

Poster Papers

Sessions 1 & 2

Poster PA1

Title: Dr.

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Affiliation: Eötvös University, Budapest

Title of contribution: **Deriving the galactic foreground of Gamma-ray bursts from AKARI FIS data**

Abstract: An accurate estimate of the density of the galactic foreground interstellar medium (ISM) in the direction of extragalactic sources is always a challenge. It is also one of the important parameters when calculating the physical parameters of gamma-ray burst (GRB) host galaxies. We have started an investigation of the infrared sky brightness towards SWIFT GRBs. In a very first step we have investigated 5 GRB positions where at least one AKARI Far-Infrared Surveyor (FIS) point source was listed in the Bright Source Catalogue with "extragalactic type" far-infrared (FIR) colors. The type refers to our automated selection of point source types. These 5 GRBs are seen at 5 different galactic latitudes ranging from 3 degrees to -50 degrees. The FIR surface brightness appeared different accordingly. The surroundings of the GRBs were searched for galaxies and galactic point sources in an attempt to separate the galactic foreground component. We located low cirrus sub-regions in all the images and call these "minimum foreground regions", where the diffuse ISM fluctuation levels were derived. Cirrus objects were defined then where the intensity was well over the level of diffuse ISM fluctuation. We have calculated the colour temperatures, column densities, and masses of the cirrus objects.

Poster PA2

Title: Dr

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Affiliation: ISAS/JAXA

Title of contribution: **FIR view of disks of isolated TTs**

Abstract: We present the preliminary results of FIR measurements of ~60 and 160 T Tauri stars in the Chamaeleon and Taurus region using AKARI/FIS, respectively. These sources were chosen as isolated TTs, which were discovered by the ROSAT survey. Our objective is to determine the disk fraction of these kinds of sources, and thus, the disk evolution. We could not find any significant FIR emission from these sources. We furthermore stacked the FIS survey images of these sources, but there were no peak emission. These results suggest that disks are already dissipated in these isolated stars.

Poster PA3

Title: Mr

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Affiliation: Nagoya University

Title of contribution: **AKARI observations of massive star-forming regions indicative of large-scale cloud-cloud collisions**

Abstract: The formation process of massive stars is still poorly understood, although many studies on massive star formation processes have been performed. One of compelling scenarios is a large-scale cloud-cloud collision which leads to an effective gas compression to trigger massive star-formation activities. Many pieces of observational evidence for cloud-cloud collisions have been found in massive star-forming regions by CO observations with NANTEN/NANTEN2 radio telescopes. Infrared observations of such star forming regions would provide estimates on the total energy of

embedded energy sources such as young massive stars in the regions. Among the massive star-forming regions indicative of large-scale cloud-cloud collisions, we carried out mid- and far-infrared surface photometry toward RCW 38, RCW 49, NGC 6334 and NGC6357, using AKARI all-sky survey data. Fitting the spectral energy distribution, we decomposed dust emission into polycyclic aromatic hydrocarbons (PAHs), warm dust and cold dust components. From the total luminosity of the dust emission, we estimate the contribution of embedded massive stars to dust heating. In particular, we report details of the results on RCW 38, where the above three components show spatially distinct distributions suggesting a complicated geometry of the clouds associated with RCW 38.

Poster PA4

Title: Mr

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Title of contribution: **AKARI/Herschel Far-Infrared Survey of Galactic Supernova Remnants**

Abstract: We present a far-infrared survey of Galactic supernova remnants (SNRs) using AKARI FIS (version 2.0) and Herschel-PACS/SPIRE data in the wavelength between 65 and 350 μm with angular resolutions ranging from 6 to 61". The new high-resolution data reveal detailed far-IR features that we have not seen before. Comparing the AKARI and the Herschel images with the radio continuum images in order to identify far-IR counterparts to all 274 known SNRs, we have found that about 70 SNRs show well-defined shell structures or spatially correlated features. For the identified SNRs, we examine the characteristics of the far-IR features and derive their fluxes. We also estimate physical parameters from their spectral energy distributions. We report the preliminary results of the survey.

Poster PA5

Title: Miss

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Affiliation: Nagoya University

Title of contribution: **Search for Debris disks by AKARI and IRSF**

Abstract: Debris disks are important observational clues for understanding on-going planetary system formation. They are usually identified by significant mid-infrared excess relative to the photosphere emission of central stars on the basis of prediction from J-, H-, Ks-band fluxes and Kurucz-model stellar spectra. In order to determine stellar spectra accurately, 2MASS near-IR fluxes have a serious problem; target stars are so bright that their fluxes suffer large uncertainties due to near-IR camera saturation. Therefore we performed follow-up observations with the IRSF 1.4 m near-IR telescope located in South Africa to obtain accurate J-, H-, Ks-band fluxes of the central stars. Among 933 dwarf stars, which were detected in the AKARI 18 μm band, we have performed photometry of 331 stars with IRSF. As a result, we have successfully improved the flux accuracy of the central stars from 18% to 0.5 % in average. Using this data set, we have detected 18 μm excess emission from 126 stars in our sample with the 5σ level. We find that some of them are older than 1 Gyr, which cannot be explained by the current planet-formation theories. We discuss the origin of such old debris disks using our new sample.

Poster PA6

Title: Mr

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Affiliation: University of Tokyo, Graduate School of Science

Title of contribution: **Spinning Dust and AKARI: A Multi-wavelength Investigation of PAHs in AME Regions**

Abstract: Our understanding of dust emission, interaction, and evolution, is evolving. In recent years, electric dipole emission by spinning dust, has been suggested to explain the anomalous microwave excess (AME), appearing between 10 and 90GHz (Draine & Lazarian, 1998). The observed frequencies suggest that spinning grains should be on the order of 10 nm in size, hinting at poly-cyclic aromatic hydrocarbon molecules. We present data from the AKARI/Infrared Camera (IRC, Onaka, et al. 2007), due to its effective PAH/Unidentified Infrared Band (UIR) coverage, and the AKARI/Far Infrared Surveyor (FIS, Doi et al., in prep) to investigate PAHs within a few regions showing strong AME. We use the DustEM code (Compiegne et al., 2011) to predict an SED and compare the AKARI data to that of IRAS. Part of the AME in these regions may in fact be due to thermal dust emission. In some star-forming regions, the vibrational modes of PAHs may be masked, suggesting further investigation for various galactic environments.

