

Nebular Emission in Star-Forming Galaxies

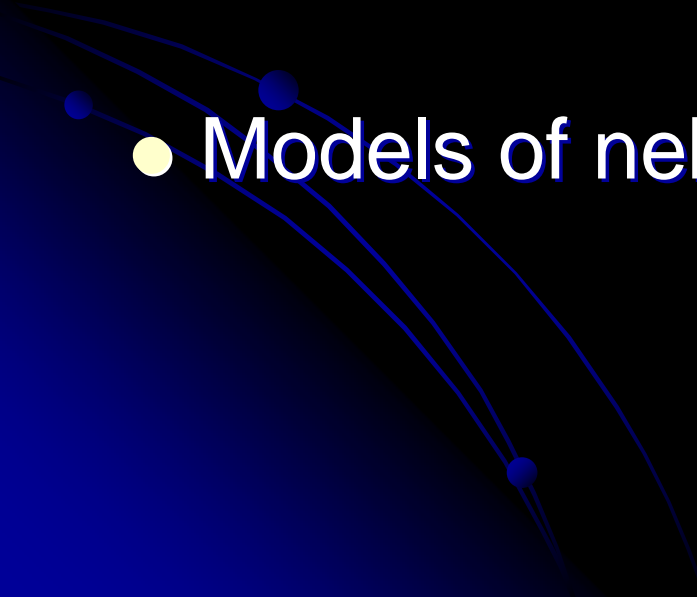
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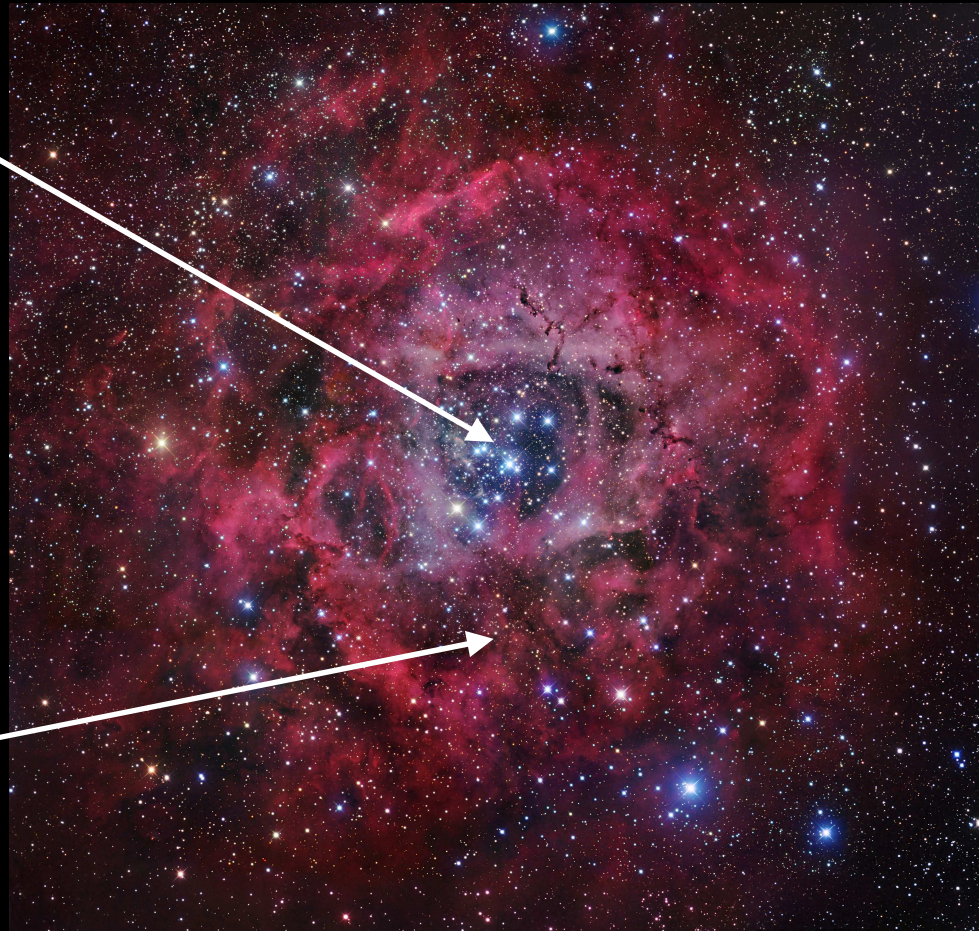


