The Origin and Evolution of Rich Clusters

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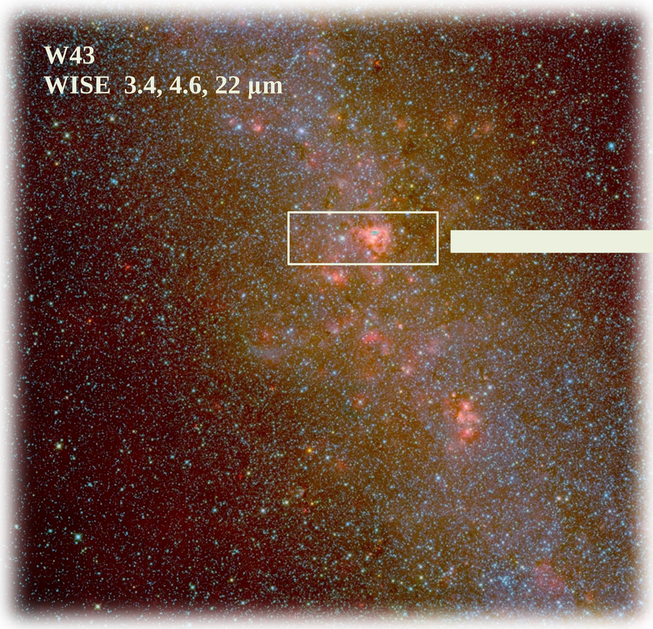
Abstract: **Massive stars play a vital role in the star formation process, yet their own formation and their effects on subsequent generations of star formation is not well understood. To improve our understanding, we have begun a detailed study of massive and active star formation regions in giant molecular clouds outside the Galactic Center. One of the main goals of this study is to identify and classify the Young Stellar Objects (YSOs) in each region by using Spitzer Space Telescope IRAC & MIPS data, Wide-field Infrared Survey Explorer (WISE) and Hershel archival data. Following this, YSO clusters will be identified based on spatial distributions of the detected sources. Studying clusters with different evolutionary stages will help us to understand the formation and evolution processes from beginning to end. This study will also provide significant information on how massive stars interact with their environment and how they affect the low-mass star formation in the cloud.**



The Study

➢ **Five massive and active star formation regions, listed in Table 1, have been chosen to study how massive stars form and effect their environment.**

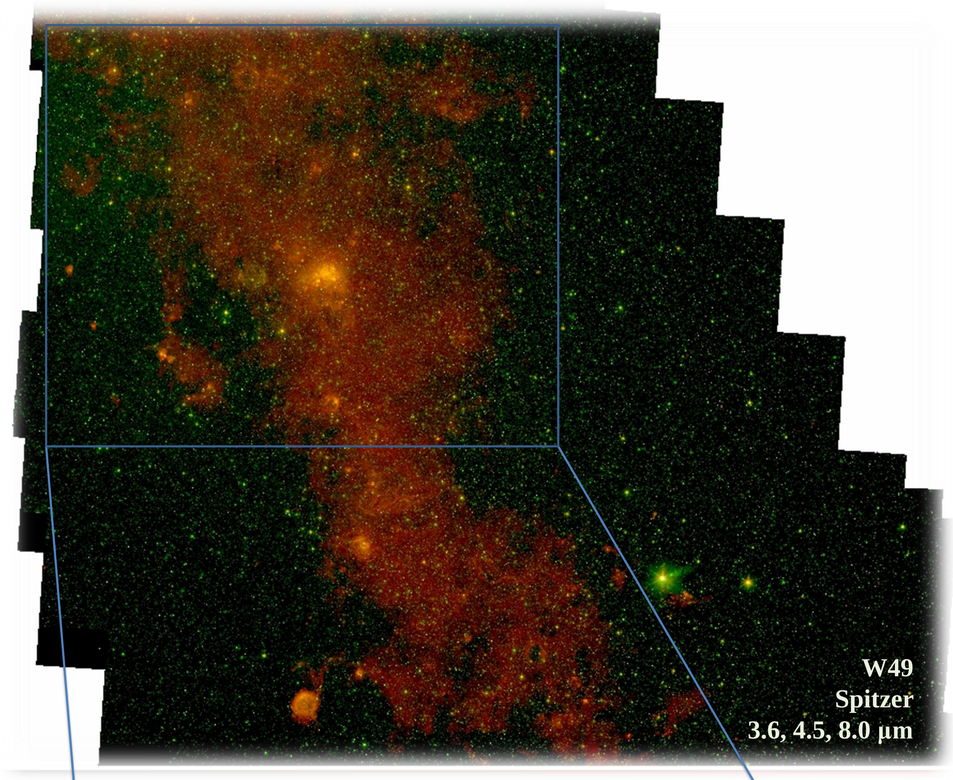
➢ **Spitzer/IRAC and MIPS data will be used for these five regions to identify and classify the population of YSOs in the star-forming regions, following the same analysis that has been applied to the Cygnus-X region in the Spitzer Legacy Survey (Hora et al. 2009, Beerer et al. 2010).**