Poster PA7

Title: Miss

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Title of contribution: **Near-Infrared Search for Deuterated PAHs**

Abstract: Near-infrared spectra of galactic and extragalactic HII regions taken in the 2.5–5.0 μm range, using the Nh slit on board the AKARI satellite, enabled a high-resolution search for deuterated polycyclic aromatic hydrocarbons (PAHs). Bumps at 4.65 and 4.4 μm , characteristic of aliphatic and aromatic C-D stretches are identified and compared to C-H stretch at 3.3 and 3.4 μm respectively. The analysis also shows a greater deuterium fraction in the aliphatic groups than the aromatic groups, which is consistent with earlier work by Peeters et al. 2004.

Poster PA8

Title: Dr

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Title of contribution: **AKARI FIS Observations of the Galactic Globular Clusters**

Abstract: We have surveyed 17 Galactic Globular Clusters (GGCs) with the Far-Infrared Surveyor (FIS) aboard AKARI. AKARI provides various observation templates for the FIS, out of which the most sensitive one was chosen to search for the intracluster dust. Our samples include NGC 7078 (M 15), within which the concentration of dust close to the cluster center was detected with the Infrared Space Observatory (ISO, Evans et al. 2003), and subsequently confirmed with the Spitzer Space Telescope (Boyer et al. 2006). We used the FIS image of NGC 7078 as the benchmark of detection of intracluster dust. In the FITS images of GGCs, extended structures and/or point-like sources are evident around the clusters. The extended structures are shown to be related to the large-scale distribution of the Galactic cirrus in the Infrared Astronomical Satellite (IRAS) observations. One point-like source around NGC 6752 seems coincident with an extra galaxy, while the origins of the others are unknown.

Poster PA9

Title: Ms

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Title of contribution: **Ice absorption features in the near-infrared spectra of Galactic objects**

Abstract: Several kinds of solid-state molecules in the interstellar medium are known to give rise to absorption features at near-infrared wavelengths (e.g., H₂O absorption at 3.05 μm , CO₂ at 4.25 μm ,

XCN at 4.62 μm , and CO at 4.67 μm). With the AKARI/IRC near-infrared slit-spectroscopy, we simultaneously investigated the abundance of H₂O and CO₂ ices along the line of sight. The observations were made for Galactic HII regions, YSO candidates and infrared diffuse sources. The abundance ratio of CO₂ to H₂O ice does not vary significantly (~ 0.17) among these different kinds of astronomical objects and also within spatially resolved objects, suggesting that a pathway to CO₂ formation driven by UV irradiation is not so effective at least among the present target objects. In addition to the H₂O and CO₂ absorption features, some spectra also show absorption features due to CO and even XCN ices. Here, we discuss the current results using the AKARI near-infrared slit-spectroscopy, focusing on ice absorption features.

Poster PA10

Title: Dr.

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Title of contribution: **Data Reduction of AKARI/IRC Spectroscopic Observations**

Abstract: AKARI performed spectroscopic observations 872 times before the liquid helium cryogen was exhausted in August 2008, while 8941 observations were carried out during the warm mission phase by the degradation of the on-board cyro-cooler in February 2010. These IRC observations provide unique spectroscopic data at near- and mid-infrared wavelengths in the next few decades because of its high sensitivity and unique wavelength coverage. All data are already open to the public via the Data ARchives and Transmission System (DARTS) at ISAS/JAXA, and the official data reduction toolkit is also provided. However, the current version of the toolkit has been developed for a small set of the data and may not provide the best results for the general use. To make the best use of the AKARI/IRC spectroscopic data and provide a consistent data set ready for the use of scientific purpose, the homogeneous, robust data reduction process is needed. In this talk, we present the current status of the activity for improving the IRC spectroscopic data reduction process, including the toolkit and related data packages, and also discuss the goal of this project of data reduction of the IRC spectroscopy.

Paper PA11

Title: Dr

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Title of contribution: **Updates of IRC imaging toolkit and data archiving plan**

Abstract: AKARI carried out ~ 3000 and ~ 4000 pointed observations with IRC in imaging modes during Phase 1&2 and 3, respectively. Currently, raw data and the reduction toolkit are open to public and reduced images have been published by many researchers. In order to make AKARI results more useful and easily accessible to a wider range of researchers including those who are not familiar with IR observations, the AKARI team is aiming to provide "science-ready" images. One aspect is to increase the reliability of calibration. We have created new templates for dark and flat frames to better calibrate their temporal variation. Bad pixels are identified from the updated dark frames and masked out. We have also investigated relative shift values between the frames during one pointed observation and their statistics helps us to exclude outliers from stacking. The other is to increase the accessibility to the data. Since the WCS information is inevitable for comparing images from different instruments and telescopes, we have developed new procedures to register WCS using the WISE catalog, which significantly reduces failures of WCS registration for MIR images. We plan to release Phase 1 & 2 images by the end of March 2015.

Paper PA12

Title: Dr

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Title of contribution: **A Signature of Chromospheric Activity in Brown Dwarfs: Recent results from the NIRLT mission programme**

Abstract: We present the latest results from the Mission Program NIRLT (PI: I. Yamamura), the near-infrared spectroscopy of brown dwarfs using the AKARI/IRC grism mode with the spectral resolution of ~ 120 . The near-infrared spectra in the wavelength range between 2.5 and 5.0 micron is especially important to study the brown dwarf atmospheres because of the presence of major molecular bands, including CH₄ at 3.3 micron, CO₂ at 4.2 micron, CO at 4.6 micron, and H₂O around 2.7 micron. We observed 27 sources, and obtained 16 good spectra. We found that there are deviations between theoretical model spectra and observed spectra in this wavelength range, which may be attributed to the physical condition of the upper atmosphere. These deviations indicate additional heating in the upper atmosphere. We hypothesize that the heating is due to chromospheric activity. We test this effect by modifying the brown dwarf atmosphere model to artificially increase the temperature of the upper atmosphere. We find that the chemical structure of the atmosphere changes dramatically, and the heating model spectra of early-type brown dwarfs can be considerably improved to match the observed spectra. Our result suggests that chromospheric activity is essential to understand early-type brown dwarf atmospheres.

Paper PA13

Title: Ms

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Title of contribution: **Infrared Observations of Dust around Helium Nova V445Pup**

Abstract: V445Pup is a classical nova discovered in the end of December 2000. It is referred to as the only Helium nova that has ever been identified and is regarded as a possible candidate of the Type Ia SN progenitor. In addition to the presence of circumstellar dust formed during the pre-outburst, new dust condensation has been reported 8 months after the outburst. We carried out the near- to mid-infrared observation of V445 Pup in 2012 (~ 4000 days after the outburst) with Gemini-S/T-Recs and IRSF/SIRIUS. We found that the obtained SED is well explained by emission from amorphous carbon of two temperatures: $\sim 7.1 \times 10^{-8}$ solar mass of 540 K, and about 1.3×10^{-4} solar mass of 160 K. The amount of dust detected in V445 Pup in 2012 is significantly larger than that in other dust forming novae. The mid- to far-infrared SED of V445 Pup ~ 5 or 6 years after the outburst was constructed using AKARI MIR and FIR All sky survey data to investigate the origin of dust emission observed around V445 Pup. In this presentation, we discuss the temporal evolution of the dust emission and the origin of the dust detected in V445 Pup.

