AKARI OPEN TIME OBSERVING PROGRAMMES FOR PHASE-3-I

APPROVED PROPOSALS (EUROPEAN TIME)

Proposal: DABUN

Title: The interstellar deuterium abundance

PI: Waters, Rens (Astronomical Institute, University of Amsterdam, The Netherlands)

Abstract:

The interstellar deuterium abundance provides a direct measure of the cosmic history of nucleosynthesis. Recent FUV studies imply that a large fraction of the deuterium is missing from the gas phase and likely locked up either in carbonaceous grains or Polycyclic Aromatic Hydrocarbon molecules. Here, we propose to measure the CD stretching mode associated with deuterated carbon-grains in the absorption spectrum of interstellar dust and the CD stretching mode associated with deuterated Polycyclic Aromatic Hydrocarbon molecules in the interstellar emission spectrum. Here we request a pilot study to establish the importance of carbon grains and/or PAHs as a main reservoir of deuterium. If successful, we plan to follow up with a large survey, in the next call, to probe the galactic variation of the deuterium abundance in order to determine the effects of astration and star formation on the elemental deuterium abundance.

Proposal: DISKD

Title: A survey of hot dust at the inner radius of protoplanetary disks

PI: Dent, William (UK ATC, Royal Observatory, Edinburgh, United Kingdom)

Abstract:

We propose a sensitive, systematic survey of the hot dust in a broad sample of young protoplanetary disks, using near-ir low-resolution spectroscopy with AKARI IRC. The targets have ages in the critical range 1-30Myr, which defines the transition from massive, gas-rich primordial disks to dust-rich debris disks. Sensitive measurements of the near-ir excesses are necessary for understanding the innermost (R<1AU) structure of these protoplanetary disks, addressing questions such as: 1) what affects the radius and vertical extent of the hot inner region facing the star? How is it affected by disk mass, spectral type, accretion, age, etc? 2) is a separate "puffed up" inner wall component required to fit the Spectral Energy Distributions? 3) how extensive is the depletion in the inner “holes”' of transition objects? Such information is necessary to understand the interaction between the inner disk and the pre-main-sequence star, as well as the global disk evolution. Up to now, measurements of near-IR excesses have generally relied on broadband photometry. Using IRC in slitless spectroscopy with NP, we will make a significant advance on this by obtaining low-resolution 2-5um spectra from a broad sample of such disks, covering a multivariate parameter space, with a wide range of stellar luminosity, disk mass, accretion rate and SED Class. Low-resolution spectroscopy will be significantly more reliable at detecting and measuring the excess compared with broad-band photometry, and so the results will provide sensitive new observations of the hottest, closest dust to the stars. Additionally, all of the proposed targets will be observed as part of our Herschel Key Project (GASPS) allowing us to combine near-infrared and far-infrared observations of the same disks and build a coherent model of the disks and their interactions with their host stars.

Proposal: DISCO

Title: Spectroscopy at the Disk-Halo Interface of Spiral Galaxies

PI: Burgdorf, Martin (Liverpool John Moores University, United Kingdom)

Abstract:

We propose IRC NIR-NP spectroscopy of 16 edge-on galaxies (including back-up) at different positions in the Hubble Tuning-Fork in order to characterize the physical/chemical state of diffuse dust and the stellar populations that reside at the disk-halo interfaces. This would be the first comprehensive study of spectral features between 2 and 5.5 microns in outer disks and inner halos. It would reveal the distributions of evolved stars, PAH scale sizes, and the composition of the extra-planar interstellar matter, and show how they depend on galaxy type. Variations for example of the PAH band at 3.3 microns as a function of height above the mid-plane can provide us with a much better understanding of how interstellar dust is ejected from the disks by galactic winds. For each object we propose to observe five different positions bracketing the mid-planes in order to characterize the emission from both disk and halo in the presence of strong foreground emission. All our targets have already been observed with Spitzer/IRAC to ensure that extra-planar emission is present in the near infrared. In combination with the existing observations, which trace the "reddest" stellar populations in the halo, thin disk, thick disk, and bulge, the proposed AKARI program will address open questions about thick disks as tracers of merger history. Such highly sensitive near-infrared spectra, which only AKARI can provide, are indispensable to a full understanding the cycle of matter in the outskirts of spiral galaxies.

