Synthetic AGB evolution

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Synthetic AGB evolution: outline

- Why ?
- History
- Synthetic AGB evolution
  - Key relations
  - Population synthesis
  - Observational constraints
- Future directions

Why ?

- Computationally fast
- Flexibility
- Population synthesis

- RETURN:
  -Insight in dredge-up efficiency and mass loss

  -“Stellar Yields”
  for Galaxy Chemical Evolution Models

History

- Iben & Truran (1978), Iben & Renzini (1983)

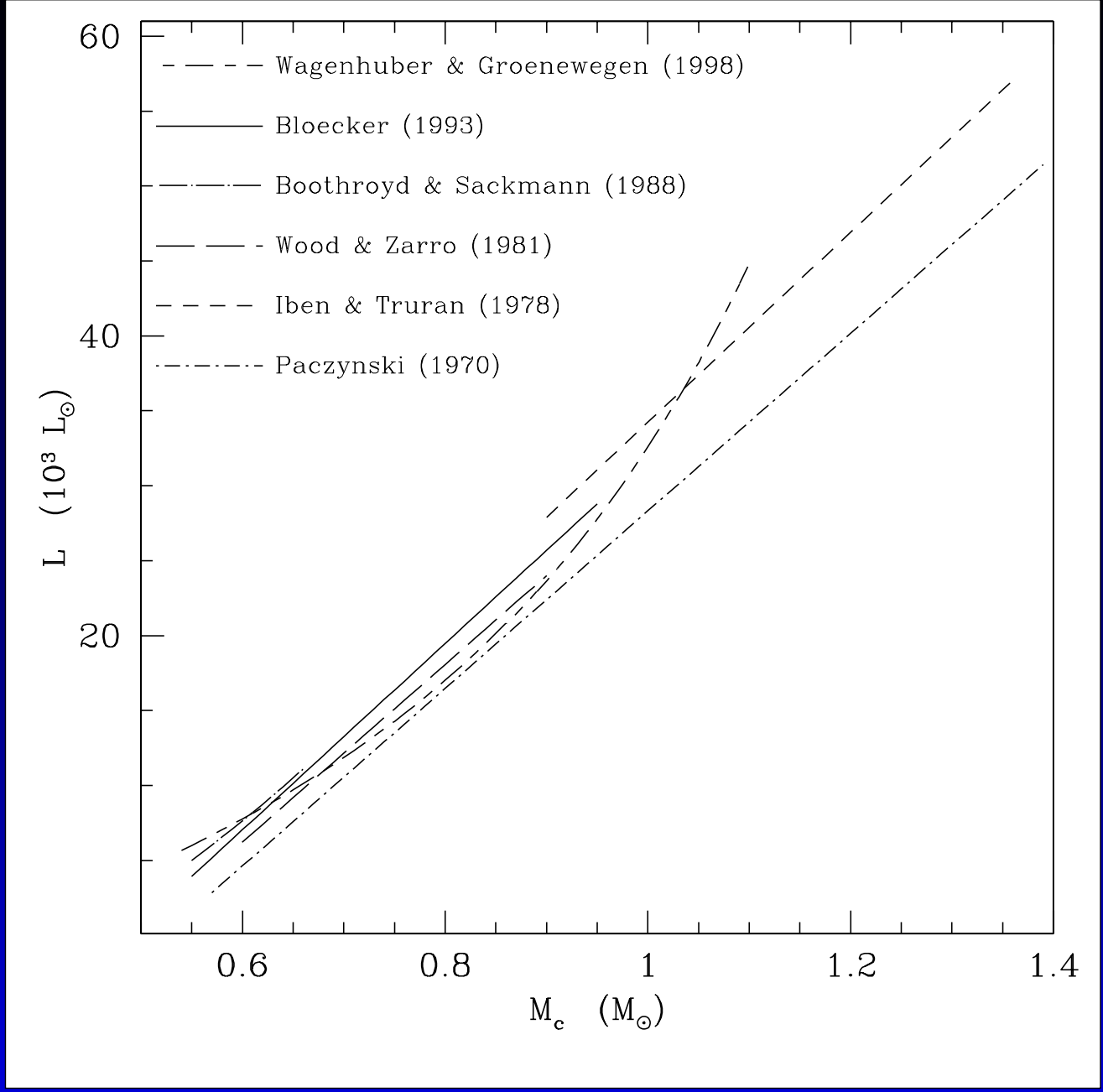
  “uncalibrated”, massive st.evol. models
- Bedijn (1988), Bryan, Volk & Kwok (1990)
- Groenewegen, de Jong, van den Hoek, Wagenhuber (1993-1998)

