

The Luminosity Functions and Timescales of MYSOs and Compact HII regions

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We present a determination of the luminosity functions of massive young stellar objects (MYSOs) and compact (C)HII regions within the Milky Way Galaxy using the large, well-selected sample of these sources identified by the Red MSX Source (RMS) survey. The MYSO luminosity function decreases monotonically such that there are few with $L \gtrsim 10^5 L_{\odot}$, whilst the CHII regions are detected up to $\sim 10^6 L_{\odot}$. The lifetimes of these phases are also calculated as a function of luminosity by comparison with the luminosity function for local main-sequence OB stars. These indicate that the MYSO phase has a duration ranging from 4×10^5 yrs for $10^4 L_{\odot}$ to $\sim 7 \times 10^4$ yrs at $10^5 L_{\odot}$, whilst the CHII region phase lasts of order 3×10^5 yrs or $\sim 3\text{-}10\%$ of the exciting star's main-sequence lifetime. MYSOs between $10^4 L_{\odot}$ and $\sim 10^5 L_{\odot}$ are massive but do not display the radio continuum or near-IR H α recombination line emission indicative of an HII region, consistent with being swollen due to high ongoing or recent accretion rates. Above $\sim 10^5 L_{\odot}$ the MYSO phase lifetime becomes comparable to the main-sequence Kelvin-Helmholtz timescale, at which point the central star can rapidly contract onto the main-sequence even if still accreting, and ionise a CHII region, thus explaining why few highly luminous MYSOs are observed.

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