Challenges in Infrared Extragalactic Astrophysics

FOREWORD

"*If you are not prepared for the unexpected you will never discover it*" - Heraclitus

The scope of this 3.5 day workshop is to bring together a small number of experts on infrared extragalactic astrophysics to discuss the outstanding questions in the field as well as how planned experiments using future facilities may address them. Emphasis will be given on how one can apply the knowledge derived from studies of the local universe to understand the properties of galaxies at higher redshifts.

Funding and support for the workshop is provided by the "ASTROSPACE" European Union 7th Framework Programme, the Foundation for Research & Technology – Hellas (FORTH), CEA/Saclay (France), and CNRS (France).

ORGANIZING COMMITTEE

Lee Armus, Spitzer Science Center, Caltech, USA
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Figure: *The Phaistos Disc was found in 1908 at the ruins of the earlier Minoan palace of Phaistos in Crete, Greece. The exact age of the disk is uncertain, but it probably dates from the MM IIB period (17th century B.C.). It was made of clay, its average diameter is 16 cm and it is 2.1 cm thick. Its mysterious inscription constitute 241 symbols, 122 on side A and 119 on side B, in spiral order. There appear 45 distinct symbols (with repetitions). Those symbols were actually impressed on wet clay and then the disk was fire-hardened. The signs belong to an ideographic and probably syllabic script, which has not yet been deciphered despite the numerous attempts over the years. Researchers have proposed widely diverse speculations about the purpose, the contents of its inscription and its creators.*

This has made the Phaestos Disc a real challenge for archaeologists and this is the reason why the Disc has been chosen by the Foundation for Research and Technology - Hellas (FORTH) as its symbol, as it expresses exactly the same challenges scientists encounter every day during their research.

WORKSHOP PROGRAM

From	To		Event
Sunday 14 September 2008			
18:00	20:00		Registration
20:00	20:45		Welcome cocktail

Monday 15 September 2008			
Session Chair: G. Helou			
	To	**Speaker**	**Topic**
09:00	09:50		Registration
09:50	10:00		Welcome
10:00	10:45	F. Boulanger	H_2 spectroscopy, gas physics and the energetics of galaxy formation
10:45	11:30	P. Appleton	Warm H_2 gas: Spitzer and beyond
11:30	**12:00**		**Coffee Break**
12:00	12:45	P. van der Werf	The warm and dense interstellar medium in ULIRGs
12:45	13:30	P. Papadopoulos	Incorporating the H_2 gas in galaxy-sized numerical simulations: realistic star formation, and a new feedback factor.
13:30	**16:30**		**Afternoon break**
Session Chair: D. Elbaz			
16:30	17:15	L. Armus	LIRGs/ULIRgs: Spitzer and beyond
17:15	18:00	V. Desai	Deeply Obscured Galaxies
18:00	19:00		Up to 6 Poster Presentations (10min each poster)
19:00	**19:30**		**Coffee Break**
19:30	**20:30**		**Poster Session**

Tuesday 16 September 2008

Session Chair: F. Combes

From	To	Speaker	Topic
09:00	09:45	L. Spinoglio	AGN and Starburst diagnostics in the IR
09:45	10:30	A. Alonso-Herrero	Understanding the properties of the obscuring torus of AGN and its Connection with the host galaxy
10:30	11:15	D. Alexander	The Infrared Identification of Distant Compton-thin and Compton-thick AGNs
11:15	**11:45**		**Coffee Break**
11:45	12:30	D. Lutz	A Spitzer view of high-z submm galaxies and QSOs
12:30	13:15	A. Pope	Understanding the Formation of the Most Massive Galaxies: The Submillimeter Phase
13:15	**17:00**		**Afternoon break**

Session Chair: A. Alonso-Herrero

17:00	17:45	D. Rigopoulou	Mid-IR properties of Lyman break galaxies
17:45	18:30	E. Daddi	Molecular gas observations of typical high-z galaxies
18:30	19:15	F. Combes	Detecting molecular gas at high-z with ALMA
20:30	**00:00**		**Conference Dinner**

