AKARI OPEN TIME OBSERVING PROGRAMMES FOR PHASE 2

APPROVED PROPOSALS (EUROPEAN TIME)

Proposal: AUSSEL_COSMS

Title: Star Formation and Environment in the COSMOS Field

PI: Aussel, Hervé (CNRS / AIM, France)

Abstract:

We propose to map a 90'x30' strip in the COSMOS field at 15 microns with the MIR-L camera of ASTRO-F to a depth of 185 micro Janskies (5 sigma). These observations will fill the gap in our Spitzer coverage of the field at 8 and 24 microns and enable us to observe the emission from Polycyclic Aromatic Hydrocarbures (PAH) of star forming galaxies and very hot dust of AGNs from z=0 to 2.5 as they are redshifted through our passbands. This dataset will alleviate the problem of measuring star formation from different indicators at different redshifts by observing the same rest-frame region of the mid-infrared spectrum of galaxies from z=0 to z=2.5. The combination of 15 and 24 microns data will allow us, together with our photometric redshifts, to correctly infer the total infrared emission of our galaxies from their mid-infrared emission, and derive more accurate star formation rates. Combining this sample of ~2500 galaxies with the COSMOS multiwavelength data, we will quantitatively study: i) The evolution of dust-enshrouded star formation with redshift. ii) The impact of environment in the triggering of the starburst and AGNs phases of galaxies. iii) The morphology of Mid Infra-red selected star forming galaxies out to z=2.

Proposal: BARRADOYNAVASCUES_DISKB
Title: Accretion and protoplanetary disks in brown dwarfs
PI: Barrado y Navascués, David (LAEFF-INTA, Spain)
Abstract:

We want to study a sample of brown dwarfs with disks and different ages (from 1 to 12 Myr) in order to establish the dependence with age of the grain growth and dust settling. This process is the initial and necessary step toward the formation planetesimals and planet formation. The proposed observations will allow us to: i) Built accurate Spectral Energy Distribution from the optical to 14 or 25 micron. ii) Search for evidence of truncated disks, in order to test the models of formation. iii) Study the composition and evolution of the disks, grain growth, dust settling/crystallization, and provide important inputs for the models of disks. In particular, we will focus on the silicates present at the S11 band. iv) The data at longer wavelengths (L15 & 25) will be very helpful in order to constrain the disk mass. v) By comparing samples with the same age (members of the same association), we will study the dependence with mass/spectra type and other parameters. vi) Study the timescales of disk decay (by comparing the SFRs with different ages). vii) Compare the disk properties (obtained with mid-IR observations) with the accretion properties (obtained with Halpha activity), in order to get crucial informations on the disk structure at small scale (where the Halpha emission takes place) and larger scale (where the mid-IR excess takes place).

Proposal: BLOMME_OBSTR
Title: Structure in the stellar winds of OB stars
PI: Blomme, Ronny (Royal Observatory of Belgium)
Abstract:

There is considerable evidence for structure (clumping) in the radiatively driven stellar winds of hot stars. The existence of clumping has important consequences for mass-loss rate determinations. Present mass-loss rates are usually not corrected for clumping, thereby providing incorrect input for stellar and galactic evolution models, and possibly influencing the extragalactic distances determined from Halpha observations of OB supergiants. Far-infrared observations are ideally suited to study the effect of clumping at a few stellar radii above the star's surface. We propose to measure the 60 mum and, possibly 160 mum, continuum fluxes of a few (2-4) representative OB stars. These observations, combined with existing Halpha and radio data, will allow us to quantify the amount of clumping. This, in turn, will put considerable constraints on the theoretical models for clumping, which is vital to our understanding of the hydrodynamics of these winds. It will allow the elimination of the systematic error in the mass-loss rate determinations.

Proposal: BURGARELLA_IRLBG

Title: Calibrating mid-IR dust attenuation tracers for LBGs with ASTRO-F

PI: Burgarella, Denis (OAMP/LAM, France)

Abstract:

Lyman Break Galaxies (LBGs) are the main objects observed at high redshift in the rest-frame ultraviolet. They are, therefore, used to estimate the ultraviolet cosmic star formation density. However, to do so, we need to apply some correction for dust attenuation. The usual wy of correcting is by applying a correction determined from the ultraviolet slope beta of the spectrum. However, this method is now proven to provide dispersed and probably bad estimates. A good estimator is the Far-Infrared (FIR) to Ultraviolet (UV) FIR/UV ratio which gives much better results. But we need to estimate the FIR/UV ratio and the best way is to use the FIR. However, the FIR is not available for Lyman Break Galaxies and we propose to verify whether mid-IR (MIR) fluxes can provide good estimate for the total bolometric dust luminosity for LBG as was previously proposed. Several bands are available but one of the most promising is only observable from ASTRO-F. This task is not doable for z=3 LBGs which are too faint to be detected at wavelength of about 12 microns and above by SPITZER and ASTRO-F. However, we have built the first LBG sample at z=1 on which we will check the validity of the above methods and provide estimates for the uncertainties. The availability of the z=1 LBG sample and the mid-IR wavelength will provide the first opportunity to check whether UV and FIR cosmic star formation densities can be used simultaneously after corrections.

