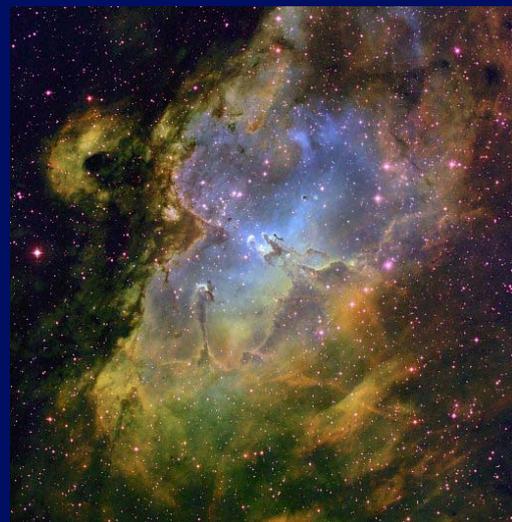


On Age Spreads in Star Forming Regions

Thomas Preibisch

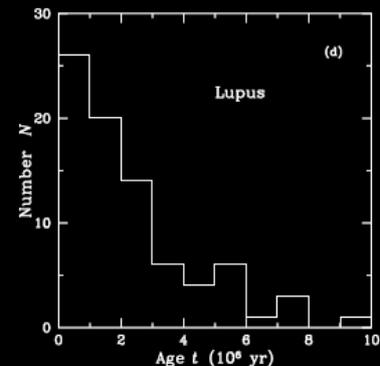
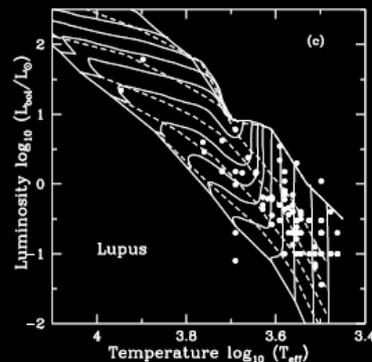
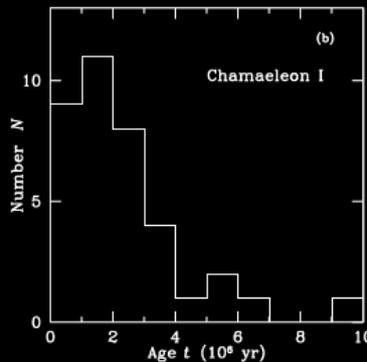
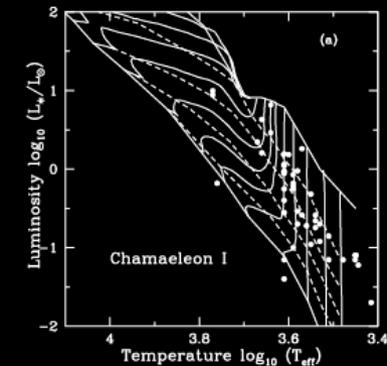
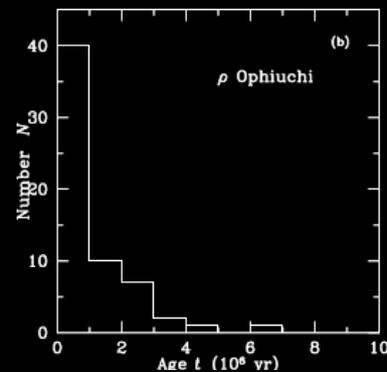
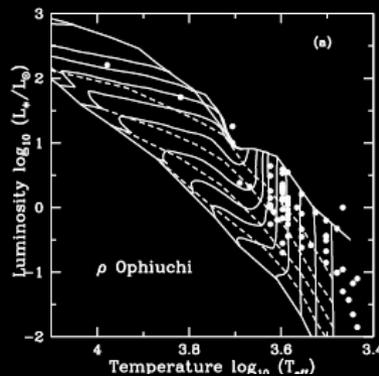
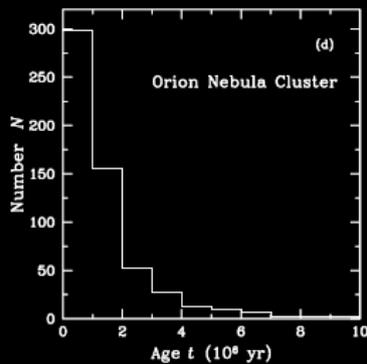
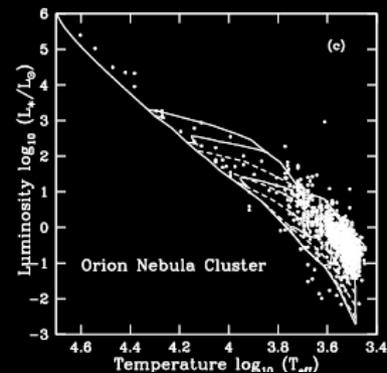
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Bonn, Germany