Wednesday 17 September 2008
Session Chair: C. Cesarsky

From	To	Speaker	Topic
09:30	10:15	S. Charlot	Modeling of galaxy SEDs
10:15	11:00	N. Scovile	Large Scale Structures in COSMOS
11:00	11:45	E. Le Floc'h	Recent results from the 24μm observations of the COSMOS field
11:45	**12:10**		**Coffee Break**
12:10	12:50	H. Aussel	Mass buildup and star formation from the S-Cosmos survey
12:50	13:30	D. Elbaz	The far infrared Universe from Spitzer to Herschel
13:30	**17:00**		**Afternoon break**
Session Chair: E. Le Floc'h			
17:00	17:45	V. Buat	Star formation from z=0 to z=1: combining IR and UV
17:45	18:15	S. Salim	Mid-IR luminosities and UV SFRs at 0.2<z<1.4
18:15	**18:45**		**Coffee Break**

Thursday 18 September 2008
Session Chair: L. Vigroux

From	To	Speaker	Topic
09:00	09:45	R. Chary	The First Gyr of Galaxy Evolution
09:45	10:30	H. Dole	The Cosmic Infrared Bouground
10:30	11:15	S. Matsuura	AKARI extragalactic surveys probing into the cosmic infrared background
11:15	**11:45**		**Coffee Break**
11:45	12:30	G. Helou	Planning for the undiscovered: A perspective
12:30	**12:45**		**Closing Remarks**
12:45	**---**		**Afternoon break**

POSTER PRESENTATIONS

The following 9 posters will be displayed throughout the duration on the conference.

Presenter	Poster Title
K. Dasyra	Black hole mass measurements for high-z obscured AGN.
K. Dasyra	The 0.9 mJy sample: A mid-infrared spectroscopic survey of infrared-luminous galaxies up to z~3.
T. Nakagawa on behalf of SPICA Consortium	SPICA: the world's First Large, Cryogenic Far-IR Space telescope
D. Rigopoulou on behalf of SAFARI Consortium	SAFARI: A FIR imaging spectrometer for SPICA
D. Le Borgne et al.	Cosmic star-formation history from the mid- and far-infrared up to z=5
E. Le Floc'h et al.	A Far-IR dissection of the host galaxy of GRB980425 / SN1998bw
A. Goulding & D. Alexander	The most complete census of AGN activity in the local Universe
G. Magdis	Lyman Break Galaxies:the Spitzer View
A. Petric	A Spectroscopic Investigation of a Complete Sample of Luminous Infrared Galaxies

CONFERENCE PARTICIPANTS (41)

Name	Last Name	Institution	Country
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Almudena	Alonso-Herrero	CSIS-Madrid	Spain
Bruno	Altieri	ESA/ESAC	Spain
Phil	Appleton	NHSC/Caltech	USA
Lee	Armus	SSC/Caltech	USA
Herve	Aussel	CEA/Saclay	France
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Vandana	Desai	SSC/Caltech	USA
Herve	Dole	IAS	France
David	Elbaz	CEA/Saclay	France
George	Helou	Caltech	USA
Nick	Kylafis	Univ. of Crete & FORTH	Greece
Emeric	Le Floc'h	Univ. of Hawaii	USA
Dieter	Lutz	MPE	Germany
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ABSTRACTS – ORAL CONTRIBUTIONS

Monday 15 September 2006

H_2 spectroscopy, gas physics and the energetics of galaxy formation

Francois Boulanger, (IAS, France)

