Comisión Nacional de Investigación Científica y Tecnológica – CONICYT

Resultados Concurso Apex 2013-B

Propuesta: 2013B-05

Investigador Principal: Mónica Rubio, Universidad de Chile

Título: Dust, Molecules, and Star Formation at Low Metallicity

Resumen: Dust affects the cooling cycle in the ISM and this affects the ability of a galaxy to form cold, dense clouds that can form stars. Thus, the low dust content of dwarf irregular galaxies should have consequences to the star formation process, but just what is the connection? We obtained a LABOCA 870 μm map of the low metallicity dwarf WLM and used it to determine dust temperatures and masses. We also targeted FIR regions for CO observations that yielded detections of CO at 13% of solar abundance, the lowest metallicity dwarf so far. We propose here to use LABOCA to map four more dwarf galaxies with low oxygen abundances. These data will trace the cold FIR dust continuum emission of low metallicity systems, and reveal probable sites of molecular material, which we will target for CO observations. These data, in combination with our exquisite HI maps, star formation history maps, and, for two systems, Herschel dust continuum maps at 110, 170, 250, 350, and 500 μm, will allow us to examine the relationship between the dust content, gas, and star formation in metal-poor dwarf galaxies. This will be important for understanding the evolution of dwarfs and star formation in the early universe.

Tiempo asignado: 98 horas

Propuesta: 2013B-13

Investigador Principal: Sebastián Pérez, Universidad de Chile

Título: Constraining the mass of the geometrically flat, gas-rich protoplanetary disk around HD 98922

Resumen: Gas-rich systems in the transition from protoplanetary to main sequence (MS) phase are of great interest because of their link to planet formation. With APEX and ASTE we have collected pointed CO(3-2) spectra toward 52 dusty young stars in order to identify new possible planet-forming disks, yielding several new detections. HD 98922 is one of a handful unambiguous disk CO detections, showing a gas-rich disk around this Herbig A1Ve star. We have conducted detailed radiative transfer modeling of this system in order to constrain both the gas and dust disk properties. The lack of long wavelength (> 500 μm) hampers the total mass disk estimate, making the comparison with other disks difficult. We propose to use LABOCA on APEX to measure the continuum 870 μm flux of the HD 98922 disk. These observations will allow us to 1) derive the total dust mass in the disk, 2) place the HD 98922 disk in the context of our other CO detections (RXJ1842 and DX Cha) and 3) provide an accurate 870 μm flux estimate for future follow up ALMA observations of this system aimed at resolving the radial and vertical structure of this presumed geometrically-flat disk.

Tiempo asignado: 3.4 horas

Propuesta: 2013B-08A

Investigador Principal: Michel Cure, Universidad de Valparaíso

Título: Dynamics and Structure of Outer Be Star Disks

Resumen: After two decades during which the circumstellar disks of Be stars were out of the focus of radio telescopes, the possibilities for observations and modeling of their outer regions have dramatically improved thanks both to the increased sensitivity of the receivers in the mm and sub-mm range and to the significant progress in theoretical modeling. We propose to observe a sample of Be stars. Their APEX observations, together with our own and archival near-IR spectro-interferometric, spectroscopic, photometric and polarimetric data will be modeled thanks to state-of-the-art 3D radiative transfer simulations. Inclusion of the radio observations will enable the first complete modeling of a Be star disk extending down to its outermost reaches. In particular we will study two processes that are thought to occur in these regions: 1) If the Be star is part of a binary system, the disk will be truncated by the secondary, in which case we will be able to measure this truncation radius. 2) If the Be star is isolated, current theory predicts a change in the disk structure between the inner part that is viscosity driven and the outer part that is pressure driven. Finally, the derived models will be an important step towards the first imaging of a Be star disk with ALMA.

Tiempo asignado: 12 horas

Propuesta: 2013B-10

Investigador Principal: Andres Jordan, Pontificia Universidad Católica de Chile

Título: The warm CO gas in flared versus flat protoplanetary disks: The evolution of a flat disk structure

Resumen: Gas and dust disks around young stars are the likely birthsites of planets. Physical disk models fitted to spectral energy distributions reveal dust structures that are 'flared' or 'flat', with disks expected to flatten as they evolve. Recent studies of Spitzer IRS spectra toward Herbig Ae stars find that flatter disks can have higher abundances of large grains in their surface layers. The conclusion is that grain growth and dust settling must speed up disk flattening and decrease gas temperatures. This result can only be tested with independent measurements of the gas component, including scale height and temperature. CHAMP+ offers a unique opportunity to detect the warm gas in these disks. We propose CO(7–6) and (6–5) observations of 2 Herbig Ae disks (1 flared, 1 flat). The disks (plus 5 more with CHAMP+ CO detections in the literature) all have mid-infrared imaging data available to help better determine the dust flaring by breaking degeneracies in the SED modeling. We also request 13CO(6–5) for all 7 (2+5) objects to constrain line opacities. All disks have CO(3–2) detections to derive the gas temperature. These observations will provide the groundwork to investigate the effects of dust evolution on gas structure and chemistry in greater detail with ALMA.

