東京大学 大学院
理学系研究科・理学部
SCHOOL OF SCIENCE, THE UNIVERSITY OF TOKYO

An Introduction of Department of Astronomy, the University of Tokyo

戸谷 友則 (TOTANI, Tomonori)

Chile-Japan Academic Forum, Nov. 7-11, 2016
Workshop 01: Astronomy and Related Technologies, Nov. 8
Punta Arenas, Chile

History

- SHIBUKAWA, Harumi （渋川春海）
  - astronomer, Go (game) player, 1639-1715
  - made the first Japanese original lunisolar calendar “Jokyo Reki”（貞享暦）used during 1685-1755, based on his own observations
    - before this, old calendar imported from China was used from 9th century for more than 800 years
  - the first director of the Observatory of the Tokugawa Shogunate （幕府天文方）, established in 1685

History (contd.)

- the Shogunate Observatory continued until the end of the Edo (old Tokyo) era (1867)
- The main site located in Asakusa, Tokyo
- drawn in Hokusai's "Torigoe-no-Fuji" （鳥越の不二図）

History (contd.)

- the Shogunate Observatory continued until the end of the Edo (old Tokyo) era (1867)

okyo

History (contd.)

- the Shogunate Observatory continued until the end of the Edo (old Tokyo) era (1867)

History (contd.)

- Soon after the Meiji Restoration (1868), the University of Tokyo was established as a modern university in 1877
  - the Shogunate Observatory is one of the three progenitors of UTokyo
  - Astronomy was one of the 8 departments of School of Science
    - Only three universities in Japan (Tokyo, Kyoto, Tohoku) have Astronomy Departments independent of physics

UTokyo Campuses

Astronomy in UTokyo

- UTokyo astronomy staff (responsible for undergraduate astronomy students)
  - Department of Astronomy in School of Science (Hongo campus)
    - 4 prof., 3 associate prof., 3 assistant prof.
  - Institute for Astronomy (IoA) in School of Science (Mitaka campus)
    - 3 prof., 4 associate prof., 5 assistant prof.
  - ~9 undergrad students every year

- "Extended" astronomy in graduate school with joint-appointment members from institutes other than the department and IoA
  - 18 prof. and associate prof. from other institutes in UTokyo, NAOJ, JAXA
    - NAOJ was originally Tokyo Observatory of UTokyo (est. 1888), and became an independent nation-wide institute in 1988
  - ~20 graduate course students every year
  - The largest astronomy department in Japan, covering wide fields in astronomy & astrophysics
    - theory
    - optical & near-infrared
    - radio
    - X-ray, gravitational waves, …

Department of Astronomy in Hongo

- core of astronomy education in UTokyo

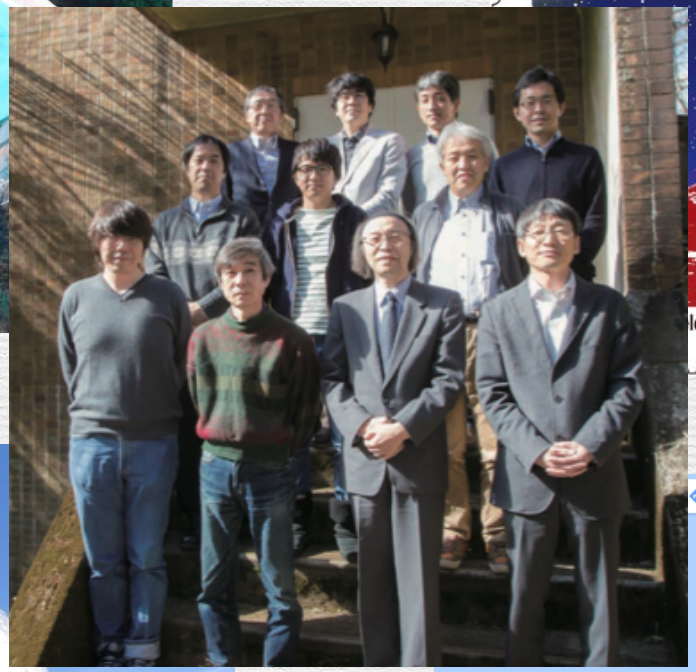
School of Science Bldg. 1
11th floor

the Yasuda Hall
(symbol of UTokyo)