The build-up of baryonic mass in galaxies is regulated by accretion and feedback: gas flows in and out of galactic disks and haloes. These flows have been mainly investigated by optical, UV and X-ray observations. Spitzer has initiated a new discovery phase with direct observations of extragalactic H_2 through its mid-IR rotational lines. There is now evidence of large quantities (up to 10^{10} Msun) of warm (T>150K) molecular gas associated with galaxy interaction, gas accretion, and feedback. Newly disclosed H_2 luminous sources include active galactic nuclei galaxies, cooling flows, star-burst winds, colliding galaxies and mergers. H_2 emission is observed to be a main contributor to gas cooling in these diverse sets of objects. We will place the Spitzer H_2 results in the broader context set by X-ray and optical observations. We will show how the observations may be understood within gas physics models and argue that in H_2 bright galaxies warm molecular hydrogen emission traces mechanical energy dissipation. We will discuss the relevance of present (Spitzer) and future (JWST, Spica) H_2 rotational lines spectroscopic observations to trace the energetics of galaxy formation through cosmic history.

Warm H_2 Gas: Spitzer and Beyond

Phil Appleton (NHSC/Caltech, USA)

Recent observations by Spitzer have revealed a class of galaxy in which powerful H_2 mid-IR rotational lines are seen in the relative absence of strong starformation. Following from the pioneering results from ISO, I will review past and present observations of powerful molecular hydrogen emission from galaxies, large-scale shocks, radio galaxies and clusters of galaxies. I will discuss three nearby examples, the giant shock structure in Stephan's Quintet, the emission from 3C326, and a recent large-scale H_2-feature in the collisional proto-ring galaxy Arp 143. From there I will discuss the observational difficulties and feasibility of detecting H_2 emission from high redshift galaxies and protogalaxies in the Far-IR: including the possibility of shock-heated H_2 in merging DM haloes at z ~10.

The warm and dense interstellar medium in ULIRGs

Paul van der Werf (Leiden Observatory, The Netherlands)

Ultraluminous infrared galaxies (ULIRGs) form stars at prodigious rates, and may also be the hosts of obscured AGNs. Their more distant and more luminous cousins, the submillimeter galaxies (SMGs) have probably played a key role in the formation of massive galaxies and their central black holes, and ALMA will revolutionize the study of these objects.
Here I review recent developments in our understanding of the interstellar medium in ULIRGs. I will discuss the thermal balance of the warm gas, the influence of the power source (star formation or AGN) on the emergent spectrum, and the nature of star formation laws in ULIRGs. Finally, I will look ahead towards the Herschel mission and discuss a project to establish a local benchmark for future ALMA observations of high-z galaxies.

Molecular gas in galaxy-sized numerical simulations: stars, molecular gas, and another type of feedback.

Padelis Papadopoulos (University of Bonn, Germany)

Stars form out of cool (~30-100K) H_2 gas, not the 10^4 K WNM HI gas phase. I will describe the first attempt to incorporate this simple fact of Nature to galaxy-sized numerical models. Aside from making such models more amenable to comparison with current observations, the new physics now included contains a new feedback mechanism: H_2-regulated star formation. This has been absent from galaxy-formation models until now. Implications regarding current approaches to feedback scenaria in galaxy formation theories will be briefly discussed.

LIRGS/ULIRGs: Spitzer and Beyond

Lee Armus (SSC/Caltech, USA)

Deeply Obscured Galaxies

Vandana Desai (SSC/Caltech, USA)

The Spitzer Space Telescope has revealed a significant population of high-redshift (z~2) dust-obscured galaxies (DOGs) selected by their large observed mid-infrared to optical flux density ratios. Based on the ~8.6 square degree NDWFS Bootes field, we estimate that DOGs contribute approximately one quarter of the infrared luminosity density at z~2. Detailed studies of the DOGs are necessary in order to understand their role in the formation of today's massive galaxies, their relation to other high-redshift populations, and their contribution to the global star formation and black hole growth rates of the universe. I will discuss what we have learned so far from ongoing follow-up efforts, including Spitzer/IRS mid-infrared spectroscopy and imaging, Keck/NIRSPEC near-infrared spectroscopy, Keck adaptive optics imaging, and HST/ACS/WFC2/NICMOS high-resolution imaging.