  “calibrated”, all st.evol. models, luminosity dip, metallicity, first pulses
- Marigo, Girardi, Chiosi, Bressan (1996-2003)

  idem; emphasis on nucleosynthesis

Key features

- Core Mass - Luminosity relation
- Core Mass - Interpulse time relation
- “Luminosity dip”
- Description of dredge-up: $M_{\rm c}^{\rm min}$, λ, composition, $T_{\rm b}^{\rm dred}$
- Description of mass-loss
- $\frac{dM_c}{dt} = \frac{q}{X} L_{\rm H}$



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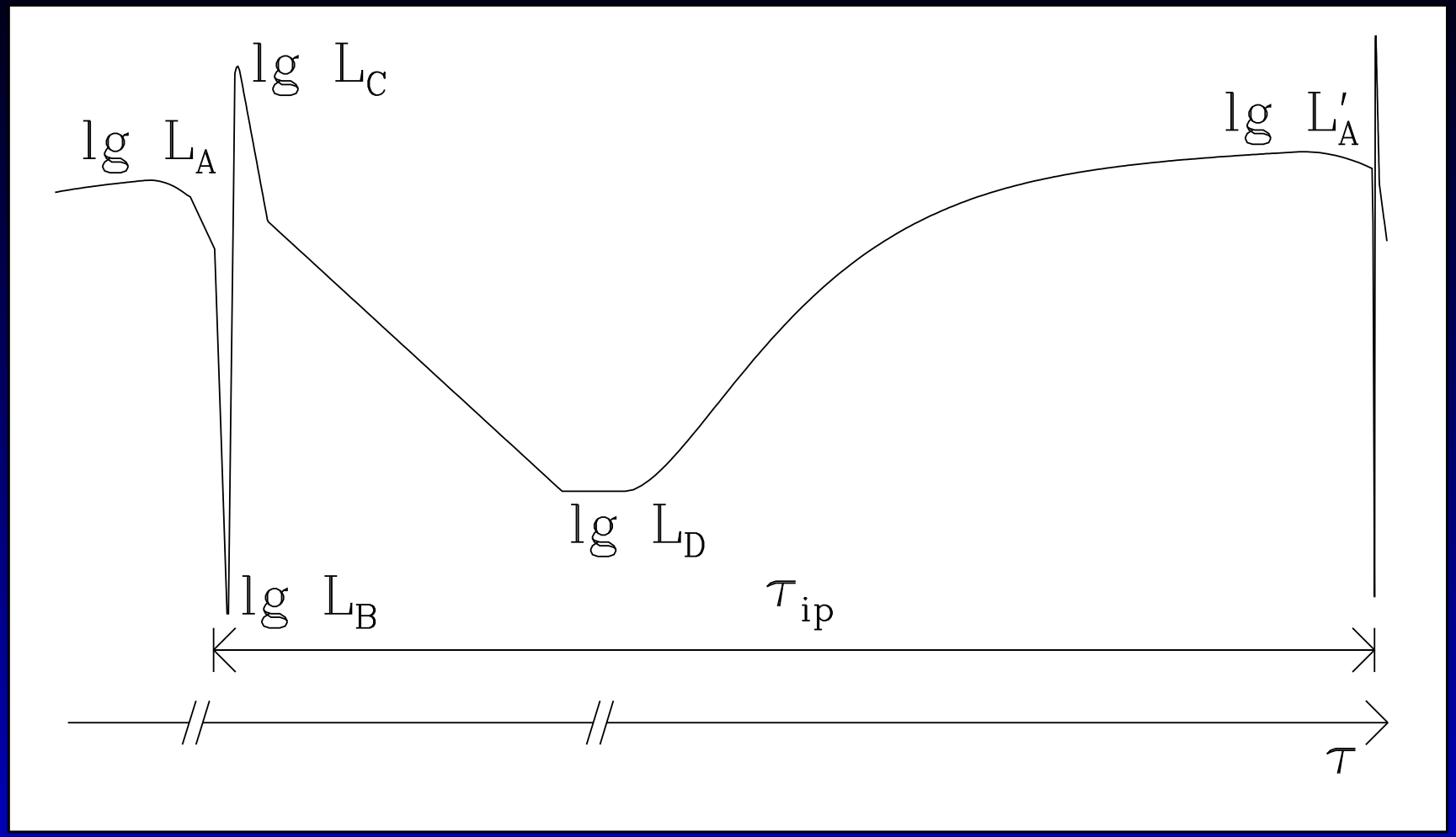