Institute for Astronomy in Mitaka

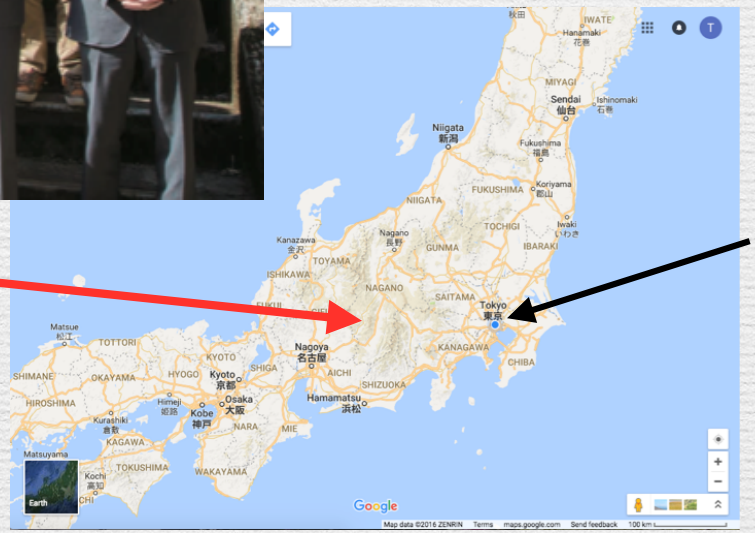
- Promoting observational projects such as Kiso Observatory and TAO in Chile

IoA building in Mitaka



TAO project in Mt. Chajnantor in Chile

Kiso Observatory



Further Astronomy/Astrophysics in UTokyo

- Some groups in Department of Physics
  - theory, X-ray, radio, gravitational waves, …
- Institute for Cosmic Ray Research (ICRR)
  - Super-Kamiokande
  - Telescope Array (ultra high energy cosmic rays)
  - KAGRA (Japanese gravitational wave experiment)
  - CTA (Cherenkov Telescope Array) (very high energy gamma-rays)
  - …
- Kavli Institute for Physics and Mathematics in the Universe (IPMU)
  - theory (fundamental physics, early universe, astrophysics, …)
  - Subaru HSC/PFS
  - …

Some Recent Scientific Results
(from the Hongo campus staff)

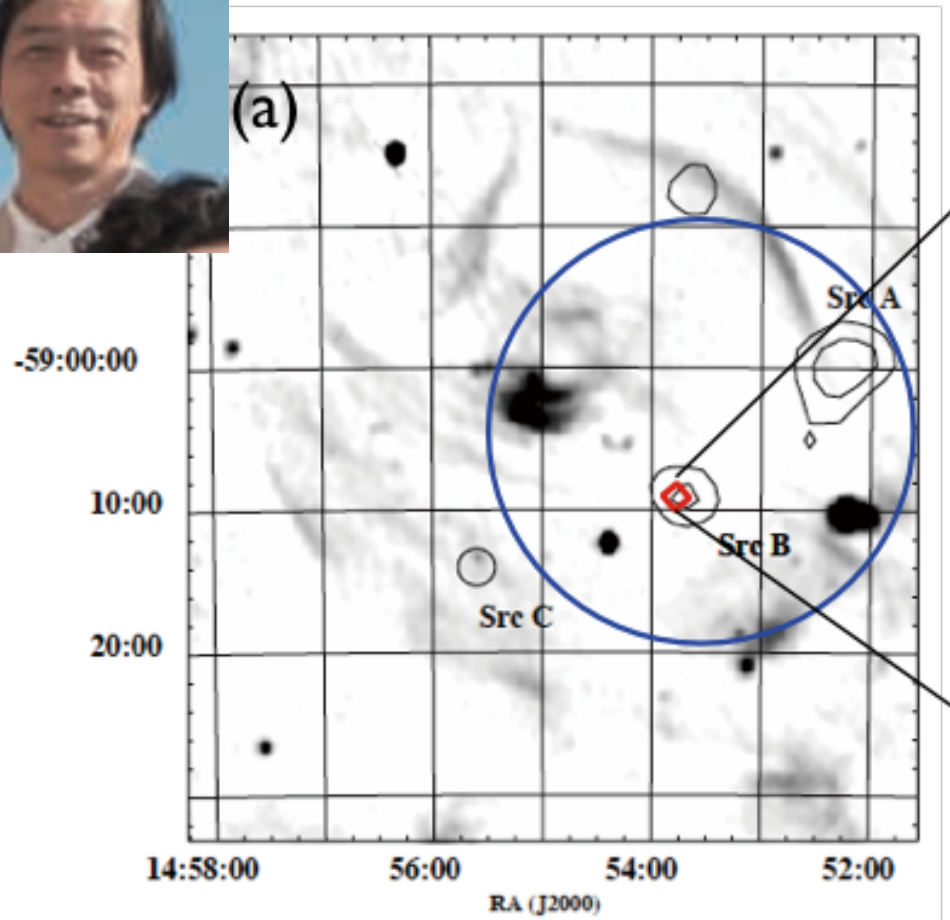
Detection of CO (v=1-0) emission toward an Extended Green Object (EGO) with AKARI