Tiempo asignado: 5 horas

Propuesta: 2013B-15

Investigador Principal: Laura Gomez, Universidad de Chile

Título: Search for Deuterium Fractionation Variation within Infrared Dark Clouds.

Resumen: Infrared dark clouds (IRDCs) are believed to harbor the earliest stages of high-mass star formation ($M_\star > 8\ M_\odot$) and indeed evidence for this is found toward distinct regions within them. Unlike the case of more evolved stages of high-mass star formation, the chemical characteristics of high-mass (pre-protocluster) clumps within IRDCs have been barely studied. Here we propose to map two IRDCs at APEX in the deuterated N2D+ molecular line with the aim of searching for deuterium fractionation (Dfrac), defined as N(N2D+)/N(N2H+). Since this ratio is thought to increase as source evolves, it will allow to find clumps in very early evolutionary phases of high-mass star formation. The obtained values will be compared to those of low-mass pre-stellar cores and to those of ultra-compact HII region candidates. We also aim at observing molecular lines that will help us study the excitation within these IRDCs. Mapping observations are crucial to find Dfrac variations within high-mass IRDCs.

Tiempo asignado: 25.9 horas

Propuesta: 2013B-06

Investigador Principal: David R. Rodriguez, Universidad de Chile

Título: Molecular Gas in the Circumstellar Disk of MP Mus

Resumen: Radio molecular line studies of residual gas in the disks orbiting nearby classical T Tauri stars o er unique opportunities to investigate timescales and processes involved in circumstellar gas depletion and Jovian planet formation. To date only four of these objects (TW Hya, V4046 Sgr, T Cha, and MP Mus) have been observed in molecular lines with a radio telescope; all four there were detected. We request observing time on the APEX 12-m to perform a line survey of the molecular circumstellar disk orbiting MP Mus, within which we recently detected CO with APEX. These observations will signi cantly increase the sample of molecular lines observed from circumstellar disks orbiting young solar analogs and better constrain models of the late
evolution of planet-forming circumstellar disks.

Tiempo asignado: 24 horas

Propuesta: 2013B-07

Investigador Principal: David R. Rodriguez, Universidad de Chile

Título: Searching for Molecular Gas in a 10 Myr-old Binary System

Resumen: Recent work has discovered hundreds of young stars (ages □10{100 Myr) in moving groups less than 100 pc from Earth. Our own research with the GALEX satellite has revealed many previously unknown candidate young, low-mass stars. To date there are only four \old" (□10-Myr) classical T Tauri systems within 100 pc that possess molecular disks. Our prior work with APEX has tentatively identified a fith one suggesting additional such molecular gas disks may be present close to Earth.
A cross-correlation and kinematic analysis of the GALEX, WISE, and 2MASS catalogs has revealed a UV- bright, M5 binary in the 10 Myr-old Pic moving group. Optical and near-IR spectroscopy reveals the system is actively accreting from a reservoir of gas in the pair of stars, each of which shows evidence for circumstellar disks. We propose to observe both components (separation □3000) with APEX to search for 12CO gas in the disks of these stars.

Tiempo asignado: 9 horas

Propuesta: 2013B-04

Investigador Principal: David R. Rodriguez, Universidad de Chile

Título: Characterizing the Molecular Disk on the Closest, Lowest Mass T Tauri System

Resumen: Recent work has discovered hundreds of young stars (ages □10{100 Myr) in moving groups less than 100 pc from the Earth. Our own research with the GALEX satellite has revealed many previously unknown candidate young, low-mass stars. To date there are only four \old" (□10-Myr) classical T Tauri systems within 100 pc that possess molecular disks. Such molecular disks orbiting pre-main sequence stars represent the raw materials necessary for (or leftover from) the formation of giant planets, Kuiper Belt objects, and comets. These evolved disks are at evolutionary stages close to end of the giant planet formation stage. Our recent work with the APEX telescope has revealed a fifth disk-bearing system: TWA 32AB. TWA 32AB exhibited CO(3{2) emission at the systemic velocity of the system. At a distance of only □60 pc and spectral type M5, this is the closest, lowest mass system known to possess a molecular disk. This proposal aims to solidify our 12CO(3{2) detection in order to study its kinematics and infer properties of the disk.

