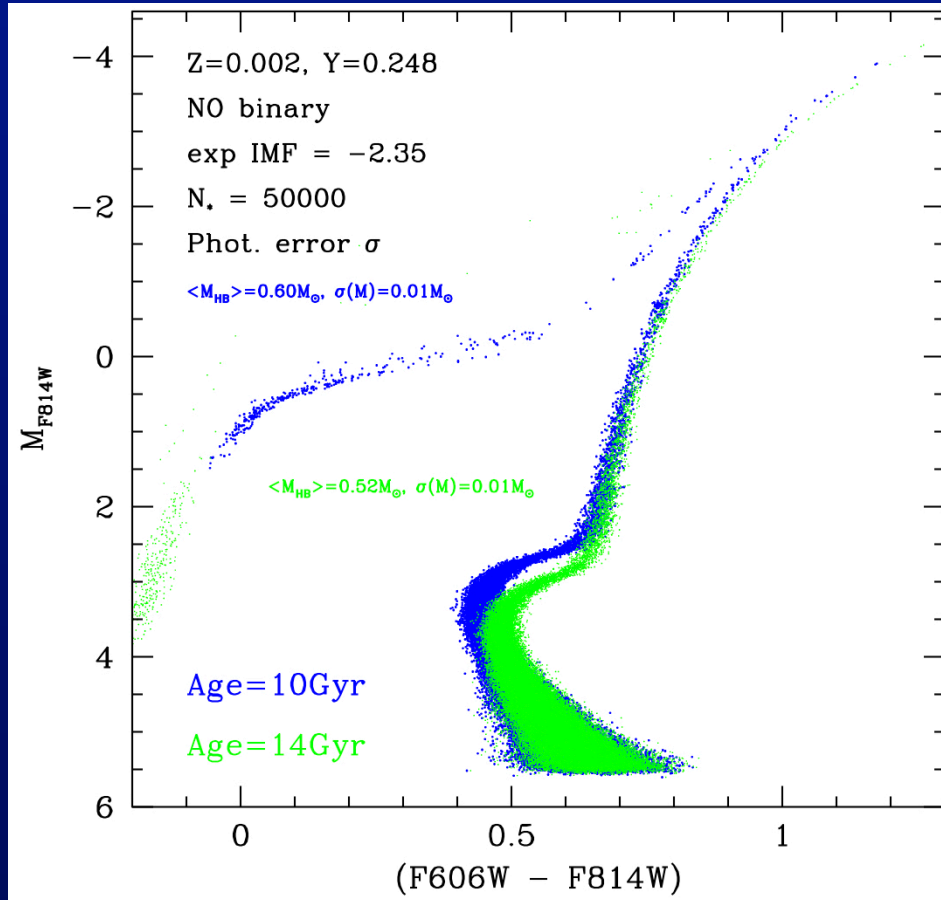
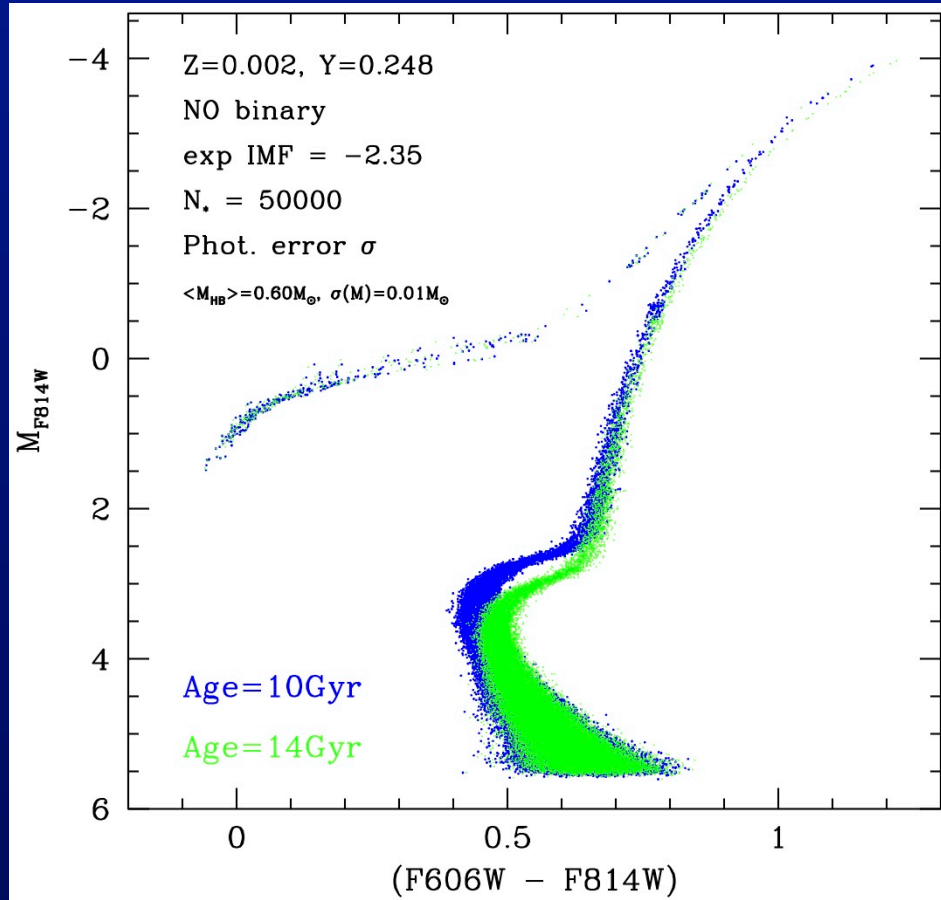