The thermal-pulse cycle (Wagenhuber & Groenewegen 1998)

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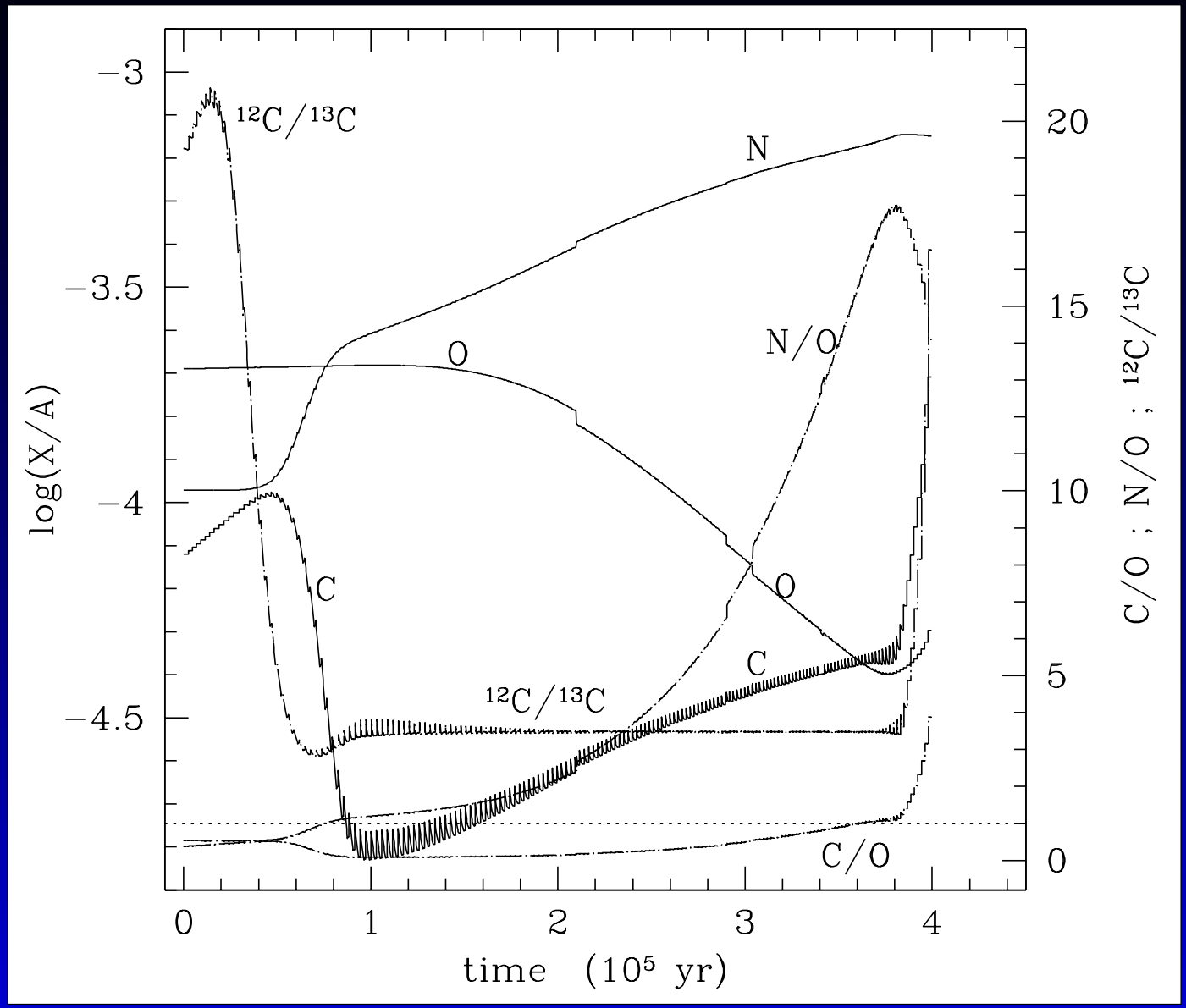


