#### SPICA Science Work Shop 2010

#### Investigation of interaction-triggered star formation process S1 OToyoaki Suzuki (ISAS/JAXA) in galaxies revealed with SPICA suzuki@ir.isas.jaxa.jp Abstruct

M101

Kennicutt-Schmidt law in the disk of a galaxy can provide a clue to a high-mass star formation process on a kiloparsec scale. AKARI mid-to-far-IR observations have ability to provide the datasets of the star formation rate (SFR) and gas surface densities at a time. To demonstrate the capability, K-S law in the disks of interacted galaxies M101, M81 and NGC1313 was investigated for the first time. AKARI has revealed sites of active star-forming regions triggered by galaxy interaction and their star formation processes. However, to study

systematically the K-S law in interacted galaxies, much of the sample cannot spatially be resolved by mid-to-far-IR observations with AKARI and Spitzer. By SPICA observations with much higher spatial resolution and sensitivity, systematic study of K-S law in the disks of interacted galaxies will be opened up. To achieve the goal, 5 bands or more within the wavelength range from 20 to 160 µm are required. In particular, 30-to 50-µm photometric observations are essential to improve the measurement accuracy of SFRs.

## 1. Background

□ Kennicutt-Schmidt law (K-S law) in glaxies

- 1. K-S law in galaxies are currently an actively discussed topic. e.g. Kennicutt et al. (2007), Bigiel et al. (2008), and Suzuki et al. (2010)
- 2. The impact of internal and external factors on *Kiloparsec* scale star formation in galaxies can be studied.

# 2. Star formation law in interacted galaxies revealed with AKARI

□ Interacted galaxy samples: M101, M81, and NGC1313





Common approach

SFR : Ha + 24um Gas : HI, CO (H2)

OMerit 1. Higher spatial resolution. 2. Application to dust poor regions.

× Demerit 1. Completeness of the datasets. 2. Extinction correction.

#### New approach (AKARI)

SFR : Warm dust luminosity Gas : Cold dust luminosity

OMerit 1. No Extinction correction. 2. Easy to provide the datasets.

× Demerit 1. Poor spatial resolution. 2. No data in the wavelength range: 30-60 um ( $\rightarrow$  SFR accuracy)





Large optical sizes  $\rightarrow$  Good candidates to demonstrate the new approach with AKARI

Spectral deconvolution analysis produces the maps of the cold and warm dust components.

Spatial distributions of the cold and warm dust components



ŃGC1313

NGC1313

3 arcmin

NOAO/AURA/NSF

#### **L**<u>K-S Law in the disks of M101, M81, and MGC1313</u>





Suzuki et al. (2010)

RightAscentior

 $\rightarrow$  Difference in the star formation process on a Kpc scale. The power-law index *N* provides us with information of the physical process of star formation.

E.g. *N*=1.5 for Jeans instability, *N*=2 for cloud-cloud collision



#### New approach

SFR : Warm dust luminosity Gas : Cold dust luminosity

 $\sum_{\text{gas}} [M_{\odot} \text{ pc}^{-2}]$ 

### 3. From AKARI to SPICA

#### □ <u>Main targets: interacted galaxies</u>

- 1. Tidally interacting galaxies 2. Galaxy-galaxy collision 3. Merger galaxies
- These events are frequently occurred in early universe, and dramatically change environments in galaxies and intergalactic medium.
- **D**<u>Requirements for the specification of SPICA/MCS</u>
  - 1. 5 bands or more within the wavelength range



9h48m



# NGC1313

OMerit (AKARI) 1. No extinction correction. 2. Easy to provide the datasets.

OMerit (SPICA) × Demerit (AKARI) 1. Higher spatial resolution. 1. Poor spatial resolution. 2. No data in the wavelength range: 2. Continuous wavelength 30-60  $\mu$ m ( $\rightarrow$  SFR accuracy)

> SPICA can provide breakthrough in the demerit for AKARI observations !!

@Merit (SPICA)

1. No extinction correction.

coverage: 20-160 µm

2. Easy to provide the datasets.

from 20 to 160 µm (SAFARI has 3 bands).  $\rightarrow$  MCS/WFC should have 2 bands !

- $\rightarrow$  Spectral deconvolution technique can be done with four free parameters (Temperatures & Amplitudes of the cold and warm dust components).
- 2. 24 & 35 µm bands are required for MCS/WFC-L.
  - $\rightarrow$  Cover the warm dust component.
    - $\rightarrow$  Accuracy enhancement of the SFR measurement.

Higher accuracy of SFR is also necessary to show up the spatial variation in the power law index in the disk of a interacted galaxy.

