

## 「あかり」IRC指向観測撮像データ

江草芙実 (ISAS/JAXA)

「あかり」データ解析チーム (山村一誠、小山祐世、瀧田怜、村田一心、山下拓時、臼井文彦、ほか)

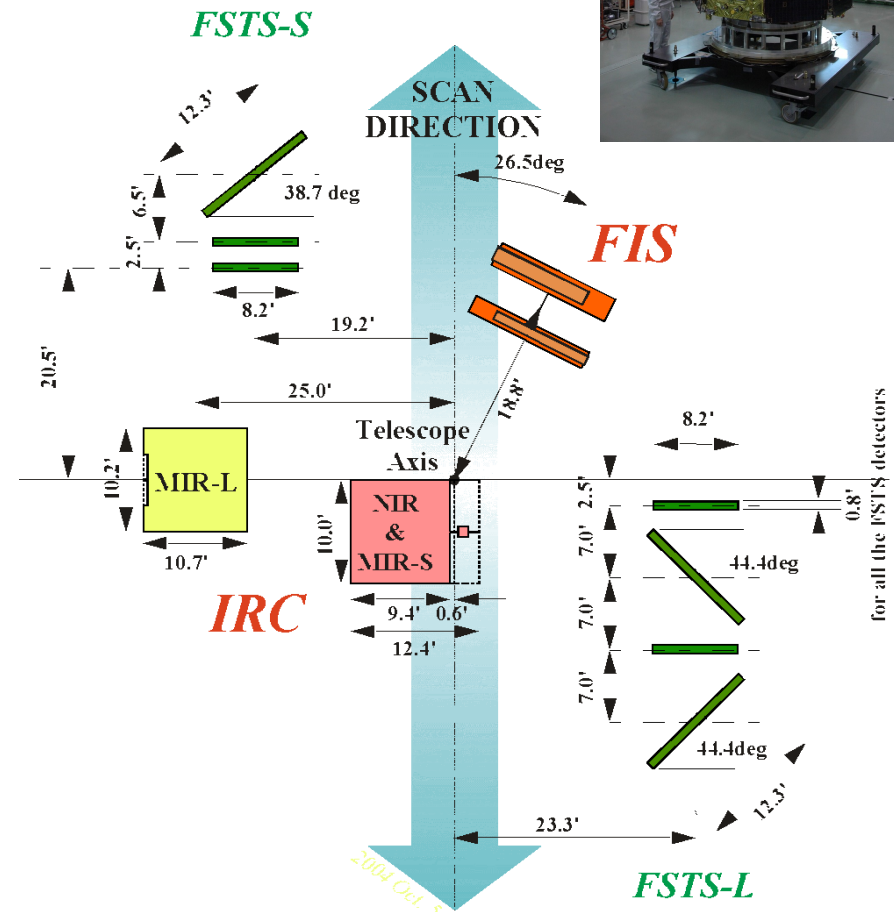
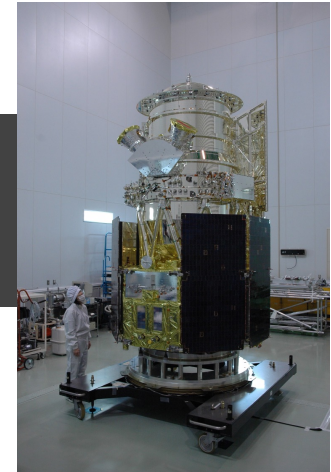
「あかり」IRCチーム (板由房、和田武彦、尾中敬、ほか)

c.f. 江草ほか (W212a)、山村ほか (P126c)



# Introduction

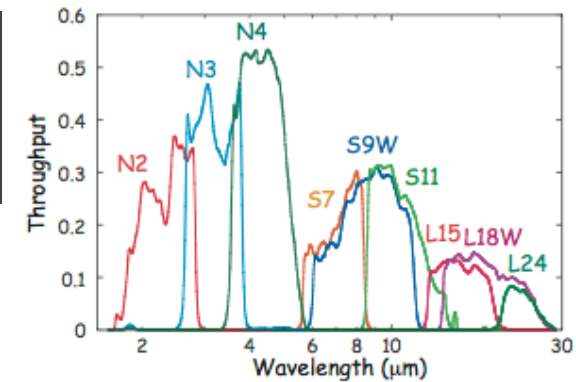
- 赤外線天文衛星「あかり」
  - 主鏡 ~ 70cm
  - 2006/02/22打ち上げ、2011/11/24停波
  - Phase 1&2: 2006/05-2007/08, with liquid He, NIR--FIR
  - Phase 3: NIR only
- 観測装置
  - Infrared Camera (近中間赤外線カメラ)
  - Far-Infrared Surveyor
    - 全天画像公開 (c.f. Q20a, L14b)



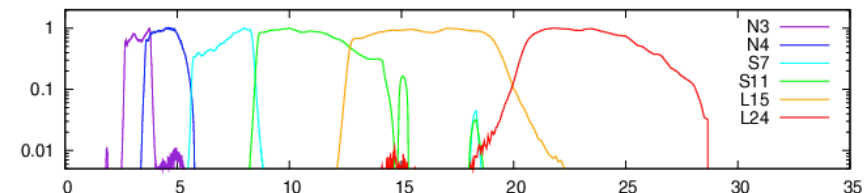
# Introduction

- InfraRed Camera: IRC
  - channels: NIR, MIR-S, -L
  - filters: N2, N3, N4, S7, S9W, S11, L15, L18W, L24
  - 波長2~27 $\mu\text{m}$ を連続的にカバー
  - 
  - 星、PAH、dust連続波 etc.
- FoV~10', PSF~5''
- N&SとLの視野は~20'離れている

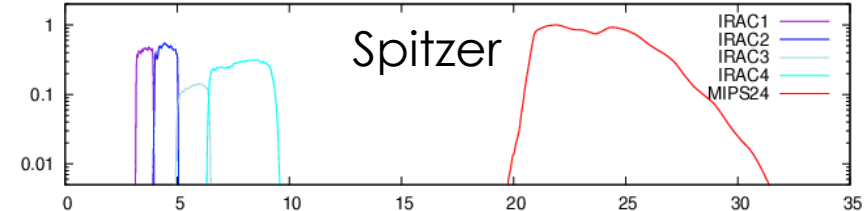
Onaka et al. (2010)