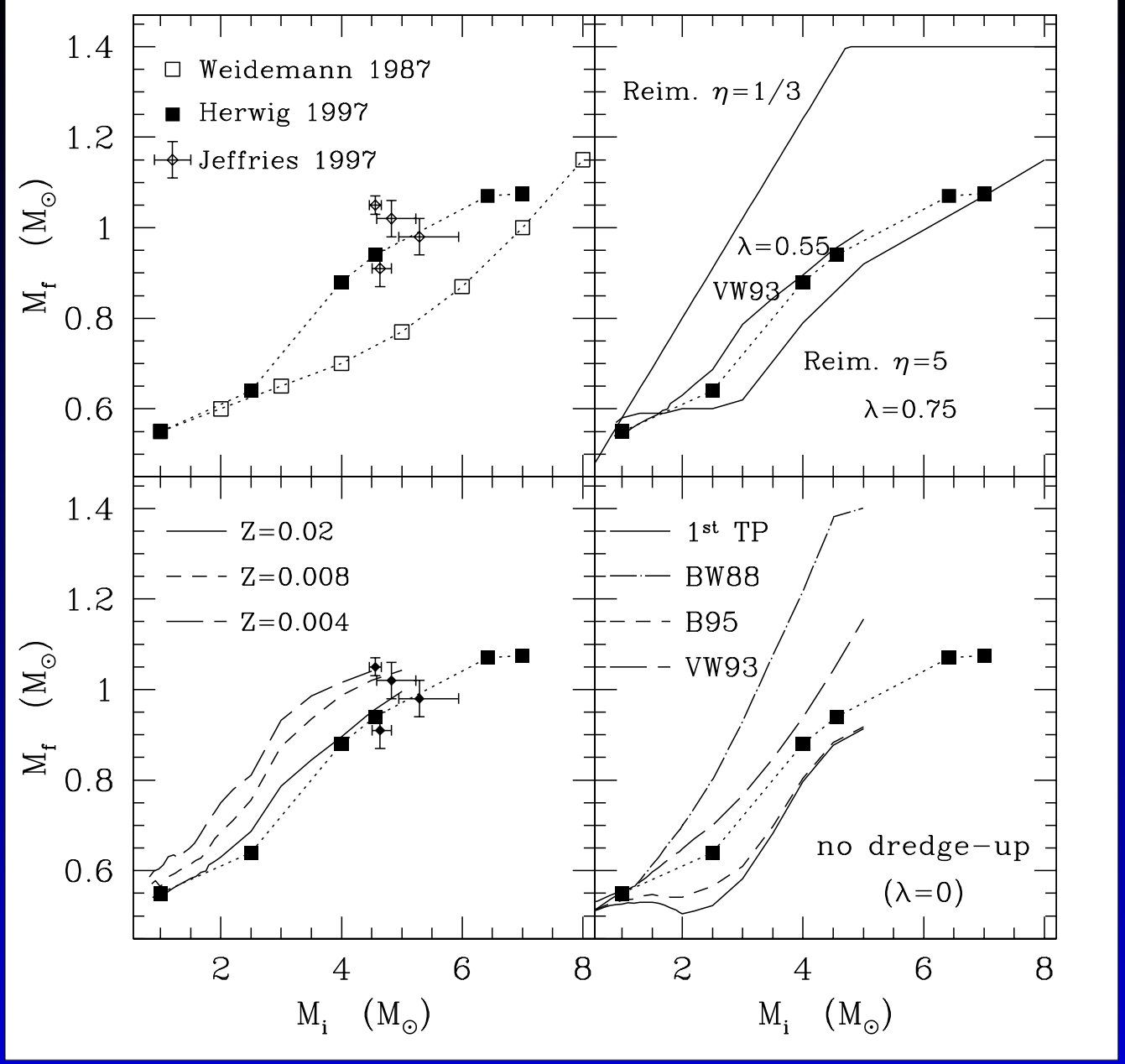
Chemical evolution (Marigo 1998)