Paper PA14

Title: Dr

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Title of contribution: **Evolution of the 3.3 micron feature with Galactic Environment**

Abstract: The existence of polycyclic aromatic hydrocarbons (PAHs) astronomically is a well accepted fact, but the specific molecular forms which dominate given environments remains uncertain. This talk discusses the evolution of the profile of the 3.3 micron emission feature and the interpretation that this is due to sub-features related to specific chemical environments within PAH structures. This is discussed astronomically in terms of variations observed in archived AKARI data, and chemically in terms of Clar theory and molecular stability.

Paper PA15

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Affiliation: Department of Astronomy, Graduate School of Science, University of Tokyo

Title of contribution: **Spectral Evolution of Novae in the Near-Infrared based on AKARI observations**

Abstract: Classical Novae are quite targets to explore the process of dust formation and the chemical enrichment around the evolved low- to intermediate-mass stars. We have carried out the near-infrared spectroscopic observations of several novae (e.g., V2468Cyg, V1280Sco) within a few years after the outburst with AKARI mainly in the framework of AKARI Open Time Observing Program for Phase 3-II "Spectral Evolution of Novae in the Near-Infrared based on AKARI Observations (Proposal ID: SENNA)". The goal of this program is to systematically understand the material evolution including the formation of precursor molecules and the process of dust condensation in the nova ejecta. The homogeneous datasets of near-infrared spectra from 2.5 to 5 micron with AKARI/IRC collected in this program are useful to infer the physical conditions of the shell formed by the ejected materials, to examine the chemical properties of the ejecta gas, and to examine the properties of dust formed in the nova ejecta. The latest results of near infrared spectroscopy of novae performed in our program will be presented.

Paper PA16

Title: Mr

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Title of contribution: **Modeling of the zodiacal light for the AKARI mid-IR all-sky diffuse maps**

Abstract: We are creating all-sky diffuse maps from the AKARI 9 and 18 micron mid-IR survey data. The AKARI 9 micron map is crucial to investigate the all-sky distribution of polycyclic aromatic hydrocarbons, while the 18 micron map is useful to trace hot dust grains. Since the mid-IR maps suffer severe foreground contamination by the zodiacal light, we have to remove this component carefully by modeling the zodiacal light. We find that there still remains 8% of the original foreground intensity after removal of the zodiacal light by the Kelsall model, and its accuracy is not high enough to study Galactic diffuse emission widely extended toward higher latitudes. We therefore modify the Kelsall model to obtain a more accurate zodiacal light model. In the previous studies, they used only the seasonal fluctuation for model fitting, while we use absolute intensities of all the seasonal data. As a result, we have succeeded in reducing the residual component level to 1~2%. Through the analysis, we obtain new information about the zodiacal light. We discuss the structure and physical properties of the zodiacal light based on our new results.

Sessions 3 & 4

Poster PB1

Title: Dr

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Title of contribution: **AKARI Infrared Camera Survey of the Large Magellanic Cloud**

Abstract: We performed an unbiased near- to mid-infrared imaging and spectroscopic survey of the Large Magellanic Cloud (LMC) as a part of the AKARI Mission Program “Large-area Survey of the LMC (LSLMC)”. An area of about 10 square degrees in the LMC was observed by five photometric bands (each centered at 3.2, 7, 11, 15, and 24 micron) and the low-resolution slitless prism spectroscopy mode (2--5 micron, R=20) with AKARI/IRC. Based on the data obtained in the survey, we have constructed photometric and spectroscopic catalogues of point sources in the LMC. The photometric catalogue includes about 650,000, 90,000, 49,000, 17,000, 7,000 sources at 3.2, 7, 11, 15, and 24 microns respectively (Kato et al. 2012), while the spectroscopic catalogue includes 1,757 sources (Shimonishi et al. 2013). Both catalogues are publicly released and available through a website (AKARI Observers Page). A large number of near-infrared spectral data, coupled with complementary broadband photometric data, possess scientific potential that can be applied to various astronomical studies. In this poster, we present details about the AKARI LMC photometric and spectroscopic catalogues.

Poster PB2

Title: Dr

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Title of contribution: **Comparison of physical properties and evolution of Akari and Spitzer 24um-detected galaxies at $z=0.4-2$**

Abstract: We present physical properties of 24um galaxies detected by Akari and Spitzer and their evolution between redshifts $0.4 < z < 2$. Using multi-wavelength data from X-ray to radio observations in NEP Deep Field (Akari) and Subaru/XMM-Newton Deep Field (Spitzer), we derive photometric redshift, stellar mass, star formation rate (SFR), dust extinction magnitude and rest-frame luminosities/colors of the 24um galaxies from photometric SED fitting. We infer the SFRs from rest-frame ultraviolet luminosity and total infrared luminosity calibrated with Herschel photometric data. For both survey fields, we obtain complete samples with stellar mass of $10^{10} M_{\text{sun}}$ and SFR of $>10 M_{\text{sun}}/\text{yr}$ up to $z = 2$. We find that specific SFRs increase with the redshift at all stellar masses in both fields. The correlations between specific SFR and stellar mass in the Akari and Spitzer galaxy samples are consistent with each other. We also discuss relations between other physical properties and AGN contribution to the galaxy evolution.

Poster PB3

Title: Dr.

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Title of contribution: **A Comparative Study of Infrared Asteroid Surveys: IRAS, AKARI, and WISE**

Abstract: Presently, number of asteroids is known to be more than 630,000. Knowledge of size and albedo is essential in many aspects of asteroid research, such as the chemical composition and mineralogy, the size-frequency distribution of dynamical families, and the relationship between small bodies in the outer solar system or comets. Recently, based on the infrared all-sky survey data obtained

by IRAS, AKARI, and WISE, the largest asteroidal catalogue containing size and albedo data for 138,285 asteroids was constructed. In this talk, we discuss the compositional distribution in the main belt regions based on the compiled data on size, albedo, and separately obtained taxonomic type information. We found that (1) albedo distribution of C- and S-type asteroids have a large variety, especially for sizes smaller than several tens km; (2) the heliocentric distribution of the mean albedo of asteroids in each taxonomic type is nearly flat, in spite of albedo transition process like space weathering; (3) the mean albedo value gradually decreases with increasing the semi-major axis, presumably due to the compositional mixing ratios of taxonomic types.

