cooling, and it is demonstrated that cooling leads to instability
and fragmentation of the dense disk that is formed. This disruptive
fragmentation is not seen for purely isothermal calculations unless
a very low-isothermal temperature is picked. I would caution against
interpreting pure isothermal calculations. Cooling should be included
(Hunter,Sandford, Whitaker and Klein; Astrophys. J. 1986).

ON EARLY EVOLUTION OF ACCRETING STARS

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Accretion is a dominant factor in the early evolution of stars. The
first time an accretion regime settles in is when a dusty opaque core
forms. The mass of adiabatically contracting core inside the isothermal-
ly collapsing envelope depends only on the optical properties of dust.
Spherically symmetric models of dusty cores were constructed using the
Henyey technique with accretion boundary conditions (Menshchikov 1986).
It appears that all protostars with normal chemical composition should
pass through the stage of a quasistatic dusty core. The evolution of
dusty cores is similar to that of "normal" young stars with accretion.
One could distinguish convective, radiative and central core contraction
phases. The life-time t_c of the core depends on the core mass M_c and the
accretion rate $\dot{M}$ (for $M_c = 0.01\ M_\odot$ and $\dot{M} = 1.6\times10^{-6}$, $1.6\times10^{-5}\ M_\odot$/year
$t_c = 1.2\times10^4$, 3×10^3 yrs consequently). After dust exhaustion in the
core it collapses and a central ionized quasistatic region grows in
several tens of years. A flash of infrared radiation at the moment is
not excluded.
According to numerical models (Tutukov and Shustov 1981) $\dot{M}$ is
nearly constant during the main accretion phase (time scale t_a(yrs)
$\sim 3\times10^5\ M/M_\odot$ for a cold cloud) and it stops abruptly in a time shorter
than t_a. This abrupt cessation of accretion is one of the reasons for
the so-called "birthline" in the H-R diagram.
The evolution of accreting stars ($0.1<M/M_\odot < 6.0$) assuming constant
$\dot{M} = 3\times10^{-6}$and $10^{-5}\ M_\odot$/year was calculated by Tutukov and Chiefi (1985).
The major problem concerns the fate of the energy liberated at the shock
front. Two limiting cases are: a) almost all the energy liberated at the
shock front is lost outward and the accreted matter therefore has low
entropy, b) almost all the energy goes into the star. Evolutionary tracks
of accreting stars (solid lines), tracks after cessation of accretion
(dashed lines) and the "birthline" (zigzag line) are shown in Figure 1.
The location of the tracks for models with accretion is insensitive to
the exact value of $\dot{M}$. More important is the relation between t_a and the
thermal time scale t_{KH}. The turnover point in the tracks for case b)
means that t_{KH} becomes smaller than t_a.
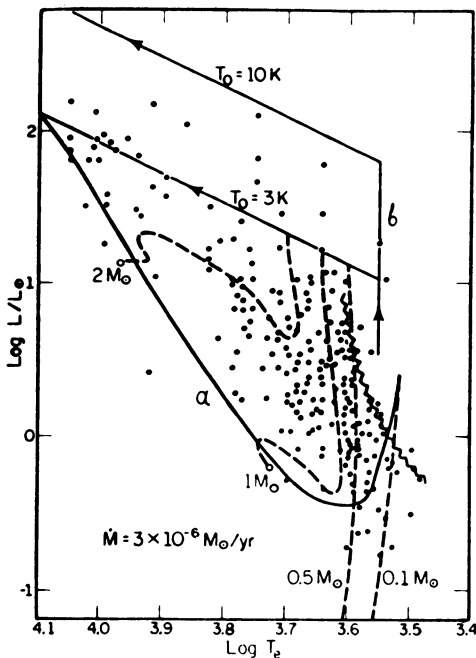
A comparison between the calculated evolutionary tracks and the positions of young stellar members of several open clusters (the dots in Figure 1 are taken from Cohen and Kuhi 1979) shows that the accretion of low entropy matter cannot explain the observed distribution of these stars. To obtain an agreement with the observations one has to assume that a large fraction of the gravitational energy liberated at the shock front goes to increase the heat content of the stars.

For low mass stars the relaxation of their overheated upper layers, after an abrupt cessation of accretion, may be a source of energy for activity of young stars. These stars can release the excess of energy in some nonstationary manner.

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MOUSCHOVIAS: Does the sudden end of accretion occur because you run out of mass or because of some (what?) outward force generated by the central object?
SHUSTOV: For low mass stars the reason for accretion to stop is the exhaustion of matter in a given fragment. The stellar wind switches on when practically all the mass is accumulated in the star. For a more massive protostar there are effective mechanisms of cessarion of accretion: radiative pressure on dust, shock wave propagation induced by ionization and the stellar wind.