Population synthesis

- Evolution of one star
- $N(M)dM \sim$
  $\phi(M) \;\; \psi(T_{\rm G} - \tau(M,Z)) \;\; t_{\rm AGB}(M,Z)$
- Initial Mass Function, $\phi(M)$
- Star Formation Rate, $\psi(t)$
- Age Metallicity Relation, AMR(t)

Observational constraints

- Initial - Final Mass relation
- Luminosity Function (carbon stars)
- $N_{\rm C}/N_{\rm M}$-ratio
- Abundances of PNe
- Effective Temperatures
- Pulsation Properties



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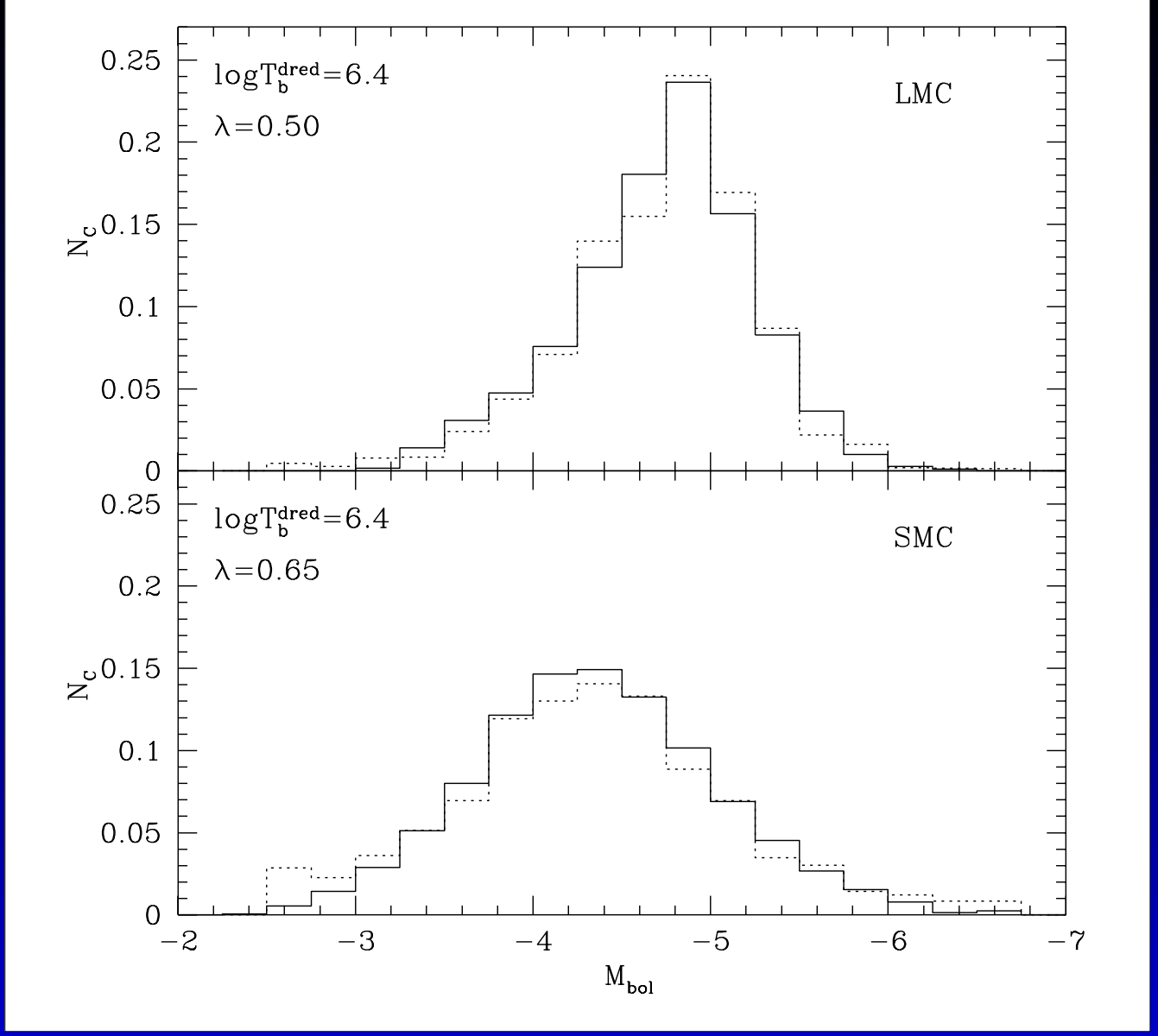