Proposal: BURGDORF_HALOS
Title: Search for Emission Outside the Disks of Edge-on Galaxies
PI: Burgdorf, Martin (Liverpool John Moores University, United Kingdom)
Abstract:

Flat galaxy rotation curves routinely observed out to large radii in HI and in optical emission lines are convincing evidence for the existence of dark matter. As yet, we know very little about the nature of this dark matter. An intriguing possibility is that a population of very cool objects - extreme brown dwarfs or "Jupiters" - accounts for a significant part of its mass. Their intrinsic faintness at visible wavelengths would explain why they have not yet been clearly detected. Guaranteed time (GT) observations with the InfraRed Array Camera (IRAC) on board Spitzer of two famous edge-on galaxies (NGC891 and NGC5907) have yielded good evidence for such a very thick, red disk component that could comprise some of this "missing mass", but the mid-infrared colours as yet offer no clear discriminant of these disks' makeup. We propose to use the IRC MIR channel for follow-up observations of the very thick disks seen in the edge-on IRAC GT program galaxies. By measuring fluxes at 7, 11, 15, and 24 microns we can obtain crucial information for example about the temperature of the objects in these disks and hence get a better idea of their nature. As the expected signal is much smaller than the foreground emission from the zodiacal light, we need the large FoV of the IRC to characterize any spatial variations in the zody emission. The radiation from the very thick disks will then appear as a surface brightness gradient measured as a function of distance on both sides of the galactic midplanes. We request one pointing per observation with AOT IRC02.

Proposal: BURGDORF_UNIRC

Title: Near-Infrared Spectroscopy of the Atmospheres of Uranus and Neptune

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

Abstract:

We propose to study Uranus and Neptune in the near- and mid- infrared with the IRC. The observations will be performed at wavelengths that are not or only poorly accessible to the infrared spectrometer on board Spitzer. Therefore they will address questions that can only be answered by ASTRO-F: - What is the abundance of the disequilibrium species carbon monoxide and phosphine? - What is the spectral shape of the continuum flux of Uranus and Neptune in the near infrared? - Is there fluorescent emission from H3+ and methane? These investigations will yield important information about the diffusion processes in the atmospheres and the electromagnetic environments of both planets.

Proposal: CERNICHARO_CERN1

Title: Dust and gas properties in AGB and post-AGB objects

PI: Cernicharo, José (DAMIR. IEM-CSIC, Spain)

Abstract:

We propose to carry out a photometric and spectrometric study between 2-200 microns with ASTRO-F of the most prominent AGB and post-AGB objects in our galaxy in order to understand the chemical evolution of dust and the gas as a function of the distance to the central objects and the degree of evolution of the stars. We would like to use the FIS instrument in FTS mode (SED and FULL resolution), and in photometric mode, towards a representative sample of AGB and post-AGB objects rich in carbon and in oxygen. In addition IRC observations (9 filters) of most of them will allow to study, for the first time in most of the proposed AGB objects, the spatial distribution of dust emission in the mid and near-IR. This information is critical when analyzing the molecular emission at all wavelengths as the dust and molecules are strongly coupled radiatively in the far and mid-IR for dusty envelopes. Finally, we would like to use IRC in slit spectroscopy mode to obtain spectra between 2-40 microns from the molecular and dusty envelopes.

Proposal: CERNICHARO_CERN2
Title: Dust, PAHs and molecules in molecular clouds
PI: Cernicharo, José (DAMIR. IEM-CSIC, Spain)
Abstract:

We would like to study the dust and gas emission in star forming regions and molecular clouds in different physical conditions and evolutionary stages: from low mass stars, and the prominent molecular outflows associated to them, to molecular clouds illuminated from bright stars. The main goal is to study the composition of the dust and its evolution as the clouds evolve from quiescent gas to regions of high velocity shocks and extreme UV radiation. The gas properties at large scale will also be traced by ASTRO-F observations. Observations with the two instruments, in photometric and spectroscopic modes, are proposed to obtain the near, mid and far-IR spectrum in, and around, these objects.