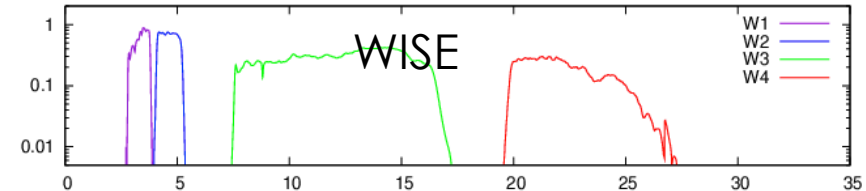
AKARI



Spitzer



WISE



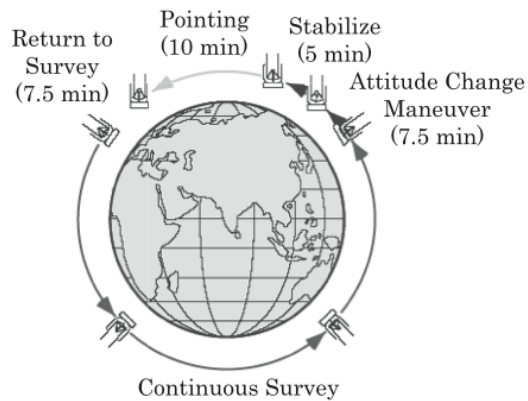
# Introduction

## □ 指向観測

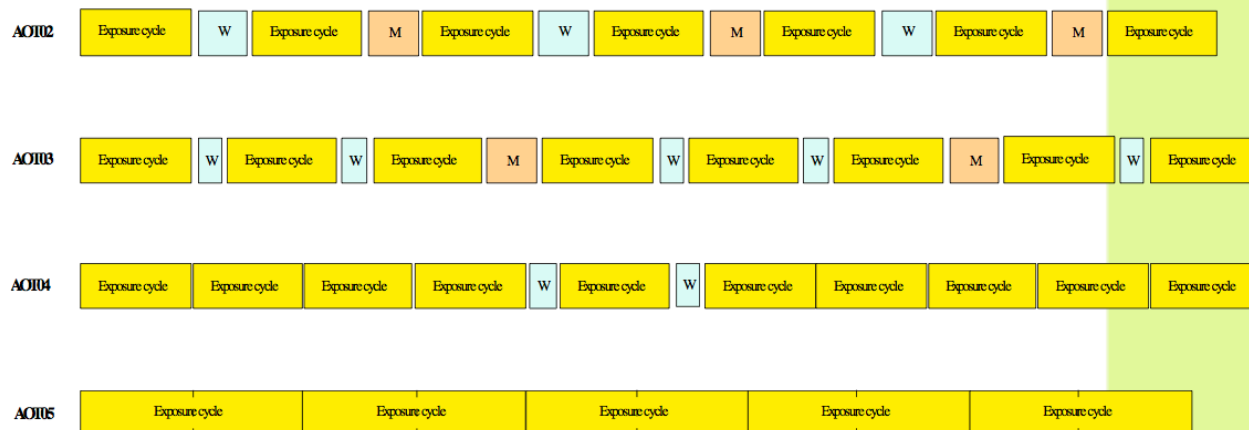
□ 1観測およそ10分（姿勢変更等除く）

□ Astronomical Observation Template: AOT

	filter/ch	dithering	# MIR-L long
IRC02	2	Y	9 or 12
IRC03	3	Y	6 or 9
IRC04	1+分光		3
IRC05	1	N	30

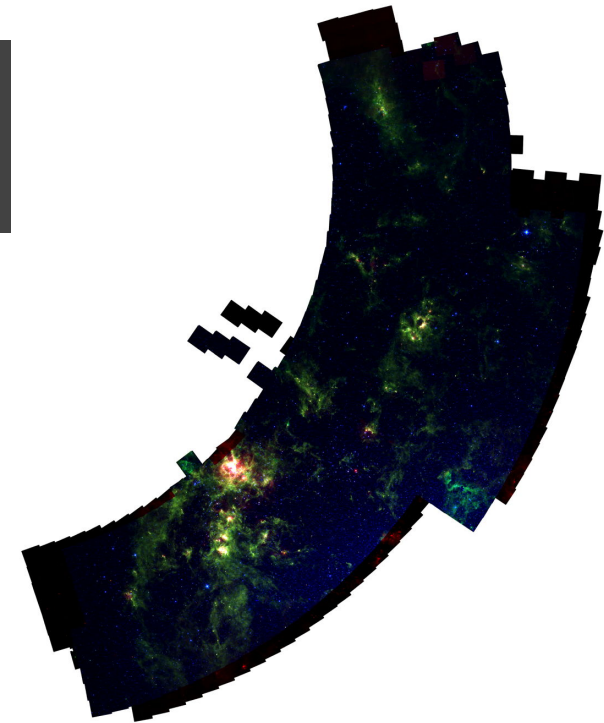


Murakami et al. (2007)



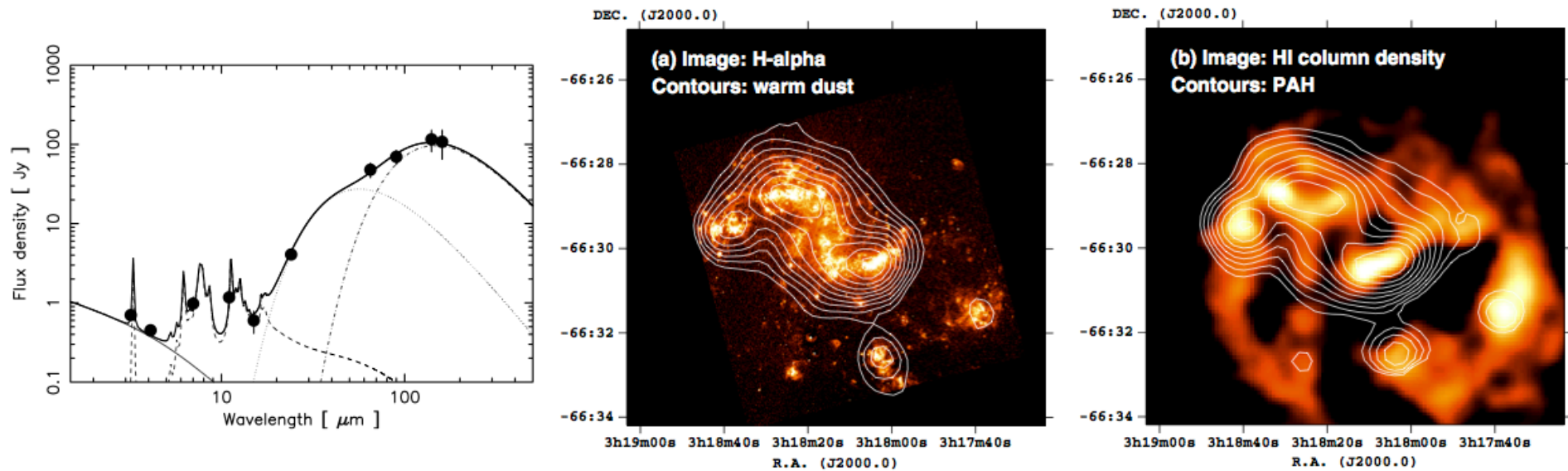
# Previous studies

- Large Surveys
  - LMC
    - 測光カタログ (Kato et al. 2012)
    - 分光カタログ (Shimonishi et al. 2013)
  - NEP
    - 測光カタログ (Murata et al. 2013, Kim et al. 2012)
    - PAH galaxies at  $z \sim 1$  (Takagi et al. 2010)