Outline

- Nebular emission – what, when, where?
 - Luminosity budget – stars versus gas
 - Models of nebular emission
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Nebular Emission

Young star cluster

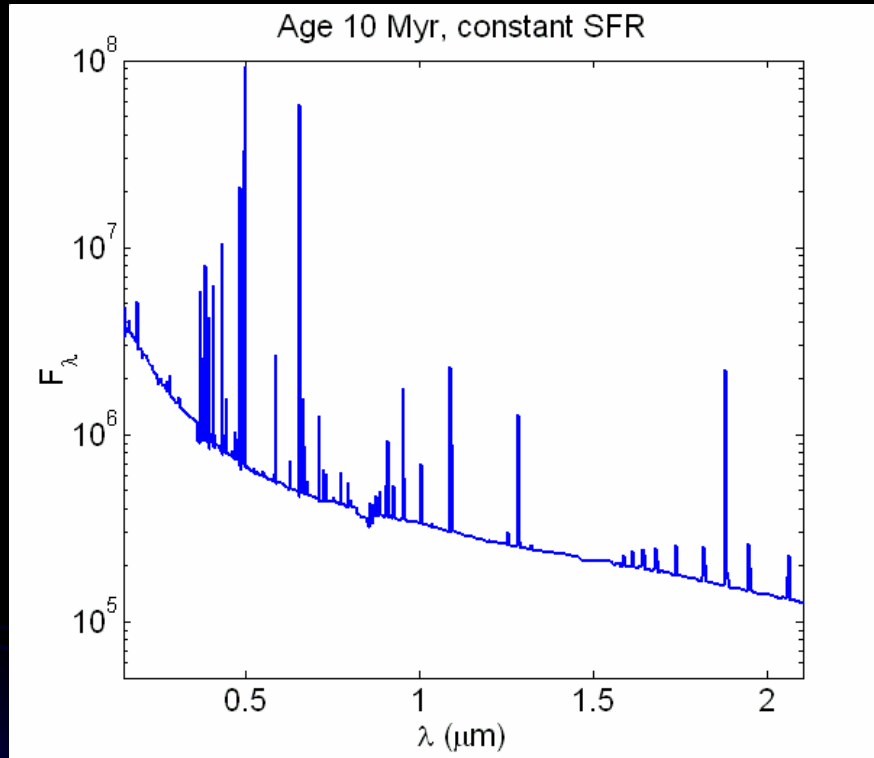


Photoionized gas

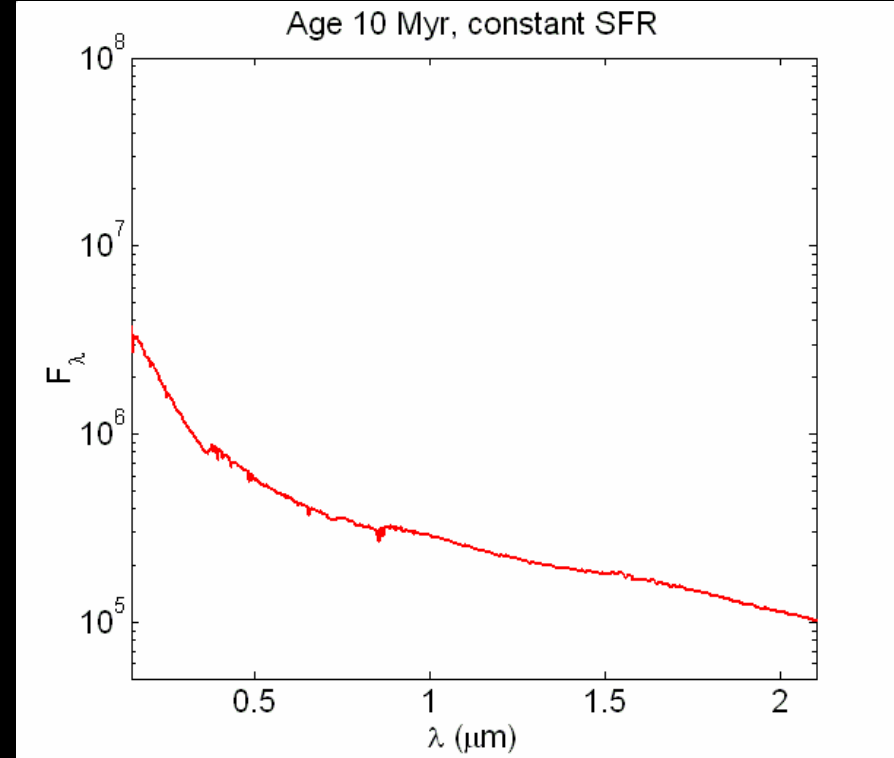
Models of nebular emission important for:

