Grid of evolutionary models of low metallicity massive stars

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Outline

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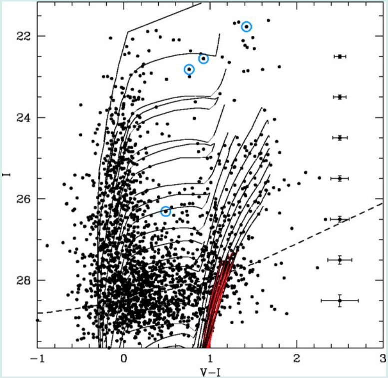
Motivation (part I.)

- Massive stars:
  - short but intense life
    - strong winds, UV-emission, SN or GRB explosion
  - $\rightarrow$ changing chemical composition of the surroundings
  - influence on star formation

- Blue Compact Dwarf galaxies (BCDs):
  - irregular; high SF rate recently
  - optical images are dominated by giant H II regions photoionized by massive stars ($\rightarrow$ blue) (Hunter & Thronson 1995)
  - laboratories for star formation, massive stars and chemical enrichment processes
  - we cannot see these at high-redshift
  - however, hierarchical galaxy formation models $\rightarrow$ dwarf galaxies were the first to collapse and form stars (and then became building-blocks) (Izotov & Thuan 2004)

Motivation (part II.)

- I Zwicky 18:
  - BCD, 18.2 Mpc, $\geq$ 1 Gyr
  - lowest metallicity galaxy containing WR stars ($\sim$1/50 $Z_\odot$)
  - HST data: resolved into stars $\rightarrow$ (Aloisi et al. 2007)
  - currently experiencing a strong starburst (Searle & Sargent 1972), (Izotov et al. 1997)



- Our goal:
  - Population synthesis (done with Geneva and Padova models (Aloisi et al. 1999), but the more the better)
  - understand stellar evolution at that low metallicity

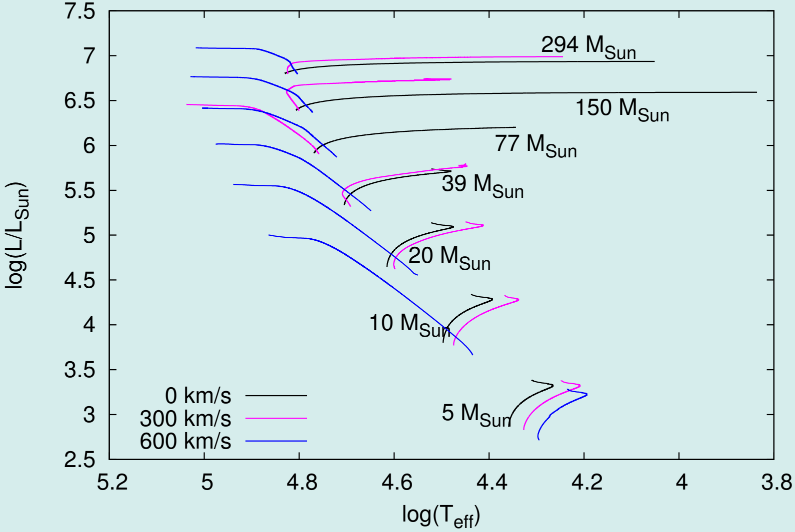
Code and initial metallicity

- BEC (version of Ines)
- Initial metallicity:
  - 0.1 of Z_{SMC}
  - not solar!

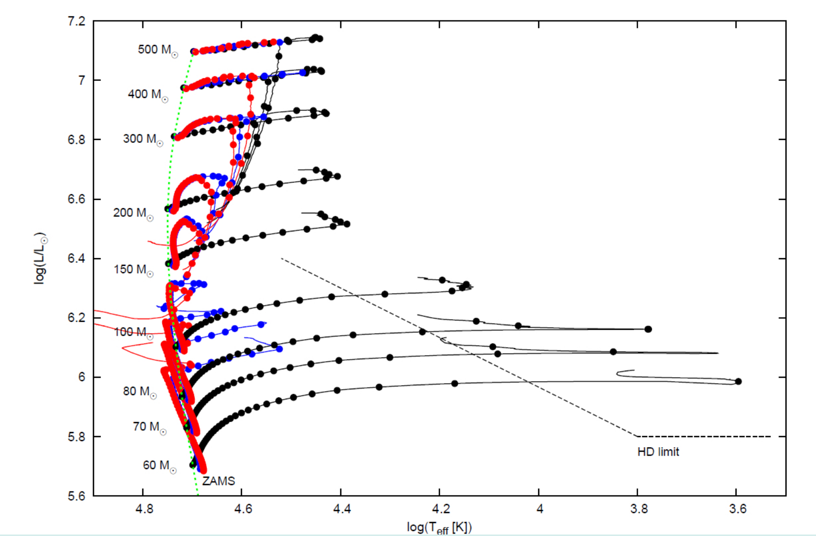
	C	N	O	Mg	Si	Fe
LMC	7.75	6.90	8.35	7.05	7.20	7.05
SMC	7.37	6.50	7.98	6.72	6.80	6.78
GAL	8.13	7.64	8.55	7.32	7.41	7.40