Poster PB4

Title: Dr

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Title of contribution: **The AKARI FIR All-Sky Point Source Catalogues: Improvement activities**

Abstract: The first version of the AKARI far-infrared All-Sky Bright Source Catalogue (BSC ver.1) was released to the public in March 2010. It has been widely used for various astrophysical researches. We are continuing efforts to produce the next edition. The new version will be improved in accuracy and reliability, as well as its volume. Many improvements to improve the data efficacy of the next version are in progress. Throughout the whole data processing for the time-line signal is being re-examined. Correction processes for signal linearity and detector responsivity, and procedure for masking signal anomaly are revised. The source extraction process is further tuned and operation parameters will be optimized. These bring better reliability of source detection, a possible rise of source numbers, and improvements to the positional accuracy, including corrections for systematic position errors around the Galactic plane. Additional information enhancing the data quality and accuracy, such as scan density, background strength, extended sources, will also be given. We plan to deliver fluxes at each observational epoch for the catalogued sources. A faint source catalogue will also be provided.

Poster PB5

Title: Mr.

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Title of contribution: **The current status of the AKARI mid-infrared all-sky diffuse maps**

Abstract: The AKARI mid-infrared all-sky survey was carried out with the two photometric bands centered at wavelengths of 9 and 18 microns. It achieves higher spatial resolution and higher sensitivity than those of the IRAS survey. In particular, the 9 micron data are unique resources as an all-sky tracer of polycyclic aromatic hydrocarbon (PAH) emission. We are creating all-sky diffuse maps from the data. The original data suffer several artifacts. Among them, we have recently improved correction methods for pixel-to-pixel variation of the detector photo-response, scattered light caused in the camera optics, and unstable behavior of signals after resets of integrated photoelectrons. These corrections successfully reduce the intensity error by about 50%, which is crucial for discussion of widely extended emission (e.g., Galactic PAH emissions). We have also made progress in the zodiacal light subtraction (Kondo et al. in this conference), the improvement of position accuracy (Nakamichi et al. in this conference), and intensity calibration (Sano et al. in this conference). We plan to release improved diffuse maps to the public within two years.

Poster PB6

Title: Ms

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Title of contribution: **Searching ULIRGs by AKARI FIS and WISE**

Abstract: ULIRGs (Ultra Luminous InfraRed Galaxies) in the local universe are scarce, and their contribution to the star formation density is very small, while their contribution to the star formation density increase at $z > 1$. Properties of ULIRGs at intermediate redshift ($0.2 < z < 0.8$) is important in understanding the cosmic star formation history. To investigate the properties, we searched $z \sim 0.5$ ULIRGs using the AKARI FIS Bright Source Catalog and WISE All-Sky catalog. Since SEDs of these galaxies show excess emission at far-IR wavelengths, far-IR/mid-IR ratio is expected to be high. Using this ratio with SDSS photometric data, we selected 1,956 intermediate-redshift ULIRG candidates. By estimating their photometric redshifts and IR luminosities using an SED fitting technique, we have found that over 500 galaxies are at $z \sim 0.5$, and that over 900 galaxies are classified as ULIRGs.

Poster PB7

Title: Mr

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Title of contribution: **AKARI all-sky bright source catalogue: far-infrared-luminous quasars and the optical far-infrared correlation**

Abstract: We have identified 22 quasars in the AKARI Space Telescope's all-sky far-infrared Bright Source Catalogue, using a tight ($< 10''$) matching radius and excluding matches which are close to foreground extended sources and cirrus. We have confirmed a relationship between the optical and far-infrared luminosities, which was found earlier using stacking analysis from a variety of sources. In addition, we have found that the 11 sources at redshift $z > 1$ show a magnification of the predicted far-infrared luminosity, and consider this may be due to gravitational lensing. [We are seeking spectroscopic confirmation of the redshifts of these sources and improved optical imaging and hope to have the results by the time of the conference.]

Poster PB8

Title: Dr

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Title of contribution: **Small-scale structure of the zodiacal dust cloud observed in far-infrared with AKARI**

Abstract: The zodiacal light emission is the thermal emission from the interplanetary dust and the dominant diffuse radiation in the mid- to far-infrared wavelength region. Even in the far-infrared, the contribution of the zodiacal emission is not negligible at high galactic latitude regions. The AKARI far-infrared all-sky survey covered 97% of the whole sky in four photometric bands, which cover continuously from 50 to 180 micron with band central wavelengths of 65, 90, 140, and 160 micron. AKARI detected the small-scale structure of the zodiacal cloud, such as the asteroidal dust bands and the circumsolar ring in far-infrared. Although the most part of the zodiacal light structure in AKARI far-IR images can be well reproduced with DIRBE zodiacal light model, there are discrepancies in the small-scale structures. In particular, the intensity and the ecliptic latitude of the peak position of the asteroidal dust bands cannot be reproduced precisely with the DIRBE models. We will show the dust bands structure observed in far-infrared with AKARI and discuss the physical properties of the zodiacal dust.

Poster PB9

Title: Mr

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Title of contribution: **A systematic study of dust in early-type galaxies with AKARI**

Abstract: Early-type galaxies (ETGs) are thought to contain much smaller amounts of dust and polycyclic aromatic hydrocarbons (PAHs) than late-type galaxies. In general ETGs provide hostile conditions for presence of dust, because of dominance of old low-mass star population not productive of dust as well as hot interstellar plasma destructive for dust. However, recent mid- and far-infrared observations, including Spitzer, AKARI, and Herschel, have revealed that fraction of ETGs possess observable amounts of dust and PAHs. Supply mechanisms of the dust and PAHs are not well understood yet, although some possibilities are suggested. We present the result of a systematic study of dust and PAHs in ETGs with AKARI mid- and far-infrared all-sky surveys. We have derived the dust mass and temperature by performing SED fitting to the far-infrared data. We have also estimated the amount of PAHs using the mid-infrared fluxes. Comparing our results with other wavelength data such as CO and Ks-band observations obtained using ground-based telescopes, we discuss the origins of dust and PAHs in ETGs.

Poster PB10

Title: Dr.

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Title of contribution: **Infrared and X-ray connection in nearby active galactic nuclei, investigated with AKARI and MAXI.**

Abstract: By making most of the infrared all-sky catalog with AKARI, and X-ray data from MAXI, an all-sky X-ray monitor, mounted on the international space station, the infrared and X-ray properties of nearby active galactic nuclei have been investigated. Through an all-sky survey that has been run for about 3 years since its activation in 2009 August, it has detected 500 point-like X-ray sources over the 4 – 10 keV range in the high-Galactic latitude region of $|b| > 10$ degree, including 100 Seyfert galaxies and 15 blazars. Among these active galactic nuclei, about 70 objects were found to have an infrared counterpart, listed in the AKARI catalog with high signal quality. Correlation between the infrared and X-ray luminosities are investigated for this sample. The physical implications of the results are discussed.