Proposal: NESID

Title: Nature and Evolution of Small Interstellar Dust

PI: Boulanger, Francois (Institut d'Astrophysique Spatiale, Paris, France)

Abstract:

Small dust particles (PAHs and VSGs) are major constituents of interstellar dust that play key roles in the physics and chemistry of the interstellar medium. Their mid-IR emission features have been observed to be an ubiquitous spectroscopic signature of dust in galaxies but the origin, nature and link between PAHs and VSGs are still debated issues. While this research field was initiated by near-IR observations, results from the IRAS, IRTS, ISO and Spitzer that followed were almost exclusively from mid-IR emission at wavelengths larger than 5 micron. The AKARI warm mission provides the opportunity to obtain the missing dust spectroscopy data at shorter wavelengths. We propose AKARI observations that will provide combined spectral and spatial information on the 3.3 micron feature, the 3.2 to 3.6 micron plateau and the near-IR dust continuum for a set of archetype PDRs with mild UV excitation conditions. The observations will also allow us to search for a spectroscopic signature of deuterated PAHs and VSGs with unprecedented sensitivity. The data will address the three following questions. (1) Is there an evolutionary link from aliphatic to aromatic carbon dust? (2) Are PAH cations the carriers of the near-IR dust continuum? (3) Do small dust particles hold a major fraction of the interstellar deuterium?

Proposal: DEPPN

Title: The chemistry of warm dust in early post-AGB stars

PI: Engels, Dieter (Hamburger Sternwarte, Hamburg, Germany)

Abstract:

We propose to use the AKARI warm phase for a study of the circumstellar envelope (CSE) emission of 33 young post-AGB stars in the 1.8 -- 5.5 micron wavelength range. We have used the AKARI and Spitzer satellite in the past to study stars, which are completely obscured in the optical and sometimes even in the near-infrared (lambda < 2 micron.) and which are thought to be in the process of terminating the AGB evolution or beginning the post-AGB phase. These stars are very bright at 10-40 micron and their emission comes from the CSE formed by the ongoing or recently terminated AGB mass loss. With the help of recent Spitzer photometry (GLIMPSE survey), we verified for quite a number of stars a near infrared excess in the spectral energy distribution. This excess is due to warm gas and dust illuminated by the remnant AGB core and which becomes visible now that the heavy AGB mass loss apparently has stopped. We propose to take near-infrared spectra to determine the chemistry of the material which is currently lost by the AGB core.

Proposal: EMSCA

Title: The ratio of NIR dust emission and scattering in interstellar clouds

PI: Juvela, Mika (Helsinki University Observatory, Helsinki, Finland)

Abstract:

Near-infrared scattered light provides a way to map interstellar clouds at close to an arc-second resolution. However, the role of NIR dust emission is poorly known and could affect the reliability of these results. In wavelength, the transition between scattering dominated NIR and emission dominated MIR takes place somewhere close to the Akari IRC N2 filter. We propose to map a cometary globule in the N2 and N4 filters. Our ground-based NIR observations trace the scattered radiation while the Akari N4 filter will reveal the distribution of pure dust emission. By correlating the surface brightness data with each other and with our extinction map, we will determine the ratio and spatial distribution of the two intensity components, dust emission and dust scattering. The results could have serious implications for the use of K-band data in the mapping of interstellar clouds. Furthermore, they will provide strong constraints to dust models concerning the abundance and spatial distribution of the smallest dust grains.

Proposal: REDHA

Title: The red halos of blue compact galaxies: the case of Haro 11

PI: Zackrisson, Erik (Tuorla Observatory, Finland)

Abstract:

Deep ground-based optical/near-IR images of blue compact galaxies have revealed faint and extremely red envelopes outside their bright star-forming centres. The colours of these structures are difficult to reconcile with normal stellar populations, and instead indicative of stellar populations with bottom-heavy initial mass functions. These red halos do, however, remain controversial due to the immense problems of accuately measuring the near-IR flux at the very faint surface brightness levels where the red excess turns up. Here, we propose deep imaging of Haro 11, the blue compact galaxy with the most extreme halo colours reported so far, to trace the near-IR surface brightness profile to unprecedented depth and to investigate the nature of its red halo.

Proposal: IMAP2

Title: The spatial distribution of ices in Spitzer-selected molecular cores

PI: Fraser, HelenJane (University of Strathclyde, Glasgow, United Kingdom)

Abstract:

In the densest star forming cores, over half the molecular species (excluding H2) are condensed onto dust grains. To effectively study the solid-state chemistry of star-forming cores, we require detailed observations of the abundances, and more importantly the spatial distribution, of as many condensed species as possible, in particular H2O, CO2 and CO. These species are directly observed via their strong stretching-mode bands at 2.5-5 microns, seen toward the continua of background stars. Ground-based facilities are far from sensitive enough to yield similar data and the Spitzer Space Telescope has no spectroscopic capability below 5.5 microns. While ices can be observed at longer wavelengths, the 2-5 micron region contains the strongest ice bands and background stars are bright, making it crucial for any spatial mapping of interstellar ices. We propose to obtain spatially well-resolved maps of molecular ices towards a sample of isolated molecular cores located in front of regions with a high density of background stars. The cores have been selected from the well-characterized sample of molecular cores imaged by Spitzer as part of the "cores to disks"' Legacy Science program. Akari presents a unique opportunity for mapping the spatial distribution of water, CO and CO2 ices toward background stars, due to its sensitive spectroscopic capability in the NIR, as well as its ability to obtain slitless spectroscopy over a large field of view. This proposal is an extension of a successful and pioneering ice-mapping endeavour, commenced during Phase II Akari Open-Time observations. The observing program includes 25 targets, each observed on at least 2 pointings, as well a crucial calibration observations (18 pointings) to enhance the quality of the ice-mapping results. Based on our experience in Phase II, we have significantly improved the observing strategy. We will use both the prism (Np) and the grism (Ng) modes with the near-infrared camera (AOT IRCZ4) to obtain spectroscopy of background stars in the entire field of view. The data be used to map the H2O, CO and CO2 ice abundances across each core. Our Phase II experience shows that we are typically able to map the distribution of ices on scales of 20-60", or 2000-6000 AU in the nearest dark clouds, thereby sampling the chemical and freeze-out scales. The proposed sample of ice maps will constitute a highly unique survey that will not be possible to match for many years into the future.

Proposal: DEBIR

Title: Stellar populations and hot dust in debris of galaxy collisions

PI: Duc, PierreAlain (CEA-Saclay, France)

Abstract:

Debris of galaxy-galaxy collisions have recently proven to be particularly useful laboratories to address a variety of challenging questions, from the triggering of star formation to the distribution of dark matter in and around galaxies. Collisional debris expelled in the intergalactic space by tidal forces provide a peculiar environment where stars may be formed in a different way than in disks, while sharing with them a similar interstellar medium. Comparing both modes of star formation (SF), one may learn about the role of large scale environmental effects on the SF process. In that aim, we have compiled the Spectral Energy Distributions (SED) of gas-rich collisional debris. One key wavelength domain is the near-infrared one where stellar emission (from UV to near-IR) and dust emission (from near-IR to mm) meet and mix. Uncertainties in the near-IR fluxes translate into large errors in the star formation history, and stellar masses, as reconstructed using evolutionary synthesis codes, while making any dust model elusive. Our Akari observations in the N2 band will provide photometric data points with the precision required to constrain our models. These data will allow us to estimate the fraction of old stars (expelled during the collision) vs young stars born in situ in gaseous tidal tails. From our numerical models, we expect some of our structures to be totally devoid of old stars. For such objects that experience their first starburst, we will be able to constrain their Initial Mass Function, in an environment where it had never been probed. Exploiting the IR side of our SED, we will confirm the existence of a possible near-IR excess in the star-forming debris which might be due to very hot dust. Finally, we will be able to obtain a precise measure of the total stellar mass, used in particular in the determination of the specific star formation. For some debris that proved to be gravitationally bound and for which we could determine a dynamical mass, we will compare it with the luminous mass (the sum of the gaseous and total stellar masses). Previous similar results revealed the existence of an unexpected missing mass in tidal debris and thus in the disk of their parent galaxies.

Proposal: MASYS
Title: A Near-IR spectroscopic survey of Magellanic Symbiotic Stars
PI: Angeloni, Rodolfo (Dept. of Astronomy, University of Padova, Italy)
Abstract:

We would like to observe the whole sample (14 objects) of Symbiotic Stars (SSs) in the Magellanic Clouds (MCs), in both the moderate (NP) and high resolution (NG) spectroscopic mode (AOT IRCZ4). These observations would provide the first ever near-IR spectra of SSs in the MCs, giving a fundamental and unique contribution to the understanding of the symbiotic phenomenon in its diverse appearance and, in general, of gas and dust properties in complex environments at different metallicity. The ecliptic latitude of MCs ensures high visibility for all the objects of the sample. No MSS in the sample is duplicated with the blocked target list.

Proposal: WITCH

Title: IC2118: star formation at high galactic latitude

PI: BarradoyNavascues, David (LAEFF-INTA, Madrid, Spain)

Abstract:

Several aggregates in the high galactic latitude molecular cloud (HLC) in the region of IC 2118, the Witch Head Nebula, appear to be forming stars (Kun et al. 2004). Star formation in HLCs, while rare, may be the origin of some of the apparently isolated T Tauri stars revealed by ROSAT. IC 2118 is a very interesting HLC located at l=208, b=-28, with an age of about 2 Myr and a distance of 210 pc. We have recently applied with success to the X-ray observatory XMM-Newton, and to ESO NTT SOFI near-infrared camera to obtain data in three regions of the Witch Head Nebula. With the present proposal we request deep mid-IR imaging. The combination of the three sets of data will allow us to derive for the first time the Initial Mass Function in a Star Forming Region (SFR) at high galactic latitudes, and compare it with other SFRs with different environment and star formation history.