THURSDAY, 5 DECEMBER 2019

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Title : Radiative and Mechanical Feedback into the Molecular Gas in the Local Starburst 30 Doradus

16:00 PM, 천문우주과학과 감민호홀(기2111호)

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ABSTRACT

In this talk, we present a high-resolution study on the physical conditions and excitation mechanisms of warm molecular gas in 30 Doradus (10 pc scales; Lee+19). With more than 1000 hot luminous stars, 30 Doradus is the most extreme starburst in the Local Universe, providing an excellent laboratory for probing the impact of radiative and mechanical feedback into the surrounding ISM. For our study, we combined *Herschel* SPIRE FTS observations with ground-based data to construct CO spectral line energy distributions (SLEDs) from J=1-0 to 13-12 over an area of 60 pc × 60 pc and found that the shape of the CO SLEDs significantly changes, e.g., peak transition varies from J=6-5 to 10-9. To investigate the source(s) of these variations in CO transitions, we analyzed the CO observations, along with [CII], [CI], [OI], H_2 0-0 S(3), and far-infrared luminosity data, using state-of-the-art models of photodissociation regions (PDRs) and shocks. Our detailed modeling showed that the observed CO likely originates from highly compressed (thermal pressure ~ 10^7−10^9 K cm^{-3}) clumps on ~0.5−2 pc scales, which could be produced by either UV photons (UV radiation field ~ 10^3−10^5 Mathis fields) or low-velocity C-type shocks (density ~ 10^4−10^6 cm^{-3} and velocity ~ 5−10 km s^{-1}) (Fig 1). Based on the stellar content in 30 Doradus, we then tentatively favored the non-stellar origin of CO excitation and concluded that low-velocity shocks driven by kpc-scale processes (e.g., interaction between the Milky Way and the Magellanic Clouds) likely play a key role in heating CO. All in all, our study demonstrates the power of multi-line diagnostics and complementary constraints (e.g., stellar content) to examine the physical conditions and energetics of the ISM and calls for systematic studies of various atomic and molecular species at high spatial and spectral resolution to probe the drivers of mechanical heating and detailed processes of energy dissipation in the ISM.

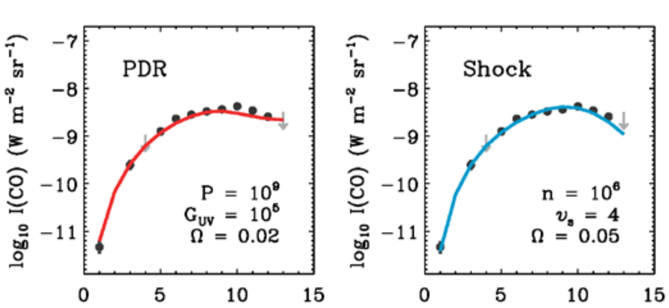

Fig 1 Observed CO SLED (dark and light gray for detections and non-detections) vs model predictions. On the left, the best-fit Meudon PDR model with P ~ 10^9 K cm^{-3}, UV radiation field ~ 10^5 Mathis fields, and beam filling factor ~ 0.02 is shown in red. Similarly, on the right, the best-fit Paris-Durham shock model with n ~ 10^6 cm^{-3}, velocity ~ 4 km s^{-1}, and beam filling factor ~ 0.05 is in blue.

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