Onaka's group
Infrared astronomy from space

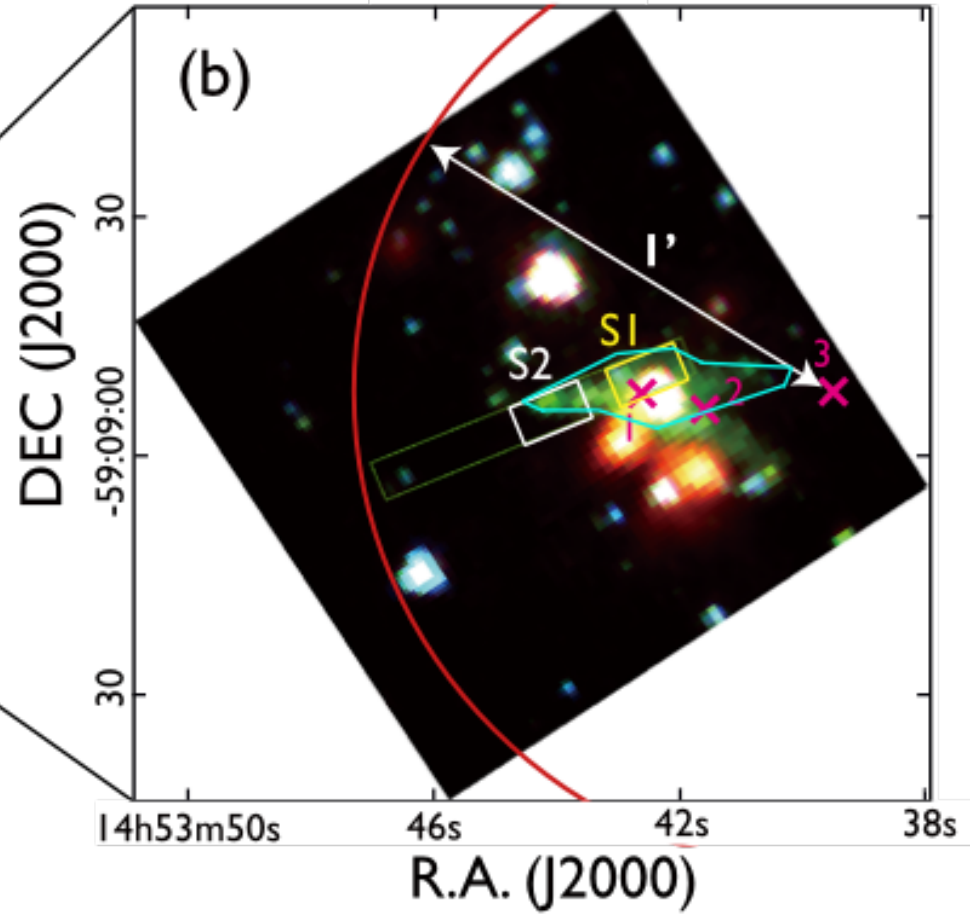
T. Onaka+ 2016 ApJ, 829, 106

Infrared satellite AKARI made near-infrared spectroscopy of the EGO G318.5+0.09, which is bright at 4.8μm (S2 in the right figure)

