A multi-scale analysis of the hierarchical cascade based on a graph theoretical framework

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Abstract

Spatial properties of young small star-systems suggest that they may originate from a fragmentation's hierarchical cascade of the cloud notably over the 1-12 kAU range. In this talk I will present a new tool based on a graph-theoretic framework to identify and characterize the multi-scale architecture of NGC 2264. Combining archival data of the Herschel Gould Belt survey with Spitzer data, we probe the span over the 5-36 kAU range, from molecular cloud down to YSOs scales. This methodology allows us to highlight the presence of two types of multi-scale structures that we associate with the imprints of two different modes of fragmentation, either monolithic or hierarchical. Despite the fact that the latter represent only about 15% in proportion, we show that half of the YSOs are formed within them. They also happen to be located at the highest column density ($N_{H_2} = 6 \times 10^{22}$ cm^{-2}) within the cloud. By comparing the hierarchical structures properties with a fractal model of fragmentation we developed, I will also show that the hierarchical cascade does not exist at all scales, but instead there seems to be a specific scale at which this cascade starts. Our work shows that young stellar systems are indeed deeply rooted in their close gaseous environment suggesting that at least part of the star clustering and multiplicity may be due to the fragmentation of their gaseous surrounding.