Tuesday 16 September 2006

AGN Starburst Diagnostics in the Infrared

Luigi Spinoglio (Istituto di Fisica dello Spazio Interplanetario, INAF, Italy)

Infrared spectroscopy provides powerful diagnostics to distinguish between the main emission mechanisms in galaxies: AGN and Starburst. After the pioneering work of ISO, Spitzer collected a large amount of IRS spectra of local active galaxies.
The main results of the Spitzer IRS spectrometer on active galaxies are reviewed. Among these, the findings on about 80 Seyfert galaxies from the 12μm Galaxy Sample are presented and discussed in the light of unification and evolution models. The observed line ratios are compared to the results of photoionization calculations, which can be used to compute the AGN and starburst contributions to the total luminosity of the galaxies.
The work of Spitzer will soon be complemented at longer wavelengths by the Herschel spectrometers and in the future by SPICA at higher redshift.

Understanding the properties of the obscuring torus of AGN and its connection with the host galaxy

Almudena Alonso-Herrero (CSIS, Spain)

The fueling of black holes occurring in AGN is fundamental to the evolution of galaxies. AGN themselves are largely explained in the context of a unified theory, by which a geometrically and optically thick torus of gas and dust obscures the AGN central engine. The exact properties of the torus remain uncertain, and there are still several open questions: (a) What is the nature of the torus material and its connection with the ISM of the host galaxy, (b) How do the properties, such as, geometry and optical depth, of the torus depend on the AGN luminosity and/or activity class, (c) Do the dust properties change with the AGN luminosity/type, and (d) What is the role of nuclear (<100 pc) starbursts in feeding and/or obscuring AGNs. Observations at mid-IR wavelengths, from both the ground and space, are essential to these investigations as the torus intercepts and re-radiates a substantial amount of flux from the central engine, peaking in the mid-IR.

I will be presenting some recent results from our group on the mid-IR properties of a few representative low redshift objects belonging to some of the main AGN classes: Seyfert galaxies, luminous infrared galaxies hosting an AGN, radio galaxies, and LINERs. Finally I will discuss a mid-IR survey of low-redshift AGN covering a large range of AGN luminosity and activity class using the mid-IR instrument CanariCam on the 10m GTC (Gran Telescopio Canarias) telescope. The observations will include diffraction limited (0.3arcsec) imaging, spectroscopy and polarimetry of a sample of LINERs, Seyferts, PG quasars, radio galaxies, and (U)LIRGs. The CanariCam data combined with existing Spitzer and X-ray data, and a detailed modeling will be used to characterize the torus properties and its relation with the host galaxy.

The Infrared Identification of Distant Compton-thin and Compton-thick AGNs

David Alexander (Univ. of Durham, UK)

I will present results on the identification of distant AGNs using X-ray and infrared data. I will show the infrared properties of distant AGNs detected in deep X-ray surveys. I will then show how infrared data has been essential in finding the X-ray weak/undetected Compton-thick AGN population and I will present their properties. I will lastly look towards the gains in the identification of AGNs that we can expect from sensitive Herschel surveys.

A Spitzer view of high-z submm galaxies and QSOs

Dieter Lutz (MPE, Germany)

I will present Spitzer spectroscopic results quantifying the coexistence of star formation and AGN activity in some high redshift populations, in particular submm galaxies and optically selected QSOs. In conjunction with high resolution mm studies, the picture of SMGs as maximally star-forming massive mergers is getting increasing detail. In both local and high redshift QSOs, the coexistence of luminous AGN with massive star formation is demonstrated by the Spitzer spectroscopy. These mid-IR spectroscopic results give further support to the great potential of Herschel surveys for quantifying AGN/star formation coevolution at high redshift.