X-ray image



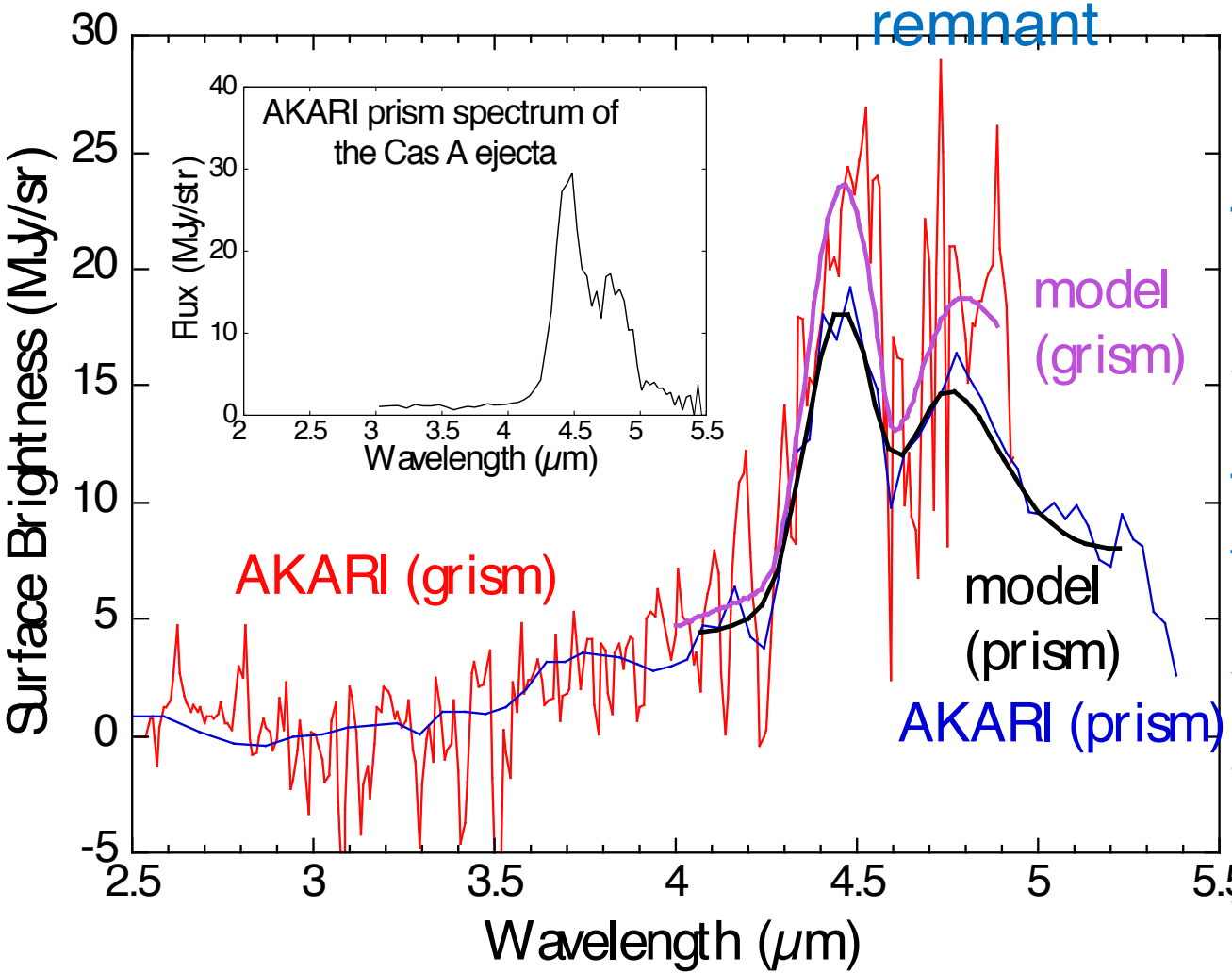
Infrared image
(B:3.6μm blue, G:4.8μm, R:8μm)



Supernova remnant?

