Investigating Multi-wavelength Signatures of the Quiescent Molecular Cloud, DC 314.8–5.1

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DC 314.8-5.1 is a quiescent molecular cloud prior to the onset of star-formation. It is unique due to a coincidental association with a B-type field star, which illuminates a reflection nebula within the cloud, resulting in infrared emission from the dust grains, specifically Polycyclic Aromatic Hydrocarbons (PAHs). The study of the individual PAH features showed that the system displays differing characteristics from similar systems with reflection nebula incident from star formation. Additionally, the emission indicated a higher than expected ionization level of the system, potentially due to cosmic-ray interactions. In addition to the uniqueness of the system with respect to its companion star and its evolutionary stage, DC 314.8-5.1 is particularly well suited for multi-wavelength investigation because of (i) its proximity (432 pc), and (ii) its location below the Galactic Plane.

In this work, we present an analysis of the multi-wavelength observations of the dark globule, DC 314.8–5.1, using the optical survey Gaia, the near-infrared survey 2MASS, the mid-infrared survey WISE, dedicated imaging with the Spitzer Space Telescope, and X-ray data obtained with the Swift-XRT telescope. For this purpose, we studied the infrared colors, optical parallax, and x-ray emission of all point sources coincident within the boundaries of the cloud. Ultimately we found no candidate sources down to a a mass of $0.01 M_{\odot}$ for Class I–III YSOs and to a Swift-XRT (0.5–10 keV) luminosity level $\lesssim 10^{31} \mathrm{erg\,s^{-1}}$.

Our detailed analysis of the gathered multi-wavelength data confirms a very young, "pre-stellar core", evolutionary stage of the cloud, supporting the claim that the high ionization level may be the result of cosmic-ray interactions. All in all, our analysis indicates that DC 314.8-5.1 constitutes a compact reservoir of cold dust and gas, providing a truly unique insight into a primordial form of the interstellar medium.