Young star clusters, starburst galaxies, population III stars

Spectra of Star-Forming Regions



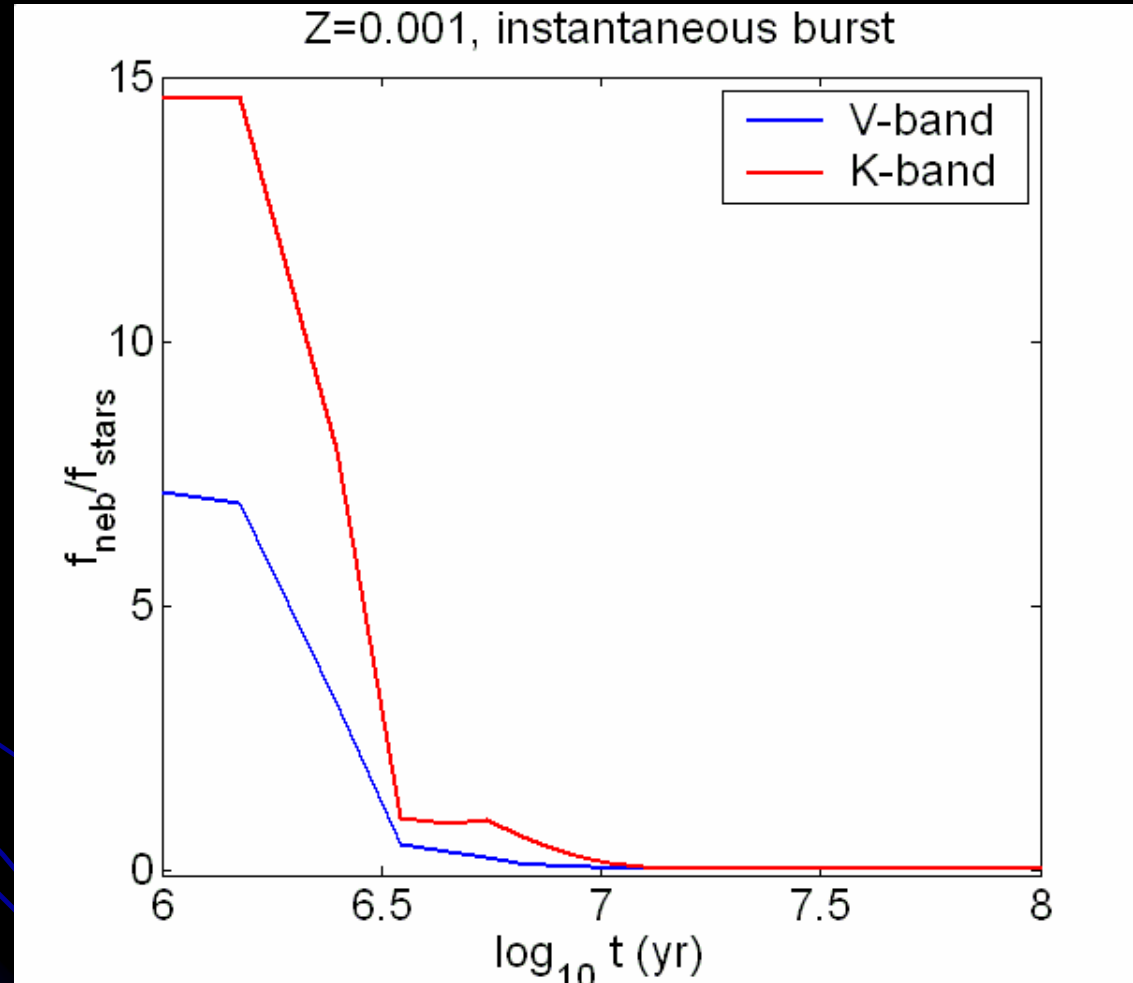
Stars + nebula



Stars only