The AKARI spectrum shows peculiar emission, which can be accounted for by highly blue-shifted (V <-2000km/s) CO(v=1-0) emission w/o H_2

The large |V| and H_2-poor characteristics together with the similarity to the Cas A spectra suggest that it may come from a unknown supernova remnant



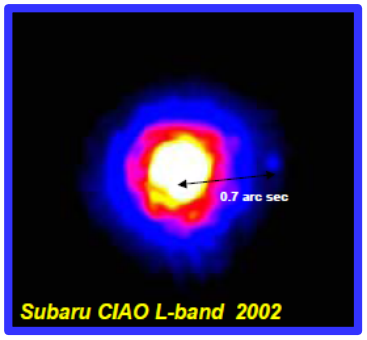
The red (grism) and blue (prism) lines are AKARI spectra

The purple and black lines are fitted model emission of CO (v=1-0) with T =2000K and V= -4100km/s (for grism spectrum) or T=1600K and V= -4700km/s (for prism spectrum)

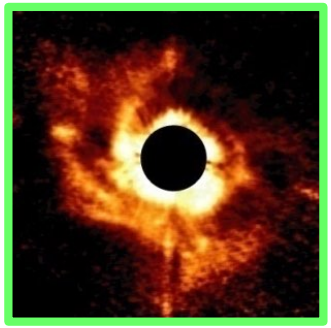
Motohide Tamura
UTokyo & NINS

SEEDS –Strategic Explorations of Exoplanets and Disks with Subaru

- The first "Subaru Strategic Program (SSP)"
- 120 nights from 2009; **finished in 2015,** only <1 night loss due to HiCIAO
- NIR direct imaging and census of **giant planets in the outer regions** (10-100AU) around **~500 solar-type and massive stars**
- Exploring **protoplanetary disks** and debris disks for the origin of their diversity and evolution at the same radial (10-100AU) regions
- **Direct linking** between planets and protoplanetary disks

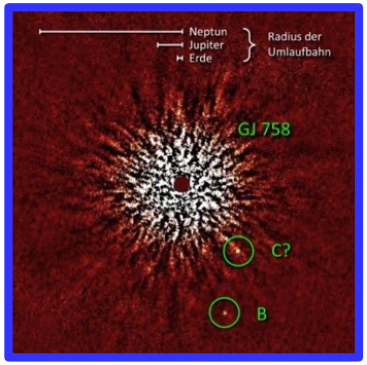


Resolution
=0.1-0.2"