Brott et al. 2001

Evolutionary tracks (MS)



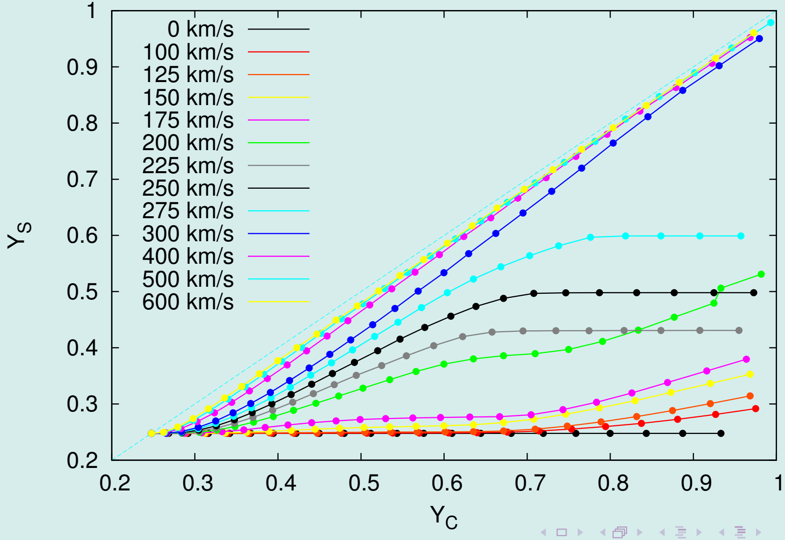
Evolutionary tracks – comparison



Köhler & Langer in prep.

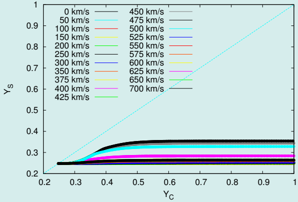
Chemically homogeneous evolution (part I.)

115 $M_\odot$

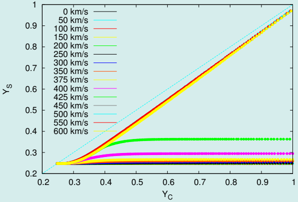


Chemically homogeneous evolution (part II.)

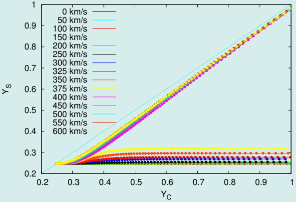
5 $M_\odot$

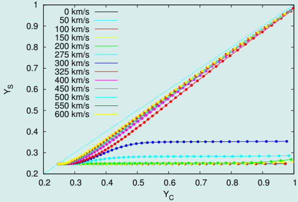


10 $M_\odot$

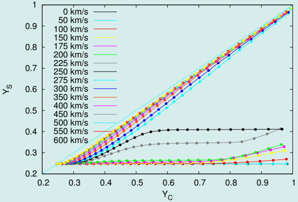


20 $M_\odot$

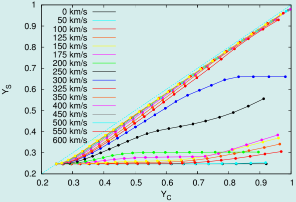




39 $M_\odot$

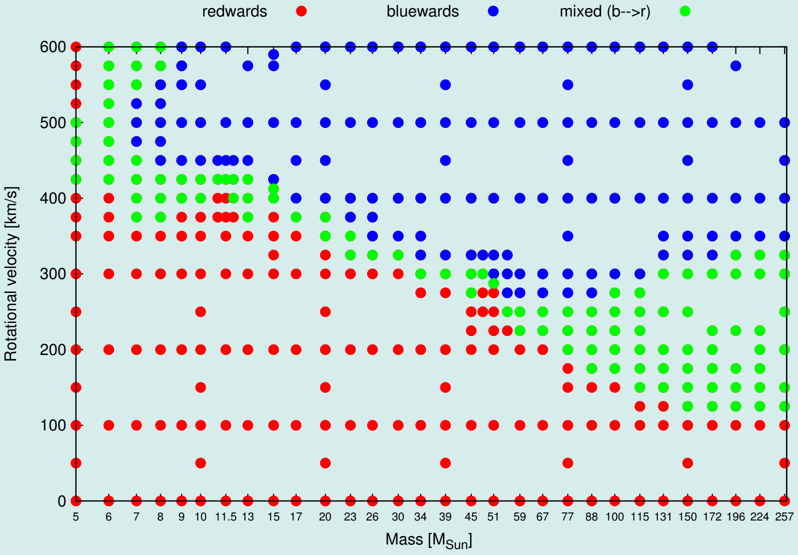


77 $M_\odot$



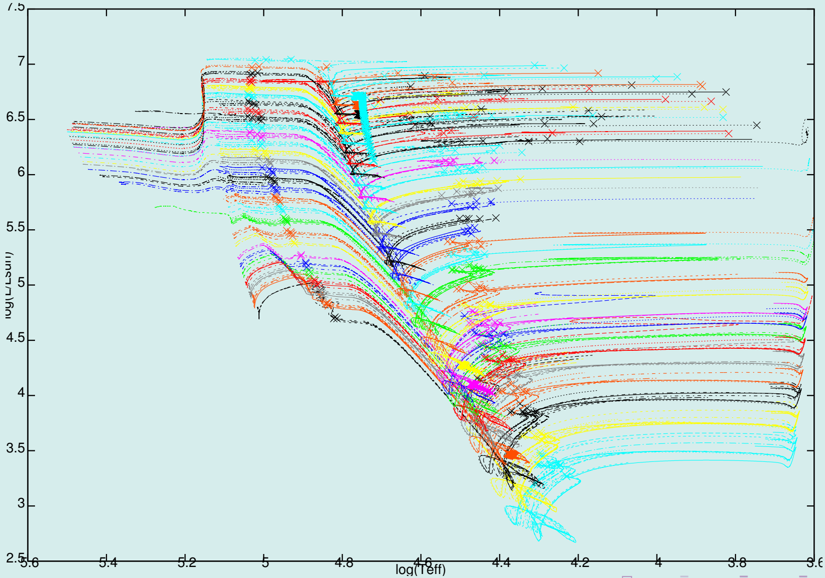
150 $M_\odot$

The grid

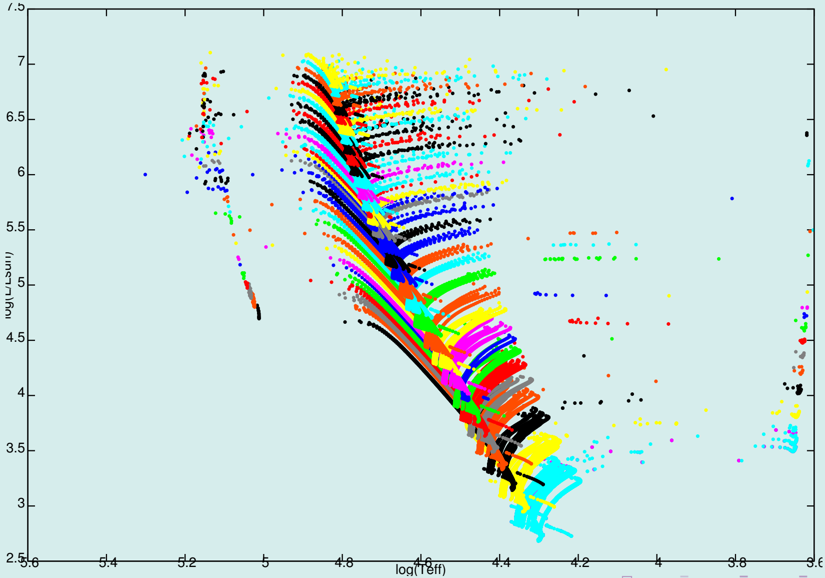


redwards
bluewards
mixed (b-->r)
Rotational velocity [km/s]
600
500
400
300
200
100
0
5 6 7 8 9 10 11.5 13 15 17 20 23 26 30 34 39 45 51 59 67 77 88 100 115 131 150 172 196 224 257
Mass [M_{Sun}]

