The Nature of the Herschel Clump Sources in the M16 Region and Ongoing Star Formation

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Abstract

We present the results of point source extraction and analysis of multi-wavelength far infrared imaging encompassing the M16 region using the PACS and SPIRE instrument on board the Herschel Space Observatory. This has been done as part of the HOBYS Key Project (Motte et al. 2010) which used Herschel to image all OB-star forming areas within 3pc of the Sun. Our analysis allows us to identify and characterize the earliest phases of intermediate and high-mass star formation and assess the importance of star formation triggers in regions containing high-mass star formation which include the famous “Fingers of God” pillars, the tips of which show cold cores. More detailed analysis of cold cores in the region is presented which shows several hundred class 0 to class I sources. These are generally distinct from the kinds of sources observed by Spitzer with an age range going to down to the youngest sources and with a markedly different spatial distribution.

Emission clumps are seen both on and (more occasionally) off the large-scale filamentary structure seen throughout the region.

Introduction

• Iconic star formation region with apparently induced star formation and strong pillars at approx. 2kpc distance.
• Large-scale Herschel Key Project previously studied by Hill et al (2012).
• Class 0 sources identified by GLIMPSE/Spitzer studies of Indebetouw et al (2007) associated mainly with stellar cluster NGC6611 which is a cavity seen in both Spitzer and Herschel PACS-SPIRE images.

In this paper we present the results from the extraction of clump sources identified in the region in the submm bands of SPIRE. These are (generally) the coldest point sources and are expected to be associated with the youngest objects in the field.

We are able to to characterize the nature of the sources and provide specific modelling for sources found at the tips of the pillars.

• We examine evidence for induced star formation and its characteristics.

Fig. 1: Combination of Spitzer/GLIMPSE (Benjamin et al 2003) at 8 µm (blue), Herschel/PACS 70 µm (green) and Herschel/SPIRE 250µm (red). The 8 µm point bright sources are scattered across the field. Hot dust is noted in the cavity area around the cluster NGC6611 (also see Flagey et al 2011).

Results and Preliminary Conclusions:

• 366 sources found with strong confidence in SPIRE submm data for M16. Sources distinctly different in nature and position form Spitzer detected YSOs in the region.
• Sources are class 0 to I. All class 0 sources are within dense filaments. More dispersion away from filamentary structure in going to class I sources.
• Timeline evident with NGC6611 cluster sources in cavity, around which are younger objects forming within the filaments formulated by the cluster winds.
• Strong sources at the tips of the pillars of M16 show SEDs of class 0/I and class I sources suggesting they are intermediate between NGC6611 sources and filament sources – SF has passed by. Likely still accreting and suggest already S-5 M_⊙ central stars.

References: