On the Origin of the Salpeter Slope for the Initial Mass Function

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We suggest that the intrinsic, stellar initial mass function (IMF)
follows a power-law slope $gamma=2$, inherited from
hierarchical fragmentation of molecular clouds into clumps and clumps
into stars. The well-known, logarithmic Salpeter slope $Gamma=1.35$ in
clusters is then the aggregate slope for all the star-forming clumps
contributing to an individual cluster, and it is steeper than the
intrinsic slope within individual clumps
because the smallest star-forming clumps contributing to any given
cluster are unable to form the highest-mass stars. Our Monte Carlo
simulations demonstrate that the Salpeter power-law index is the
limiting value obtained for the cluster IMF when the lower-mass limits
for allowed stellar masses and star-forming clumps are effectively
equal, $m_{rm lo} = M_{rm lo}$. This condition indeed is imposed for the
high-mass IMF tail by the turn-over at the characteristic value
$m_csim 1 rm M_odot$. IMF slopes of $Gammasim 2$ are obtained if
the stellar and clump upper-mass limits are also equal $m_{rm up} = M_{rm up}
sim 100 rm M_odot$,
and so our model explains the observed range of IMF slopes between
$Gammasim 1$ to 2. Flatter slopes of $Gamma =1$ are expected when
$M_{rm lo} > m_{rm up}$, which is a plausible condition in starbursts, where
such slopes are suggested to occur. While this model is a simplistic
parameterization of the star-formation process, it seems likely to
capture the essential elements that generate the Salpeter tail of the
IMF for massive stars. These principles also likely explain the
IGIMF effect seen in low-density star-forming environments.

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Comments:

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