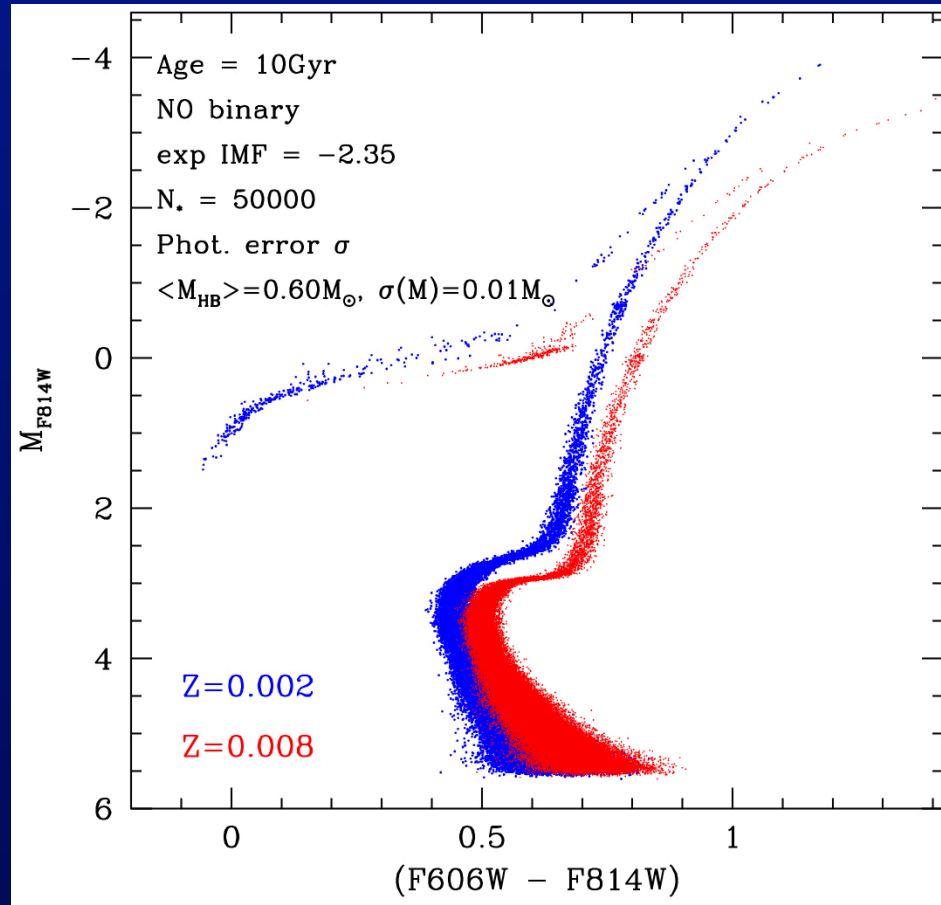
The age effect



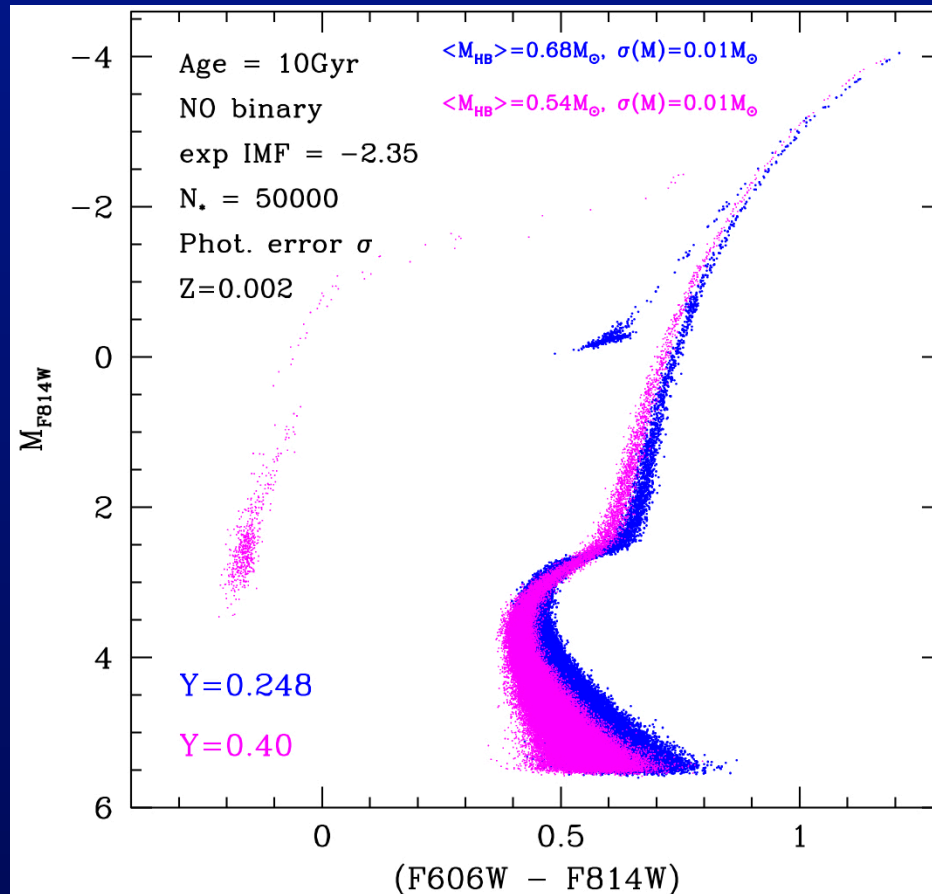