➢ **Available Spitzer, Herschel, and WISE data on all these regions have assembled and mosaics have been generated. Source detection and photometry are ongoing.**

➢ **While W43 and W49 are young, massive star formation regions, W51 which contains a supernova remnant with luminous star forming regions, will give us a chance to study more evolved regions.**

➢ **NGC 3603 (below) and Wd1 (on the left) are dominated by rich clusters in their center, which will be a reference for the end of the evolutionary process.**

➢ **By studying massive star-forming complexes, which are at various stages of evolution, it would be possible to test models of star formation and determine which are consistent with observations.**



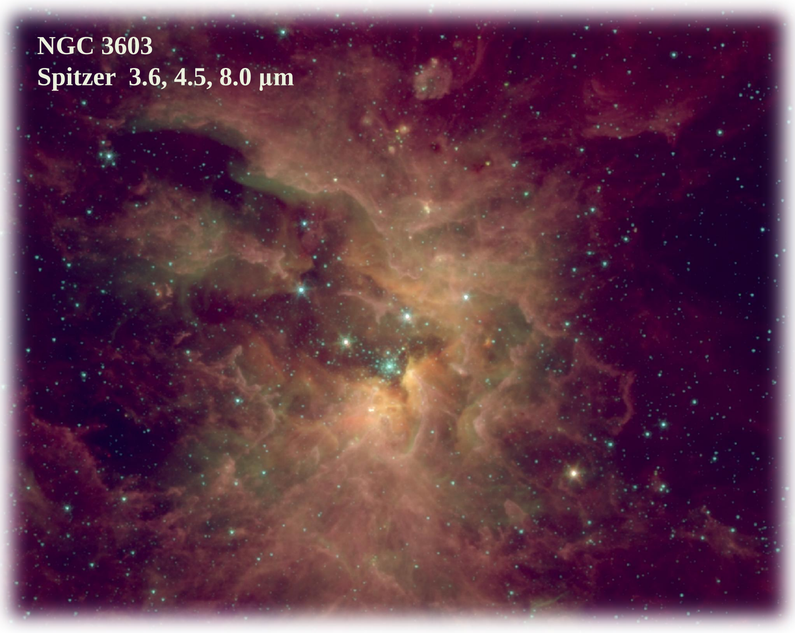
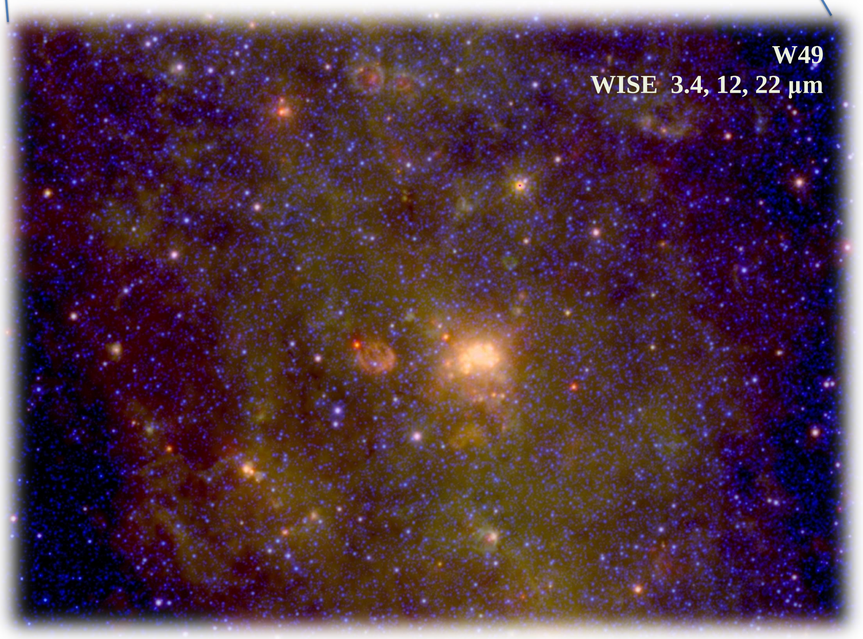


Table 1. Regions to be studied

Region	Size of Study Area (degrees)	Distance (kpc)	Estimated mass ($M_\odot$)
W51	1.8 x 1.4	5.5-8	3×10^6
W49	0.4 x 0.3	11.4	$\sim10^6$
W43	1.3 x 1.35	6	7×10^6
NGC 3603	0.7 x 0.7	6	4×10^5
Wd 1	0.3 x 0.3	5.2	10^5

W49 is probably the youngest, most luminous (10^7 $L_\odot$ e.g. Becklin et al. 1973, Harvey et al. 1977), and most massive star formation region in the Galaxy.



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