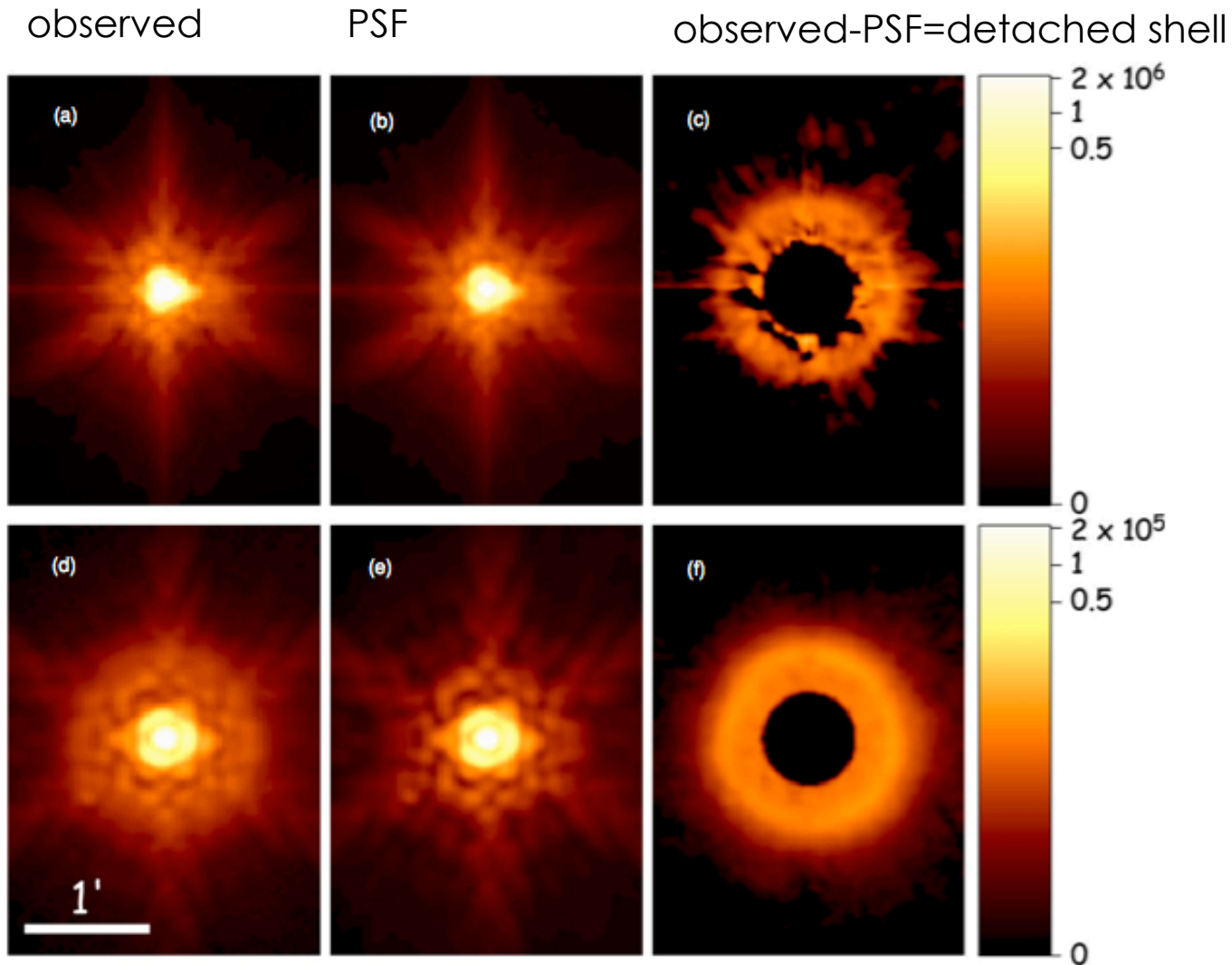


N3, S7, L15 images of LMC

# Previous studies



SED and images of nearby galaxy NGC1313 (Suzuki et al. 2013)



L15 (top) and L24 (bottom) images of AGB star U Ant (Arimatsu et al. 2011). PSF are available from AKARI observers website (<http://www.ir.isas.jaxa.jp/AKARI/Observation/>).