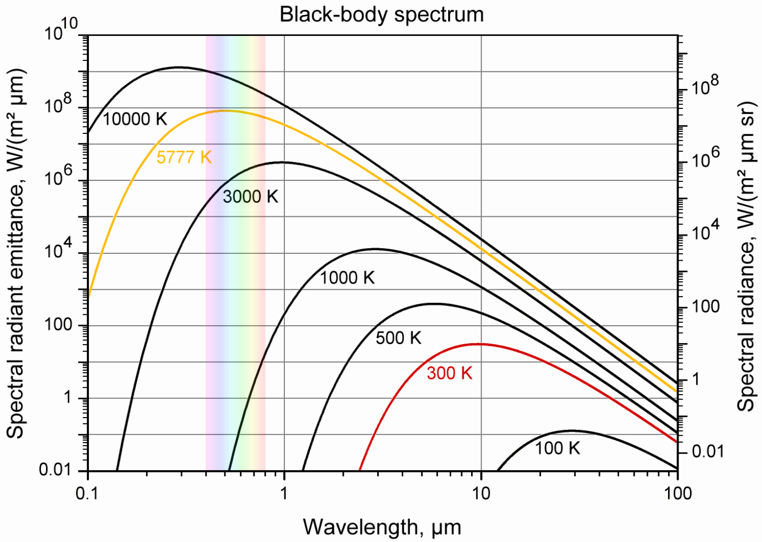
Showing every single track...



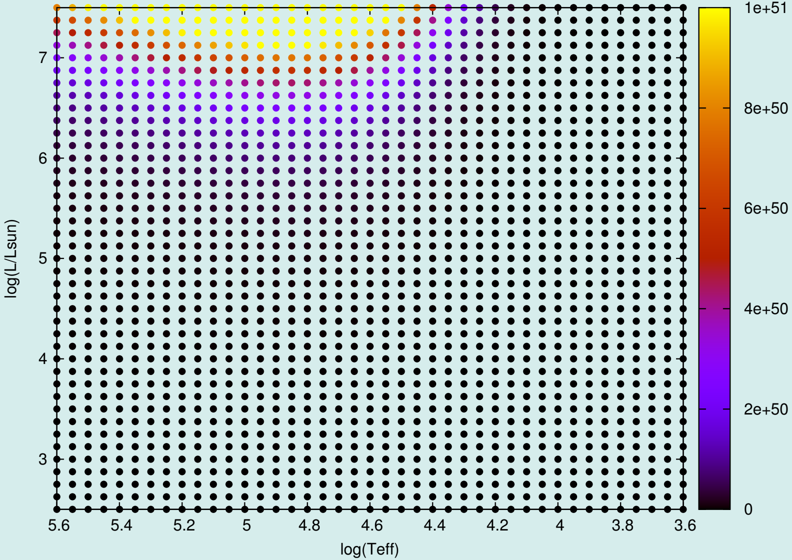
Showing every 10^5 years...