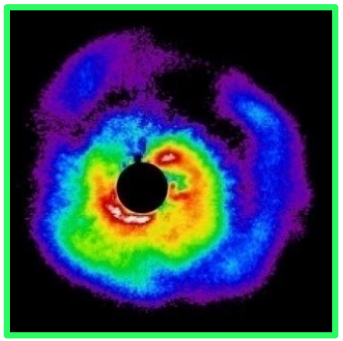


>100AU scale
w/ CIAO

⇒



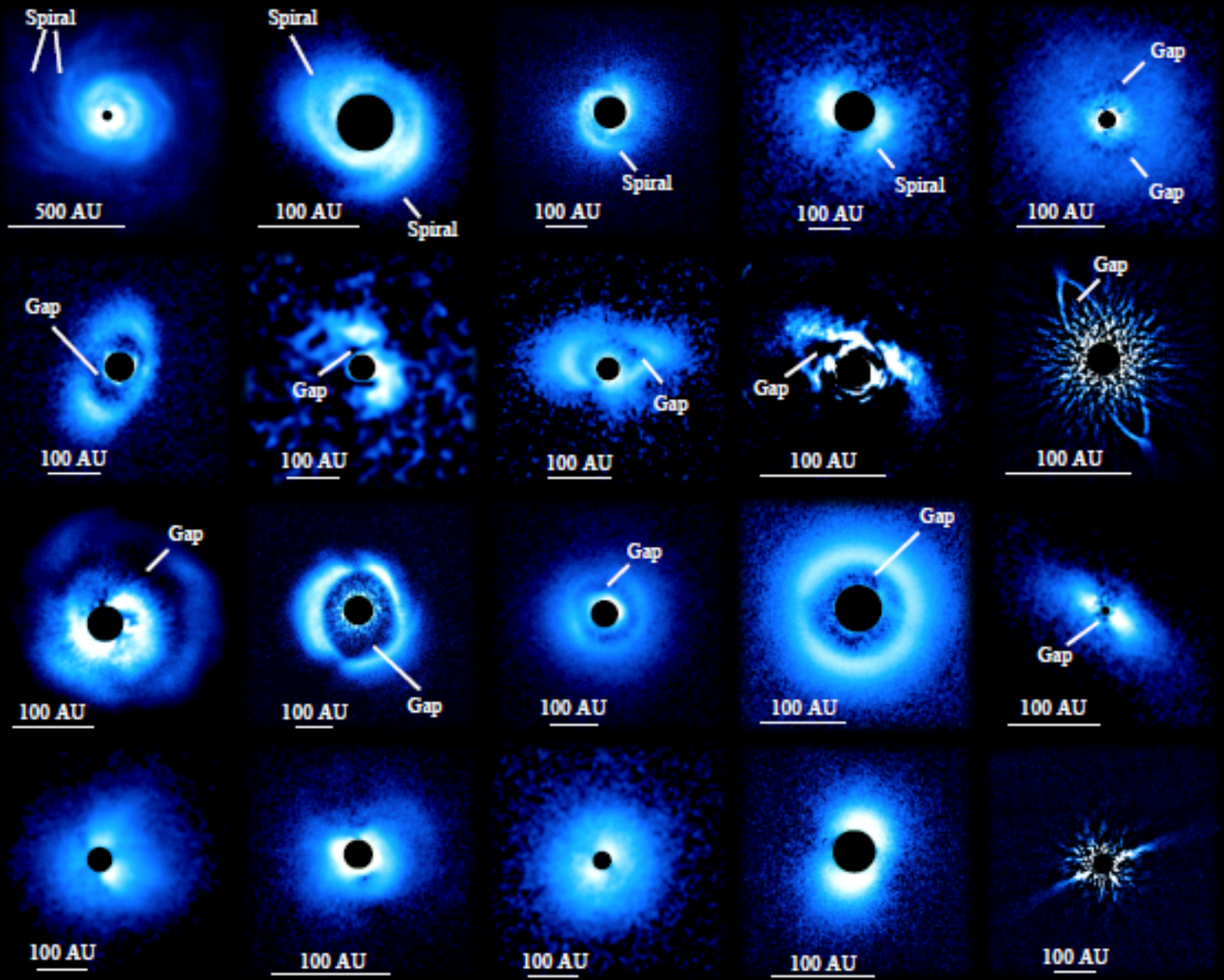
Resolution
=0.05-0.1"
Contrast
Improved by ~10



Solar-System Scale (<100AU) w/ HiCIAO

SEEDS has revealed gaps & rings of <100AU scale in many disks by polarimetric imaging (Res.~0.06", IWA~0.1")

Note that ALMA HL Tau image (2015) is thermal emission .