Carbon star LF (Marigo et al. 1999)

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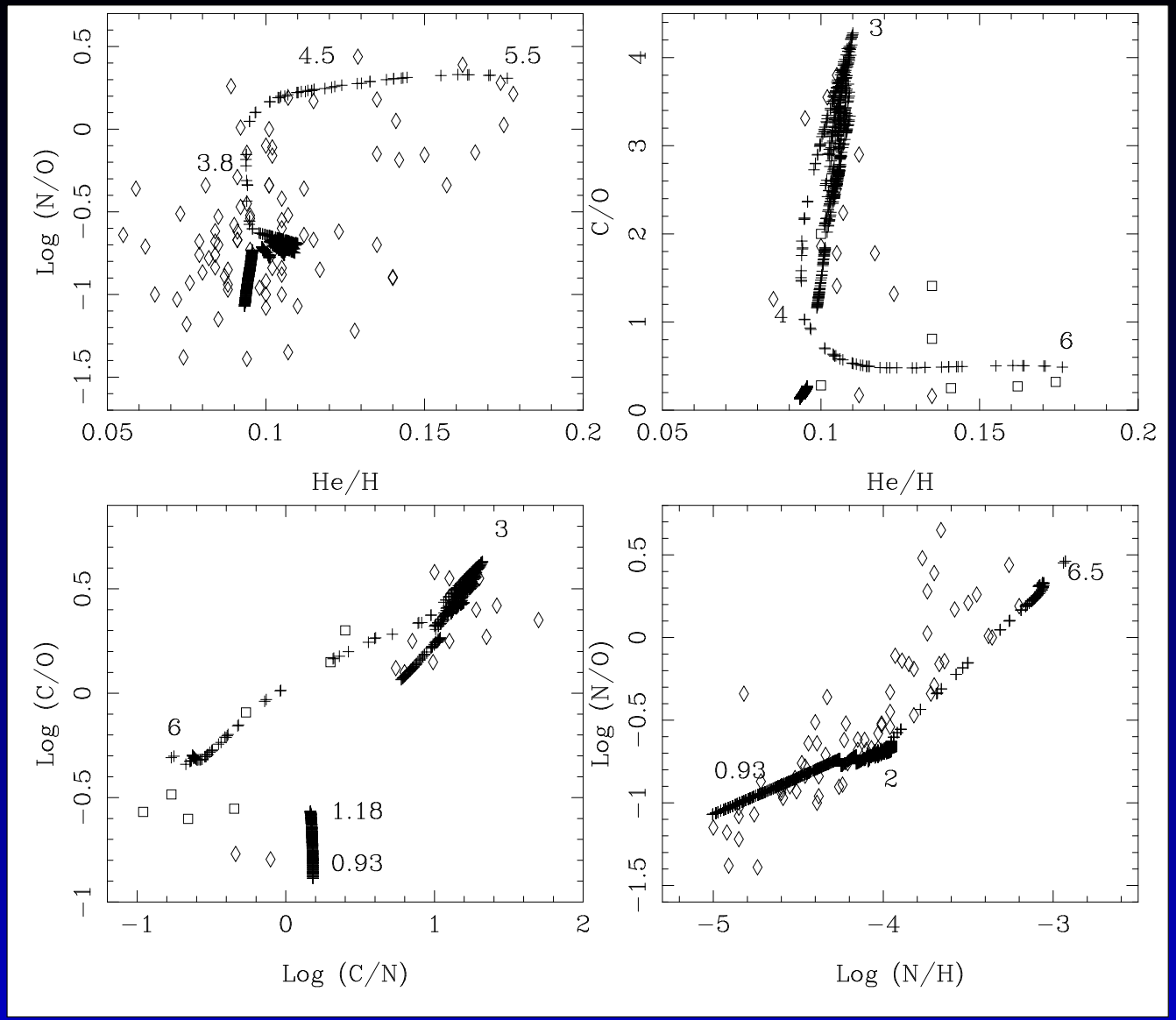

PNe abundance patterns (Groenewegen 1994)