**Is star formation and
cloud evolution
slow & quasi-static
or
rapid & dynamic ?**



Palla & Stahler 2000 (ApJ 540, 255): HRDs of many star forming regions suggest

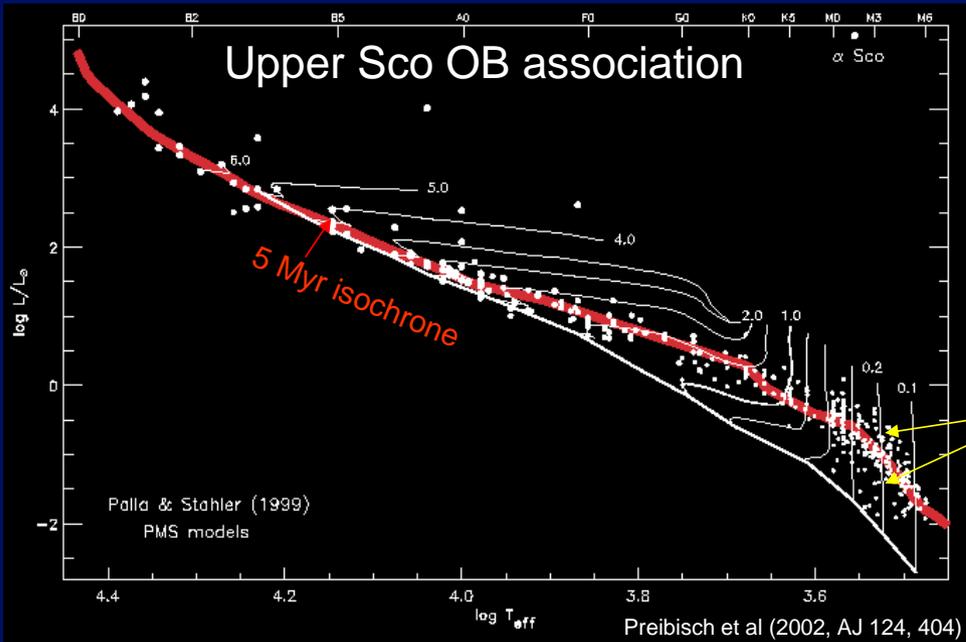
- large age spreads (> 5 Myr)
- increasing star formation rates over the last few Myr



Problem: errors and biases in the determination of L_{bol} and T_{eff}

\rightarrow "isochronal age" \neq true age of a star

A closer look:



Does this spread imply
~10 Myr age spread ??

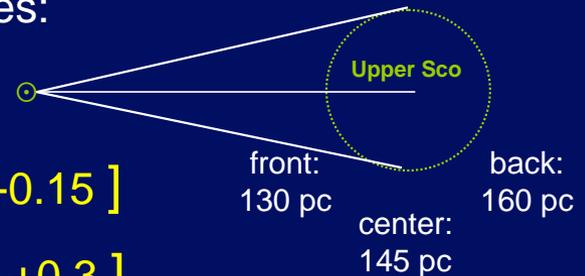
The observed spread of isochronal ages includes:

- spread of individual stellar distances:

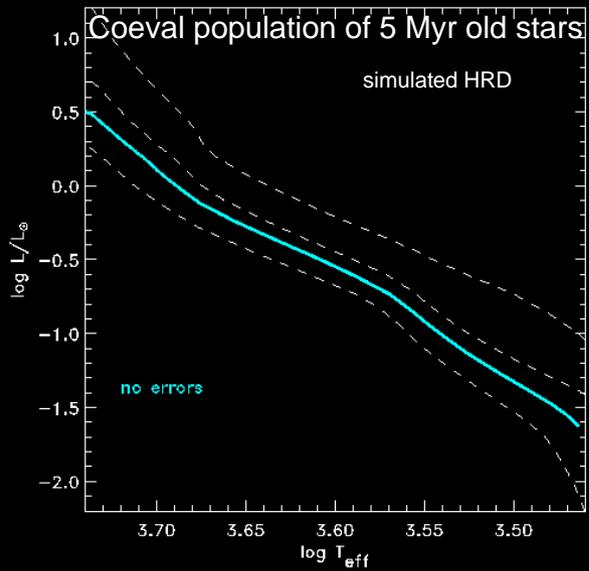
$$\Delta \log L = [-0.15 \quad \dots \quad +0.15]$$

- unresolved binaries: $\Delta \log L = [\quad 0 \quad \dots \quad +0.3]$

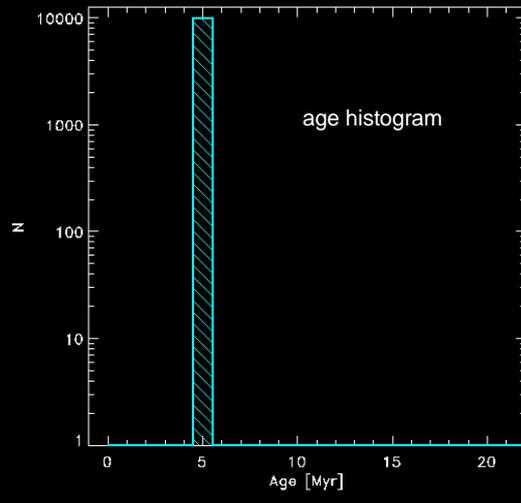
- photometric variability: $\Delta \log L = [-0.1 \quad \dots \quad +0.1]$



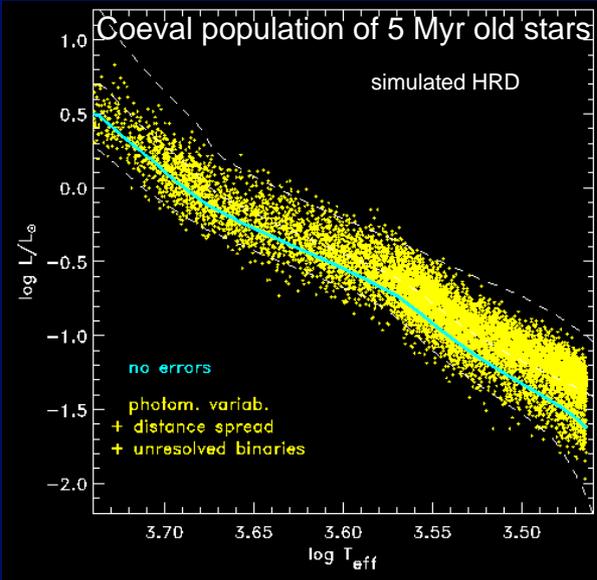
Monte-Carlo Simulation



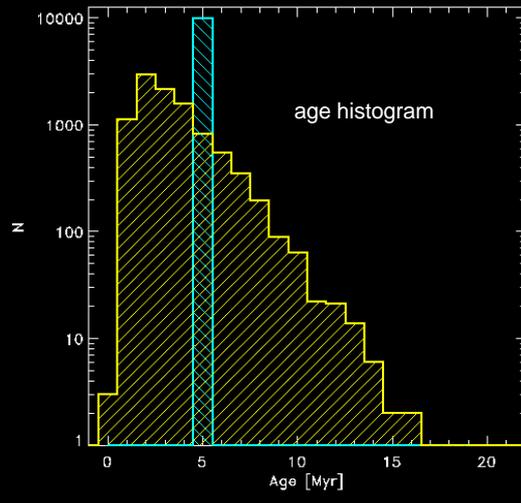
Perfect world: no errors, no uncertainties