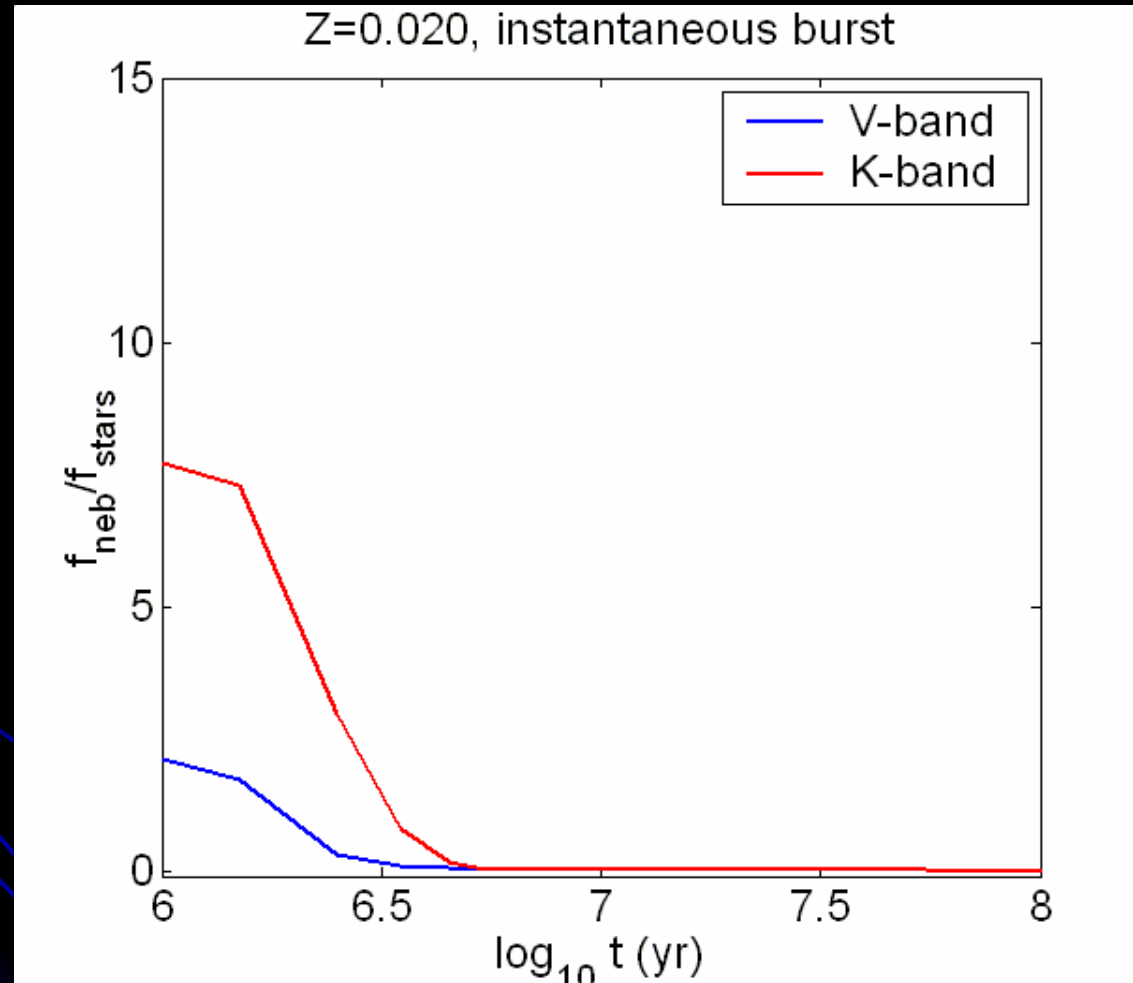
When dealing with young or star-forming systems:
Don't use models that only treat the stars
(e.g. Bruzual & Charlot 2003, Maraston 2005)!