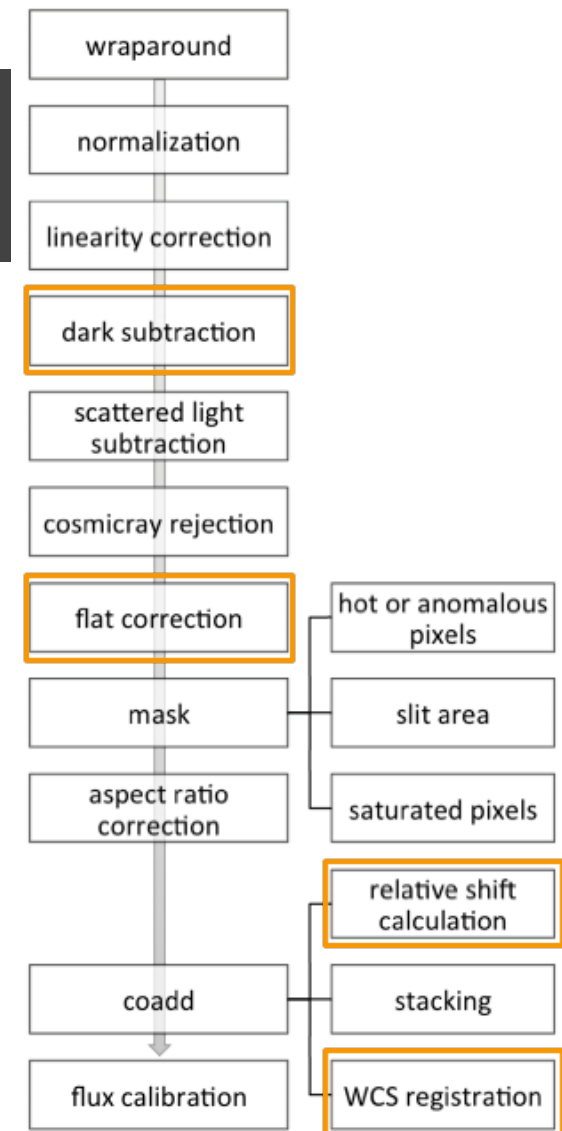
# Introduction

- データの現状
  - 解析用toolkitと生データが別々に公開
  - 処理済データは古いtoolkitによるquick look用のみ
  
- 新処理済データの公開 (Phase 1&2)
  - 解析用toolkitの改訂
  - 新toolkitによる再処理
  - チーム内公開 (2014/12/26) 後、再度の改訂と処理
  - 一般公開 (2015/03末予定)



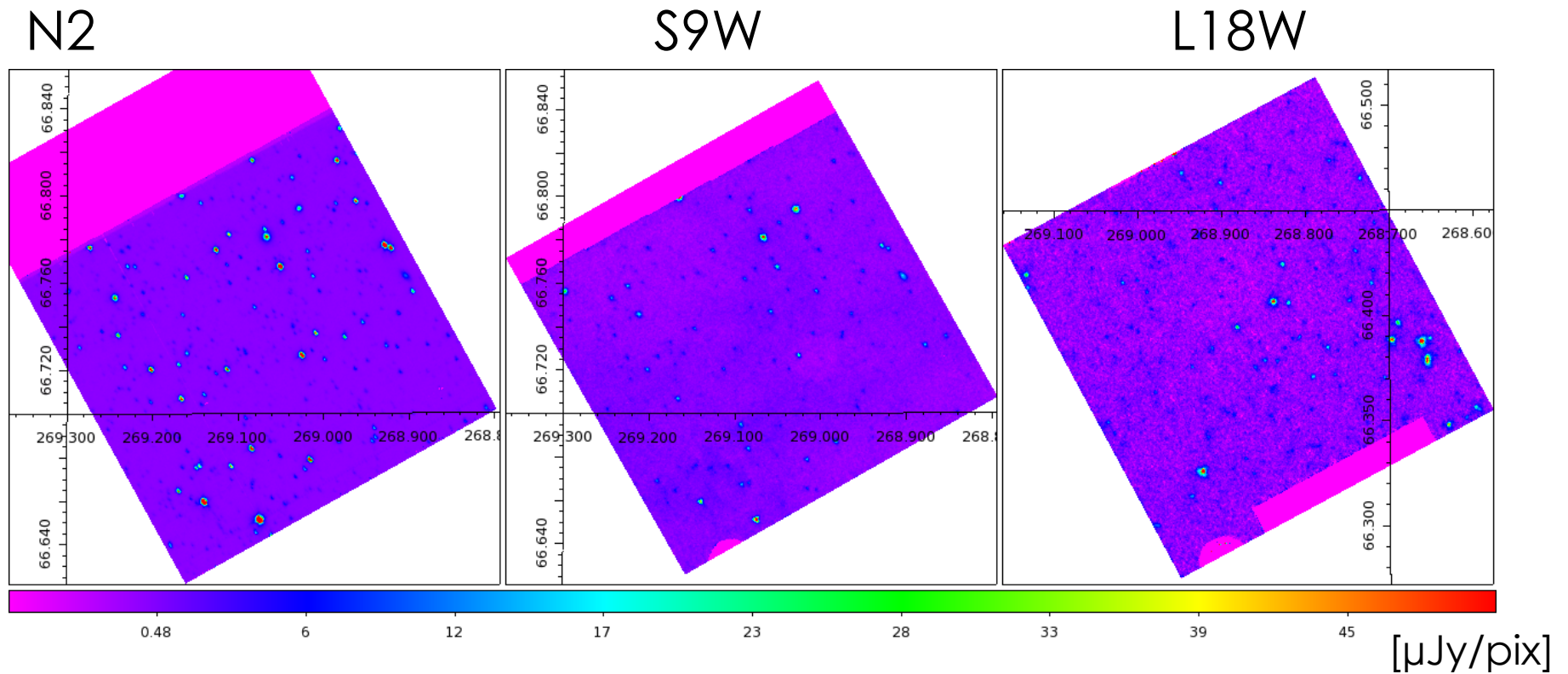
# IRC imaging toolkit

- A package of IRAF tasks
  - with some perl and .c programs
- Recent updates
  - new MIR-S and -L dark frames for each ObsID
  - new MIR-S flat
  - hot pixel masking
  - more reliable stacking and WCS matching

