SOFIA Basic Science GREAT Abstracts

81_0011 High frequency water masers with SOFIA/GREAT

Principal Investigator: Prof. Michael J Kaufman

San Jose State University

Scientific Category: ISM AND CIRCUMSTELLAR MATTER

Abstract

Using the GREAT instrument, we will observe the 8(27)-7(34) line of water vapor at 1296.411 GHz, a predicted maser transition, toward the massive star-forming regions W49N, W51 and W3(OH); and toward the oxygen-rich evolved stars W Hya and RT Vir. In combination with maser transitions of lower frequency that can be observed from the ground, the proposed observations will constrain the conditions of gas temperature, gas density, and IR radiation field within the maser-emitting region, providing important constraints upon the maser pumping mechanism. In the case of the star-forming interstellar regions, the proposed observations will also constrain the nature of the shock waves that power the maser emission.

81_0014 Search for interstellar mercapto radicals (SH) with SOFIA

Principal Investigator: Prof. David A Neufeld

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Scientific Category: ISM AND CIRCUMSTELLAR MATTER

Abstract

Using the GREAT instrument, we propose to search for interstellar mercapto (SH), a molecule not previously detected in the interstellar gas. We will observe the 1.383 THz (ground-state) transition of SH toward six bright submillimeter continuum sources - Sgr B2 (M), W49N, W51, G34.3+0.1, G29.96-0.02 and G10.6-0.4 (W31C) - all lying in the Galactic plane with sight-lines that intersect diffuse molecular material in foreground spiral arms. The proposed observations will complement previous studies of H2S and SH+, which indicate that the abundances of sulfur-bearing hydrides are much greater than the predictions of standard chemical models, and suggest the presence of a "warm chemistry" that enhances the abundances of these species. Our program has the goal of testing chemical models for formation of sulfur-bearing molecules in the interstellar medium, both in UV-irradiated regions and in turbulent dissipation regions or shocks.

81_0034 Pillars of Creation: physical origin and connection to star formation

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Scientific Category: ISM AND CIRCUMSTELLAR MATTER

Abstract

Herschel SPIRE/PACS photometry observations performed within the HOBYS (Herschel imaging survey of OB Young Stellar objects) key program have revealed a wealth of interesting structures in high-mass star forming regions. The most spectacular of these are 'pillars' and 'globules'. These features - partly known from Hubble Space telescope or Spitzer images - are formed due to photoevaporation at the interface between a molecular cloud and an HII region, and are thus intimately linked to high-mass star formation. The processes of how these pillars are created, and under which conditions low- or high-mass stars form within them, are not yet clear. We have embarked upon a dedicated project to fully simulate pillars and globules using the (magneto)-hydrodynamic code HERACLES that comprises gravity and ionization. We propose here to make use of the GREAT instrument onboard SOFIA to map the [CII] line at 1.92 THz and the 12CO 11-10 line in the Photon Dominated Region of Cygnus X South, containing pillars and globules. These data will provide the physical structure of these features, i.e. the excitation conditions from the hot external PDR gas phase into the cooler and denser central gas. This will reveal the penetration depth of UV radiation and the relative importance of the different cooling lines (CII vs. CO). The objective is to use observational information from [CII] to determine e.g. UV flux and abundances, and cooling and heating functions as input for HERACLES. The spectrally resolved [CII] and CO line profiles allow us to derive the properties of the turbulent velocity field. The observations will be compared to the large existing complementary data set for Cygnus, and will additionally serve as input for the model to ultimately explain pillar formation and star formation within them.

81_0040 Mapping "Dark Gas" in Rho Ophiuchus A

Principal Investigator: Dr. Di Li

Jet Propulsion Laboratory

Scientific Category: ISM AND CIRCUMSTELLAR MATTER

Abstract

We propose to map Rho Ophiuchus A in C+, the abundance of which traces the transition from diffuse to dense ISM. At 125 pc, the Rho Ophiuchi region is readily resolvable by SOFIA and potentially provides a sampling of all layers of ISM. Our existing CO and CI maps reveal interesting spatial and spectral structures in rho Oph. Their implication to our fundamental understanding of cloud structure will be clarified by SOFIA GREAT data. In this nearby star forming region, our proposed observations would reveal the "dark gas", the existence of which is supported by stronger than expected C+ intensity in GOT C+ data. Toward rho Oph, SOFIA GREAT provides excellent (0.01 pc) and spectral (1 km/s) resolution, which are impossible until now and still impossible for distant regions. The proposed data set will

provide a detailed picture of the multiple states of ISM in a star forming region and enhance our understanding of the transition phase, which is an essential step of star formation.

81_0063 GREAT Diagnostics of Molecular Shocks in Interacting Supernova Remnants

Principal Investigator: Dr. John William Hewitt

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Scientific Category: ISM AND CIRCUMSTELLAR MATTER

Abstract

Supernova remnants interacting with dense molecular clouds provide astrochemical laboratories to study heating and cooling of the dense ISM, shock chemistry, destruction and sputtering of dust, and the reformation of molecules. SOFIA GREAT observations of the major cooling lines of C+, CO, OH, and N+ allow for sensitive shock diagnostics to be measured. We have selected three remnants with particularly high shocked gas densities, high dust and IR line luminosities, and extreme ionization environments, which will serve as an important differentiation from the typically observed remnants (such as IC 443). The scientific objectives of this proposal are: (1) to determine the abundance and excitation of hydroxyl, which is not expected in dense shocks, (2) to study the effects of shock and X-ray ionization on the observed non-equilibrium oxygen chemistry, and (3) to utilize velocity resolved spectra to discern between existing shock models.

81_0065 Using GREAT to Probe [CII] emission in the Ring Nebula

Principal Investigator: Dr. Raghvendra Sahai

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Scientific Category: ISM AND CIRCUMSTELLAR MATTER

Abstract

We propose to use GREAT/SOFIA to observe the [CII] 158 micron line emission in NGC6720, one of the most famous and best-studied planetary nebulae. This object, one of the brightest emitters of far-infrared fine structure lines detected with ISO, is about 1 arcmin in size and will be well resolved by SOFIA. This proposal makes use of the unprecedented opportunity offered by GREAT to study the physics of photo-dissociation regions (PDRs) in an astrophysical "laboratory" setting, with special emphasis on testing PDR models in clumpy media. In addition, since this line will sample regions both within and outside the bright optical shell of the nebula (unlike traditional tracers like optical forbidden lines), it is a promising new probe of the 3- dimensional structure of planetary nebulae, and our proposed study of NGC6720 will enable us to test its potential.