Proposal: CHARMANDARIS_BLOBS
Title: 15 Micron Imaging of the z=2.38 Filament
PI: Charmandaris, Vassilis (University of Crete, Greece)
Abstract:

We propose 15 micron mid-infrared imaging of the central 400 arcmin^2 of the J2143-4423 filament structure (Palunas et al. 2004) at z=2.38. Extending more than 100 Mpc, it is the largest known structure above z=2. This field has been imaged with both the Spitzer MIPS 24um and IRAC 3.6-8um cameras, leading to the discovery multiple ultraviolet-bright ULIRGs, including its extended Lyman alpha "blobs". At z=2.38 the Astro-F 15um filter will provide the critical photometric data point between the stellar contribution measured by IRAC and the rest-wavelength 7um flux measured by MIPS, allowing discrimination between warm (AGN) and cool (star-forming) ULIRGs. The Spitzer Space Telescope can not image this area in a reasonable length of time, as its IRS 16um camera has a field-of-view roughly 100 times less than that of the Astro-F Infrared Camera (IRC).

Proposal: DELBO_ADEAS
Title: ASTRO-F Deep Ecliptic Asteroid Survey
PI: Delbo, Marco (INAF - Astronomical Observatory of Turin, Italy)
Abstract:

The present knowledge of the the size-frequency distribution (SFD) of main belt asteroids (MBAs) is increasingly uncertain as one goes to smaller sizes, and at a diameter of 1 km, this uncertainty is about a factor of 3. Information on the MBA SFD is crucial to improve our understanding of the mechanisms of formation and evolution of our planetary system and those processes (such as the Yarkovsky effect) invoked to explain the delivery of km-sized asteroids from the main belt to near Earth space. This project - the ASTRO-F Deep Ecliptic Survey (ADEAS) - aims at determining the SFD of main belt asteroids down to sub-kilometer sizes with ASTRO-F. Results expected from this project will thus also be important for understanding the Near Earth Object (NEO) numbers and size distribution. From observations of two (possibly four) 10'x50' sky areas at 0 (and -5 degree) ecliptic latitude will obtain with ASTRO-F the number of km- and sub km- sized asteroids through the entire main belt. Combining ASTRO-F observations with ground based follow up at visual wavelengths we will derive accurate diameters and albedos for all detected asteroids. From our sample of asteroids we will obtain a physically based SFD for small main belt asteroids. A second objective of this proposal, for which we require ASTRO-F to map our "priority B" region at ecliptic latitude -5 degree, addresses the investigation of the puzzling discrepancy in the ecliptic latitude distribution of MBAs discovered by the Spitzer First Look Survey-Ecliptic Plane Component (FLS-EPC). Determining the SFD of main belt asteroids from observations in the mid-infrared is a study that can only be performed from space telescopes. ASTRO-F is a superb instrument, due to the field of view and the sensitivity of the IRC. Furthermore, given its orbit around the Earth, ASTRO-F facilitates the critical ground-based follow-up observations in contrast to observations carried out e.g. from Spitzer.

Proposal: ENGELS_DEAGB
Title: Stars departing from the Asymptotic Giant Branch
PI: Engels, Dieter (Hamburger Sternwarte, Germany)
Abstract:

I propose to observe a sample of extremely red IRAS sources, which are considered to be in an advanced evolutionary state on the Asymptotic Giant Branch (AGB) or in different phases of their transition to become a Planetary Nebula (PN). The transition process itself is poorly understood. The departure from the AGB is characterized by short timescales, the loss of radial symmetry of the mass loss process, and increasing velocities of the outflows. The large diversity of properties of post-AGB stars is probably reflecting the complex processes involved, and make their identification with particular phases of the transition process difficult. It is proposed to observe with MIR-S the strength and shape of the 10 micron absorption feature which is due to absorption by dust composed of amorphous silicates, and with MIR-L the region 18-25 micron in which emission features of forsterite crystalline silicates are expected to be found. The 10 micron feature decreases in strength while features of crystalline silicates increase their strength during the transition. Optical depths, mass loss rates, and strengths of the dust features of the circumstellar shells will be derived from the observations. The goal is to map the stars on a evolutionary sequence, which characterizes the transition process.

Proposal: FRASER_IMAPE

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

PI: Fraser, Helen (University of Strathclyde, 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 micron seen toward the continua of background stars. 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 sample of molecular cores imaged by Spitzer as part of the “cores to disks” Legacy Science program, and are therefore very well characterized. Astro-F presents a unique opportunity for mapping the spatial distribution of H2O, CO and CO2 ices toward background stars, due to its sensitive spectroscopic capability in the 2-5 micron region as well as its ability to obtain slitless spectroscopy over a large field of view. Ground-based facilities are far from sensitive enough to yield similar data and the Spitzer Space Telescope has no spectroscopic capability below 5.5 micron. 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. The observing programme includes 28 targets. We will use both the prism (Np) and the grism (Ng) modes with the near-infrared camera (AOT IRC04) to obtain spectroscopy of background stars in the entire field of view. This will enable us to map the distribution of ices on scales of 10-20", or a few 1000 AU in the nearest dark clouds, thereby sampling the spatial scales of the chemistry and freeze-out processes of the most abundant ice species. The combination of the proposed observations with dynamical core models will enable a measurement of the time scales of the formation of water and CO2 ice.

Proposal: GARCIAHERNANDEZ_AGBPN

Title: The hidden evolution from AGB stars to PNe as seen by ASTRO-F/IRC

PI: García Hernandez, Domingo Anibal (European Space Astronomy Centre, ESA, Spain)

Abstract:

We propose to take 5-25 micron ASTRO-F/IRC spectra of a selected sample of heavily obscured objects in the transition phase between the Asymptotic Giant Branch (AGB) stars and the Planetary Nebulae (PNe) stage. They are all bright IRAS sources identified as optically invisible post-AGB stars during previous ground-based observations and they are suspected to represent a hidden population of PNe precursors not previously studied. Their strong obscuration is due to the thick circumstellar shell formed as a consequence of the strong mass loss rate (up to 10^-4 Msun/yr) experienced by these stars at the end of the AGB. Some of them are not even detectable in the near-infrared (<3 microns). In contrast, they are among the brightest sources of the sky at mid- to far-infrared wavelengths and, thus ideally suited to be observed from space with ASTRO-F by using a small number of pointings per target. The transition phase from AGB stars to PNe is thought to be very short (100-1000 years) but it is during this evolutionary phase where crucial processes (i.e. chemical composition changes) take place which completely determine the subsequent evolution of these stars as PNe. With the proposed observations we want to determine for the first time the dominant chemistry (C-rich vs. O-rich) of the dust in the circumstellar shell of these stars and establish connections between the characteristics of the solid state features (strength, relative intensities and shape) and the shape of the underlying continuum observed and the evolutionary stage and/or the mass loss history of each source in the sample. The results obtained will eventually be used to test the current evolutionary models which predict different chemical compositions depending on the initial mass of the progenitor star.

Proposal: GARCIALARIO_FISPN

Title: Far infrared imaging of young PN and PPNe with ASTRO-F/FIS

PI: García-Lario, Pedro (European Space Astronomy Centre, ESA, Spain)

Abstract:

In this proposal we plan to take advantage of the sensitivity and spatial resolution of ASTRO-F/FIS and of its wide field of view to perform a systematic study of the infrared size and morphology of a carefully selected sample of very young PNe and proto-PNe in the four FIS filters N60, WIDE-S, N90 and WIDE-L, covering the range from 60 to 160 microns in order to trace the distribution of cool dust in their extended shells. Extended structures with a typical size of ~2 pc will be resolved by ASTRO-F up to distances of ~3 kpc. The main purpose of this research is to recover the mass loss history experienced by these stars in their recent past, an essential ingredient of the models which try to reproduce the AGB to PN transition phase. The results obtained will also be used to try to determine the overall optical properties of the dust (temperature, optical thickness, emissivity) and to impose constraints on the moment when the departure from spherical symmetry took place, if this is detected. The observations resulting from this proposal will undoubtfully constitute a unique database which will serve as a reference for future follow-up observations with the Herschel Space Observatory.

Proposal: GOMEZ_EGALS
Title: Understanding the Dust Properties of Ellitpical Galaxies
PI: Gomez, Haley (Cardiff University, United Kingdom)
Abstract:

Elliptical galaxies are thought to be the descendants of the spectacular star-forming galaxies discovered in deep sub-millimetre surveys. How they form into the gas and dust poor systems we see in the local Universe is largely unknown. The processes governing the evolution of the ISM in today's ellipticals is poorly understood and indeed there is no current consensus on the origin of dust seen in recent ISO observations. The two major competing theories are (1) dust formed via stellar mass loss in the galaxy and (2) dust accreted from merging/interacting systems. Elliptical galaxies are an ideal laboratory to study not only the origin of grains (now a controversial question even in our own galaxy), but also their evolution. Despite this, only a small fraction of ellipticals have been observed with ISO and IRAS. This project is designed to be a definitive study of elliptical galaxies, using a statistically significant, unbiased sample, allowing us to globally determine the relationship of the dust to galactic properties as well as the dust properties themselves. The high sensitivity of Astro-f combined with the large field-of-view and wide wavelength coverage from NIR to FIR will enable us to take on such an ambitious survey and begin to address the questions hinted at by previous IR observations.

Proposal: HABART_DGPDR
Title: Evolution of dust and gas in Photodissociation Regions
PI: Habart, Emilie (IAS, France)
Abstract:

The scientific motivation of this proposal is to study the nature and the evolution of the interstellar dust grains together with the physics and chemistry of the gas. The ASTRO-F mission, which offers a unique opportunity to observe continuously between 2 and 180 mum including most of the dust components and gas lines emission from Photo-Dissociation Regions (PDRs), will provide a fundamental step in our understanding of the interstellar matter evolution. We propose to obtain images and spectra using the IRC camera and the FTS spectrometer for a selected sample of PDRs. Infrared spectro-imagery at high angular resolution, which allows to follow at small spatial scales the evolution of dust and gas through their IR emission, is a unique tool for tracing the dominant processes in grain/gas evolution which can take place at small scales. The selected sources has been observed with Spitzer and will be observed with Herschel (Guaranteed Time Observations), in imaging and spectroscopic modes. By combining ASTRO-F data with near- and mid-infrared data (mainly from Spitzer but also ISO) and observations at longer wavelengths (Herschel), the proposed observations will provide for the first time a complete view of the emission of interstellar gas and dust in PDRs from the infrared to the sub-millimetre and will allow us to identify and characterize (i) the processes that control the dust evolution (ii) the impact of dust grains on the heating and chemistry of the gas (ii) the structure of the interstellar clouds and the influence of the surrounding stars on their evolution and the star formation associated with the cloud.

Proposal: LEFLOCH_M20BL

Title: Stellar Factories in Young HII Regions: the Trifid Nebula

PI: Lefloch, Bertrand (LAOG, France)

Abstract:

HII regions play an important role in the formation of new generations of stars. In particular, about 15% of the high-mass stars could form under the influence of adjacent HII regions. Yet, the properties of the young stellar and protostellar populations which form at their periphery is not well characterized, nor the impact of the UV radiation on their evolution. The Trifid nebula is an ideal object for such study. We have undertaken a systematic multiwavelength program to understand the formation of young stars in such harsh conditions. Recent SPITZER/IRAC observations made by us have revealed a large population of about 150 young (proto)stellar objects. The sample appears to cover a broad range of evolutionary stages of objects, from Class 0 to Class II. All these objects form an homogeneous sample of sources which have all formed in the same cloud, under similar physical conditions. However, the characterization of the sources is based on SEDs built from fluxes measurements obtained between 1.5-24microns with IRAC and in the optical. Such determinations remain uncertain as they neglect the contribution of the cold material of the parental cocoon, which dominate the SED of protostars. ASTRO-F offers the unique opportunity to determine accurately the nature of the sources discovered with SPITZER and the physical conditions in their parental cores. By observing the emission of the cold material with FIS in its four colors, we will expand the SEDs up to 160 microns and will be able to characterize the whole young stellar population discovered, including the coldest, and youngest (proto)stellar objects. Using the IRC spectroscopic capabilities, we will precise the physical conditions of the parental cores in which young stellar objects are forming : the dust composition and its spatial variations across the core, the impact of the UV radiation on the gas and dust of the protostellar envelope.

Proposal: MARSTON_WRENV

Title: Cool Dust in the Environments of Evolved Massive Stars

PI: Marston, Anthony (European Space Astronomy Centre, ESA, Spain)

Abstract:

The evolution of massive stars have significant chemical and dynamical effects on the galaxies in which they reside. However, how and when material is lost during the evolution of the most massive stars is not well understood, due in large part to the lack of observational constraints on the genealogy of the intermediate phases of massive star evolution, namely in how Wolf-Rayet stars are connected to the Red Supergiant/OH-IR and Luminous Blue Variable star phases in different mass ranges. And yet the details of surface mass-loss in an evolutionary context are central to understanding the dynamical interactions with the interstellar medium that lead to galactic chemical enrichment and star formation. We propose to investigate the extended, cool, circumstellar environments of massive stars using ASTRO-F IRC and FIS imaging capabilities. These provide mass-loss history indicators via the distribution of material and the physical properties of the dust and gas, as well as indicating the extent to which star formation is being induced.

Proposal: MAZZOTTAEPIFANI_ADAMB

Title: Activity of Small Solar System Bodies far from the Sun

PI: Mazzotta Epifani, Elena (INAF - Osservatorio Astronomico di Capodimonte,Italy)

Abstract:

Centaurs and Short Period Comets are two classes of the Minor Bodies orbiting in the Solar System. Centaurs are brief residents of the region between the gas giant planets, with calculated orbital lifetimes less than 10 million of years. They are often considered as objects originating from the Kuiper Belt, especially from the so called Scattered Disk. Centaurs that survive the dynamical environment of this region may evolve towards the class of Jupiter family comets. Comets are minor bodies populating the inner Solar System, believed to be remnant planetesimals of the early Solar System and to be composed of the less modified materials carrying information on the proto-solar nebula chemical and physical properties. Recent observations show that these two classes of Small Solar System Objects can exhibit coma activity at larger heliocentric distances than previously believed. The scientific aim of the proposal is to analyse in the IR range the far activity of a sample of Short Period Comets and Centaurs, at a heliocentric distance greater than 4 AU, in order to compare activity levels and obtain hints about evolutionary differences for objects with different dynamical histories. Beyond 4 AU, the water sublimation rate is low and so the sublimation of other surface volatiles, such for example CO, could drive the presence of a coma and give rise to a dust environment expected to be different from that due to water. The activity far from the Sun has important implication both for the cometary population (the total lifetimes of nuclei could be overestimated) and for the replenishment of the zodiacal dust cloud. This problem is strictly connected also to the presence of a trail, considered common to all Short Period Comets. To analyse the far activity of these Small Solar System Bodies, we propose to get images of the objects, in order to monitor the dust environment, and to get low resolution spectra of the coma, in order to analyse the far gaseous environment and the composition of the dust. Images in the continuum will be used as input for inverse coma and tail models, to get information on the dynamical evolution of grains in the coma and on dust physical parameters. Low resolution spectra will allow to evaluate the molecule production rate for non standard emission-driving compounds (CO, CO2) and to investigate the presence of amorphous or crystalline silicates grains in the coma.

Proposal: NUTTER_ENVIR
Title: The Environments and Evolution of Pre-stellar Cores
PI: Nutter, David (Cardiff University, United Kingdom)
Abstract:

The earliest stage of star formation, the evolution of pre-stellar cores, is the least understood aspect of star formation. One reason for this is that observational studies to date have used very different tracers to study pre-stellar cores and their natal molecular cloud. The thermal emission from cold (10-15 K) dust peaks in the far-IR. Data in this region of the spectrum is therefore crucial for determining the temperature of the emitting dust, and hence obtaining a reliable measure of the density. The FIS instrument on board Astro-F has the required sensitivity to image both the dense pre-stellar cores and the surrounding molecular cloud, and provides the first opportunity to observe both the cores and their environment using the same tracer. We therefore propose to map a number of pre-stellar cores and the surrounding molecular cloud using the FIS instrument. The density and temperature information will allow us to distinguish between competing theoretical models of pre-stellar collapse, which are controlled either by magnetic forces, or the dissipation of turbulence. We will measure the pressure both within and without the pre-stellar cores and hence ascertain whether the cores are gravitationally bound, or are confined by a higher pressure in the ambient cloud. The presence or absence of sharp edges between the pre-stellar cores and their surroundings will inform us as to whether or not the cores have detached from the molecular cloud, and are therefore evolving essentially independently of their surroundings.

Proposal: PEARSON_SUBMM
Title: Mapping the Spectral Energy Distributions of Sub-mm Bright QSOs
PI: Pearson, Chris (European Space Astronomy Centre, ESA, Spain)
Abstract:

We propose to carry out photometry with the IRC and FIS instruments on a sample of SCUBA observed sub-mm QSOs selected so as to be well matched with optical luminosity (specifically brighter than -27.5 absolute B magnitude. Our sample is divided into 3 redshift ranges from local objects to the most distant objects in the Universe and are characterized by their sub--mm fluxes, or outstanding individual objects for which extensive follow up observations have already been made or targets for which it will be, or has already been possible to obtain good IR redshifts to facilitate CO follow up. All targets posses complementary SCUBA and a vast array of follow up data from X-ray to radio wavelengths with some including IR redshifts from CO measurements. The ASTRO-F data will fill the gap between the sub-mm and near infrared observations of these sources allowing us to investigate the AGN component as a function of redshift, optical/sub-mm ratio, the presence of molecular gas (indicative of starburst). By combining the data sets we will be able to provide a clear distinction between the AGN and Starburst components in QSOs leading to reliable radiative transfer models and determination of the Accretion/starburst energy budget of the Universe as a function of redshift.

Proposal: SARACCO_EROMU
Title: The stellar mass and the obscured star formation harboured by EROs
PI: Saracco, Paolo (INAF - Osservatorio Astronomico di Brera, Italy)
Abstract:

One of the difficulties of the galaxy formation models consists in explaining the large population of extremely red (R-K>5) galaxies (EROs) seen at z>1. In particular, models have to face with two uncertain properties of this population: (1) the "mass scale"' of EROs, i.e. the abundance of massive red galaxies at 1<2 in the ERO population and (2) the "redness"' of EROs, i.e. the balance among the number of early-type galaxies and that of obscured star-forming systems. The "mass scale" problem arises from the uncertainties affecting the estimate of the stellar mass of galaxies at z>1: the near-IR luminosity, best suited to trace the stellar mass, is extrapolated from the observed optical flux since no mid-IR observations are usually available. However, optical emission is affected by dust extinction and is dominated by young stars whose contribution to the near-IR emission is almost negligible. Thus, in the case of EROs, composed of old stellar systems and of dusty starbursts, these uncertainties are extremely high. The "redness" problem deals with the difficulty in identifying early-type galaxies and star-forming galaxies among the EROs and in quantifying the star formation and the dust extinction hidden by EROs. The photometric diagnostics proposed to distinguish the different classes of EROs are based on the observed colors of galaxies. In fact, these color-color plots deals with the rest-frame optical and UV continuum of EROs (being them at z>1) where the degeneracy between age and dust is extremely high. These facts, coupled with the faintness and the small size of the EROs samples collected so far, provide very poor constraints on the abundance of massive red galaxies at z>1 and no constraints at all on the star formation and on the dust content of EROs. We propose to survey an area of about 420 arcmin^2 with IRC (N3) and FIS (WIDE-L) in order to measure the rest-frame emission at 2 mu and at 50-90 mu for a complete sample of ~200 bright (K~19) EROs at 0.8<2. The IRC observations we propose will sample the rest-frame near-IR emission of the EROs allowing a reliable estimate of their near-IR luminosities. The FIS observations will sample the thermal emission from the hot dust characterizing the starburst galaxies. This will allow us (1) to distinguish starburst from passive early-type galaxies providing a statistic of about 80-100 objects per class; (2) to derive the SFR of the starburst galaxies through the mid-IR luminosity; (3) to constrain the mean dust content of starburst EROs by comparing the SFR derived from the un-obscured mid-IR light and from the L[2800] and L[O[II]] luminosities measured from the photometric and spectroscopic data; (4) to derive the stellar mass of early-types and starbursts from the rest-frame near-IR luminosity.

Proposal: SERJEANT_A2218
Title: An ultra-deep survey through a well-constrained lensing cluster
PI: Serjeant, Stephen (University of Kent, United Kingdom)
Abstract:

We propose ultra-deep mapping of the exceptionally well-constrained gravitational lensing cluster Abell 2218 near the North Ecliptic Pole. Our 11+15 micron imaging to the confusion limits will complement the extremely deep Spitzer 3.6-8 micron and 24 micron imaging obtained by us, with the lens magnification taking our survey up to 10x deeper than even the deepest blank-field ASTRO-F survey. Uniquely for cluster lenses, the redshifts of multiply-imaged galaxies can be derived geometrically from the lens mass model (a technique pioneered by us); these directly test the photometric redshifts made possible only with our combined ASTRO-F + Spitzer wavelength coverage. Compared to blank-field surveys, our survey will probe a much more representative sample of galaxies which make up the remainder of the integrated near-mid-infrared extragalactic background light and the dust-shrouded cosmic star formation history. Subsequent studies will provide the gas masses and dynamical information necessary to place this population within its correct context in galaxy formation models.

Proposal: SIMPSON_6AND7

Title: Making AGN come of age as cosmological probes

PI: Simpson, Chris (Durham University, United Kingdom)

Abstract:

We propose four-band infrared imaging with the IRC of radio-loud active galactic nuclei (AGN) drawn from subsets of the 6C and 7C catalogues which have complete spectroscopic redshift information. These data will be combined with Spitzer data for the more luminous 3C objects to obtain SED information from 3-11 microns for a large number of AGN properly sampling the luminosity-redshift plane. This will enable us to break the degeneracy between redshift and luminosity inherent in flux-limited AGN samples. Our aims are (i) determine the true fraction of obscured AGN to allow a comparison between the AGN luminosity functions revealed by simulations and observations; (ii) determine the number of heavily-obscured (and likely Compton-thick) AGN to improve our understanding of the Cosmic X-ray Background; (iii) determine the distribution of extinctions as a function of luminosity and/or redshift to allow AGN number counts in the optical/infrared to be derived from simulations; (iv) investigate the relationship between black hole and host galaxy mass at high redshift to better understand the importance of AGN-driven feedback in controlling baryon cooling in galaxies. All these aims are essential if AGN are to be used to their full advantage to constrain simulations of the Universe and improve our understanding of their role in galaxy formation and evolution.