Understanding the Formation of the Most Massive Galaxies: The Submillimeter Phase

Alex Pope (NOAO, USA)

Submillimeter galaxies (SMGs) contribute significantly to the total star formation rate density at redshift of 2, and are thought to be a crucial phase in the evolution of massive galaxies. While SMGs are the most luminous objects in the high redshift Universe at rest-frame far-IR wavelengths, they are often invisible in the optical due to extreme dust obscuration. Recent observations with the Spitzer Space Telescope have advanced our understanding of these dusty systems. Together deep mid-IR and radio observations provide secure counterparts, redshift estimates, dust temperatures, star formation rates, and constraints on the AGN activity in SMGs. I will summarize recent results from a range of submm surveys from our deep GOODS-N super-map to the wider SHADES fields where we use deep multi-wavelength observations in order to place SMGs in the context of galaxy evolution scenarios. In particular, I will highlight results from mid-IR spectroscopy where we discovered strong PAH emission in SMGs suggesting an evolution in the mediation between AGN and star formation activity from local to high redshift galaxies as a function of luminosity. Current submm observations are only sensitive to the tip of the submm luminosity function and are strongly biased by the average dust temperature. I will briefly mention the next generation of submm surveys (e.g. SCUBA-2/450microns, LMT, etc.) which will probe deeper down the luminosity function to constrain the far-side of the dust peak of more typical star forming galaxies at high redshift.

Mid-IR properties of Lyman Break Galaxies

Dimitra Rigopoulou (Oxford Univ. & Ratherford Appleton Lab, UK)

I will review results from the biggest Spitzer photometric survey of Lyman Break Galaxies carried out as part of IRAC's GTO program. I will discuss the rather inhomogeneous nature of LBGs as revealed by observations at mid-infrared wavelengths. Our study focuses specifically on LBGs detected at 8 microns (rest-frame K-band). Using stellar synthesis evolutionary codes we estimate masses, ages and extinction and argue that these 8 micron detected LBGs are massive and relatively older in comparison to more typical blue LBGs. The power of mid-IR spectroscopy in unveiling obscured AGN is demonstrated giving further support to the claim that LBGs display a wide spread in their properties. Finally, I will briefly touch upon our expectations on the study of LBGs with upcoming missions such as HERSCHEL and ALMA.

Molecular Gas Observations of Typical high-z galaxies

Emanuele Daddi (CEA/Saclay, France)

By observing a pilot sample of 2 galaxies with the IRAM Plateau de Bure Interferometer, we recently demonstrated that massive, disk galaxies in the distant Universe (z~1.5) have luminous CO emission lines, accessible with existing facilities even before the ALMA era. I will present our ongoing CO survey, including some new results from 2008 observations, and a discussion of the implications of these finding for understanding galaxy formation and evolution and star formation in the high redshift Universe, and for ALMA observations in the next decade.

Detecting Molecular Gas at high-z with ALMA

Francoise Combes (Obs. de Paris, France)

In this talk, I will review current progress in CO detection at high redshift with the presently available instruments. Simulations of galaxy evolution, their gaseous content and star formation as a function of redshifts will be used to predict what will be possible to detect in molecules with ALMA.

Wednesday 17 September 2006

Modeling of Galaxies Spectral Energy Distributions

Stephane Charlot (IAP, France)

Large Scale Structures in COSMOS

Nick Scoville (Caltech, USA)

Recent results from the 24μm observations of the COSMOS field

Emeric Le Floc'h (Univ. of Hawaii, USA), H.Aussel, O.Ilbert, M.Salvato, L.Yan, D.Frayer, D.Sanders, N.Scoville on behalf on the COSMOS collaboration.