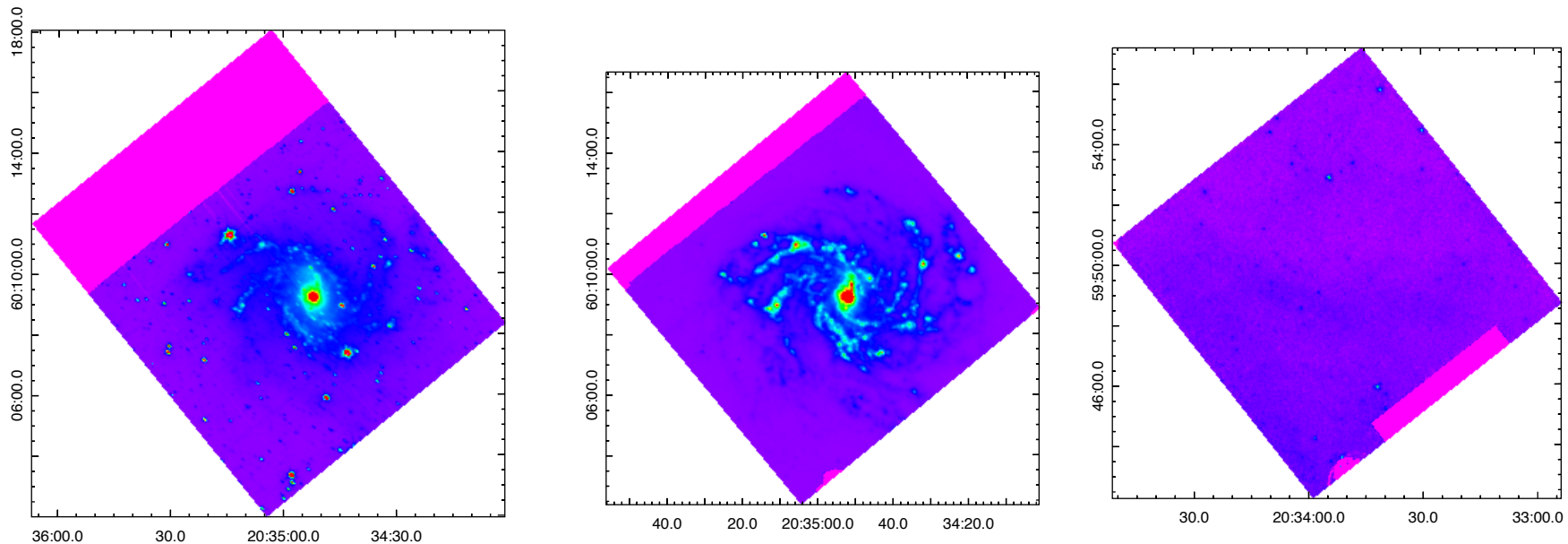


outline of calibration flow

# Sample of processed images

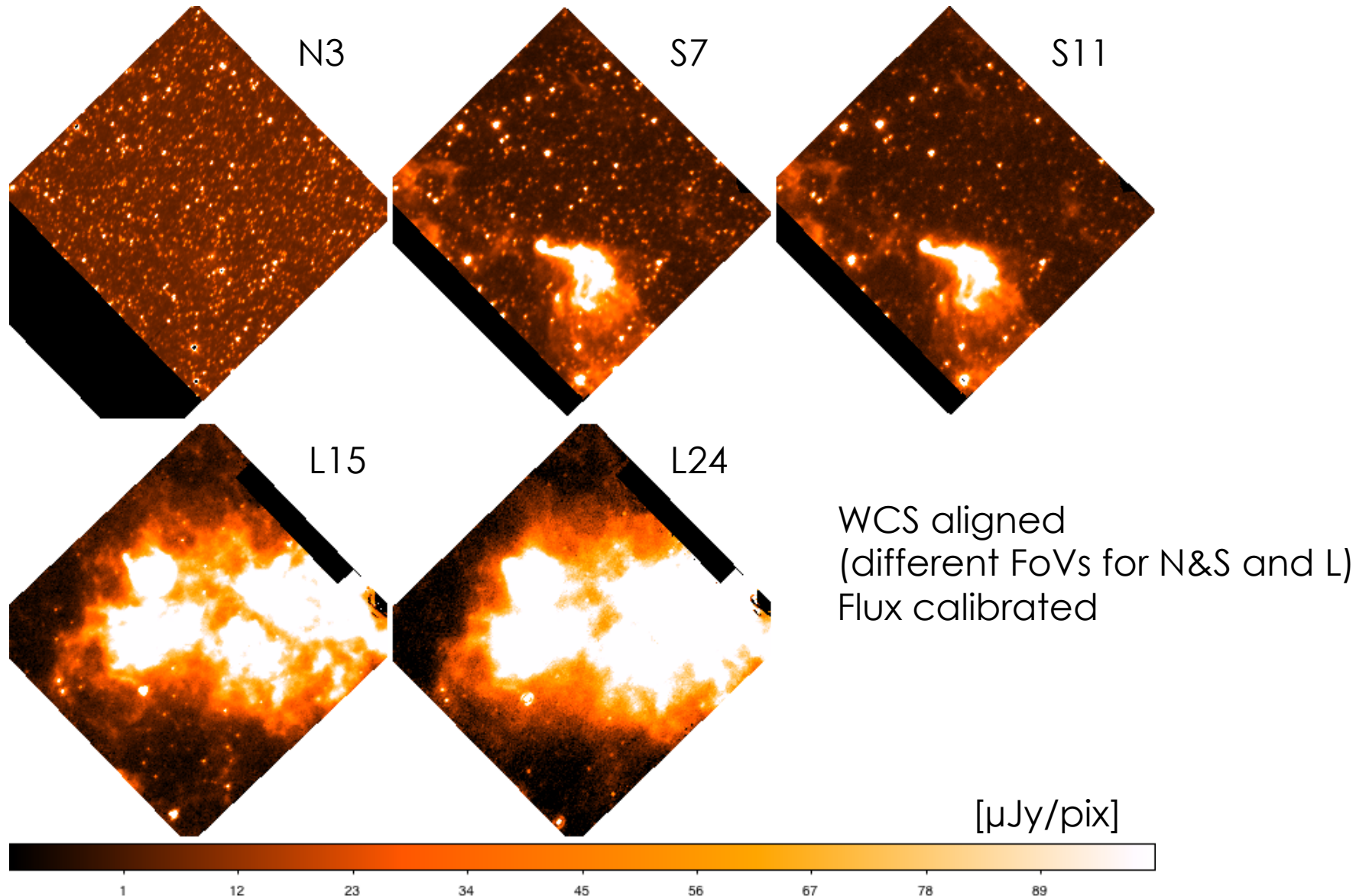


# Another sample ...



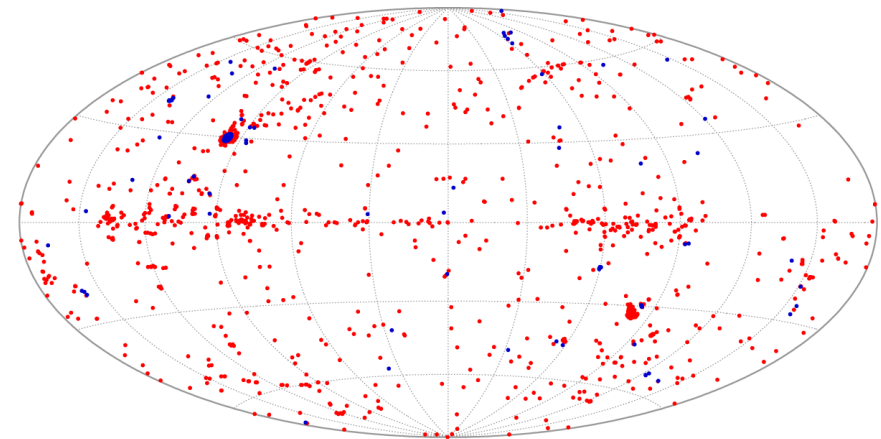
Sample of processed images (N3, S11, and L15 from left to right) from a pointed observation toward a nearby spiral galaxy NGC 6946 in the NIR and MIR-S FoVs. Coordinates are R.A. and Dec. (J2000). The flux ranges presented are  $[-10, 100]$ ,  $[-100, 1000]$ , and  $[-20, 200]$   $\mu\text{Jy/pix}$  for N3, S11, and L15, respectively. Magenta area are masked pixels mostly due to the slit for spectroscopic observations.