Proposal: SWINYARD_SNRBS
Title: FIR Spectroscopy of Super Nova Remnants
PI: Swinyard, Bruce (Rutherford Appleton Laboratory, United Kingdom)
Abstract:

We propose to observe the SNR first observed using the ISOLWS in order better understand the physical characteristics of the shocked and unshocked neutral and ionised regions within the SNR. We plan to use the FIS03 AOT, which, with its higher spectral resolution than ISOLWS will enable us to better detect the FIR fine structure lines and better distinguish between the different velocity components present in the gas phase. Separating the cooler neutral phase from the hot ionised phase in a variety of objects will enable use to through some light on the debate about whether the cold dust "seen" in the sub-mm is pre-existing; originates for the Sn itself or is merely foreground material.

Proposal: WALKER_YOUDD
Title: Mapping young debris disks
PI: Walker, Helen (CCLRC Rutherford Appleton Laboratory, United Kingdom)
Abstract:

Many young stars have massive dust disks and yet most main sequence stars have little or no dust around them. This proposal builds on work with ISOPHOT which has shown that it is possible to resolve some of the debris disks around stars younger than Vega and Beta Pictoris in the infrared. A sample of stars has been selected where we think ASTRO-F can resolve the debris disk at long infrared wavelengths, in order to produce a consistent set of data allowing scientific comparison of disk sizes, both amongst the sample itself and at two different infrared wavelengths.

Proposal: ZAVAGNO_AZTSF

Title: Triggered massive-star formation in the Galaxy

PI: Zavagno, Annie (Observatoire Astronomique de Marseille Provence, France)

Abstract:

Massive stars ionize their environment, forming HII regions. These regions expands into the surrounding medium, ionizing the molecular material. A shock front travels ahead of the ionization front; the region between the two is a hot photo-dissociation region. Several processes linked to the expansion of an HII region may trigger star formation at their borders. Among those, the collect and collapse process is particularly attractive because it leads to the formation of massive fragments, and thus of massive objects (stars or clusters). In this process, the expansion of an HII region leads to the accumulation of a dense layer between the ionization and the shock fronts. This layer then eventually collapses in dense fragments, observed on the borders of the ionized zones. Those fragments represent potential sites of triggered massive-star forming regions. We are engaged in a multi-wavelength analysis of bright Galactic HII regions surrounded by annular hot photo-dissociation regions. We have shown the first evidences for the collect and collapse being at work, as the main triggering agent of massive-star formation in two Galactic HII regions. With ASTRO-F, we want to further study this way of forming massive star. Imaging the sites of massive star formation observed on the borders of ionized regions at longer wavelengths will allow us to derive the spectral energy distribution of those sources and to better characterize their nature and evolutionary stage. We also want to derive physical conditions in the hot photo-dissociation regions that host massive-star formation sites, using the Fourier Transform Spectrometer. Apart than characterizing this star forming process, the ASTRO-F observations will represent a precious and unique input to carefully prepare the Guaranteed Time observations we have on Herschel, especially on the SPIRE-Fourier Transform Spectrometer for which we develop the simulator and pipeline for data analysis.

Proposal: ZIBETTI_DUDES
Title: The Nature of the Dusty Medium in Dwarf Elliptical Galaxies
PI: Zibetti, Stefano (MPI fuer Extraterrestrische Physisk, Germany)
Abstract:

Dwarf early-type galaxies are the most common galaxies in the local Universe, nevertheless almost nothing is known about their dusty medium, owing to the intrinsic faintness of these systems also at mid- and far-IR wavelengths. The advent of the last generation IR satellites, such as ASTRO-F, allows to detect the emission from the native populations of dust grains present in these low-mass, small systems thanks to their excellent sensitivity both in the mid- and the far-IR. Furthermore, the IRC camera on ASTRO-F allows to map at a suitable spatial resolution the distribution of the mixture of dust grains emitting at wavelengths between 3 and 24 micron. Therefore, we propose to obtain IRC and FIS imaging at all bands for a pair of well-studied, dwarf elliptical galaxies (dEs) in the Virgo cluster, one evolving passively and the other being in a post-starburst phase. With these observations, we will determine the total amount of dust and the distribution of the different dust grains emitting at different IR wavelengths with respect to the local sources of the stellar radiation field. Hence, we will be able to investigate the nature of the sources of dust and the existence of a dusty interstellar medium (ISM) in addition to the circumstellar one in these two dE galaxies with extremely different star-formation histories within the last 2 Gyr. These results are needed to interpret the origin of the dusty ISM in giant elliptical galaxies and to establish the sources of metals (and dust) in the intracluster medium.