

A *Herschel* Survey of the [N II] 205 μm Emission in Local Infrared Luminous Galaxies

Yinghe Zhao^{1,2,*}, Nanyao Lu², C. Kevin Xu², Yu Gao¹ and GOALS FTS Team

¹Purple Mountain Observatory, Chinese Academic of Sciences, Nanjing 210008, China

²Infrared Analysis and Processing Center, California Institute of Technology, Pasadena, CA 91125, USA

*email: yzhao@ipac.caltech.edu

Abstract. The [N II] 205 μm line is a major coolant in ionized interstellar medium, and is expected to be a good star formation rate indicator. Here we present a statistical study of [N II] 205 μm line emission for a large sample of local luminous infrared galaxies (LIRGs) using *Herschel* SPIRE FTS data (Lu *et al.* 2012; Zhao *et al.* 2012, in preparation). For our sample of galaxies, the [N II] to the total infrared luminosity ratio ($L_{\text{[NII]}}/L_{\text{IR}}$) varies from $\sim 10^{-5}$ to $\sim 10^{-4}$. We investigate the correlation between $L_{\text{[NII]}}$ and L_{IR} , as well as the dependence of $L_{\text{[NII]}}/L_{\text{IR}}$ on L_{IR} , infrared colors (f_{60}/f_{100}) and the [O III] 88 μm to [N II] luminosity ratio. We find that $L_{\text{[NII]}}$ strongly, and almost linearly correlates with L_{IR} for star-forming galaxies, namely $\log L_{\text{IR}} = (4.23 \pm 0.33) + (0.99 \pm 0.05) \log L_{\text{[NII]}}$ (see Fig. 1). The scatter in this relation is mainly due to the variation of hardness, and/or high ionization parameter, of the background UV field.

Keywords. galaxies: evolution — galaxies: ISM — galaxies: starburst — infrared: ISM

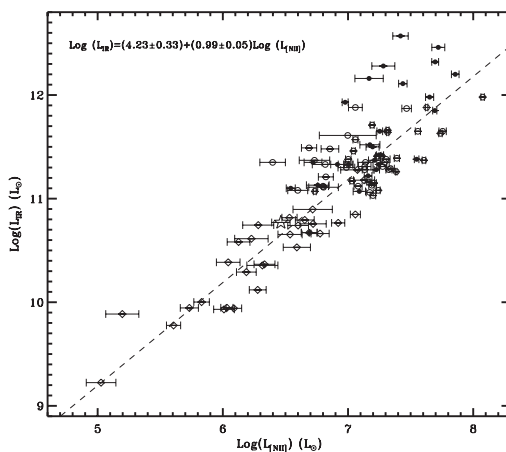


Figure 1. Correlation between $L_{\text{[NII]}}$ and L_{IR} for normal and luminous infrared galaxies. Circles are galaxies having *Herschel* observations. Squares are galaxies in Brauher *et al.* (2008, *ApJS*, 178, 280) and $L_{\text{[NII]}}$ is derived by using the observed [N II] 122 μm flux [see Zhao *et al.* (2012, in preparation) for details]. The superposed lines represent an ordinary least squares bisector, linear fit to the data (the solid symbols in the plot, which indicate AGN/LINERs, are not included in the fit).