Luminosities – Stars vs. Gas I



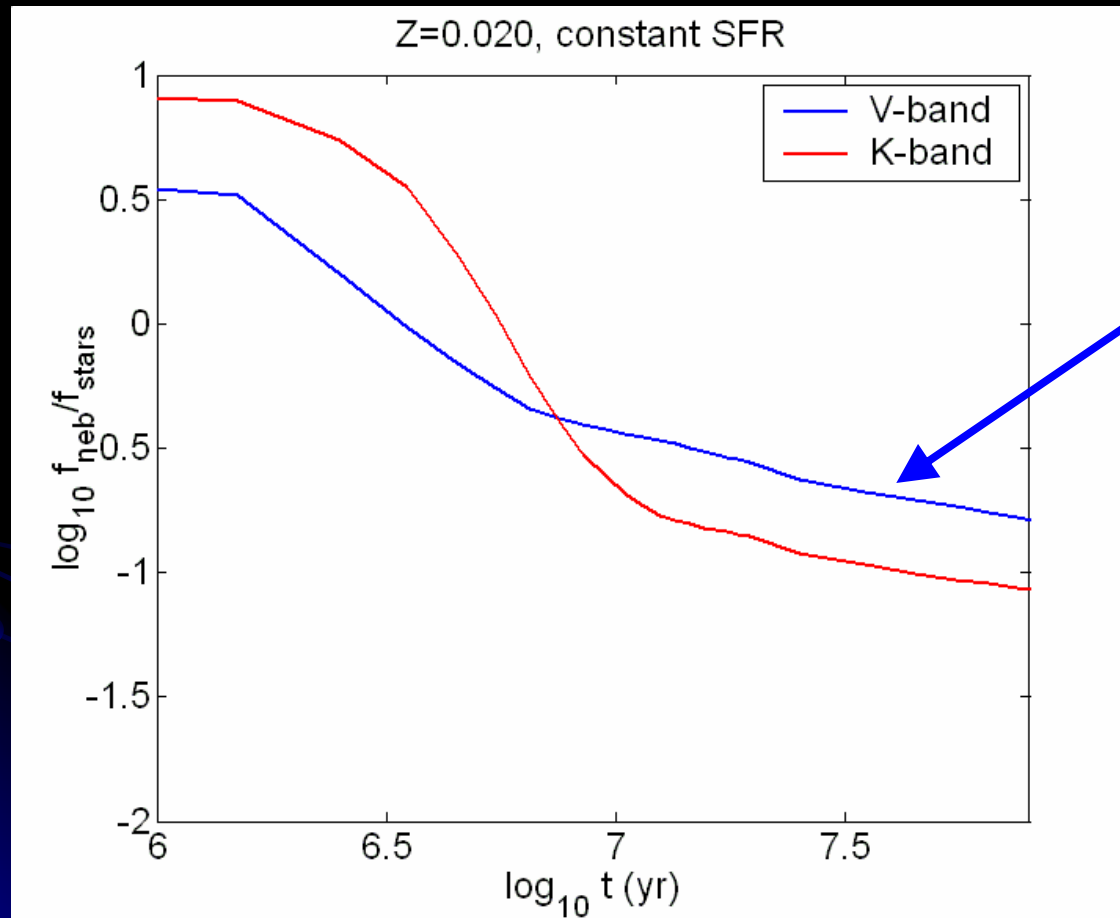
Low-metallicity population, instantaneous burst (e.g. SSC)