I will review some of the latest results we obtained from our wide (2sq.deg.) and deep (S24>60μJy) observations of COSMOS at 24μm This will include (i) the resolution of the mid-IR background as a function of optical magnitude and redshift, (ii) the redshift distribution of the 24μm selected galaxy population and its comparison with both phenomenological and semi-analytic models, (iii) a characterization of the contribution of optically-faint mid-IR sources that are missed with the traditional optical/near-IR color selection techniques, (iv) our preliminary results on the clustering of 24μm sources, (v) a comparison between the contributions of X-ray and power-law selected AGN sources to the mid-IR galaxy populations, and (vi) our attempt to resolve the "missing" fraction of the X-ray background using stacking analysis of the 24mic data. I will also emphasize the current limitations we are facing and how future facilities such as Herschel, SCUBA2, LMT and ALMA will provide a more completee characterization of the population of high-redshift IR-luminous galaxies in COSMOS.

Mass buildup and star formation from the S-Cosmos survey.

Herve Aussel (CEA/Saclay, France) on behalf on the COSMOS collaboration

I will show how we make use of rich photometric dataset over the COSMOS field to derive accurate photometric redshifts, galactic stellar masses and star formation rates. This allow us to measure the mass function of galaxies out to z=1.5, and to compare the star formation activities of galaxies with their stellar mass buildup. We also measure how these quantities depend on the environment.

The far infrared Universe from Spitzer to Herschel

David Elbaz (CEA/Saclay, France)

I will review some recent results obtained with Spitzer from the mid to far infrared on the redshift evolution of the far infrared luminosity function of galaxies and its implications on the evolution of the star formation rate per unit comoving volume as a function of cosmic time as compared to the supermassive black hole growth history. This result will be put into perspective by combining constraints at all infrared wavelengths using an "inversion model" of galaxy counts. We will then discuss the possible main drivers of this evolution with particular emphasis on the effect of the local environment of galaxies. Finally, we will put these new findings in perspective before the launch of Herschel and discuss some of the results that we might expect Herschel to achieve, in particular with the GOODS-Herschel Open Time Key Program.

Star formation from z=0 to z=1: combining IR and UV

Veronique Buat (Univ. de Provence et Obs. Astronomique Marseille, France)

I will present an overview of our work in the field of the star formation and dust attenuation mainly based on a bi-variate analysis of both UV(1200-3000) and IR (8-1000 microns) emissions of galaxies from z=0 to z=1 as observed by GALEX, SPITZER, AKARI (& IRAS for the local universe) The galaxies are found to brighten in UV and in IR from z=0 to z=1. The evolution is stronger in IR than in UV, as a consequence the mean dust attenuation in the universe is found to increase by ~1 mag and about 80% of the star formation at z=1 is observed via the dust re-emission. Nevertheless when galaxies are selected either in UV or in IR with a given luminosity, there is some hint for a decrease of their dust attenuation as a function of z, the effect being larger for UV selected galaxies at z=1.
The next step is to draw the star formation history of these star-forming galaxies selected either in UV or in IR and for which we have a measure of their total star formation rate (SFR). We will compare the properties of our samples in terms of SFR and stellar mass to models predicting the evolution of galaxies: there is no need of strong modifications of the physical properties in galaxies with redshift to explain their average evolution from z=0 to z=0.7. Our observations are also found consistent with some predictions of semi-analytical models.

Mid-IR Luminosities and UV Star Formation Rates at 0.2<z<1.4

Samir Salim (NOAO, USA)

Each of the various SFR indicators suffers from a variety of difficulties, and historically different indicators have been used in different redshift ranges. Here we focus on a comparison between mid-IR luminosities and UV/optical star formation rates at 0.2<z<1.4. We study 2400 galaxies with spectroscopic redshifts having very deep MIPS 24 um imaging, and very deep GALEX UV and optical/near-IR photoetry (AEGIS/FIDEL collaboration). We constrain dust-corrected UV/optical SFRs from a Bayesian fitting to a suite of BC03 models containing dust attenuation. We compare UV/optical SFRs averaged over various timescales (from 0.1 to several Gyr) with IR luminosity. We find that for blue, actively star-forming galaxies, IR luminosity correlates better with SF averaged over longer (~Gyr) timescales than with the recent SF. We also look for evidence of AGN heating of dust in green-valley and red-sequence galaxies, but find that most of the IR is due to evolved populations, i.e,. we find no evidence for IR excess in our sample.