The age effect



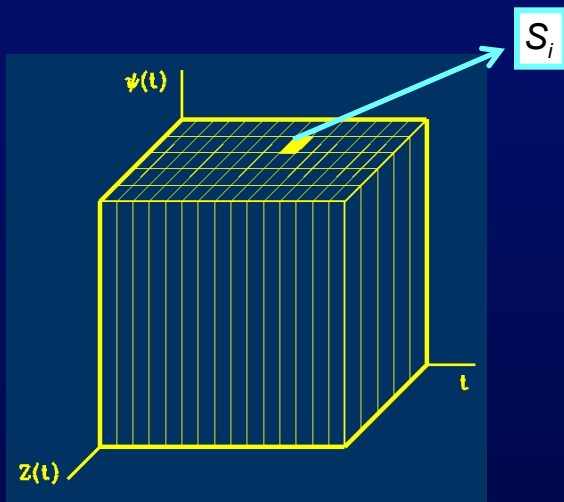
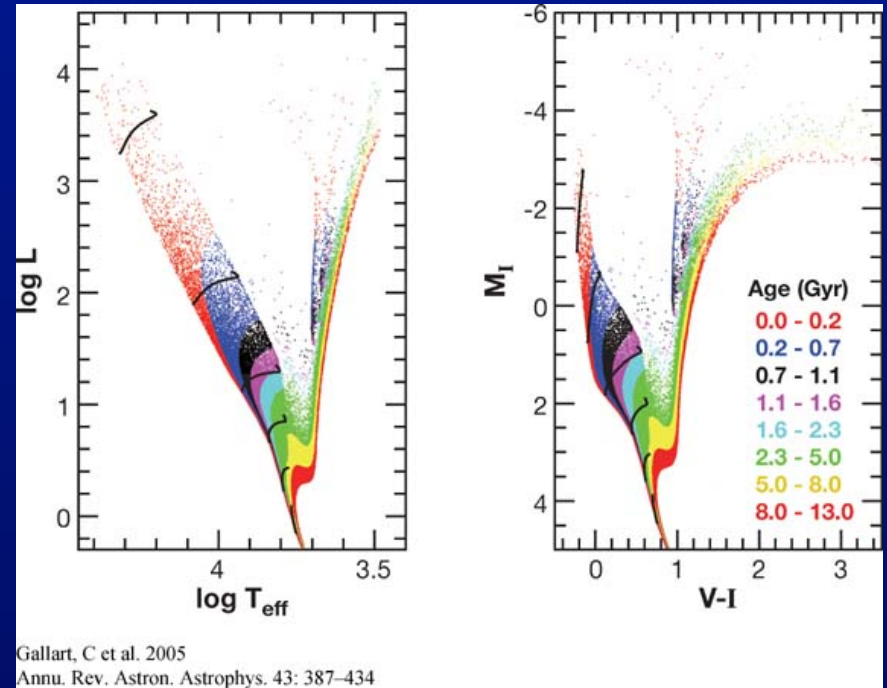