Tiempo asignado: 12 horas

Propuesta: 2013B-01

Investigador Principal: Hector Canovas, Universidad de Valparaíso

Título: Probing the Photoevaporation scenario through the protoplanetary disk evolution

Resumen: Protoplanetary disks evolve from being accreting, gas-rich disks (CTTS) to non-accreting, gas poor disks (WTTS). The intermediate stage of this evolution path is the so-called "transition-disk" phase. These objects are characterized by the opacity holes observed in their inner disk zone, while their outer disks remain optically thick. Many di_erent mechanisms may play a relevant role in cleaning the inner part of the disks: grain growth, planet formation, binarity, and photoevaporation. The latter is generally thought to be the driving mechanism of the _nal disk clearing. However, the mass loss rates predicted by current photoevaporation models di_er by two orders of magnitude ranging from 10□8 to 10□10M_ yr□1, and observational input is urgently required to solve this issue. Photoevaporation models predict a direct relation between the strength of the X-ray luminosity and the outer disk mass of protoplanetary disks. We propose to use the LABOCA/SABOCA bolometers to obtain 870_m/350_m continuum observations for a selected sample of 5 CTTS and 4 WTTS disks with known X-ray luminosities and di_erent accretion rates. We will probe the photoevaporation scenario at di_erent stages of the disk evolution with these observations.

Tiempo asignado: 8 horas

Propuesta: 2013B-02

Investigador Principal: Guido Garay, Universidad de Chile

Título: SuperMALT: determining the physical and chemical evolution of high-mass star-forming clumps

Resumen: MALT90 was a recent, large survey that observed over 2600 high-mass star-forming clumps within the Galaxy. Using the Mopra telescope, it obtained small maps in 16 molecular lines near 90 GHz around each of the ATLASGAL-selected clumps. The low-J transitions of the molecules included in the MALT90 survey traced a combination of the cold, dense and hot/shocked gas. While these data reveal a wealth of information about the gas morphology, chemistry, and kinematics, alone, they are unable to constrain the physical properties of the clumps. In order to characterise the various stages in the evolution of a high-mass star-forming clump, we now propose a large APEX program, SuperMALT, to observe the higher J transitions of these molecular species toward a carefully selected sub-sample of the MALT90 clumps. The combination of the Mopra and APEX data will constrain the molecular excitation and allow us to deduce accurate temperatures and column/volume densities within each clump. Reliably determining these parameters is critical to establish their evolutionary stage. With an accurate measurement of their global properties, we will then select the best candidates for detailed followup with ALMA with the goal of testing star and cluster formation scenarios.

Tiempo asignado: 47 horas

Propuesta: 2013B-03

Investigador Principal:

Título: Structure and dynamics of the Galactic ISM at all scales: clumps, clouds, filaments, and molecular complexes

Resumen: Over the last decade, many surveys performed systematic mapping of the inner Galactic Disk in various tracers. Most of these surveys were observing continuum emission at different wavelengths, e.g. GLIMPSE (3.6 to 8 μm), MIPSGAL (24 and 70 μm), ATLASGAL (870 μm) or Hi-GAL (5 bands between 70 and 500 μm). Here we propose to conduct a systematic survey of the southern Galactic plane in the J=2–1 molecular transition of 13CO, similar to the Galactic Ring Survey (GRS, Jackson et al. 2006) covering the northern Galactic plane in 13CO(1-0). We propose to map 120 deg2: -60!! GLon ! 0!, with GLat = ±1!. With the proposed observing strategy, we will also be able to detect the C18O(2-1) line in many places. The immediate aims are: 1) to study the dynamics of the interstellar medium at all scales (dense clumps, long filaments and molecular complexes); 2) to assign radial velocities and thus distances to compact sources identified in other surveys, and to their surrounding medium; 3) to map the Galactic structure as traced by molecular gas, and 4) to constrain the star formation processes by measuring star formation efficiency as a function of environment.

Tiempo asignado: 32 horas

Propuesta: 2013B-14A

Investigador Principal: Verónica Motta, Universidad de Valparaíso

Título: Testing cosmologies with the Southern Massive Cluster Survey

Resumen: It is commonly accepted that the _CDM model provides the best description of the universe. However, several puzzling results have questioned this model. Galaxy clusters are invaluable for cosmological studies as independent and complementary observational probes to test the standard paradigm. We propose a comprehensive Sunyaev-Zeldovich survey of a complete and representative sample of the most X-ray luminous (hence most massive) galaxy clusters at $0.3 < z < 0.5$ observable only from the South (and which are not present in the Planck data release). Our target list comprises galaxy clusters at _ < −30◦ from the Massive Cluster Survey (MACS) and its southern extension, SMACS. For each cluster target, we propose to measure the surface brightness of SZ emission which, along with the X-ray and spectroscopic data, will allow us to determine the clusters' SZE-X-ray distances, use them to test different alternatives to the _CDM paradigm, and constrain the relevant parameters (_, k, h).