Thursday 18 September 2006

The First Gyr of Galaxy Evolution

Ranga Chary (NHSC/Caltech, USA)

Deep optical/near-infrared extragalactic surveys and ground-based spectroscopic follow-up have reliably detected galaxies out to z~7. Candidate emission line galaxies have been claimed even at z~10 through observations of lensed clusters. The multiband photometry on many of these galaxies enables the stellar mass and star-formation rates of the bright subsample to be directly measured while ensemble properties of galaxies at the faint end of the luminosity function can be assessed through stacking. Armed with these measurements, we can then derive estimates of the stellar mass density at z~6 and minimal constraints on the stellar initial mass function in these galaxies required to reionize the Universe at higher redshift. I will present our current understanding of galaxy evolution at z>6 while discussing the possibilities for solving the reionization conundrum with future surveys/missions.

The Cosmic Infrared Background

Herve Dole (IAS, France)

I will review the current techniques to measure the intensity of the Extragalactic Background Light and discuss the measurements. Then, I'll review some of the information that the Cosmic Infrared Background (CIB) carries, and that we are able to extract (or not). I will also mention what can be measured and constrained beyond the CIB intensity, i.e. the fluctuations. I will finally discuss some perspectives about what can be done with CIB measurements (galaxy evolution, structure formation, cosmology) and what Herschel and Planck and other experiments can bring.

AKARI extragalactic surveys probing into the Cosmic Infrared Background

Shuji Matsuura (JAXA, Japan)

We have carried out cosmological surveys in a broad range from near-infrared to far-infrared with AKARI to investigate the evolution of star-forming galaxies, the large-scale structure, and the cosmic infrared background radiation (CIRB). We present the survey strategy, data analysis, scientific topics and results, and the future research plan.
The near- and mid-infrared surveys were carried in a wide area (~6 sq.deg) around the north ecliptic pole, which is the best site to secure deep exposure because of high visibility and to monitor seasonal variation of the zodiacal foreground for the background measurement. For the far-infrared survey, we selected the lowest cirrus density region with an area of ~12 sq.deg near the south ecliptic pole (AKARI Deep Field South: ADFS) as a cosmological window.
The AKARI extragalactic surveys are unique in respect of their continuous wavelength coverage with photometric bands in the entire infrared range and of their contiguous mapping in wide area. As a result, we have detected many galaxies and obtained their infrared colors. The multi-band galaxy counts provide us new

constraints on the galaxy evolution model. For further investigation for the infrared sources, we have also carried out many follow-up observations to measure the broad-band SEDs at wavelengths ranging from UV to radio and the optical spectra.
Thanks to AKARI's capability of the absolute measurement and to the field selection to cover a wide area minimizing the foreground, we have successfully detected significant extragalactic background and their fluctuations. High angular resolution of AKARI was also essential for resolving nearby galaxies and for selective extraction of the CIRB composed of distant objects. The measured CIRB brightness and fluctuations provide new constraints on the evolutionary scenario.

Planning for the undiscovered: A perspective

George Helou (Caltech, USA)

ABSTRACTS – POSTER CONTRIBUTIONS

Black hole mass measurements for high-z obscured AGN.

Kalliopi Dasyra (SSC/Caltech, USA)

Optical narrow-line-region (NLR) lines are often used to estimate black hole masses at high-z, assuming that the NLR kinematics are influenced by the potential of the stellar bulge. Using high-resolution (R~600) Spitzer IRS and (1300<R<1900) ISO SWS spectra of local AGN, we recently demonstrated that the dispersions of the high-ionization MIR narrow lines [NeV] and [OIV] follow the well-established black hole (BH) mass - stellar velocity dispersion relation, and that they can be used for the computation of black hole masses. The major advantage of the use of MIR lines is that they can be applied both to type 1 systems, and mainly, to obscured, type-2 systems. In this poster, we present the NLR kinematic tools that can be used for studies of obscured black hole growth with the next generation infrared telescopes.