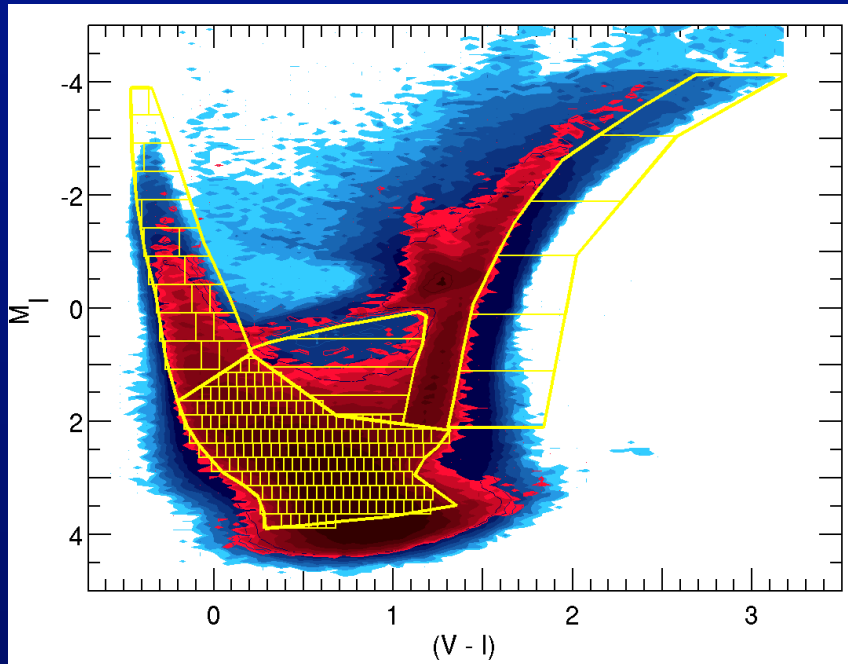
The chemical composition: metallicity effects