Example: AKARI\_IRC\_2211413\_001\_201412



# Summary of all-data processing

- ~4000 IDs from Phase 1&2
  - 分光、FIS同時観測含む
  - Not thoroughly processed and checked yet
- Typical sensitivity
  - better than WISE all-sky
  - comparable to SINGS



銀河座標系での観測点分布 (赤：撮像、青：分光)

Typical sky rms [ $\mu\text{Jy}/\text{pix}$ ] from NEP observations during 2006/08-2007/04

	N2	N3	N4	S7	S9W	S11	L15	L18W	L24
IRC03	0.11	0.079	0.078	0.65	0.70	1.1	2.0	1.9	4.0
IRC05	0.061	0.043	0.042	0.38	0.54	0.75	1.2	1.1	2.6

1 pix = 0.723", 1.17", 1.19", for NIR, MIR-S, and -L, respectively.

# Summary of all-data processing

- Stacking success rate
  - 成功率(Ncomb/Nall)の平均：94%以上
- WCS success rate
  - WCS matching by the toolkit: MIR-Lでは成功率低下
  - visual check: ~1% of “Good” are in fact false matching

toolkitによるWCS matchingの成功率（目視チェック前）

	N2	N3	N4	S7	S9W	S11	L15	L18W	L24
Good	829	2467	1718	2331	1674	2212	2218	1317	1266
Bad	13	45	26	238	66	175	356	390	1140
成功率	0.99	0.99	0.99	0.91	0.96	0.93	0.86	0.77	0.53

# データ取得方法

## □ 現状

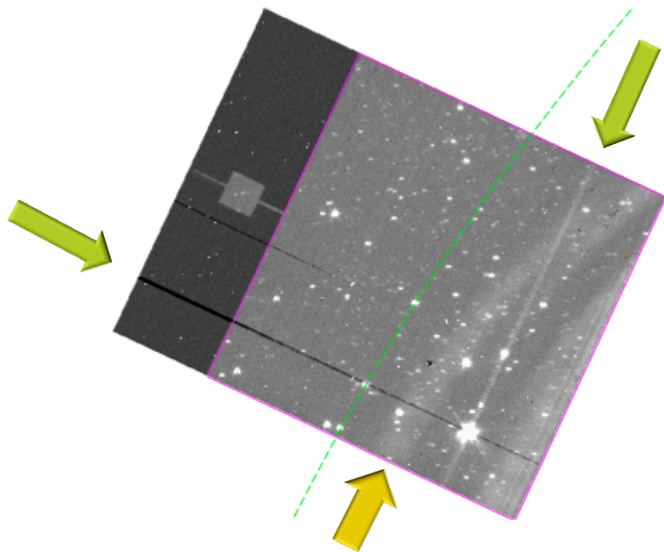
- チーム内公開（処理済データ、文書など）
- DARTS（生データ）
  - <http://darts.isas.jaxa.jp/astro/akari/akarilog/top.do>
- AKARI observers page（解析toolkit、文書など）
  - <http://www.ir.isas.jaxa.jp/AKARI/Observation/>

## □ 今後

- C-SODA (ISAS/JAXA)
- JVO (NAOJ)