Poster PB11

Title: Mr

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Affiliation:

Title of contribution: **A new source confirmation method for the AKARI mid-IR faint source catalogue**

Abstract: We are planning to produce a faint source catalogue from the AKARI mid-infrared (IR) all-sky diffuse maps. In the publicly available version of the AKARI mid-IR point source catalogue (PSC), sources were extracted from single-scan images, and confirmed by using other scan images. By stacking multiple scan images, however, we can detect fainter sources, which are not detected in the PSC. Hence we divide the all-sky data into three seasons, i.e., Phases I, IIa, and IIb, and create stacking images every season, from which we extract and confirm sources. We optimize the source extraction process using a 2 x 2 degree area around the star-forming region, Cepheus B. We finely adjust positions of sources for each scan image using the 2MASS PSC as a reference, and then stack multiple scan images per season. As a result, our new source confirmation method works well; more than 95 % of the confirmed sources were also identified in the WISE catalogue. In this method, we have achieved a detection limit twice as deep as that of the AKARI mid-IR PSC. The number of sources is 1.5 times larger than that in the PSC for the same area. We will apply this method to the all-sky data.

Paper PB12

Title: Dr

First name: Ronin

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Affiliation: University of Tokyo

Title of contribution: **Spatially resolved physical conditions of molecular gas and potential star-forming tracers in M83**

Abstract: Since the launch of the Herschel Space Observatory, our understanding about the photo-dissociation regions (PDR) has taken a step forward. In the bandwidth of the Fourier Transform Spectrometer (FTS) of the Spectral and Photometric Imaging REceiver (SPIRE) on board Herschel, ten CO rotational transitions, including J=4-3 to J=13-12, and three fine structure lines, including [CI] 609, [CI] 370, and [NII] 250 micron, are covered. In this talk, I present our findings from the FTS observations at the nuclear region of M83, based on the spatially resolved physical parameters derived from the CO spectral line energy distribution (SLED) map and the comparisons with the dust properties and star-formation tracers. I will discuss (1) the potential of using [NII] 250 and [CI] 370 micron as star-formation tracers; (2) the reliability of tracing molecular gas with CO; (3) the excitation mechanisms of warm CO; (4) the possibility of studying stellar feedback by tracing the thermal pressure of molecular gas in the nuclear region of M83.

Paper PB13

Title: Dr

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Affiliation: Seoul National University

Title of contribution: **The MIR luminosity function of local SF galaxies in the NEP-Wide Survey**

Abstract: We present the mid-infrared (MIR) luminosity functions (LFs) of local ($z < 0.3$) star-forming galaxies based on the AKARI's NEP-Wide survey data. We used the photometric catalogue of NEP-Wide and redshifts (z) data for \sim about 1000 galaxies obtained from the optical follow-up survey with MMT/Hectospec and WIYN/Hydra. The AKARI's continuous 2 - 24 micron coverage and the spectroscopic redshifts allow us to determine the spectral energy distribution (SED) in the mid-infrared. The luminosity function (e.g., 8 μ m LF) generally agrees well with the previous works over wide flux ranges. The comparison with the results of the NEP-Deep data (Goto et al.) implies the luminosity evolution towards the higher redshifts, which is consistent with the downsizing evolutionary pattern of galaxies.

Paper PB14

Title: Dr

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Affiliation: Seoul National University

Title of contribution: **Galaxies on diet: feedback signatures in radio-AGN hosts (to be presented by Professor Im)**

Abstract: There exist strong evidence supporting the co-evolution of central supermassive black holes and their host galaxies; however it is still under debate how such a relation comes about and whether it is relevant for all or only a subset of galaxies. An important mechanism connecting AGN to their host galaxies is AGN feedback, potentially heating up or even expelling gas from galaxies. AGN feedback may hence be responsible for the eventual quenching of star formation and halting of galaxy growth. A rich multi-wavelength dataset ranging from the X-ray regime (Chandra), to far-IR (Herschel), and radio (WSRT) is available for the North Ecliptic Pole field, most notably surveyed by the AKARI infrared space telescope, covering a total area on the sky of 5.4 sq. degrees. We investigate the star formation properties and possible signatures of radio feedback mechanisms in the host galaxies of 237 radio sources below redshift $z = 2$ and at a radio 1.4 GHz flux density limit of 0.1 mJy. Using broadband SED modelling, the nuclear and host galaxy components of these sources are studied simultaneously as

a function of their radio luminosity. Here we present results concerning the AGN content of the radio sources in this field, while also offering evidence showcasing a link between AGN activity and host galaxy star formation. In particular, I will show results supporting a "maintenance" type of feedback from powerful radio-jets. Finally, I will show constraints on the very faint star formation component in the most radio-luminous AGN in the AKARI-NEP field from a stacking analysis of their Herschel far-IR data.

Paper PB15

Title: Dr

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Affiliation: Seoul National University

Title of contribution: **AKARI observation of the fluctuation of the near-infrared background II**

Abstract: We report a study for spatial fluctuations of the sky brightness from observations toward the north ecliptic pole (NEP) by the AKARI, at 2.4 and 3.2 microns. As follow up study of our previous work on the Monitor field of AKARI, we used NEP deep survey data, which covered a circular area of about 0.4 square degrees, in order to investigate fluctuations of the sky brightness at angular scales up to 1000 arcseconds. We obtained mosaic images for two bands, and estimated spatial fluctuations by using power spectrum analysis. We found an excess fluctuation over the estimated shot noise at larger angular scales than 100 arcseconds. The excess fluctuation from NEP deep field smoothly connects with that of Monitor field and extends to larger angular scales than a few hundred arcseconds up to 1000 arcseconds. We find the result of this study to be consistent with observations at 3.6 microns by NASA's Spitzer Space Telescope. The origin of the excess fluctuation in the near infrared background remains unanswered, but we could exclude zodiacal light, diffuse Galactic light or faint galaxies at intermediate redshifts. One of the remaining possibilities includes the contribution from the very early objects at $z > 10$.

Paper PB16

Title: Dr

First name: Yoshiki

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Title of contribution: **Luminosity Dependence of the Covering Factor of the Dust Torus in Active Galactic Nuclei Revealed by AKARI**

Abstract: We demonstrate the luminosity dependence of the covering factor (CF) of active galactic nuclei (AGNs), based on AKARI mid-infrared all-sky survey catalogue. Combining the AKARI with Sloan Digital Sky Survey (SDSS) spectroscopic data, we selected 243 galaxies at 9 micron and 255 galaxies at 18 micron. We then identified 64 AGNs at 9 micron and 105 AGNs at 18 micron by their optical emission lines. Following that, we estimated the CF as the fraction of type 2 AGN in all AGNs. We found that the CF decreased with increasing 18 micron luminosity, regardless of the choice of type 2 AGN classification criteria. Furthermore, we carried out various tests to determine the influence of selection bias and confirmed similar dependences exist even when taking these uncertainties into account (Toba et al. 2013).

