important: peaks in pre-MS luminosity functions do not really correspond to peaks in the pre-MS stellar mass function!

Deuterium burning

at $T \sim 10^6$ K

in stellar centers

$\rightarrow$ delay contraction (mass-dependent)

$\Rightarrow$ cause a feature in pre-MS mass-lum. relation

$\Rightarrow$ $\frac{dN}{d\log L} = \frac{dN}{d\log M} \frac{d\log M}{d\log L}$

LF = IMF × (↖ time-dep.)

pre-MS luminosities
are time-dependent
due to grav. contraction:

$$\frac{d}{dt}\frac{GM^2}{R(t)} = 4\pi R^2(t)\,\sigma\,T_{eff}^4$$

$M = M_* = \text{const}$ (after accretion ended)

$T_{eff} \sim M^{0.2}$ (on Hayashi track)

solve for $R(t) = R_0\, M^{2/5}\, t^{-1/3}$

convective Hayashi track $L(t) = L_0\, M^{8/5}\, t^{-2/3}$

rad. Henyey track $L(t) \approx \text{const}$

Logical steps to get good pre-MS masses ages

1. pre-MS evolutionary tracks

   vertical Hayashi tracks convective M = const.
   horiz. Henyey radiative

   $L(M,t) \sim M^{1.6} t^{-2/3}$
   $R(M,t) \sim M^{0.4} t^{-1/3}$
   $T(M,t) \sim M^{0.2}$

   } for Hay. phase

2. test/calibrate tracks before placing pre-MS stars into the HR-diagram

   How? young binaries!

   dynamical masses, orbits resolv
   coevality of components, isochrones

in more detail...

a) use a naked star without IR-excess
(weak T-Tauri star)
correct for A_V

if classical T-Tauri star,
use SED to correct
for disk accretion luminosity

b) use spectroscopic binaries ($P < 3yr$)
need SB2 (RV)

if SB1, do
infrared spectroscopy
to convert SB1 → SB2
(cf. Prato & Simon)

c) resolve SB2 orbit with VLTI/Keck-I

Taurus: 1 AU at 150 pc = 7 mas

TW Hyd: 1 AU at 50 pc = 20 mas

details, ctd.

d) resolved SB2 orbit yields <u>two</u> things:

1) individ. masses ($\sin i$)

2) orbital parallax (RV + astrom

↳ absolute brightness

<u>Note</u>

masses of young single stars can only be deduced from orbital gas motion in a Keplerian disk (enclosed mass, Simon et al.)

details, ctd.

e) placing pre-MS binary components in the HR-diagr—

(orbits are nice but not enough)

need SpT — true templates / IR

need L_* — (J, H, K, Δm)

eg. VLTI/AMBER

Note: thought experiment

suppose SB2 unresolved and unrecognized as such

how wrong would masses and ages be?

(cf. Brandner/Zinn. 1997) AA