Oral Talks

Invited - I1

Title: Prof.
First name: Takao
Surname: Nakagawa
Email Address: nakagawa@ir.isas.jaxa.jp
Affiliation: ISAS/JAXA
Title of contribution: **The AKARI project and Legacy**

Abstract: We describe an overview of the AKARI project. The AKARI project started officially at ISAS in 1997. The AKARI satellite was launched 2006, and performed both all-sky survey and pointed observations during its 550 days in the He-cooled mission phases (Phases 1 and 2). After the He ran out, we continued near-infrared observations with mechanical cryocoolers (Phase 3). Due to the failure of its power supply, AKARI's operational phase was terminated in 2011. AKARI was a JAXA mission with ESA participation. A consortium including The Open University, Imperial College, University of Kent, Sussex University, and SRON-Groningen with the University of Groningen (IKSG consortium) participates on the data reduction of the All-Sky Survey. Seoul National University representing the Korean community also joins the data reduction activity.

Invited - I2

Title: Dr.
First name: Issei
Surname: Yamamura
Email Address: yamamura@ir.isas.jaxa.jp
Affiliation: ISAS/JAXA
Title of contribution: **AKARI data processing and archiving activity: Overview**
Abstract:

During its five year mission, AKARI has made an All-Sky Survey along with about two thousand pointed observations. This enormously valuable data must be properly archived to contribute to the future astronomical research. So far, the mid- and far-IR All-Sky Point Source Catalogues, the Asteroid catalogue, the North-Ecliptic Polar region point source catalogues, along with data from the Large Magellanic Cloud region point source and spectroscopic catalogues, have been released to public. Several catalogues contributed by science users have also been archived in the AKARI web site. There is however much more data still to be provided to users in an usable format. A dedicated team responsible for data processing and archiving of the AKARI data was established in April 2013, taking over the AKARI satellite project. This activity will last for five years; with three years for the data processing and the following two years to facilitate permanent archiving and maintenance of the data. The goal of the project is to provide uniformly processed data products, such as point source catalogues, images, and spectra from the AKARI data. The expected data products and their delivery schedule will be presented. We welcome feedback and inputs from the AKARI data users.

Invited - I3

Title: Dr.
First name: Yasuo
Surname: Doi
Email Address: doi@ea.c.u-tokyo.ac.jp
Affiliation: Univ. of Tokyo
Title of contribution: **The AKARI FIR all-sky maps**

Abstract:
We present the AKARI far-infrared (FIR) all-sky maps and describe its characteristics, calibration accuracy and scientific capabilities. The AKARI FIR survey has covered >97% of the whole sky in four photometric bands, which cover continuously 50--180 micron with band central wavelengths of 65, 90, 140, and 160 microns. The spatial resolution of the maps is ~60-90 arc seconds and the detection limit is ~ 1-12 [MJy/sr] with an absolute accuracy of ~20%. The data for the first time reveal

the whole sky distribution of interstellar matter with arc minute scale spatial resolutions at the peak of dust continuum emission, enabling us to investigate large-scale distribution of interstellar medium in great detail. The cirrus filamentary structure covering the whole sky is well traced and characterised by the all-sky maps. The potential capability of stacking analyses is being demonstrated by unveiling extended low surface brightness emission commonly surrounding a large number of point sources detected by the all-sky survey. The FIR all-sky maps are currently under scientific investigation by the AKARI science team members and to be publicly released later this year. The release schedule is also described in this presentation.

Invited - I4

Title: Prof.
First name: Takashi
Surname: Onaka
Email Address: onaka@astron.s.u-tokyo.ac.jp
Affiliation: onaka@astron.s.u-tokyo.ac.jp
Title of contribution: **Processing of the Interstellar Medium as Divulged by AKARI**

Abstract: The wide spectral coverage from the NIR to the FIR of AKARI both for imaging and spectroscopy enables us to efficiently study the emission from gas and dust in the interstellar medium (ISM). In particular, the infrared camera (IRC) offers the unique opportunity to carry out very sensitive spectroscopy in the near-infrared (NIR, 2-5 microns) for the first time. This spectral range contains a number of important dust bands and gas lines, such as the aromatic and aliphatic emission bands at 3.3 and 3.4--3.5 micron, H_2O and CO_2 ice at 3.0 and 4.3 micron, CO fundamental vibration bands around 4.6 micron, hydrogen recombination lines, and molecular hydrogen lines. Deuterated aromatic and aliphatic features are also expected at 4.4-4.6 micron. The balance between dust supply and destruction suggests significant dust processing taking place as well as dust formation in the ISM. Detailed analysis of the aromatic and aliphatic bands under various physical environments divulges the processing of carbonaceous dust in the ISM. The ice formation process and possible dust precursors could also be studied with NIR spectroscopy. In this presentation, a review of AKARI observations of the ISM is given with stress on the interstellar processing of dust grains.

Invited - I5

Title: Prof.
First name: Bon-Chul
Surname: Koo
Email Address: koo@astro.snu.ac.kr
Affiliation: Seoul National University
Title of contribution: **Dust Infrared Emission from Supernova Remnants**

Abstract: Thermal infrared emission by dust is a major emission from supernova remnants. It provides essential information regarding the dust processing by shocks, dust heating in hot plasma, and dust formation in supernovae. Recent infrared space missions including AKARI have considerably improved our understanding on these important astrophysical processes. In this talk, I will review the important contributions made by AKARI in this field and present related developments.

Invited - I6

Title: Prof
First name: Derek
Surname: Ward-Thompson
Email Address: dward-thompson@uclan.ac.uk
Affiliation: University of Central Lancashire
Title of contribution: **Akari, SCUBA2 and Herschel data on pre-stellar cores**

Abstract: We present observations of pre-stellar cores in molecular clouds, taken using the Far Infrared Surveyor (FIS) instrument on the Akari satellite. We compare these data to submillimetre data taken using the Submillimetre Common-User Bolometer Array 2 (SCUBA2) camera on the James Clerk Maxwell Telescope in Hawaii, and far-infrared data taken with the Herschel Space Telescope. The

combination of the different data sets yields powerful new insights and interesting results emerge relating to the link between the Initial Mass Function (IMF) of stars and the core mass function (CMF) of prestellar cores. Furthermore, the processes governing the formation and evolution of prestellar cores are now becoming clearer, and the role played by filamentary structures now appears crucial. The probability density function (PDF) of the cloud structure also yields valuable insight into the formation mechanism of prestellar cores.

Invited - I7

Title: Dr
First name: Helen Jane
Surname: Fraser
Email Address: helen.fraser@open.ac.uk
Affiliation: The Open University
Title of contribution: **Mapping the Frozen Void**

Abstract: In star-forming regions condensed molecular material, or ice, which coats interstellar dust grains, forms the single largest reservoir of molecular material. Through our AKARI programmes we have successfully mapped the distribution of H_2O, CO and CO_2 ices towards 28 pre-stellar cores, on scales between 1' ^{2} and 10' ^{2}. These show wide chemical variations on scales as small as 1000 AU - i.e. solid-state chemical differentiation from clump to clump, which might therefore be related to those different materials that can subsequently be made available for star and planet formation. By comparison with sub-mm gas-phase emission and continuum observations to the same regions, the links between ice distribution; dust, extinction and gas solid synergies have been investigated. These show that the dynamics and physics of star-forming regions also have a strong influence on the ice spectra observed. The unique data reduction and ice spectral analysis methods we have developed have subsequently been equally retrospectively applied to VLT and Spitzer data, corroborating the accuracy of the analysis, and showing for the first time the widespread existence of CH_3OH ice across pre-stellar cores. We also report the first detections of HDO ice towards background stars. Finally we will use our knowledge from AKARI to look forwards - to JWST, SPICA and E-ELT Metis, and the prospects for ice observations in the decades to come.

Invited - I8

Title: Dr.
First name: Hideyuki
Surname: Izumiura
Email Address: izumiura@oao.nao.ac.jp
Affiliation: NAO, Japan
Title of contribution: **AKARI observations of evolved stars**

Abstract: Stars more massive than the sun are considered to expel a significant amount of their own mass at their last stages of evolution. As they become red (super)giants, dust begins to form in their upper atmosphere, which is considered to be the agent of dust driven winds that causes a significant reduction of their mass. The structure and kinematics of the dust envelopes around evolved stars may tell us their history of mass-loss. AKARI was directed to many evolved stars to observe their circumstellar dust envelopes. IRC observations of detached shells of U Ant have resulted in a further fine structure seen only in dust emission. The results delineate the potential of high sensitivity mid-infrared imaging of the circumstellar envelopes of evolved stars. FIS pointed observations with slow scan are made toward about 140 evolved objects, in which a sensitivity as good as 1 MJy/sr has been achieved in the WIDE-S filter at 90 um for extended emission components. Many dust envelopes have been revealed, showing various shapes, thanks to this high sensitivity. In this talk I will review the results obtained to date from the observations of evolved stars with both IRC and FIS, and discuss briefly their implications.

Invited I9

Title: Dr.
First name: Toshio
Surname: Matsumoto

Email Address: matsumoto@asiaa.sinica.edu.tw
Affiliation: Institute of Astronomy and Astrophysics, Academia Sinica
Title of contribution: **Observations of the near-infrared extragalactic background**

Abstract: Recent observations with AKARI, Spitzer, etc. indicate there exist excess background brightness and fluctuations in the near-infrared sky which can not be explained with known foreground sources. I will review the observations of near-infrared extragalactic background light and discuss its astronomical implication.

Invited I10

Title: Dr.
First name: Woong-Seob
Surname: Jeong
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Affiliation: KASI
Title of contribution: **Analysis of Cosmic Infrared Background Fluctuations from the NEP Region**

Abstract: The North Ecliptic Pole (NEP) is one of the AKARI deep fields that is suitable to study the Cosmic Infrared Background (CIB), due to its low background brightness. The CIB contains information about the number and distribution of unresolved contributing sources. Thus, a fluctuation analysis of the CIB enables us to understand indirectly the early Universe. In order to reveal the origin of CIB, near-, far-infrared and submm observations have been performed in the NEP region using the space infrared telescopes: AKARI, MIRIS and Herschel. Here, I will report on the recent results from MIRIS and Herschel for the NEP region.

Invited I11

Title: Prof
First name: Hidehiro
Surname: Kaneda
Email Address: kaneda@u.phys.nagoya-u.ac.jp
Affiliation: Nagoya University
Title of contribution: **Properties of dust in various environments of nearby galaxies**

Abstract: With AKARI, we have performed a systematic study of interstellar dust grains in various environments of nearby galaxies including our Galaxy. Because of its unique capabilities, such as near- and far-IR spectroscopy combined with all-sky coverage in the mid- and far-IR, AKARI has provided new knowledge on the processing of dust, particularly carbonaceous grains including polycyclic aromatic hydrocarbons (PAHs), in galaxies. For example, we find that copious amounts of large grains and PAHs are flowing out of starburst galaxies by galactic super winds, which are being shattered and destroyed in galactic haloes. With near-IR spectroscopy, we detect large variations in the intensity of the aliphatic emission relative to aromatic emission within galaxies and even between galaxies, indicating systematic changes in the properties of hydrocarbon grains possibly due to large-scale shocks in galaxies. In this talk, I will review the results obtained from our AKARI observations on the processing of interstellar dust grains in various harsh environments of galaxies, also adding representative results from our Spitzer and Herschel observations, together with our future prospect for this topic with SPICA.

Invited I12

Title: Prof.
First name: Hyung Mok
Surname: Lee
Email Address: hmlee@snu.ac.kr
Affiliation: Seoul National University
Title of contribution: **Photometric and Spectroscopic Surveys of NEP-Wide**

Abstract: The NEP-Wide survey was one of the wide area surveys of the AKARI. In addition to the AKARI survey with 9 photometric bands of IRC, optical and near infrared surveys were carried out with various ground-based telescopes. Based on these surveys point source catalogue that covers from

~350 nm (u'-band) to ~24 um. For further studies, optical spectroscopic surveys with MMT/Hectospec and WYIN/Hydra have been carried out for the sources selected primarily based on 11 um fluxes. By combining the spectroscopic and photometric data, one can construct SEDs of large number of galaxies toward the NEP region. The star formation activities can be derived from line intensities as well as mid-IR fluxes. Accurate luminosity functions in the local universe can also be constructed. We review the recent works based on these surveys in this talk.

Invited I13

Title: Prof
First name: Peter
Surname: Barthel
Email Address: pdb@astro.rug.nl
Affiliation: Kapteyn Institute, Univ. of Groningen
Title of contribution: **AGN with Akari and Herschel**

Abstract: AKARI and Herschel have yielded important new understanding of the astrophysics of active galaxies and AGN - both the unobscured and the obscured populations - and their role in galaxy formation and evolution. This talk will review the most important results, and the still open questions...

Invited I14

Title: Dr
First name: Shinki
Surname: Oyabu
Email Address: oyabu@u.phys.nagoya-u.ac.jp
Affiliation: Nagoya University
Title of contribution: **AKARI observations of AGN dusty tori**

Abstract: The dusty torus of Active Galactic Nuclei (AGNs) is one of the important components of the unification theory of AGNs. However, the geometry and properties of the dusty torus obscuring the nuclear central engine are still under discussion, while they are key factors in understanding not only the nature of AGNs but also the formation and evolution of AGNs. AKARI had a capability of the near- and mid-infrared spectroscopy. In addition, AKARI also performed the all-sky survey in the mid- and far-infrared. These data are very useful to study the dusty tori of AGNs from low-z to high-z universe. For the low-z AGNs, we decomposed the infrared spectral energy distributions of AGNs into dusty torus components with different temperatures. For the high-z AGNs, AKARI traced rest-frame optical and near-infrared spectra of AGNs. Combining the WISE data, we found the AGNs, the temperatures of which in the innermost dusty torus are lower than typical AGNs. Combining these results, we will discuss the evolution of dusty tori in AGNs.

Invited I15

Title: Dr
First name: Georgios
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Affiliation: University of Oxford
Title of contribution: **Tracing the evolution of the ULIRGs phenomenon across cosmic time**

Abstract: Ultraluminous Infrared Galaxies (ULIRGs) are signposts of the most intense star forming activity in the Universe dominating the star formation rate density during the epoch of galaxy assembly ($z \sim 1$-2). Although matched in luminosity, increasing evidence suggests that the physical properties of local ($z \sim 0$) and distant ($z > 1$) ULIRGs are markedly different. Studies of ULIRGs have so far focused on either local ($z \sim 0$) or distant ($z > 1$) samples leaving the critical ``transition" epoch of $0 < z < 1$, that coincides with the epoch when the universe experienced a strong increase in its star formation rate density, significantly understudied. Using data from a far-IR spectroscopic survey of atomic lines ([CII], [NII] and [OI], submm photometry of the dust continuum and CO observations that trace the

molecular gas of a Herschel – selected ULIRGs sample in the redshift range of $0.2 < z < 0.8$, I will present evidence that the evolution of the ULIRG phenomenon is already taking place by $z \sim 0.3$.

Invited I16

Title: Prof
First name: Hideo
Surname: Matsuhara
Email Address: maruma@ir.isas.jaxa.jp
Affiliation: ISAS/JAXA
Title of contribution: **Overview of the North Ecliptic Pole Deep Field Multi-wavelength survey(NEP-DEEP)**

Abstract: Results from the North Ecliptic Pole (NEP) deep multi-wavelength survey, extending from X-ray to radio wavelengths, will be presented in this review. The main science objective of this multi-wavelength project is to unveil the star-formation and AGN activity obscured by dust during the violent epoch of the Universe (z=0.5-2), when the star formation and black-hole evolution activity were much stronger than the present. The AKARI/IRC NEP project consists of the shallow wide (8.2 sq. deg) NEP-Wide and deeper (0.6 sq. deg) NEP-Deep surveys. NEP-Deep provides us with new 15 and 18 micron selected samples of several thousand galaxies, the largest sample ever made at these wavelengths, and has been presented in Murata et al (2013). The continuous filter coverage at mid-IR wavelengths (7, 9, 11, 15, 18, and 24 microns) uniquely allows us to diagnose the contributions from starburst and AGN activity to the galaxies during this epoch (Karouzos et al 2014). Recent updates to the ancillary data are also reported, including: new optical/near-IR measurements (Subaru, CFHT) and optical catalogues that have been reported by Nagisa et al. (2014), X-ray (Chandra), FUV/NUV (GALEX), radio (WSRT, GMRT), optical spectra (Keck/DEIMOS etc.) and Subaru/FMOS. The recent Herschel/SPIRE, JCMT/SCUBA-2 and GMRT surveys will be reported by Serjeant, Pearson, White, and Barrufet De Soto in separate contributions.

Invited I17

Title: Dr
First name: Stephen
Surname: Serjeant
Email Address: stephen.serjeant@open.ac.uk
Affiliation: The Open University
Title of contribution: **Multi-wavelength galaxy surveys in the NEP**

Abstract: The North Ecliptic Pole is the natural deep field for a wide class of space telescopes and ground-based facilities. It is the premier extragalactic deep survey for AKARI, a legacy field for Herschel and SCUBA-2, a CIBER near-IR background survey field, and a planned legacy field for Euclid and SPICA. In this talk I will review some of the key results from the multi-wavelength surveys in this field, including constraints on the solid-state ISM composition on and off the putative galaxy 'main sequence' and the co-evolution of star formation and black hole accretion.

Invited I18

Title: Dr
First name: David
Surname: Clements
Email Address: d.clements@imperial.ac.uk
Affiliation: Imperial College London
Title of contribution: **The AKARI Deep Field South: Pushing to High Redshift**
Abstract (max 200 words): The Akari Deep Field South is now one of the premier southern extragalactic legacy fields, with observations ranging from UV to radio. I will discuss progress with the exploitation of this legacy in the specific context of the search for distant dusty galaxies, both as individual sources and in clusters.

Invited I19

Title: Dr
First name: Chris
Surname: Pearson
Email Address: chris.pearson@stfc.ac.uk
Affiliation: RAL Space
Title of contribution: **The Herschel Survey of the AKARI NEP Field**

Abstract: The North Ecliptic Pole (NEP) is the site of the premier mid-infrared survey for the AKARI satellite in the 2-24 micron range. Moreover, the NEP is host to major legacy ancillary observations from radio to X-ray wavelengths. The NEP field was also observed by ESA's Herschel Space Observatory as an Open Time Programme with both the SPIRE instrument (250,350,500 microns) and the PACS instrument (100,160 microns). The SPIRE observations were wide and shallow but have been carefully combined with archival and calibration data to produce a confusion limited survey in the central region of the NEP. We report on the current status of the Herschel SPIRE data reduction, the source extraction, photometry, and catalogue production. We also present the source counts in the NEP region in the SPIRE bands and compare our results with other Guaranteed Time surveys and contemporary source count models.

Invited I20

Title: Prof
First name: Michael
Surname: Rowan-Robinson
Email Address: mrr@imperial.ac.uk
Affiliation: Imperial College
Title of contribution: **Far infrared and submillimetre surveys, from IRAS to Akari, Herschel and Planck**

Abstract: A new version of the IRAS Faint Source Catalogue Redshift Survey, incorporating data from SDSS, 2MASS, WISE, Planck and Akari, is described. I also describe progress on merging data from the Herschel-SPIRE HerMES survey with the new version of the SWIRE photometric redshift catalogue. Both studies demonstrate the existence of galaxies with exceptionally cold dust. In the submillimetre the role of gravitational lensing has to be carefully monitored.

Invited I21

Title: Dr
First name: Denis
Surname: Burgarella
Email Address: denis.burgarella@lam.fr
Affiliation: Laboratoire d'Astrophysique de Marseille / Aix-Marseille University
Title of contribution: Multi-Wavelength Modeling of Galaxies

Abstract: Galaxies are complex astrophysical bodies consisting of many different and connected parts that are not always easy to analyse and understand. To capture the physical nature and evolution of galaxies (either as individuals, or as populations), we cannot restrict our analysis to a single or even just a few wavelength domains. We therefore need a multiwavelength approach that encompasses all, or at least a maximum of the emissions related to the aspect that we are interested in. To meet this goal, we will show that we have to make use of the spectral information spread over the far-ultraviolet to the sub-millimetre wavelength ranges including the nebular emission. Several codes are able to perform this difficult task and we will compare some of the characteristics of a few illustrative examples. Finally, we will show how the new version of a specific code that we have developed within our team (http://cigale.lam.fr) is able to estimate the physical parameters of a few very different categories of galaxies.

Invited I22

Title: Prof
First name: Veronique

Surname: Buat
Email Address: veronique.buat@lam.fr
Affiliation: Laboratoire d'Astrophysique de Marseille
Title of contribution: **Star formation and dust attenuation in 8 microns selected galaxies up to z=2**

Abstract: We built a 8 microns selected sample of galaxies in the NEP-AKARI field by defining 4 redshift bins with the four AKARI bands at 11, 15, 18 and 24 microns (z=[0.15:0.49], [0.75:1.34],[1.34:1.7], [1.7:2.05] . Our sample contains 4276 sources, 629 are securely detected with PACS at 100 microns. Adding UV data, we performed SED fitting using the physically motivated code CIGALE to extract physical parameters like (specific) star formation rate, stellar mass, dust attenuation, dust luminosity and the AGN contribution to this luminosity. We will discuss the impact of PACS data on the reliability of the estimation of these parameters, the impact of the adopted attenuation curve as well as the role of potential input parameters, which are found critical for the results of the fitting process. Then, we will focus on L* galaxies in the different redshift bins to study the evolution of the dust attenuation and star formation activity in these galaxies.

Invited I23

Dr Eiichi Egami

Title: Dr
First name: Eichi
Surname: Egami
Email Address: eegami@as.arizona.edu
Affiliation: Steward Observatory, Arizona
Title of contribution: **Using Massive Galaxy Clusters as Cosmic Gravitational Lensing Telescopes**

Abstract: Recent years have seen the progressive use of massive galaxy clusters as powerful cosmic telescopes that can magnify background distant galaxies with their strong gravitational lensing power. The gain in sensitivity is enormous: a factor of 10x magnification would result in a gain of 100x in observing time, making a 1-hour integration equivalent to a 100-hour one. Even a magnification factor of 20-30x is not that uncommon, and in this case, a 1-hour integration would become equivalent to a 400-900-hour integration. Considering that such a huge gain in sensitivity is provided by nature for free, it is natural to take full advantage of this amazing effect by specifically targeting the fields of massive galaxy clusters. In this talk, I will present results from such lensing cluster surveys using a variety of space (Hubble, Spitzer, Herschel) and ground-based telescopes, highlighting some of the most exciting findings on the nature of extremely distant galaxies and dust-obscured vigorously star-forming galaxies.

Invited I24

Title: Dr
First name: Göran
Surname: Pilbratt
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Affiliation: ESA Science Support Office / Herschel Project Scientist
Title of contribution: **Herschel - Science Highlights and Legacy**

Abstract: The ESA Herschel cornerstone far-infrared observatory mission was launched on 14 May 2009, made its last observation on 29 April 2013, and in between has carried out in excess of 23,000 hours of successful science observing. I will present a selection of science highlights to date, ranging from the first billion of cosmic history to the detection of water in the asteroid belt. Finally I want to stress the Herschel legacy in terms of available data and data products, and pose the question: What should be done in order to make these data as valuable as possible, for now and for the future? Are there lessons from the AKARI post-operations phase that Herschel should take onboard?

Invited I25

Title: Prof.

First name: Takao
Surname: Nakagawa
Email Address: nakagawa@ir.isas.jaxa.jp
Affiliation: ISAS/JAXA
Title of contribution: **The next-generation infrared space mission SPICA in a new framework**

Abstract: Following the success of AKARI and Herschel, we are now promoting the next-generation infrared space mission SPICA (Space Infrared Telescope for Cosmology and Astrophysics). SPICA is optimized for mid- and far-infrared astronomy with very low background, which will be achieved using a cryogenically cooled (6 K), large (3.2 m) telescope. SPICA is expected to address a number of key questions in present-day astronomy, ranging from studies of the star-formation history of the Universe, to the formation and evolution of planets. SPICA was proposed as a JAXA-led, international mission with the participation of ESA in 2007. The SPICA project framework is now being re-visited, and ESA is expected to play a more important role than the original plan, while JAXA is responsible for leading the whole program. To enable the change of the framework, a proposal to ESA is being prepared under the framework of the Cosmic Vision program. The current target launch year is 2025.

Invited I26

Title: Prof
First name: Peter
Surname: Roelfsema
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Affiliation: SRON
Preference: Invited Talk
Title of contribution: **The European SAFARI instrument on SPICA**

Abstract: The Japanese SPace Infrared telescope for Cosmology and Astrophysics, SPICA, will provide astronomers with a new window on the universe in the next decade. With a large -3 meter class- cold -6K- telescope, the mission will provide a unique environment optimally suited for instruments that are limited only by the cosmic background itself. SAFARI, the SpicA FAR infrared Instrument SAFARI, is a Fourier Transform imaging spectrometer designed to fully exploit this extremely low far infrared background environment provided by the SPICA observatory.

The SAFARI baseline instrument employs three extremely sensitive Transition Edge Sensor arrays covering the 35 to 210 μm domain with R~1000 spectral imaging capabilities instantaneously covering a 2' by 2' field of view.

Options are investigated to further improve the instrument capabilities by reducing the broadband background radiation – e.g. from zodiacal light emission at shorter wavelengths or telescope baffle emission at longer wavelengths – like dedicated masks or dispersive elements which can be inserted in the optics. With SAFARI astronomers will be able to study thousands of galaxies out to redshift 3 and even many hundreds out to redshifts of 5 or 6. Nearer by SAFARI will investigate the structure of protoplanetary disks and the properties of nearby Kuiper belt objects.

Invited I27

Title: Professor
First name: Bruce
Surname: Swinyard
Email Address: bruce.swinyard@stfc.ac.uk
Affiliation: University College London
Title of contribution: **Where do we go from here?**

Abstract: Far Infrared (>30 um) astronomy has had something of a golden age in the past 30 years in terms of space facilities. Starting from IRAS through to Herschel there has been an almost constant supply of high quality data that has truly revolutionised our view of the cool universe. This has been

matched by complementary data in the sub-mm from increasingly sophisticated ground based facilities culminating in ALMA. This talk will pose the question of where does FIR space astronomy go in a (hopefully) post SPICA world in an age of constrained budgets and a seemingly increasingly conservative approach to space missions by the space agencies.

Contributed A3
Title: Dr
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Affiliation: University of Tokyo
Title of contribution: Near-Infrared PAH features in Galactic Planetary Nebulae revealed by AKARI/IRC

Abstract: Polycyclic aromatic hydrocarbons (PAHs) are considered to be carriers of the unidentified infrared bands, which are ubiquitously observed in the Universe. PAHs are mainly formed around evolved carbon-rich stars and injected into interstellar space. Planetary nebulae (PNe), a late stage of low-and intermediate stellar mass evolution, are suitable objects to investigate the formation and evolution of PAHs. The shortest PAH feature is located in 3.3 micron, which is important to examine the excitation and size distribution of PAHs. While the number of samples had been limited before, the high sensitivity of AKARI/IRC has drastically increased the number of samples. We obtained the 2--5 micron spectra of Galactic PNe with AKARI/IRC and compiled a near-infrared spectral catalog, containing 73 PNe. We investigate the detection rate and the evolution of the PAH features. In the presentation, the characteristics of the catalog are illustrated and the origin of the evolution of the PAH feature is discussed.

Contributed A4
Title: Dr
First name: Ho-Gyu
Surname: Lee
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Affiliation: Korea Astronomy and Space Science Institute
Title of contribution: AKARI near-infrared spectroscopy of supernova remnants interacting with molecular clouds

Abstract: We present the recent results of near-infrared (NIR) observations of supernova remnants (SNRs) interacting with molecular clouds. Using the NIR slit spectroscopy of AKARI, we observe evolved SNRs and relatively young SNRs toward the bright positions previously detected by IR imaging observations. We obtain prominent emission line spectra covering the wavelength range of 2.5-5 um. In many cases, strong molecular hydrogen lines originating from shock-heated hot molecular gas dominate the spectra. The estimated excitation temperatures are >2000 K. Comparing with the results of Spitzer mid-IR observations, AKARI observations prove hotter components of molecular gas, suggesting the existence of strong shock propagating into the molecular cloud. We model the emission of molecular hydrogen lines using thermal admixture gas assuming a power law temperature distribution. Interestingly, some of NIR molecular-line-dominated SNRs are also bright in far-IR continuum, although there is no direct emitting mechanism between the two wavelengths. On the other hand, we detect interesting features from more complex particles at some SNRs. We find the 3.3 um emission feature carried by polycyclic aromatic hydrocarbon. In addition, we also report a detection of CO_2 ice absorption.

Contributed A5
Title: Dr.
First name: Hideaki
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Affiliation: Subaru Telescope, National Astronomical Observatory of Japan
Title of contribution: Warm Debris Disks Proved by AKARI Observations

Abstract: Debris disks around main-sequence stars are expected to be related to the stability of minor

bodies and, potentially, to the presence of planets around stars. Recent high-sensitivity observations in the mid-infrared allow us to investigate the properties of warm dust grains in the inner region of debris disks, which should have a more direct link to the formation of terrestrial planets than the low-temperature dust that has been previously studied. Here we report the results of our survey of warm debris disks based on photometric measurements at 18 micron taken from the AKARI/IRC All-Sky Survey data. We have identified 24 debris disk candidates with bright mid-infrared excess emission above the stellar photospheric emission out of the 856 sources that were detected at 18 micron. We find that A stars and solar-type FGK stars have different characteristics of their debris disks. We also show the results of our follow-up observations of the AKARI-identified warm debris disks in the mid- and far-infrared and discuss their nature.

Contributed A7
Title: Prof.
First name: Yasuo
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Title of contribution: Optically thick HI dominant in the local interstellar medium; an alternative interpretation to "dark gas"

Abstract: The 21 m HI line emission has been useful in probing the major part of the interstellar gas over more than a half century. The sub-mm dust properties derived by the Planck satellite offer a new accurate measure of the interstellar dust column density, and, accordingly, the gas column density. We present a new method to calculate HI column density and dust opacity with high accuracy by taking into account dust temperature stratification. This method allows us to estimate both spin temperature T_s and HI column density for optically thick HI; T_s of the local interstellar medium is generally low in a range 15-40 K and HI density is high in a range 30-200 cm^{-3}. We discuss possible implications of the new HI analysis on “dark gas” and dust evolution. References: arXiv:1403.0999 and arXiv:1401.7398

Contributed A8
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Title of contribution: Debris disks and the zodiacal light explored by the AKARI mid-infrared all-sky survey

Abstract: Debris disks are circumstellar dust disks around main-sequence stars. Most of them are interpreted as clues to planetary system formation. However, many mysteries remain for the comprehensive understanding of their nature. For example, the relation between debris disks and the zodiacal light, a thermal emission from the dust disk of our solar system, is still unknown. For a statistical study of bright zodiacal light analogs, we explore warm debris disks using AKARI mid-infrared all-sky point source catalog. We try to investigate faint disks by applying accurate flux estimate of the central stars based on follow-up observations (Takeuchi et al. in this conference). For a detailed study of the dust disk in our solar system, we analyze the AKARI mid-infrared all-sky diffuse maps (Kondo et al. in this conference). As a result, some of the warm debris disks are found to be notably old (>1 Gyr), which cannot be explained simply by planet-forming activities. For the zodiacal light, we obtain geometrical and compositional information of individual dust clouds with different dust origin as well as the time variation since the IRAS era. Combining these results, we discuss the formation process of the old debris disks and the zodiacal light.

Contributed A11
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Title of contribution: The AKARI Far-Infrared Surveyor young stellar object catalog

Abstract: A new catalog of AKARI Far-Infrared Surveyor (FIS) young stellar object (YSO) candidates including 44001 sources has been prepared. The reliability of the classification is over 90%, as tested in comparison to known YSOs. As much as 76% of our YSO candidates are previously uncatalogued. The vast majority of these sources are Class I and II types according to the Lada classification. The distribution of AKARI FIS YSOs is well correlated with that of the galactic interstellar medium (ISM). Local over-densities were found on infrared loops, and HI shells. We specifically examined the distribution of AKARI YSOs of the Taurus, the Perseus and the Auriga regions using pattern analysis, and located YSO groups. An excess of AKARI YSOs towards cold clumps detected by the Planck space telescope is also addressed, as well as the YSO-ISM relation deriving the structure and physical parameters of the ISM from AKARI FIS data.

Contributed B2
Title: Dr
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Title of contribution: A multiwavelength spectroscopic study of molecular chemistry in the Large Magellanic Cloud

Abstract: Chemical evolution of molecules in low metallicity environment is one of the key topics of recent astrochemistry. It provides us essential information to understand the chemical processes in the past universe which the metallicity is believed to be significantly low. The Large Magellanic Cloud (LMC) is an excellent target for such studies thanks to its proximity and low metallicity environment. We present the results of multiwavelength spectroscopic observations toward young stellar objects (YSOs) and the surrounding molecular gas in the LMC. We first present infrared spectra of embedded high-mass YSOs obtained by AKARI and VLT/ISAAC to discuss chemical compositions of ice mantles in the LMC. Next, we present sub-/millimeter spectra toward LMC's YSOs obtained by ALMA and the Mopra single-dish telescope to discuss the chemical composition of dense molecular gas. Finally, we present numerical simulation models on molecular cloud chemistry in a low metallicity environment to interpret the observation data. Based on these results, we found that a harsh radiation environment in the LMC causes ice chemistry that differs from our Galaxy, and this difference leads to different chemical compositions of gas-phase molecules. We also discuss the potential of spectroscopic observations toward YSOs in nearby galaxies with SPICA.

Contributed B4
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Title of contribution: Ultraluminous Infrared Galaxies in the AKARI All-sky Survey

Abstract: We present a catalog of local ($z<0.49$) Ultraluminous Infrared Galaxies (ULIRGs) identified in the AKARI All-sky Survey. We combine multi-wavelength imaging and spectroscopic data from AKARI and SDSS. We investigate morphologies, optical spectral types, star formation rates (SFR), stellar masses (M), metallicities and colors of the ULIRGs in our sample. We examine the position of ULIRGs on the SFR-M, M-Metallicity, SFR-M-Metallicity, and color magnitude diagrams. We show that ULIRGs are extreme outliers compared to the main sequence of local galaxies, but they are close to the main sequence of $z=2$ galaxies. We find that ULIRGs follow the SFR-M Metallicity plane. ULIRGs in our sample mostly exhibit blue colors and populate around the blue cloud.

Contributed B7
Title: Dr
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Title of contribution: The AGN/Starburst Specific Star Formation Rate using AKARI and Herschel Space Observatories

Abstract: AKARI and Herschel provide us with unique data sets to study Star Forming Galaxies across cosmic time. Thanks to their combined observations in 14 bands between 1.7 to 500 μm, together with other multi-wavelength data, we are now able to describe in detail the SED of IR galaxies and thus their physical properties. In particular, different studies have been arguing the role played by AGN and BH accretion in Galaxy Formation and Evolution and how these are connected with the star formation activity in galaxies. AKARI and Herschel observations provide us with our best chance to understand these phenomena by studying the emission of extragalactic sources at IR wavelengths where the bulk of AGN emission and obscured star formation activity occur. In my talk I will describe some recent results obtained by jointly exploiting AKARI/Herschel data in the AKARI NEP field, making use of different SED fitting codes to disentangle the AGN and SF contribution to IR emission and comparing our estimates with modeling predictions and results from the literature. I will then explain how future facilities such as JWST and SPICA will allow us to make progress on these issues.

Contributed B9

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Title of contribution: Near-Infrared spectroscopy of CO ro-vibrational absorption toward heavily obscured AGNs

Abstract: In order to reveal physical characteristics of molecular clouds which could be related with molecular torus around AGN, we performed near-infrared spectroscopic observations of heavily obscured AGNs, especially focused on the CO fundamental ro-vibrational absorption around 4.7 micron. We have made systematic moderate-resolution (R~100) spectroscopic observations toward 30 representative ULIRGs using the IRC NG grism mode on the AKARI satellite, and some of ULIRGs showed the strong CO absorption. For three bright ULIRGs that show a steep red continuum with deep CO absorption feature, IRAS 08572+3915, UGC 05101, and IRAS 01250+2832, we have also made high-resolution (R~10.000) spectroscopic observations using the IRCS+AO188 on the Subaru Telescope. We have successfully detected many absorption lines up to highly excited rotational levels, and these lines are very deep (tau~4) and extremely broad (FWHM~200 km s^{-1}). The derived physical conditions of molecular clouds are extreme; the gas temperature is as high as a few 100 to a 1000 K, the H_2 column density is larger than 10^{22} cm^{-2}, and the gas density is greater than 10^{7} cm^{-3}. Typical photo-dissociation models cannot explain the existence of hot and dense molecular clouds with such a large column density, hence we proposed that these molecular clouds are exposed by the X-ray radiation originative in AGN.

Contributed B12

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Title of contribution: Low-Resolution Spectrum of the Extragalactic Background Light with the AKARI InfraRed Camera

Abstract: The Extragalactic Background Light (EBL) as integrated light from outside of our Galaxy includes information about the early universe and the Dark Ages. We analyzed spectral data of the astrophysical diffuse emission obtained with the low-resolution spectroscopy mode on the AKARI Infra-Red Camera (IRC) in the 1.8-5.3 um wavelength region. Although previous EBL observations in this wavelength region were restricted to observations by DIRBE and IRTS, this study adds a new independent result with negligible contamination of Galactic stars owing to higher sensitivity for point sources. Advanced reduction methods specialized for the slit spectroscopy of diffuse sky spectra have been developed, and a catalog of 278 spectra of the diffuse sky covering a wide range of Galactic and ecliptic latitudes was constructed. Using this catalog, two other major foreground components, zodiacal light (ZL) and diffuse Galactic light (DGL), were separated and subtracted by taking correlations with ZL brightness estimated by the DIRBE ZL model and with the 100 um dust thermal emission, respectively. The isotropic emission was obtained as EBL, which shows significant excess over

integrated light of galaxies at < 4 um. The obtained EBL is consistent with the previous measurements by IRTS and DIRBE.

Contributed B13
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Title of contribution: Study of CO_2/H_2O ice abundance ratios in nearby galaxies with the AKARI near-infrared spectroscopy

Abstract: AKARI near-infrared spectroscopy can cover absorption features due to interstellar ices (e.g., H_2O ice at 3.05 micron and CO_2 ice at 4.27 micron), which are important probes of the interstellar environment. Among them, CO_2 ice is the most important one because CO_2 ice is thought to be a secondary product unlike H_2O ice, which is primarily formed on dust grains. Therefore a CO_2/H_2O ice abundance ratio effectively reflects the ice-forming interstellar environment. In the ice study, CO_2/H_2O ratios mainly in Galactic sources have been intensively observed, which show large variations from object to object. The cause of the variations is, however, still under debate. In this presentation, we report CO_2/H_2O ratios in nearby galaxies based on the AKARI near-infrared (2.5-5.0 microns) spectra for 1031 regions in 158 galaxies. The CO_2/H_2O ratios in our sample are in a range of 0.05-0.30. We find that the CO_2/H_2O ratios significantly correlate with the Br alpha/PAH 3.3 micron ratios. Furthermore, we find a positive correlation between the CO_2/H_2O ratios and the specific star formation rates of the galaxies. Based on the results, we discuss implications of the variations in CO_2/H_2O ice abundance ratios for the interstellar environment and the galaxy evolution.

Contributed C1
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Title of contribution: AKARI SPECTROSCOPY OF QUASARS AT 2.5 - 5 MICRON

Abstract: We will give an overview of scientific results from an AKARI mission program QSONG (Quasar Spectroscopic Observation with NIR Grism). AKARI had a unique capability of obtaining low-resolution spectra (R ~ 120) at 2.5 - 5.0 micron which is difficult to access from the ground and out of spectral coverage of the Spitzer. Under QSONG, we carried out observational studies of nearby AGNs to understand this previously poorly understood spectral range, and also obtained the rest-frame optical spectra of quasars at $3 < z < 6.42$ to understand the spectral evolution of quasars since $z = 6.42$. We will present the detection of H-alpha lines at $z > 3$ and its implication to black mass growth in the early universe, and show the NIR spectra of nearby quasars including Brackett lines and 3.3 micron PAHs which could be useful for deriving BH mass and host galaxy properties of obscured AGNs.

Contributed C2
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Title of contribution: Cosmic star formation history from AKARI and new CFHT optical-IR data

Abstract: AKARI's continuous filter coverage in the mid-IR wavelength is advantageous in estimating rest frame 8um and 12um luminosities without using a large extrapolation based on a SED fit, which was the largest uncertainty in previous work. Total infrared luminosity is also obtained more reliably due to this continuous filter coverage. However, previous work was limited to the central 0.25 sq. degrees where deep optical photometry existed. We have newly-obtained CFHT optical/near-IR images, which covered 4 times larger area (1 sq. degree) than previous work, allowing us fully exploiting irreplaceable AKARI space-borne data. We present resulting 8um, 12um and total IR LFs,

and cosmic star formation history derived from them.

Contributed C3
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Title of contribution: Polycyclic Aromatic Hydrocarbon feature deficit of starburst galaxies in the AKARI North Ecliptic Pole Deep Field

Abstract: We study the behaviour of Polycyclic Aromatic Hydrocarbon emission in galaxies at $z=0.3-1.4$ using 1868 samples from the revised catalogue of AKARI North Ecliptic Pole Deep survey. The continuous filter coverage at 2-24μm makes it possible to measure 8μm luminosity, which is dominated by Polycyclic Aromatic Hydrocarbon emission, for galaxies at up to $z=2$. We compare the IR8 and 8μm to 4.5μm luminosity ratio ($\nu L(8)/\nu L(4.5)$) with the starburstiness, R_{SB}, defined as excess of specific star formation rate over that of main-sequence galaxy. All AGN candidates were excluded from our sample using an SED fitting. We found $\nu L(8)/\nu L(4.5)$ increases with starburstiness at log $R_{SB}<$0.5, and stays constant at higher starburstiness. On the other hand, IR8 is constant at log $R_{SB}<$0 while it increases with starburstiness at log $R_{SB}>$0. This behaviour is seen in all redshift range of our study. These results indicate that starburst galaxies have deficient Polycyclic Aromatic Hydrocarbon emission compared with main-sequence galaxies. We also find galaxies with extremely high $\nu L(8)/\nu L(4.5)$ ratio have moderate starburstiness. These results suggest that starburst galaxies have compact star-forming regions with intense radiation which destroys PAHs and/or have dusty HII regions resulting in a lack of ionising photons.

Contributed C5
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Title of contribution: Propertied of Dust Obscured Galaxies in the NEP-Deep field

Abstract: Galaxies and Super-massive black holes (SMBHs) have been growing more rapidly at z~1-2 compared with today. To investigate the activity of galaxies and SMBHs, it is important to understand the properties of Dust Obscured Galaxies (so called DOGs) at z~1-2, which are considered to be glowing at this very moment with hidden by bulk of dust. We are using a sample of extremely red sources, i.e., (r or R) - ([18] or [24]) > 7.5, in the North Ecliptic Pole (NEP) deep survey field to study the nature of the DOGs. We have used the AKARI/IRC 9-band photometric data sets with excellent wavelength coverage at MIR wavelength with rich follow-up data available in the NEP-Deep field to build SEDs extending from UV to far-IR wavelength. Using SED fitting technique by CIGALE code, we have estimated the physical properties of the DOGs such as star-formation rate, stellar mass, and fraction of AGN contribution. We present the results of the fitting and compare the properties between AGN dominated or star-formation dominated DOGs.

Contributed C8
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Title of contribution: Panoramic mid-infrared views of distant clusters of galaxies with AKARI

Abstract: We present the results of our MIR observations of a distant galaxy cluster with AKARI. The wide-field of view of IRC/AKARI (10'x10') is ideally suited for studying dust-obscured star-formation activity of galaxies along the cosmic web in the distant universe. We performed a deep and wide-field 15um (rest-frame 8um) imaging observation of RXJ1716+6708 cluster (z=0.81) and its surrounding

region with IRC/AKARI. We find that 15um-detected cluster member galaxies (with LIRG-class IR luminosity) are most preferentially located in the cluster outskirt regions, whilst such IR-luminous galaxies clearly avoid the cluster centre. Our H-alpha follow-up study of this field with Subaru Telescope confirmed that a significant fraction of 15um-detected distant cluster LIRGs are heavily obscured by dust (with A(Ha)>3 mag in some extreme cases). Interestingly, we find that the environment of such dusty starburst galaxies coincides with the place where we see a sharp "break" of the colour-density relation, suggesting an important link between dust-obscured star-formation activity and environmental quenching. We will also present our recent efforts of studying star-forming galaxies in more distant clusters at z>1. In particular, we report the discovery of a strong over-density of galaxies around a radio galaxy field 4C65.22 at z = 1.52, where we possess one of the deepest IRC/AKARI imaging datasets (with full 2,3,4,7,9,11,15,18,24um-band). This field will provide us with the final, excellent laboratory for studying the dust-enshrouded star-formation activity of galaxies along the cosmic web at the critical epoch of cluster galaxy evolution with AKARI.

Contributed C9
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Title of contribution: AKARI Deep Field South: spectroscopic observations of infrared sources

Abstract: We present a spectroscopic redshift catalogue of 408 sources in the AKARI Deep Field South (ADF-S). We have used the AAOmega spectrograph to target mid-infrared and far-infrared sources selected primarily from AKARI observations in this field, for which we were able to obtain optical counterparts. Our sources with identified redshifts include 320 with H-alpha detections at z < 0.345 and 14 sources at z > 1 with MgII and/or Ly-alpha emission lines. We have analysed the emission lines to obtain further properties of these sources. Less than 10% of our sources are dominated by active galactic nuclei (AGN) emission, although many shown emission from both star formation and AGNs. The Balmer decrement H-alpha/H-beta for our sources ranges from the intrinsic ratio of about 3, through a median value of about 6, up to several sources showing a ratio of over 12, in general showing stronger dust obscuration with increasing redshift. This field has attracted many follow-up observations, from UV/optical through to radio wavelengths. We include details of all these campaigns and have matched these data to our 408 spectroscopic sources. For sources with sufficient observations, we have fitted SED templates to obtain further properties of our sources.