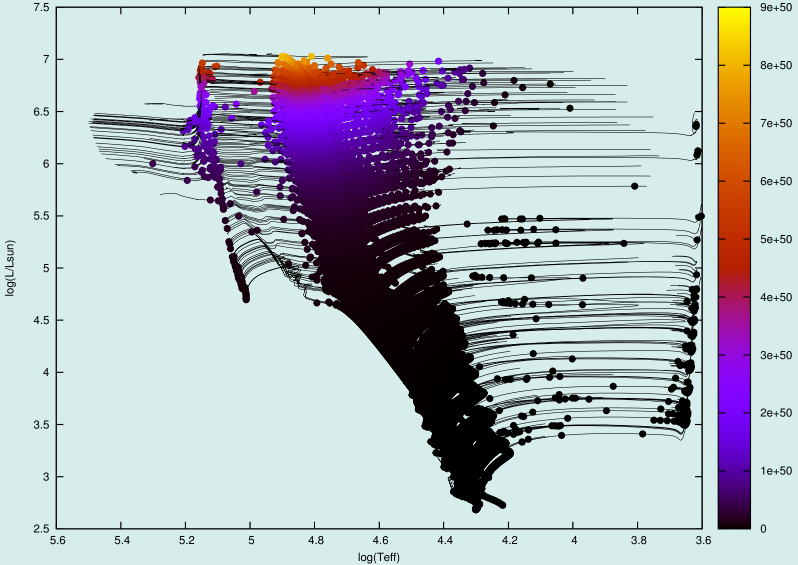
Stars as Black Bodies – Planck function



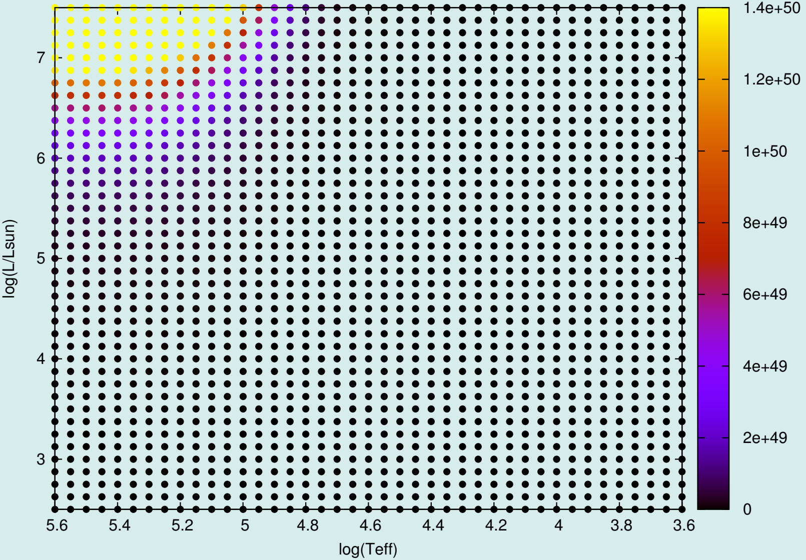
Ionization flux – Lyman continuum (part I.)



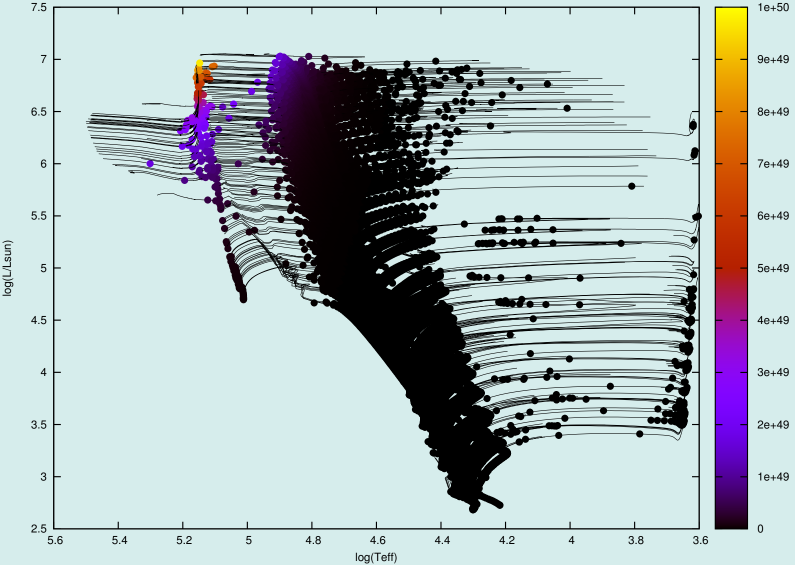
Ionization flux – Lyman continuum (part II.)



Ionization flux – He continuum (part I.)



Ionization flux – He continuum (part II.)



Summary

- First steps toward an understanding of massive stars at so low metallicity as BCD I Zw 18
  - Grid of evolutionary sequences
  - Chemically homogeneous evolution
  - Photoionization fluxes (black body
  - Aim: population synthesis
- I Zw 18: $\sim 1/50 \, Z_\odot$
  - lowest metallicity with local star formation
  - Z of globular clusters
  - $Z \approx 0$: Pop. III. stars, long GRBs

Thank you for your attention!