Paper PB17

Title: Prof.

First name: Takao

Surname: Nakagawa

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Affiliation: ISAS/JAXA

Title of contribution: **Highly excited CO lines in active galaxies both in absorption and emission**

Abstract: In order to reveal physical conditions of molecular gas in active ("active galaxies" mean both starbursts and AGNs in this paper) galaxies, we have been carrying out systematic observations (R~100) of CO fundamental band at 4.6 micron in absorption with AKARI. We also made follow-up

CO absorption observations at higher spectral resolution ($R \sim 5000$) with Subaru. Recently, Herschel made extensive observations of highly excited CO lines in emission in the far-infrared. The two data sets (absorption and emission) sometimes provide us with apparently inconsistent results. For example, Herschel detected highly excited CO lines in emission in a nearby ULIRG Mrk 231, while AKARI and Subaru observations showed no hint of CO absorption in the near-infrared. We attribute this apparent discrepancy to the very dusty molecular clouds which are optically thick by dust in the mid-infrared. On the other hand, Subaru observations showed low temperature of molecular gas in a starburst NGC253, while Herschel detected highly excited CO lines also in starburst. This suggests that warm molecular clouds are more deeply embedded than newly formed star clusters. We propose to use these data sets (CO absorption and emission) to reveal geometry of warm molecular clouds in active galaxies.

Paper PB18

Title: Mr.

First name: Angel

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Affiliation: Instituto de Astronomia - UNAM

Title of contribution: **Infrared Camera Observations of the 3.3 μm PAH Feature in Swift/BAT AGNs**

Abstract: We explore the relationships between the 3.3 micron PAH feature AGN properties of a sample of 54 hard X-ray selected bright AGN, using the InfraRed Camera (IRC) on board AKARI. The sample is selected from the 9-month Swift BAT survey in the 14--195 keV band and all of them have measured X-ray spectra at $E < 10$ keV. We use the 3.3 micron PAH luminosity ($L_{3.3}$) as a proxy for star formation activity and hard X-ray luminosity ($L_{14-195\text{keV}}$) as an indicator of the AGN activity. We search for possible difference of star-formation activity between type 1 (un-absorbed) and type 2 (absorbed) AGNs. We have made several statistical analyses taking the upper-limits of the PAH lines into account. The results of our $\log L_{14-195\text{keV}}$ versus $\log L_{3.3}$ regression shows a positive correlation and the slope seems steeper for type 1/unobscured AGNs than that of type 2/obscured AGNs. Also our analysis shows that circumnuclear star-formation is more enhanced in type 2/absorbed AGNs than in type 1/un-absorbed AGNs for low X-ray luminosity/low Eddington ratio AGNs, while there is no significant dependence of star-formation activity on the AGN type in the high X-ray luminosities/Eddington ratios.

Sessions 5 & 6

Poster PC1

Title: Miss

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Affiliation: ISAS/JAXA

Title of contribution: **Spectral Energy Distribution of Galaxies with Principal Component Analysis**

Abstract: To characterise the spectral energy distribution of galaxies in the mid- and far-infrared, we have carried out a principal component analysis (PCA) for IRAS Bright Galaxy Sample (Soifer et al.). We use both the AKARI and IRAS data sets together with optical data. We applied PCA to this data set and found that the first principal component included about 60% of whole information and it corresponded to the combination of the infrared-optical flux ratio and the far-infrared color. We propose to use this component to characterise starburst activity. The second principal component showed a flux ratio difference between the IRAS and AKARI data sets, which we attribute to the size of galaxies, since the IRAS beam sizes were significantly larger than those of AKARI. This study has shown the effectiveness of applying the PCA technique to far-infrared data, and we plan to extend this study for larger samples of galaxies.

Poster PC2

Title: Ms.
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Affiliation: The Rutherford Appleton Laboratory
Title of contribution: **Characterising rare objects in the AKARI North Ecliptic Pole Deep Field**

Abstract: The AKARI North Ecliptic Pole Deep field survey has provided one of our most sensitive views of the extragalactic Universe. The AKARI observations have been supplemented with many sets of ancillary data extending from radio frequencies through to x-ray wavelengths. These ancillary programmes have allowed us to identify the underlying source populations, search for extreme or rare objects, study the evolution, formation and growth of galaxies with redshift, and to view the distant universe through a relatively low extinction window. We report a detailed analysis of the AKARI data, comparing it with recent observations from the Indian Giant Metre Wave Radio Telescope (GMRT), identifying a new population of radio loud extreme objects, which appear to lie at high redshifts. Our analysis includes discussion of the spectral index of the radio source populations, by comparing the GMRT data with our earlier Westerbork Radio Synthesis Telescope survey. We will also report on the radio source number counts, morphological types of identified galaxies, optical identifications in the NEP Deep and Wide survey regions, and on a detailed near and far-IR colour-colour analysis of the radio sources with associations, including those from our recent sensitive HERSCHEL SPIRE survey of the same region, that will be reported elsewhere at this Conference.

Poster PC3

Title: Dr
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Affiliation: JAXA/ISAS
Title of contribution: **Development of wide infrared spectral disperser of ZnS grism**

Abstract: Usually wavelength region of infrared observation using ground based telescopes is limited the transmission window of the atmosphere. But space-borne telescope is essentially free from the atmosphere. For covering wider infrared wavelength region, we fabricated a proto-type of grism spectral disperser made of ZnS. First, material of the device was selected by some properties: infrared refractive index curve, availability, and capability of machining. The proto-type device was designed to cover ~1-13 micron and to have low spectral resolution. Then fabrication was carried out. Quality of the fabricated grism (e.g., whole shape, surface roughness, pitch, blaze angle, sharpness of edge, and so on) was observed in laboratory testing. Such a wide infrared spectral disperser with a space infrared telescope has potential to be useful for observation of time-variable objects, e.g., transiting exoplanets, super novae, gamma ray bursts, active galactic nuclei, variable stars, and so on.