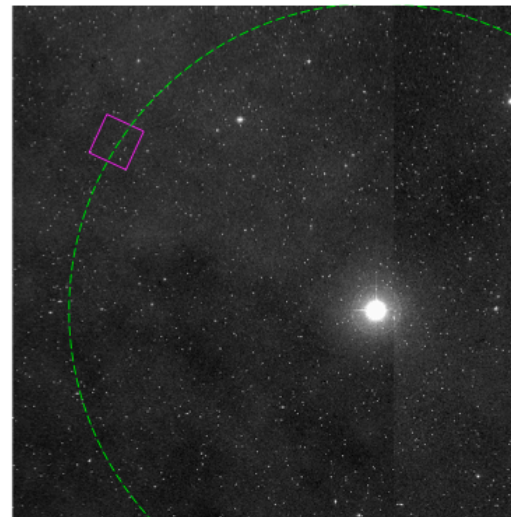
# Remaining issues

- NIR column pulldown & muxbleed

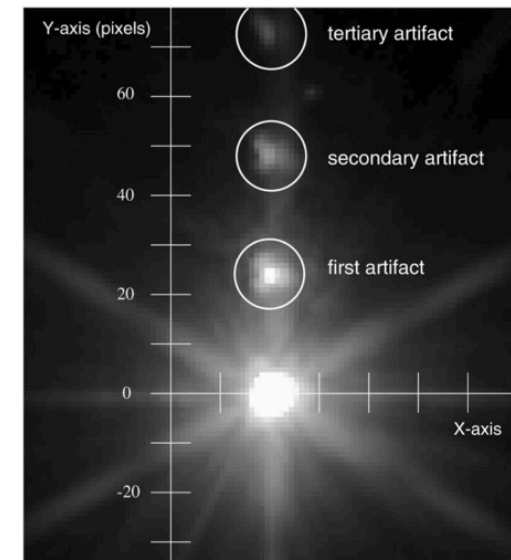


- Ghosts

- large-scale:  $r \sim 1.2\text{deg}$
- small-scale:  $\sim \text{arcmin}$



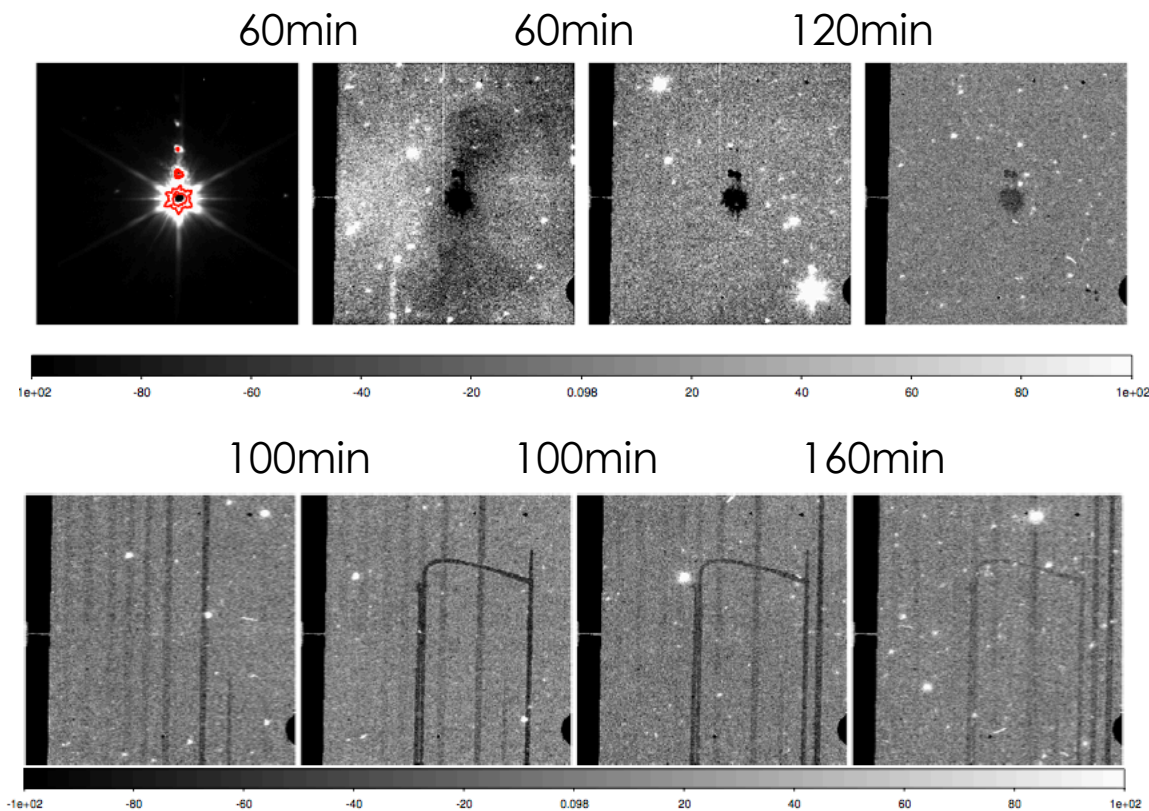
背景画像 : DSS



Arimatsu et al. (2011)



# Remaining issues

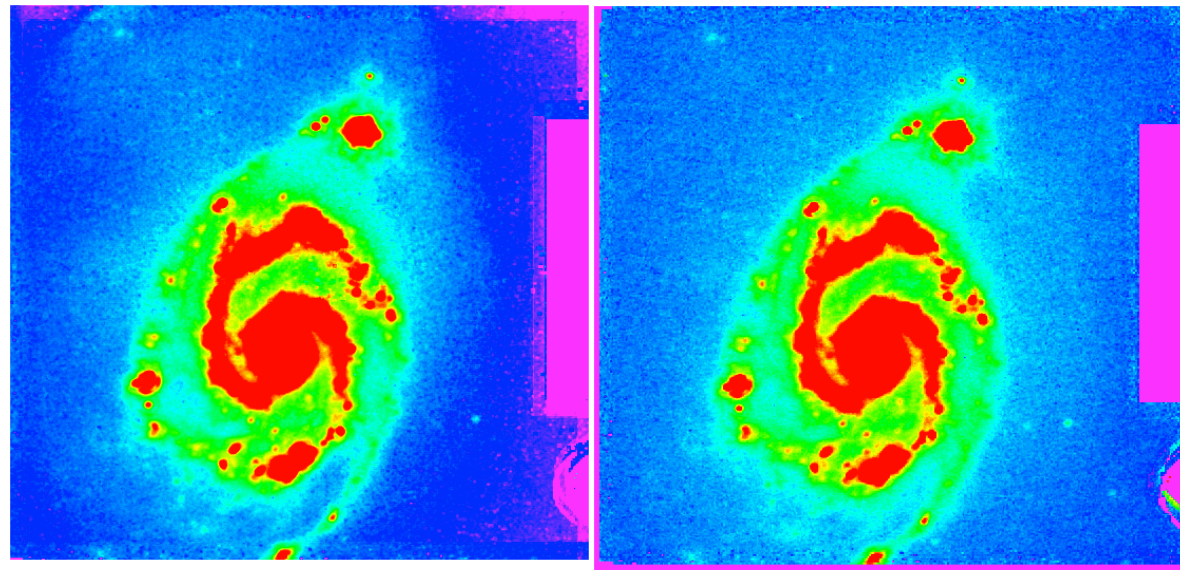


- MIR memory effect
  - 明るい天体を観測した後の感度の減少
  - from pointed observation
    - warning in Readme
    - tasks available in the toolkit
  - from slow-scan or all-sky survey

# Remaining issues

- Earthshine Light
  - 地球からの迷光
  - 夏至前後、北黄極付近で強い
  - tasks available in the toolkit

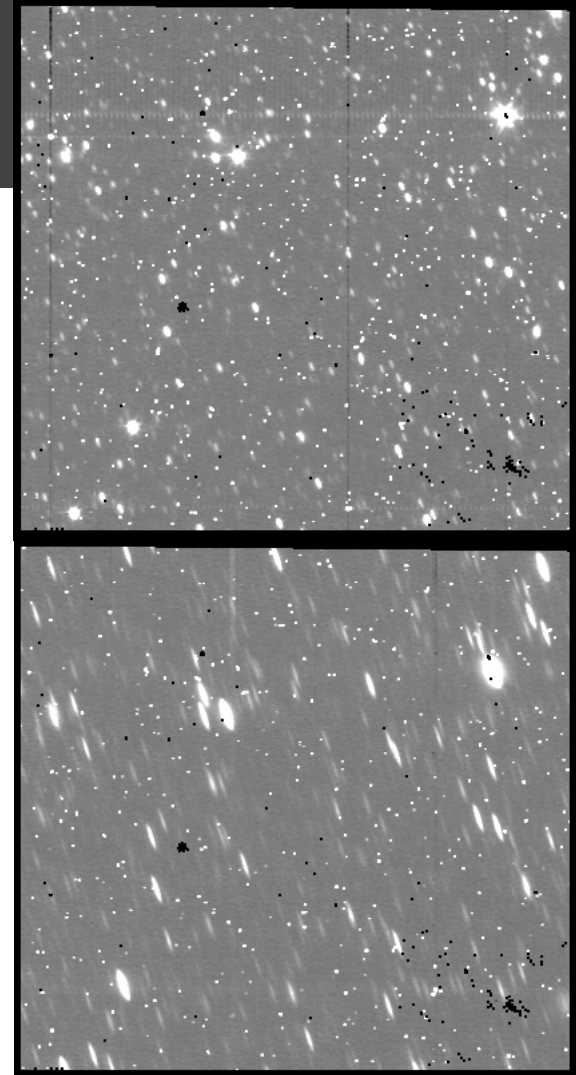
Egusa et al. (2013)



