Far-infrared spectroscopic observation around Eta Car with AKARI Fourier Transform Spectrometer

Aya KOSAKA(U. Tokyo), Hiroshi MATSUO(NAOJ), Masuo TANAKA(U. Tokyo), Hidenori TAKAHASHI(Gunma Astronomical Observatory)

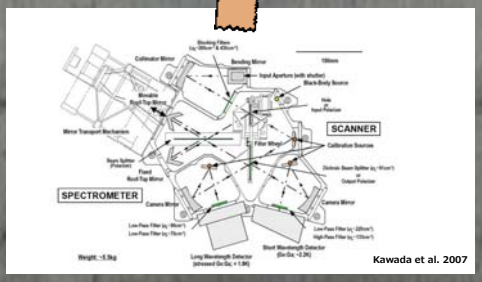
We have made observations with AKARI FIS-FTS (Far Infrared Surveyor - Fourier Transform Spectrometer) and [CII]158, [NII]122, [OIII]88μm intensity image of about 5'x10' field around Eta Car were obtained.

SPICA/SAFARI is equipped with FTS same as AKARI FIS-FTS. In this poster, we show the results of AKARI as an example of FTS observation and present the importance of large scale observation by using FTS.

Property of massive stars

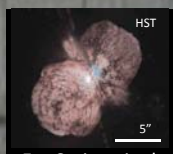
- **short life time**
  … because of this property, stars at the early universe are considered to be massive
- **high mass-loss rate**
  … their mass-loss activities give out metals to interstellar space
- **strong UV radiation and stellar wind**
  … massive stars provide strong energy through strong UV radiation and stellar wind, which cause the formation of HII regions, PDRs and shocked regions

AKARI/FIS-FTS



Kawada et al. 2007

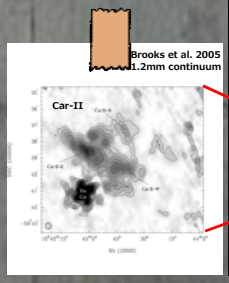
Eta Car and its surroundings



Luminosity	~5x10^6 Lo
Current Mass	90~100 Mo
Zero Age Main Sequence Mass	~ 150Mo

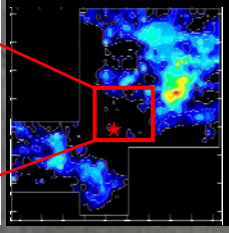
Humphreys et al. 1999

Eta Carinae is classified as LBVs (Luminous Blue Variables). It is considered that this bipolar shape of Eta Car was made by 1840s eruption. Eta Car became that bipolar shape. Total mass ejected at the eruption was estimated 3-15Mo.



Brooks et al. 2005
1.2mm continuum

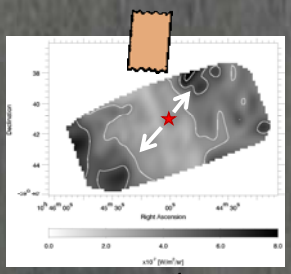
HII regions called Car-II are next to Eta Car.



	Wide-S	Wide-L
Wavelength Range (μm)	60-110	110-180
Detector	monolithic Ge:Ga	stressed Ge:Ga
Array size	3 x 20	3 x 15
pixel size (")	26.8 "	44.2"
beam size (major/minor)	44"/39"	57"/53"

Resolution
Full-resolution mode : 0.36cm^{-1}

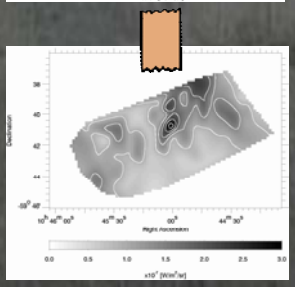
AkARI Results



Spices	transition	wavelength	Ionization potential
[CII]	$^2P_{3/2} \rightarrow {}^2P_{1/2}$	158μm	11.26eV

- peaks are shown at the northwest and southeast of Eta Car which is on the axis of the bipolar wind
- peak intensity is about 8.0x10^{-7} [W/m^2/sr]
- northwest peak coincide with Car-II
- southeast peaks are at the interface region with molecular cloud

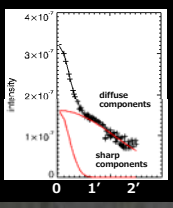
red star : position of Eta Car
arrows : direction of bipolar wind

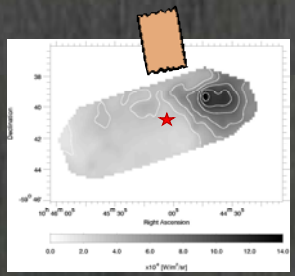


Spices	transition	wavelength	Ionization potential
[NII]	$^3P_2 \rightarrow {}^3P_1$	122μm	14.53eV

- sharp peak about 3x10^{-7} [W/m^2/sr] is shown at the position of Eta Car
- diffuse gas around Eta Car are situated within a 2' radius

radial profile around Eta Car →





Spices	transition	wavelength	Ionization potential
[OIII]	$^3P_1 \rightarrow {}^3P_0$	88μm	35.12eV

- peak about 1.4x10^{-5} [W/m^2/sr] is situated at the edge of Car-II , which is suggested other ionizing source
- line intensity are higher than that of [CII] and [NII] by a order of magnitude even for the diffuse components

(there is no data at the position of Eta Car due to saturation)

SPICA/SAFARI

Spectrometer of SAFARI is also FTS same as AKARI FIS-FTS.

SAFARI is suitable to observe diffuse components in the interstellar space because it has large field of view and FTS can sweep wide region at one time.

Comparison with other FIR spectrometer

	AKARI/FIS-FTS	Herschel/PACS	SPICA/SAFARI
Wavelength range [μm]	60-110/110-180	55-210	34-60/60-110/110-210
Spectrometer	FTS	image slicer + grating	FTS
Detector	Ge:Ga	Ge:Ga	TES bolometer
Field of view	1.4'x9.8'/2.4'x12.2'	47"x47"	1.9'x1.9'
Sensitivity [W/m^2] (5σ 1hour)	10^{-14} ~10^{-15}	2-5x10^{-18}	2x10^{-19}
Resolution (λ/Δλ)	450-150	5400-900	2000 @100μm

Requirements of dynamic range for SAFARI is estimated based on AKARI [OIII] observation. [OIII] peak intensity 2x10^{-12} [W/m^2] within averaged beam width 45". Signal intensity for SPICA with beam size of ~10" is estimated as 1x10^{-13}[W/m^2]. So dynamic range of 1x10^{-13} / 2x10^{-19}= 5x10^5 is required !!