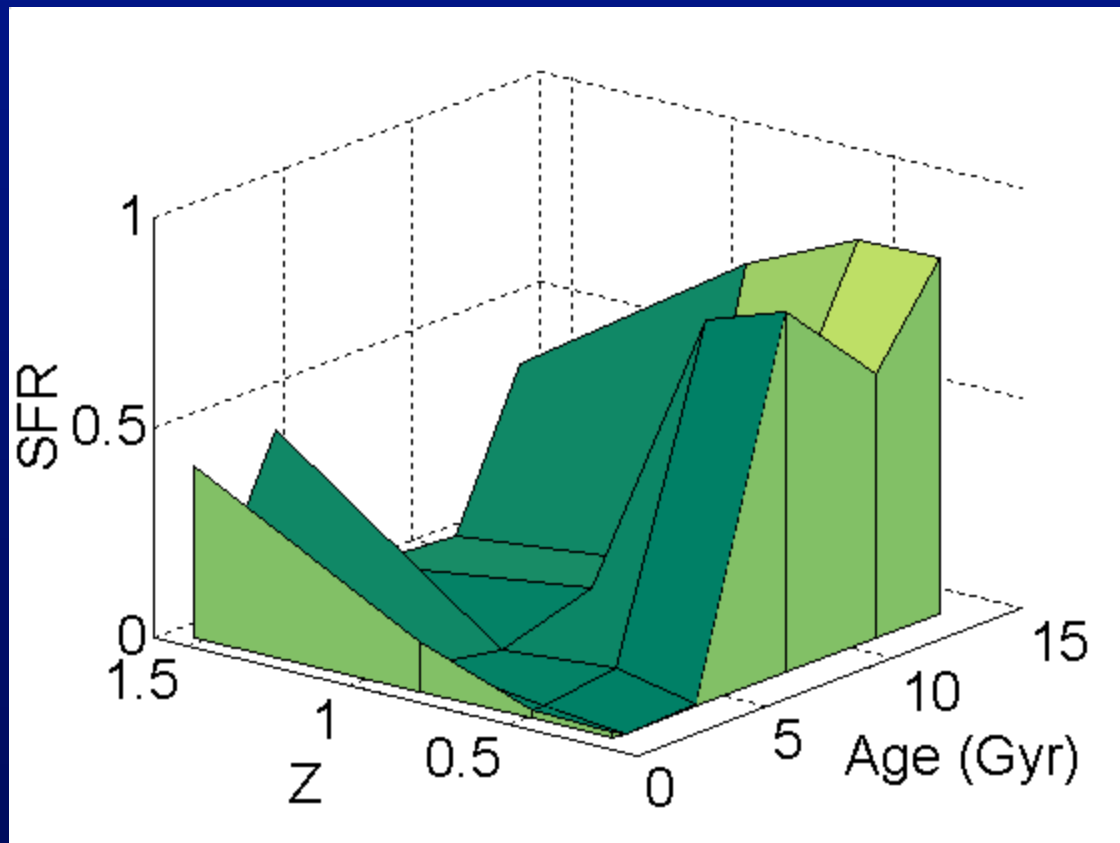
The chemical composition: Helium effects



Playing with (synthetic) stars...



$$S(\psi, Z) = A \sum_I \alpha_i S_i$$



Synthetic CMD generator: BaSTI

http://193.204.1.62/BASTI/WEB_TOOLS/synth_pop2/

Stellar Population Synthesis Program **WEB TOOL**

Population Synthesis Program is a web interface written in PERL language by Dr. D. Cordier from ENSCR (France) in collaboration with Dr. S. Cassisi, Dr. A. Pietrinferni from Teramo Observatory (Italy) and Dr. M. Salaris from Liverpool John Moores University (UK). Through this interface the user can run the population synthesis code SYNTHETIC MAN described in Pietrinferni A., Cassisi S., Salaris M. and Castellì F. (2004, *Apl* - vol. 612, 168), and updated in Cordier D., Pietrinferni A., Cassisi S., Salaris M. (*astro-ph/0612669*). SYNTHETIC MAN determines the photometric properties of stellar populations with an arbitrary star formation history, taking into account photometric errors and unresolved binaries. The user receives a notification by e-mail when computations are completed. This web Tool is not a simple applet and, being server based, it is robust and fast.

User Id:

| | |
|--|---|
| Photometric error <input type="radio"/> No error <input type="radio"/> Gaussian error with the mean photometric error: <input type="text" value="0.02"/> (in mag) | Mean spectroscopic error <input type="text" value="0.0001"/> (in dex) |
| Fraction of unresolved binaries <input type="text" value="0.1"/> (e.g. 1/10 -> 0.1) | Minimum mass ratio for binary systems <input type="text" value="0.7"/> |
| Scale factor for SFR <input type="text" value="12000"/> (Max. 8 digits integer) | Mass range <input type="radio"/> Default mass range (0.1-120 M_{sun}) <input type="checkbox"/> User-specified lower mass limit: <input type="text" value="0.1"/> (solar masses) |
| Initial Mass Function IMF type <input type="radio"/> Single power law <input checked="" type="radio"/> Kroupa, Tout, Gilmore (1993) IMF exponent (in case of single power law) <input type="text" value="-2.35"/> | Star Formation History <input type="radio"/> Fixed Star Formation Histories (SFH) <ul style="list-style-type: none"><input checked="" type="radio"/> NGC6822 (*) <input type="radio"/> Milky Way bulge<input checked="" type="radio"/> SMC (*) <input type="radio"/> Sextans A<input checked="" type="radio"/> LMC (bar field) <input type="radio"/> LGS3<input type="radio"/> Local disk (*) (global SFH) <input type="radio"/> User Specified SFH Number of age values: <input type="text" value="50"/> (max. 200) |
| Search for variable stars <input type="radio"/> yes <input checked="" type="radio"/> no | Selected set of isochrones Heavy Elements Mixture <input type="radio"/> Scaled to solar mixture <input checked="" type="radio"/> Alpha enhanced mixture Mass loss <input type="radio"/> $\eta=0.2$ <input checked="" type="radio"/> $\eta=0.4$ Extra core mixing <input type="radio"/> Standard (No overshooting) <input checked="" type="radio"/> Overshooting |
| Color-Temperature Transformation <input type="radio"/> UBVRJHKL <input checked="" type="radio"/> Strömgren <input checked="" type="radio"/> Walraven <input checked="" type="radio"/> WFC3@HST UVIS channel | <input checked="" type="radio"/> ACS <input checked="" type="radio"/> Sloan <input checked="" type="radio"/> WFC2@HST <input checked="" type="radio"/> WFC3@HST IR channel |
| Random numbers generating <input type="radio"/> The random number generator is automatically initialized through the Web taking a seed from http://www.random.org (recommended option) <input checked="" type="radio"/> The random number generator is initialized with seeds provided by the user: | |
| Seed 1: <input type="text" value="860934"/> | Seed 2: <input type="text" value="542039"/> |

Stellar Population Synthesis Program

WEB TOOL

You have to choose your 4 age values, stellar formation rates, metallicity and metallicity spread. Please be careful when typing your data! After that click on the "submit" button at the bottom of this page, or type RETURN.

| | Age (in years) (allowed range: 30 My to 14 Gy) | Star Formation Rate | The metallicity [Fe/H] (of the stars formed at that age) | The metallicity spread (Delta [Fe/H], in dex) at that age |
|---|--|-------------------------------------|--|---|
| 1 | <input type="text" value="12000000000"/> | <input type="text" value="0.7000"/> | <input type="text" value="-1.80"/> | <input type="text" value="0.03"/> |
| 2 | <input type="text" value="12000000000"/> | <input type="text" value="0.0000"/> | <input type="text" value="-1.90"/> | <input type="text" value="0.03"/> |
| 3 | <input type="text" value="30000000000"/> | <input type="text" value="0.3000"/> | <input type="text" value="-1.3"/> | <input type="text" value="0.05"/> |
| 4 | <input type="text" value="30000000000"/> | <input type="text" value="0.0000"/> | <input type="text" value="-1.3"/> | <input type="text" value="0.05"/> |

