

## Fermi-LAT $\gamma$ -ray study of the Chamaeleon molecular cloud complex using thermal dust optical depth obtained with *Planck*

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The diffuse  $\gamma$ -ray emission from local molecular clouds is a powerful probe of local cosmic rays and interstellar gas. Here we report a  $\gamma$ -ray analysis for the Chamaeleon molecular-cloud complex using *Fermi* Large Area Telescope (LAT) data. The Chamaeleon molecular cloud is located in the solar neighborhood at a distance of about 150 pc. In previous *Fermi*-LAT analyses of the Chamaeleon region (Ackermann et al. 2012 and Planck Collaboration XXVIII, 2015), the  $\gamma$ -ray emitting interstellar gas was mainly decomposed into three components: atomic hydrogen, molecular hydrogen and some excess gas not traced properly by standard H1 and CO surveys. In this analysis, we take a different approach and examine total column density ( $N_{\rm H}$ ) models based on the dust optical depth at 353 GHz ( $\tau_{353}$ ) obtained with *Planck* observations. Recent studies of the relation between  $N_{\rm H}$  and dust optical depth in local molecular clouds found a large deviation from a simple linear relation (e.g., Roy et al. 2013 and Planck Collaboration XXVIII, 2015), possibly due to evolutions of dust grains in cores of clouds. In fitting  $\gamma$ -ray data with several  $N_{\rm H}$  models, including both linear and non-linear relations with  $\tau_{353}$ , we found that a non-linear relation of  $\tau_{353}$  proportional to the  $\sim$ 1.3-th power of  $N_{\rm H}$  gives the best fit, which may indicate dust evolutions in high density regions.

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