Poster PC4

Title: Dr
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Affiliation: Nagoya University
Title of contribution: **A quality check of the AKARI mid-infrared all-sky diffuse maps**

Abstract: We are currently preparing for the AKARI mid-infrared all-sky survey diffuse map containing two photometric bands of the infrared camera (IRC) onboard the AKARI satellite at wavelengths of 9 and 18 microns, which trace the interstellar polycyclic aromatic hydrocarbon (PAH) and the thermal dust components, respectively. Therefore, these band images are strongly connected with the interstellar molecular/atomic gas and a comparative study among them is one of the useful methods for evaluating a calibration quality of the AKARI diffuse maps. We investigate the comparative study between the AKARI diffuse maps and the NANTEN CO datasets (Mizuno & Fukui et al. 2004) in order to verify the calibration of AKARI diffuse maps, which consists of the zodiacal light subtraction (Kondo et al. in this conference), the artifacts subtraction (Amatsutsu et al. in this

conference), and the improvement of position accuracy (Nakamichi et al. in this conference). We selected the 10 deg x 10 deg region which is located around the massive star-forming regions NGC6334 and NGC6357. In the present poster, we show the results of comparative studies before and after the calibrations are applied to the AKARI diffuse maps.

Poster PC5

Title: Miss

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Affiliation: Nagoya University

Title of contribution: **Evaluation of far-infrared BIB-type Ge detectors fabricated with the surface-activated wafer bonding technology**

Abstract: To realize large-format compact array detectors covering a wide far-infrared wavelength range up to 200 microns, we have developed Blocked-Impurity-Band (BIB) type Ge detectors using a room-temperature, surface-activated wafer bonding technology provided by Mitsubishi Heavy Industries. The detectors consist of a heavily-doped Ge:Ga (p+ layer) for detecting far-infrared photons, and a non-doped intrinsic Ge (i layer) for blocking dark current. The cut-off wavelength can be extended by using shallower energy levels of the impurity band without mechanical stress which is required for conventional Ge:Ga bulk photoconductors. We fabricated various types of p+-i junction devices, which possess a BIB-type structure, and evaluated their spectral response curves using a Fourier transform spectrometer. We also obtained the physical characteristics of the p+ and i layers which constitute the p+-i junction devices from Hall effect measurements. The overall result of our measurement shows that the p+-i junction devices possess a promising applicability as a new far-infrared detector to cover wavelength of 100 to 200 microns. To further improve the performance, we require modifications such as thinning the i layer and more heavily doping the p+ layer.

Poster PC6

Title: Ms

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Title of contribution: **Development of new stitching interferometry for the SPICA telescope**

Abstract: The SPICA telescope has an aperture diameter of 3.2 m, and will be operated at 6 K. The imaging performance of the SPICA telescope is to be diffraction-limited at 20 microns at the operational temperature, which requires that the total wave-front error (WFE) of the telescope should be smaller than 1.4 microns rms. In order to measure the WFE of the telescope, we plan to use an optical interferometer through autocollimation by reflecting flat mirrors (autocollimation flats; ACFs). However, manufacturing precise ACFs with sizes comparable to the SPICA telescope is not currently technically feasible, and therefore it is very difficult to measure the WFE of the telescope at one time. Hence we apply stitching interferometry to optical testing of the SPICA telescope. We have performed stitching experiments in a vacuum at ambient temperatures, using an 800 mm lightweight telescope made of C/SiC, which is a material proposed for the SPICA telescope, and a 300 mm ACF, which is rotated with respect to the optical axis of the telescope. We have verified the applicability of the stitching technique to the SPICA telescope. We have also developed a new method to reduce uncertainties possibly caused by cryogenic and gravitational deformations of ACFs.

Poster PC7

Title: Mr

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Title of contribution: **Extension of reliable wavelength coverage of the NG grism mode**

Abstract: The Infrared Camera (IRC) onboard AKARI had carried out spectroscopic observations in 2.5 - 5.0 micron with the NG grism mode. Spectroscopy up to 5 micron is a unique capability of the AKARI satellite. We aim to analyze the CO ro-vibrational absorption in nearby ultra-luminous infrared galaxies (ULIRGs) using this capability. For our study, calibration in the 4.5 - 5.0 micron range, where the CO absorption lines are located, is essential. The current flux calibration procedure, however, does not take account of the 2nd order light contamination, which affects flux calibration above 4.9 micron especially for red objects. We examined a new response curve in 4.8 - 5.0 micron to remove this contamination. For five ULIRGs whose spectra are red and featureless, we interpolated the AKARI spectra below 4.8 micron and Spitzer ones above 5.2 micron into the 4.8 - 5.2 micron range. Comparing these estimated spectra with raw data, we derived new response curve. The current response is possible to overestimate the efficiency in the range by up to 40%. This revision made 4.8 - 5.0 micron spectra reliable and turned it possible to analyze the CO absorption in nearby ULIRGs.

Poster PC8

Title: Mr

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Affiliation: NAGOYA University

Title of contribution: **Laboratory experiments of a pupil coronagraph instrument with aluminum mirrors for space infrared missions**

Abstract: We report the results of our laboratory experiments of a pupil coronagraph instrument with aluminum mirrors for space infrared missions. The coronagraph is designed for high contrast observations by controlling a point spread function (PSF) with a pupil mask. The coronagraph optics requires high wavefront accuracy, while space infrared observations require cooling the whole system. To realize the accuracy even at low temperatures, mirrors are made of aluminum alloy, generally used for focal-plane instrument structures. Therefore, we have fabricated highly accurate aluminum mirrors and evaluated their performance through the coronagraph experiments. We integrated the mirrors into the coronagraph optical system and tested it with a He-Ne laser at an ambient temperature. As a result, the total wavefront error of the system is estimated to be 33 nm RMS from the Strehl ratio thus measured. With a pupil mask, we obtained the PSF, whose contrast reached five orders of magnitude at an inner working angle of 0.8 arcmin, which corresponds the seven orders of magnitude contrast at a wavelength of 5 microns. Hence we conclude that aluminum mirrors are applicable to a pupil coronagraph instrument on space infrared missions.

Poster PC9

Title: Ms

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Affiliation: NAGOYA University

Title of contribution: **Development of a cryogenic testing system for mid-infrared detectors on SPICA**

Abstract: It is crucial for future space infrared missions, such as SPICA, to establish an experimental method for evaluating the performance of mid-infrared detectors. In particular, the wavelength dependence of the sensitivity is important and difficult to be measured properly. We are now preparing a testing system for Si:As/Si:Sb detectors on SPICA. We have designed a cryogenic optical system in which infrared signal light from a pinhole is collimated, passed through an optical filter, and focused onto a detector. With this system, we can measure the photo-response of the detector for various infrared light using optical filters with different wavelength properties. Aluminum mirrors are adopted to minimize thermal distortion effects. We have evaluated the surface figure errors of fabricated aluminum mirrors. The total wavefront error of the optical system is 1.63 microns RMS, which is small enough for the target wavelengths for SPICA (20-37 microns). The point spread function measured at a room temperature is consistent with that predicted by simulation. We will report the optical performance of the system at cryogenic temperatures and preliminary result on the measurement of the

wavelength dependence of the sensitivity of a Si:As detector.