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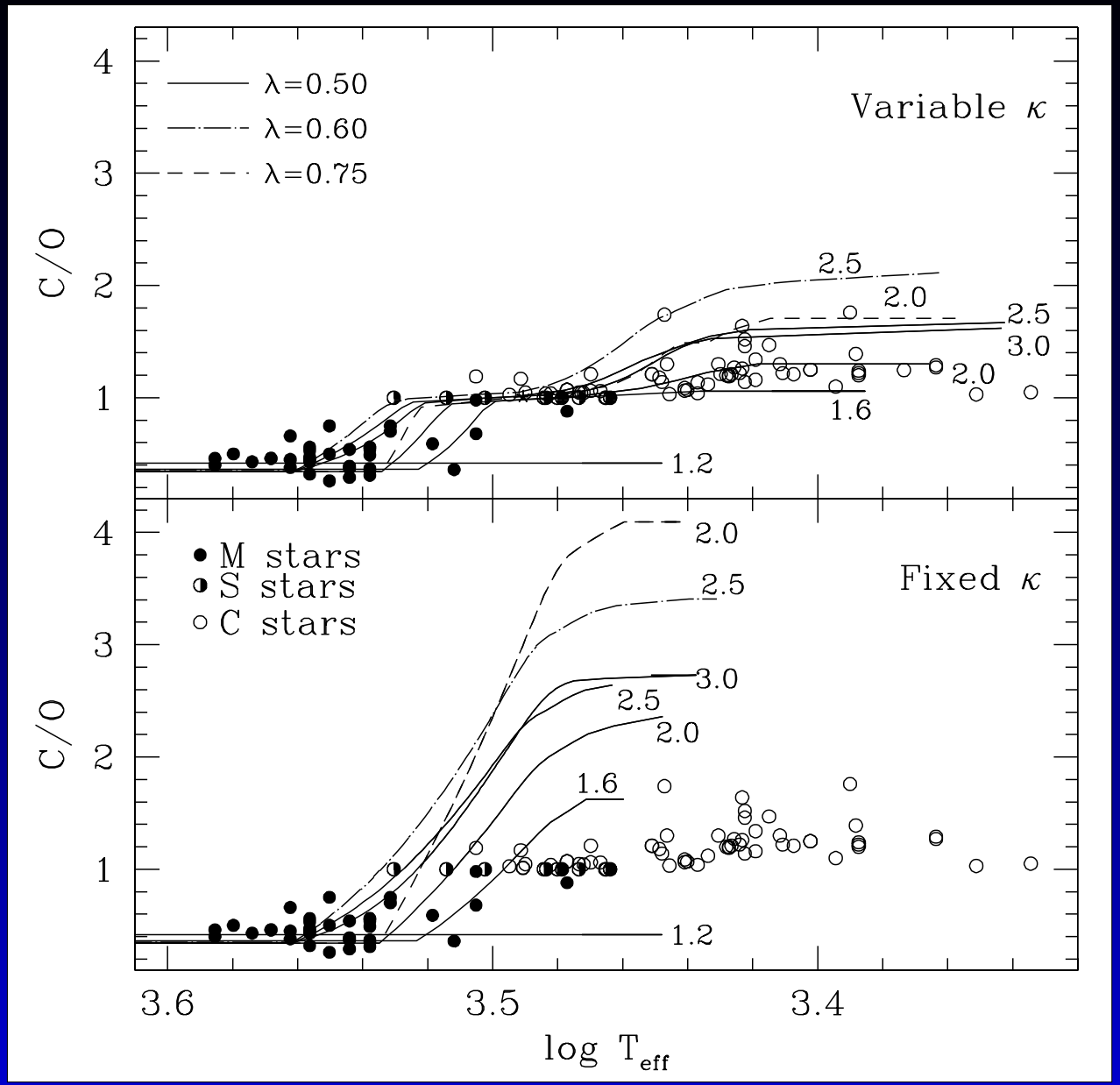

The effect of opacity (Marigo 2002)

Future Directions

- Pulsational properties: MACHO, OGLE, EROS.
  Links between SR and Mira?
  Test different hypothesis on evolution.

- Coupling of (full) population synthesis models to radiative transfer models to predict numbers *and* FIR fluxes (Herschel, SIRTF)

- Fit C-star LF and $N_{\rm C}/N_{\rm M}$-ratio in LG galaxies

THE END