L24 stacked image without (left) and with (right) EL subtraction

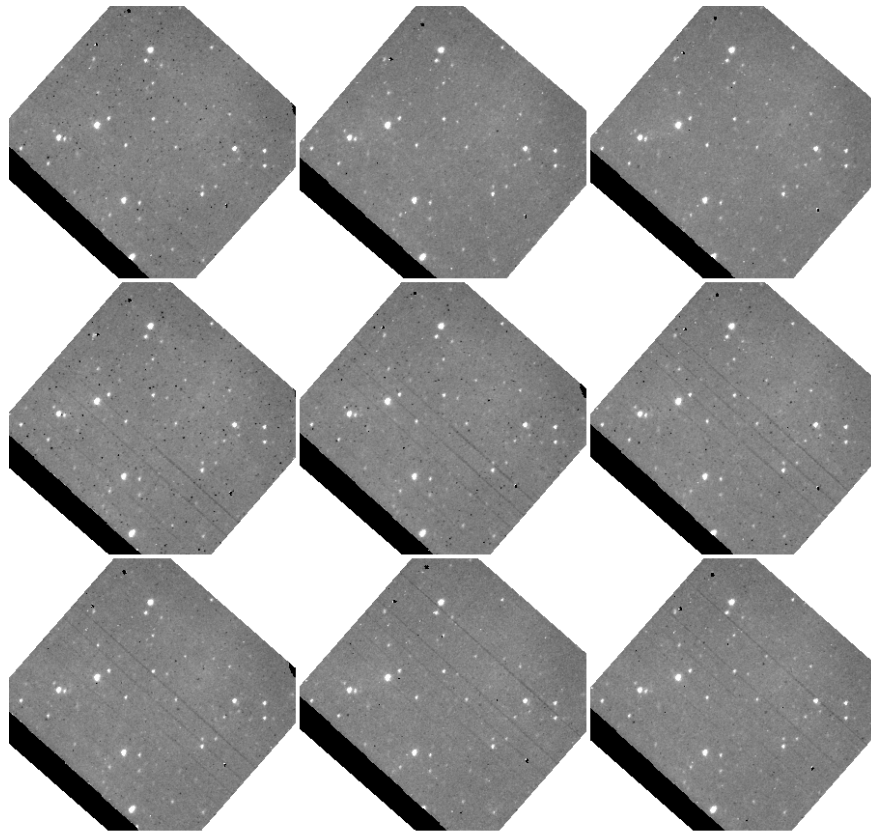
# Remaining issues

- Drifting
  - 望遠鏡の姿勢決定精度が悪い場合に起きる
  - elongated NIR PSFs
  - some MIR frames excluded from stacking



N3 frames from ObsID= 1320235\_001 (top) and \_002 (bottom)

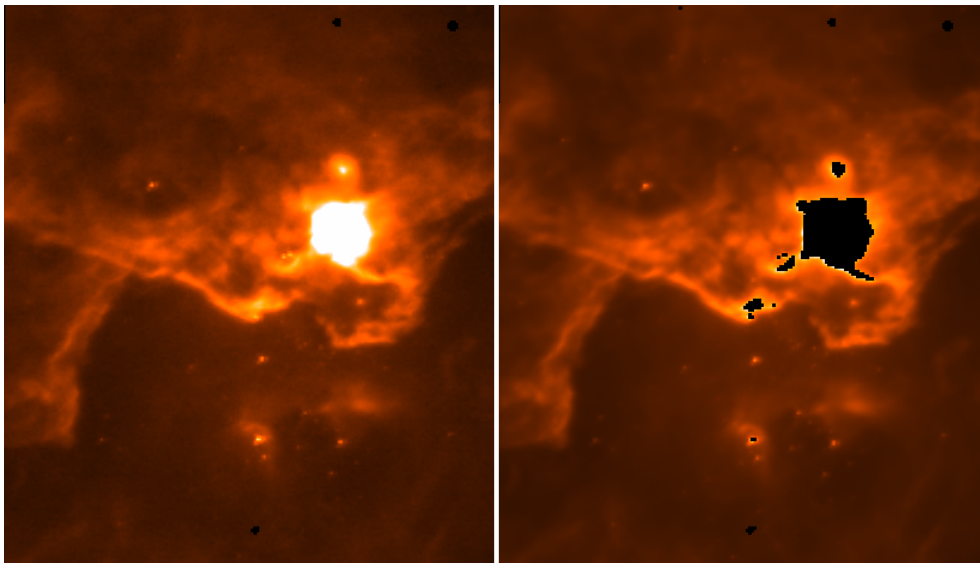
# Remaining issues



S7 stacked images from ObsID=1300330\_00\*

- Multi-pointing
  - stacking frames from multiple IDs not supported in the toolkit yet

# Remaining issues



S11 short (left) and long (right) exposure frames  
black=masked area

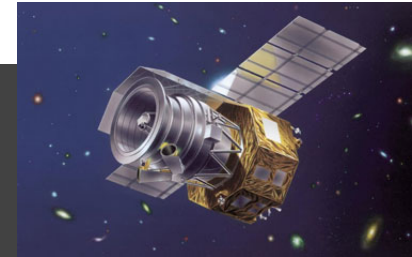
- Short-exposure frames
  - currently not used nor stacked
  - saturated pixels in long-exposure frames may be recovered

**Table 1.** Unit number and exposure time of each channel/exposure configuration.

Channel	Exposure	Unit number	$t_{\text{exp}}$
NIR	short	8	4.6752
	long	76	44.4144
	long (IRC05)	112	65.4528
MIR	short	1	0.5844
	long	28	16.3632

Tanabe et al. (2008)

# Summary



- Toolkit
  - new dark frames
  - new flat frames
  - improved stacking
  - improved WCS
  - flux calibration
- Processed data
  - ~4000 IDs from Phase 1&2
- Data release
  - expected: end of March, 2015
  - interface will be revised and enhanced
- Documents
  - Data Users Manual
  - journal paper (Egusa et al., in prep.)