The 0.9 mJy sample: A mid-infrared spectroscopic survey of infrared-luminous galaxies up to z~3.

Kalliopi Dasyra (SSC/Caltech, USA)

We will present first results from a IRS spectroscopic survey and its HST imaging follow-up of 24 micron-selected sources with a flux threshold of 0.9 mJy. The redshift distribution of the sample peaks at z~1 and its tail reaches z of 3.5. A comparable number of sources have star-formation-associated features, a featureless continuum, or a deep silicate absorption feature in their mid-infrared spectra. Evidence for increasing AGN activity with z comes from the increasing [NeIII]/[NeII] ratio as a function of redshift and luminosity and the existence of [NeV] in the stacked spectra of sources with individual [NeIII] detections at z>0.8. The classification of sources based on IR color-color diagrams that are used to select AGN based on broad-band IR data often differs from that based on the MIR spectrum. The HST images acquired so far indicate a smaller amount of perturbations for the galaxies of these systems than for those of local ULIRGs and z~2 sub-mm galaxies.

Cosmic star-formation history from the mid- and far-infrared up to z=5

Damien Le Borgne (CEA, France), David Elbaz (CEA, France), Pierre Ocvirk (AIP, Germany), Christophe Pichon (IAP, France)

In the context of future Herschel observations in the far-infrared, we show how star formation activity can be efficiently measured in the distant universe, up to redshift 5, from two complementary methods: direct measurements of luminosity functions from deep surveys on the one hand, and indirect constraints from non-parametric inversion of multi-wavelengths/multi-scales galaxy counts on the other hand. These works use data from the mid-infrared (Spitzer) and the sub-millimeter (SCUBA) and will benefit greatly from future Herschel programs.

A Far-IR dissection of the host galaxy of GRB980425 / SN1998bw

Emeric Le Floc'h, Vassilis Charmandaris, Karl Gordon, Bernhard Brandl, Lee Armus, Bill Forrest, Francois Hammer, Mirka Dessauges & Daniel Schaerer

The GRB980425 occurred in a nearby star-forming galaxy (z=0.0085), which gives us a unique opportunity to scrutinize the physical properties of environments favoring the formation of such catastrophic events. Our Spitzer observations of the GRB980425 host with IRAC (4.5/8μm), MIPS (24/70μm) and IRS (5-35 μm) reveal that the bulk of its bolometric luminosity originates from a very compact and dust-embedded super-star cluster located outside of the nuclear region of the galaxy. The mid-IR properties of this compact source are similar to those observed in starburst galaxies and its optical spectral energy distribution also reveals very clear signatures for the presence of Wolf-Rayet stars. The GRB980425 occurred 900pc away from this luminous HII region and although the origin of its progenitor can not be firmly established we discuss its possible link with the intense star-forming activity revealed in this part of the host galaxy by Spitzer.

A Spectroscopic Investigation of a Complete Sample of Luminous Infrared Galaxies

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I will present an investigation of the of the fine structure and molecular lines in a sample of Luminous Infrared Galaxies as part of the Great Observatory All-sky LIRG Survey (GOALS) Legacy project. We search for buried AGN emission via the detection of high-ionization fine structure lines and find that [Ne V] is detected in 14% of our sources. We compare the ratios of fine structure lines with the equivalent width of the 6.2 PAH line to estimate the relative importance of a starburst or a buried AGN to the bolometric luminosity. For several sources we find very high [Fe II]/[OIV] ratios that are similar to what is seen in extreme starbursts. I will also report on the H2 properties of those sources, and compare with what is found in nearby Galaxies, and in the brighter ULIRGs.