Monte-Carlo Simulation



Perfect world: no errors, no uncertainties



Reality:

- photom. variability
- unres. binaries
- distance spread

→ **false impression of a large age spread
and an accelerating star formation rate
in an actually perfectly coeval population !**

Observed HRD for Upper Sco is consistent with **no age spread**

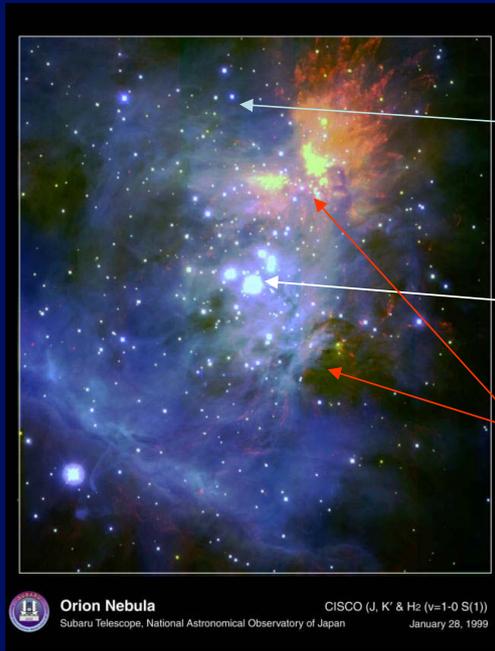
$$\Delta\tau < 1 - 2 \text{ Myr}$$

Another problem: projection effects

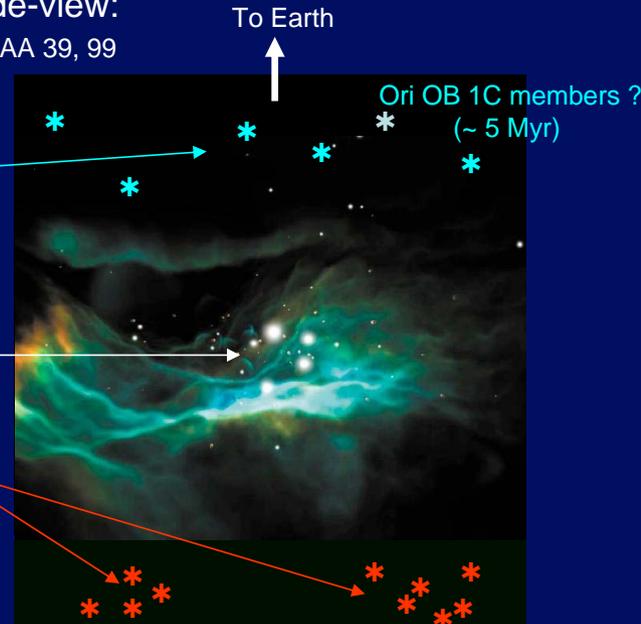
Projection of different stellar groups with distinct ages along the line-of-sight can give a false impression of a large age spread.

This seems to be the case in the Orion Nebula:

view from Earth:



simulated side-view:
O'Dell, 2001, ARAA 39, 99



Distributed
T Tauri stars: ~ 2 -10 Myr

Trapezium cluster
stars: ~ 1 Myr

BN complex, OMC-S
protostars: <~ 0.1 Myr

Conclusions:

- Individual stellar ages derived from the HRD (isochronal ages) must not be taken too literally.
- The spread of isochronal ages is only an ***upper limit*** to any true age spread.
- The ***true age spreads*** of many star forming regions are ***remarkably small***.

This seems to support scenarios of ***rapid cloud and star formation***.
(e.g. Hartmann et al. 2001, ApJ 562,852; Hartmann 2003, ApJ 585,398)

For further information see the **Protostars and Planets V** chapter by Briceno et al. (2006; astro-ph/0602446)