Astronomy Department Faculty Publication Series

DUST EMISSION AND STAR FORMATION IN STEPHAN'S QUINTET

G Natale
RJ Tuffs
CK Xu
CC Popescu
J Fischera
U Lisenfeld
N Lu
P Appleton
M Dopita
P-A Duc
W Reach
J Sulentic
Min Yun, *University of Massachusetts - Amherst*

Publication Date
2010

Comments
This is the pre-published version harvested from ArXiv. The published version is located at http://iopscience.iop.org/0004-637X/725/1/955/?rss=1.0

Abstract
We analyze a comprehensive set of MIR/FIR observations of Stephan's Quintet (SQ), taken with the *Spitzer Space Telescope*. Our study reveals the presence of a luminous (L_{IR} 4.6 × 10^{43} erg s^{-1}) and extended component of infrared dust emission, not connected with the main bodies of the galaxies, but roughly coincident with the X-ray halo of the group. We fitted the inferred dust emission spectral energy distribution of this extended source and the other main infrared emission components of SQ,

including the intergalactic shock, to elucidate the mechanisms powering the dust and polycyclic aromatic hydrocarbon emission, taking into account collisional heating by the plasma and heating through UV and optical photons. Combining the inferred direct and dust-processed UV emission to estimate the star formation rate (SFR) for each source we obtain a total SFR for SQ of 7.5 M yr^{-1}, similar to that expected for non-interacting galaxies with stellar mass comparable to the SQ galaxies. Although star formation in SQ is mainly occurring at, or external to the periphery of the galaxies, the relation of SFR per unit physical area to gas column density for the brightest sources is similar to that seen for star formation regions in galactic disks. We also show that available sources of dust in the group halo can provide enough dust to produce up to L_{IR} 10^{42} erg s^{-1} powered by collisional heating. Though a minority of the total infrared emission (which we infer to trace distributed star-formation), this is several times higher than the X-ray luminosity of the halo, so could indicate an important cooling mechanism for the hot intergalactic medium (IGM) and account for the overall correspondence between FIR and X-ray emission. We investigate two potential modes of star formation in SQ consistent with the data, fueled either by gas from a virialized hot IGM continuously accreting onto the group, whose cooling is enhanced by grains injected from an in situ population of intermediate mass stars, or by interstellar gas stripped from the galaxies. The former mode offers a natural explanation for the observed baryon deficiency in the IGM of SQ as well as for the steep L_X-T_X relation of groups such as SQ with lower velocity dispersions.

Pages

955

Volume

725

Issue

1

Journal Title

The Astrophysical Journal