Luminosities – Stars vs. Gas II



High-metallicity population, instantaneous burst (e.g. SSC)

Luminosities – Stars vs. Gas III



Constant SFR \rightarrow
Nebula contributes
~20% to total flux
even at 30 Myr
(would be ~1 % for
Instantaneous burst)

High-metallicity population, constant SFR (e.g. starburst galaxy)

Modelling Nebular emission – Level of Sophistication: I

Stellar $L_{\text{LyC}}(t) \rightarrow$
Nebular $L_{\text{H}\beta}(t)$ & continuum (analytical)

Empirical strengths adopted for non-H lines:
[OIII]/H β , [OII]/H β , [SII]/H β ...

Examples: PEGASE.2

GALEV (Anders & Fritze-v. Alvensleben 2003)

Pros: Computationally fast

Cons: No temporal evolution of line ratios

Not suitable for systems different from the
empirical templates

Modelling Nebular emission – Level of Sophistication: II

Galaxy / star cluster treated as single HII-region, modelled using a photoionization code (e.g. Cloudy, Mappings)



Examples: Zackrisson et al. (2001, 2008), (Starburst99)

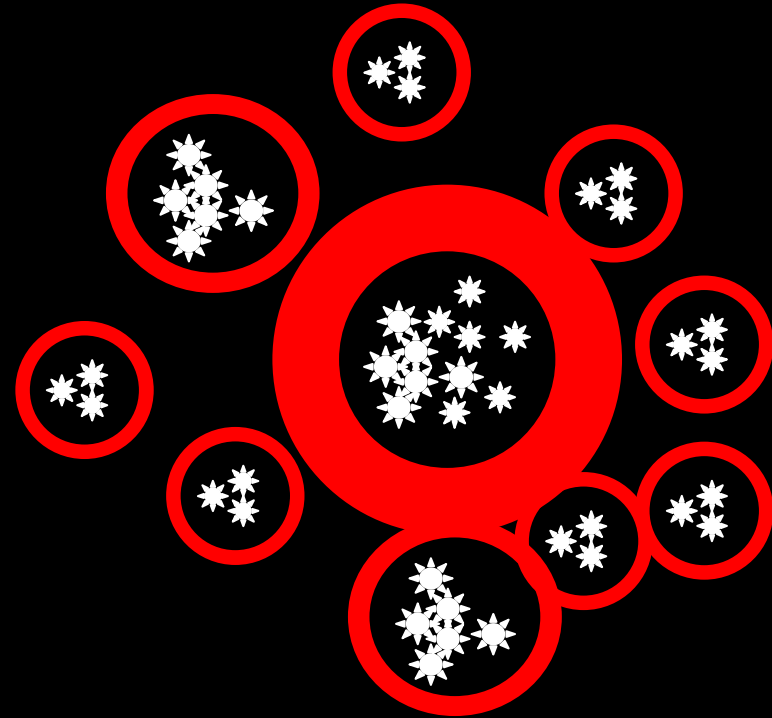
Pros: Reasonably realistic treatment

Cons: CPU-demanding

For a single time step only

Modelling Nebular emission – Level of Sophistication: III

Galaxy treated as a many
HII-regions, with different
properties, modelled
using a photoionization code
(e.g. Cloudy, Mappings)



Example: Dopita et al. (2006)

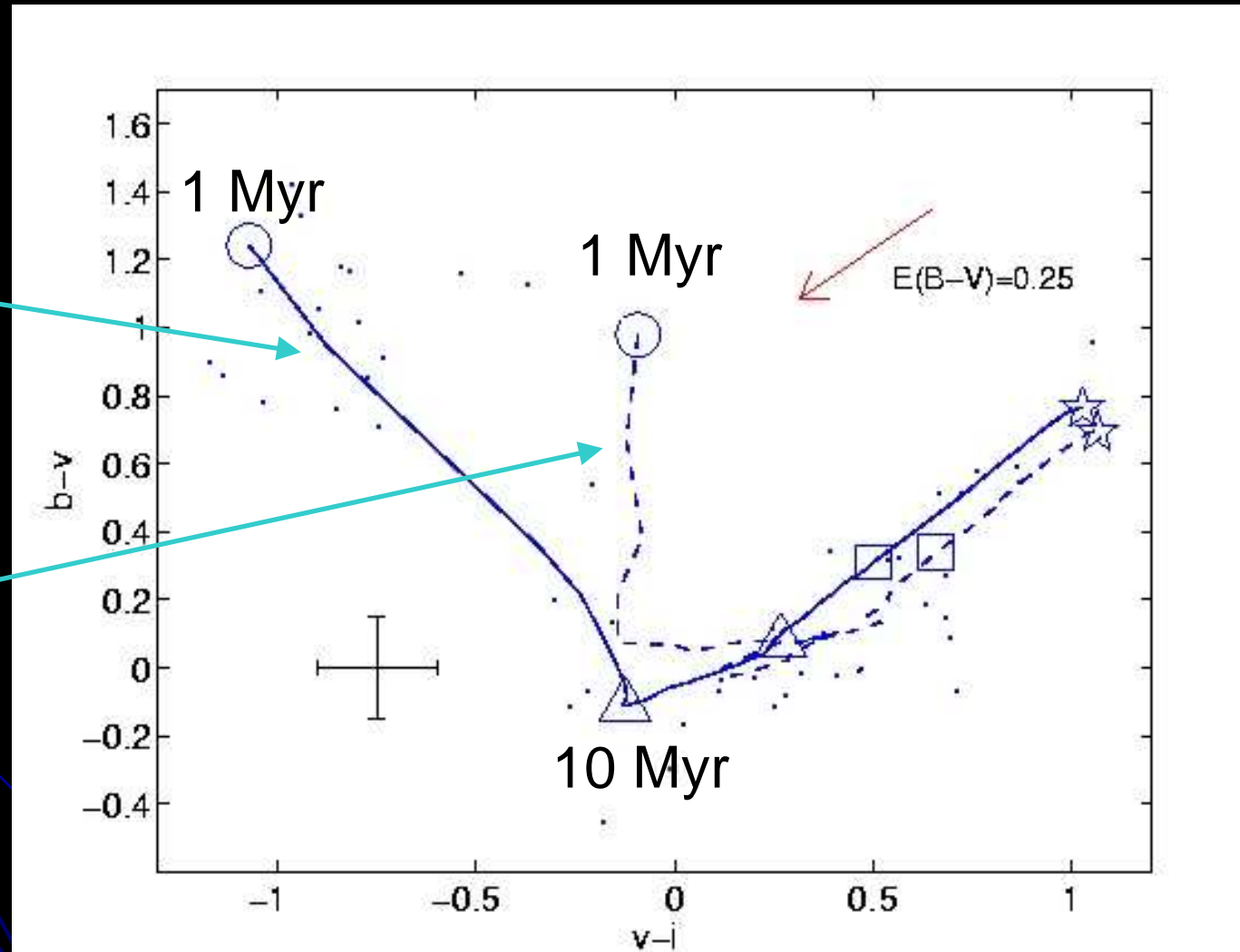
Pros: Highly realistic treatment

Cons: Very CPU-demanding, lots of free parameters

Does it matter? Yes!

Zackrisson et al.
(2001) –
(Level II model)

PEGASE.2
(Level I)



Super star clusters in ESO 338-IG04 (Östlin et al. 2003)

Summary

- Nebular emission is important, but often neglected!
 - Worried about the impact on your data?
 - Try a simple model first (e.g. PEGASE.2)
 - Move on to more complicated ones if necessary
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