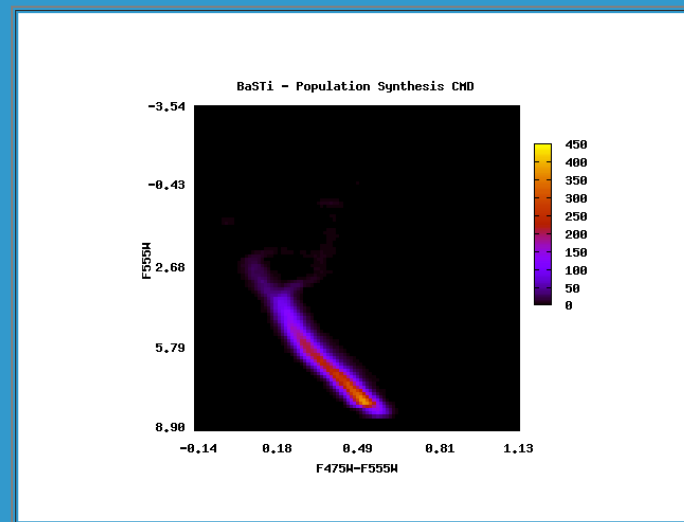
Submit

Stellar Population Synthesis Program

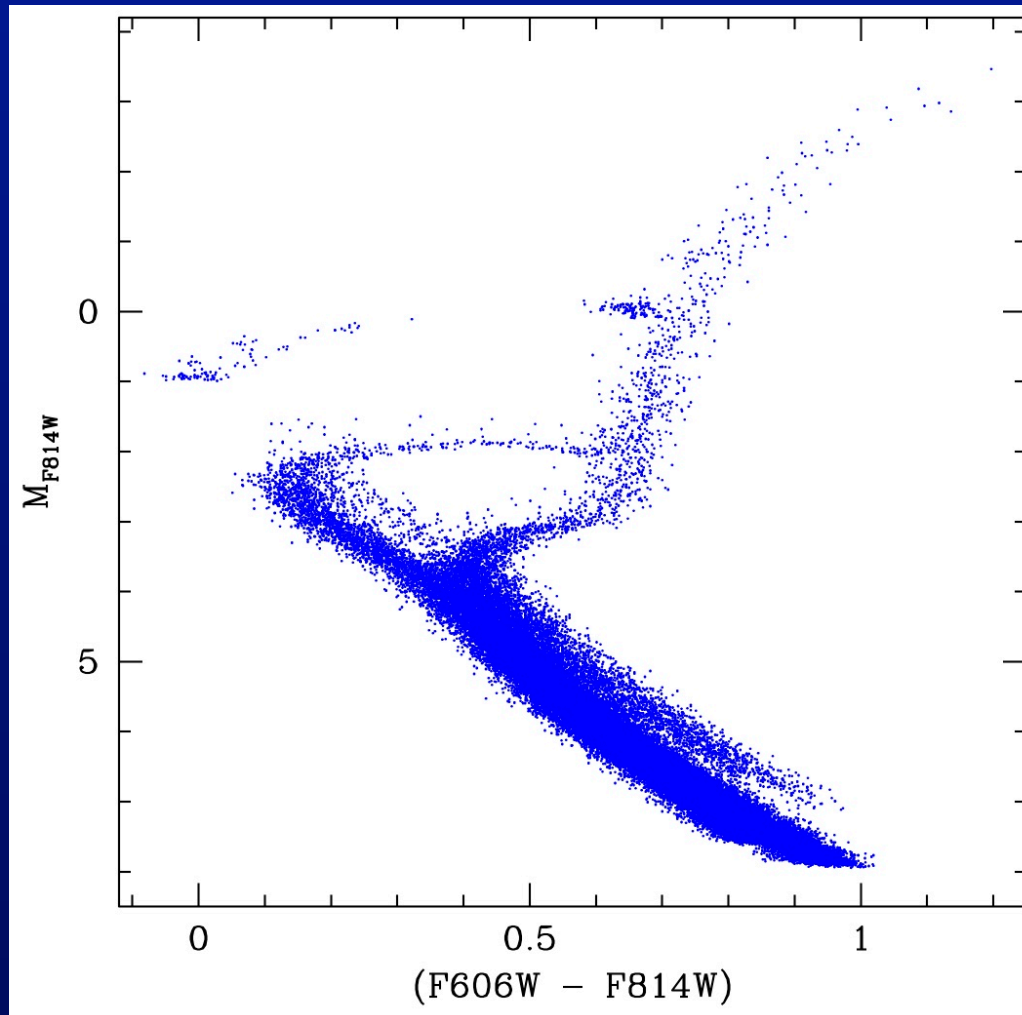
WEB TOOL

outputs "Synth_Pop__Sep_24_08.54.31_CEST_2015_" for cassisi--AT--oa-teramo.inaf.it:

- The parameters file: [Synth_Pop__Sep_24_08.54.31_CEST_2015_user.in](#)
- The Gzipped synthetic HRD file: [Synth_Pop__Sep_24_08.54.31_CEST_2015_HRD.gz \(size: 1.9MB\)](#)
- The stellar formation history file used for this calculation: [Synth_Pop__Sep_24_08.54.31_CEST_2015_sfh](#)
- The integrated colors file: [Synth_Pop__Sep_24_08.54.31_CEST_2015_INT_PROPERTIES](#)



[Hess's diagram of the outputs, the scale on the right gives the number of stars per pixel]



if you want to perform your own game...
please ask for a user ID by sending an e_mail to:

cassisi@oa-teramo.inaf.it