Tiempo asignado: 60 horas

Propuesta: 2013B-12

Investigador Principal: C. Romero, Pontificia Universidad Católica de Chile.

Título: APEX observations of the Bird: Global star formation and dust properties of a rare triple merger

Resumen: IRAS 19115−2124 (the Bird) is a luminous infrared galaxy (LIRG), logLIR(L⊙) = 11.89, with a triple merger nature, as deduced from near-IR imaging and optical spectroscopy, and with a global high molecular hydrogen mass, as inferred from CO J = 1 − 0 observations. Owing to the complexity of the system, we can expect to find a variety of gas components of distinct density, temperature and chemistry, which can be unveiled with the aid of different molecules. We propose APEX observations of the CO J = 3 − 2 line towards the Bird, which is a good tracer of star formation activity and of the 870 μm (at a wavelength comparable to the CO 3-2 line) and the 350 μm continuum emission, with LABOCA and SABOCA, respectively, to probe the emission of the dust at sub-mm wavelengths. This study will provide us with global characteristics of the Bird' system, while serving as a pathfinder towards a full ALMA study, where details at smaller scales can be revealed.

Tiempo asignado: 17 horas

Propuesta: 2013B-09

Investigador Principal: Leonardo Bronfman, Universidad de Chile

Título: Gas kinematics toward the high mass star formation region IRAS 16172-5028

Resumen: Kinematic studies of large structures in giant molecular clouds can help us understanding how massive stars form. IRAS 16172-5028 is a massive star formation region, _0.5 deg below the galactic plane at a distance of 3.5 kpc from Sun, surrounded by several clumps forming a spherical shape with a size of about 20 pc. We propose to observe 13CO(3-2) line emission toward IRAS 16172-5028 using the APEX-2 (SHeFI) receiver mounted on the APEX Telescope. We will make a map covering 20 pc× 20 pc, to determine the kinematics associated with the process of forming massive stars. Using Local Thermal Equilibrium (LTE), gas masses will be compared with dust masses determined in the ATLASGAL survey at 870 μm. Are the clumps in IRAS 16172-5028 part of an expanding shell? Is the star formation in IRAS 16172-5028 triggered by ram pressure from supersonic flows? We request in total 20 hrs, covering an area of 250 arcmin2.

Tiempo asignado: 20 horas

Propuesta: 2013B-08

Investigador Principal: Michel Cure, Universidad de Valparaíso.

Título: Dynamics and Structure of Outer Be Star Disks

Resumen: After two decades during which the circumstellar disks of Be stars were out of the focus of radio telescopes, the possibilities for observations and modeling of their outer regions have dramatically improved thanks both to the increased sensitivity of the receivers in the mm and sub-mm range and to the significant progress in theoretical modeling. We propose to observe a sample of Be stars. Their APEX observations, together with our own and archival near-IR spectro-interferometric, spectroscopic, photometric and polarimetric data will be modeled thanks to state-of-the-art 3D radiative transfer simulations. Inclusion of the radio observations will enable the first complete modeling of a Be star disk extending down to its outermost reaches. In particular we will study two processes that are thought to occur in these regions: 1) If the Be star is part of a binary system, the disk will be truncated by the secondary, in which case we will be able to measure this truncation radius. 2) If the Be star is isolated, current theory predicts a change in the disk structure between the inner part that is viscosity driven and the outer part that is pressure driven. Finally, the derived models will be an important step towards the first imaging of a Be star disk with ALMA.

Tiempo asignado: 30 horas

Propuesta: 2013B-14B

Investigador Principal: Verónica Motta, Universidad de Valparaíso

Título: Testing cosmologies with the Southern Massive Cluster Survey

Resumen: It is commonly accepted that the _CDM model provides the best description of the universe. However, several puzzling results have questioned this model. Galaxy clusters are invaluable for cosmological studies as independent and complementary observational probes to test the standard paradigm. We propose a comprehensive Sunyaev-Zeldovich survey of a complete and representative sample of the most X-ray luminous (hence most massive) galaxy clusters at $0.3 < z < 0.5$ observable only from the South (and which are not present in the Planck data release). Our target list comprises galaxy clusters at _ $< -30^{\circ}$ from the Massive Cluster Survey (MACS) and its southern extension, SMACS. For each cluster target, we propose to measure the surface brightness of SZ emission which, along with the X-ray and spectroscopic data, will allow us to determine the clusters' SZE-X-ray distances, use them to test different alternatives to the _CDM paradigm, and constrain the relevant parameters (_, k, h).

Tiempo asignado: 15 horas