Paper PC10

Title: Dr.

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Title of contribution: **Chandra Observation of AKARI NEP Deep Field: Search for Compton-thick Accretion**

Abstract: Thanks to its continuous coverage of 2-24 microns in 9 bands, the dataset available in AKARI NEP Deep Field provides robust ways of the mid infrared (MIR) selection of AGNs, including Compton-thick (CT) AGNs, which are highly suppressed in deep X-ray surveys with XMM-Newton or Chandra. In order to identify CT AGNs among MIR selected AGNs, we have made 300 ks (including previously archived data) of Chandra ACIS-I observations covering the entire Subaru Suprime-Cam region. About 450 X-ray sources have been detected and catalogued. We identify 32 strong CT AGN candidates by the ratio of the observed 2-7 keV luminosity or its upper limit and AGN infrared luminosity obtained from SED fittings. One of the indications of the presence of a CT AGN is a large equivalent width of the fluorescent Fe K-alpha line at 6.4 keV. We have made a rest-frame X-ray stacking analysis of these 32 strong CT AGN candidates, and have marginally detected the stacked Fe line, the equivalent width of which is consistent with that of CT AGNs. We discuss the constraints on the CT AGN population at $z \sim 1$ and prospects for further 750 ks of Chandra observations that we proposed this year.

Paper PC11

Title: Dr.

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Title of contribution: **A cosmological PAH survey by SPICA**

Abstract: We propose a cosmological survey probing star-forming and AGN activities in galaxies at $z=1-4$ by PAH lines using SPICA. The PAH lines as well as the other MIR/FIR lines are most powerful diagnosis in study of star-formation and AGN activity because they are less sensitive to dust extinction than UV-OPT lines. In cosmological survey, they have two advantages against the other MIR/FIR lines. 1) They are more luminous than the atomic lines. 2) They are broad and low-resolution spectroscopic surveys are very efficient. We plan to conduct a spectro-imaging survey with a spectral resolution of $R=20$ using the SPICA mid-infrared instruments (SPICA/SMI) imager with a set of narrow band filters. We will cover 20-36 μ m that corresponds to $z=1-4$ for the PAH lines (11.3, 7.7, and 6.2 μ m). The sensitivity will be $1E19$ W/m² (5 sigma) in case of a reference survey that covers 4 arcmin² field in one hour observation. It corresponds to $L_{\text{IR}}=1E10$ and $2E11$ at $z=1$ (PAH 11.3 μ m) and $z=3$ (PAH 6.2 μ m), respectively, and will give us more than 10000 samples in 450 hours survey including PAH 7.7 μ m. Follow-up observations by SAFARI, SMI/spectrometer, and ALMA will reveal the nature and evolution of PAH in high-redshift universe.

Paper PC12

Title: Ms

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Title of contribution: **Analysis of the IRAC Dark Field using a new AKARI/IRC data analysis pipeline**

Abstract: AKARI is an ideal instrument for studying extragalactic fields, covering the wavelength range to track redshifted PAH and silicate features, and the peak bolometric output of AGN-heated

dust. Part of the AKARI/IRC observational range spans the Spitzer/IRAC-Spitzer/MIPS 8-24 micron gap. There is currently no space telescope observing in the mid-infrared and none will be operational until 2018 at the earliest. Therefore best use must be made of archive data. To this purpose we have created a bespoke data analysis pipeline to process AKARI/IRC observations, optimized for extragalactic images. Our long-term objective is the reprocessing of AKARI/IRC archive images, thus creating a major legacy product of galaxy catalogues and images, in the nine bands from 2-24 microns. In this talk I will present the first science results for this pipeline, focusing on the careful analysis of the IRAC Dark Field, the deepest images of the sky at 4, 11, 15 and 18 microns. This field has been observed by Spitzer and Herschel at a comparable depth, thus are the best multi-wavelength sample to start with for our science case. I will present preliminary source counts, comparisons with source count models, and constraints on the contributing populations to the extragalactic infrared background.

Paper PC13

Title: Mr

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Title of contribution: **Probing star formation in ultraluminous infrared galaxies using AKARI near-infrared spectroscopy**

Abstract: We carried out systematic observations of the hydrogen recombination line Br-alpha (at 4.05 micron) in nearby 51 ultraluminous infrared galaxies (ULIRGs) with AKARI near-infrared spectroscopy and estimated star formation rates (SFRs). The Br-alpha line is less affected by dust extinction than optical lines owing to its near-infrared wavelength, and its observed flux is predicted to be the highest among those of other hydrogen recombination lines in ULIRGs with large dust extinction (visual extinction exceeds 15 mag). Using 35 ULIRGs, where the Br-alpha line is detected, we also calibrated the 3.3 micron polycyclic aromatic hydrocarbon (PAH) as an indicator of SFR. By the combination of the Br-alpha line and the 3.3 micron PAH emission, we estimated the contribution of the star formation (SF) to the total infrared luminosity in all 51 ULIRGs. The SF contributions in H II galaxies are significantly larger than those of LINERs or Seyferts. This result suggests that the active galactic nuclei are needed as energy sources in LINERs as well as Seyferts. However, the absolute SF contribution even in H II galaxies is only 22% on average. We attribute this apparently low SF contribution to the absorption of ionizing photons by dust within H II regions.

Paper PC14

Title: Dr

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Title of contribution: **Legacy of the SPICA Coronagraph Instrument: high-contrast technology for study of exoplanets**

Abstract: The SPICA Coronagraph Instrument was previously proposed for SPICA in order to realize high-contrast observation of exoplanets and other objects in mid-infrared. There is no the SCI in the new framework of SPICA any more. However, technologies pioneered with the SCI is generally useful for high-contrast observations: Binary shaped pupil mask is one of the key device. Binary pupil mask coronagraph dependence on either telescope pointing error or wavelength is very small in various coronagraph in principle, and it is simple. We started laboratory demonstration of its principle with high-precision fabrication on a substrate using electron beam lithography. Fine fabrication of free-standing masks for wide infrared wavelength region was also established. Advanced design of masks for telescope pupil with obscuration was presented. Coronagraphic performance of the masks were experimentally demonstrated in visible wavelength region. Off-axis metal mirror optics is another widely useful technology. Both mirrors and the structure is made of same metal, e.g., aluminum, so we can expect thermal shrinkage on cooling to cryogenic temperatures. Tip-tilt mirror, deformable mirror, and beam splitter are also important products. At the talk, such technology is introduced based on reviewing public material.