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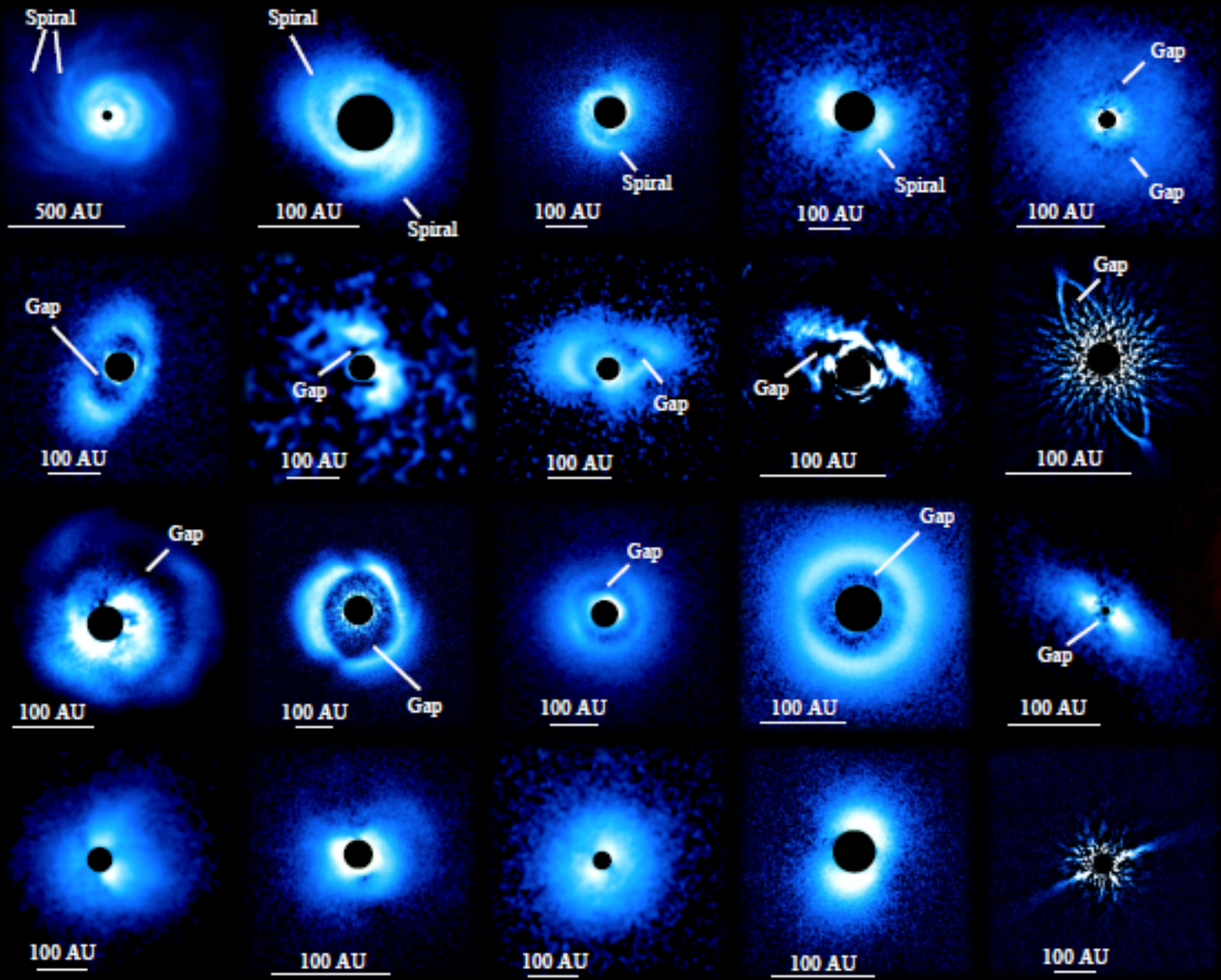
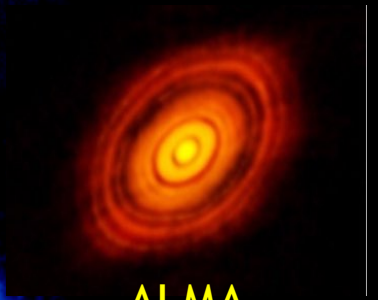


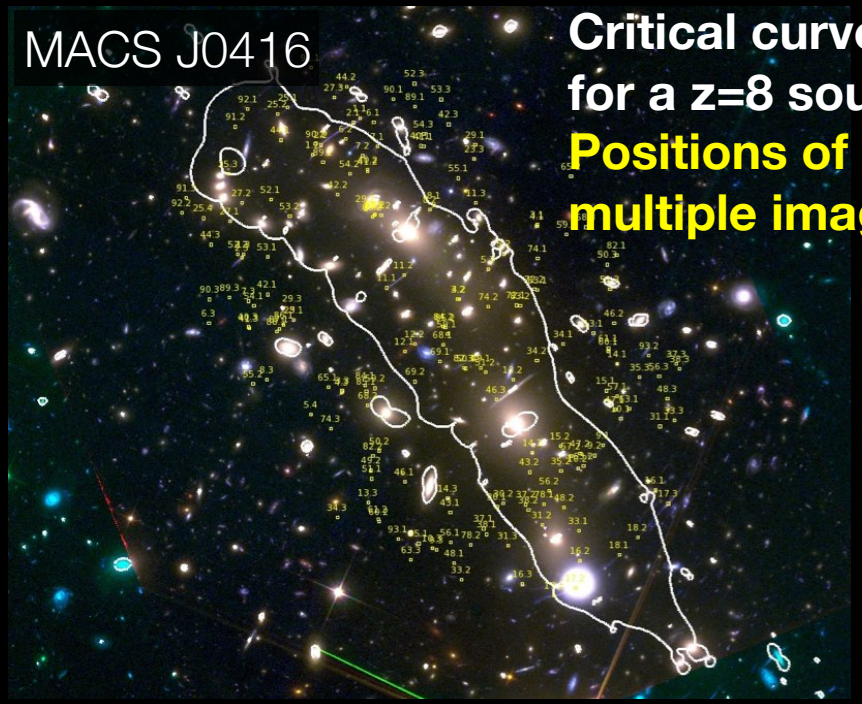


ALMA
HL Tau

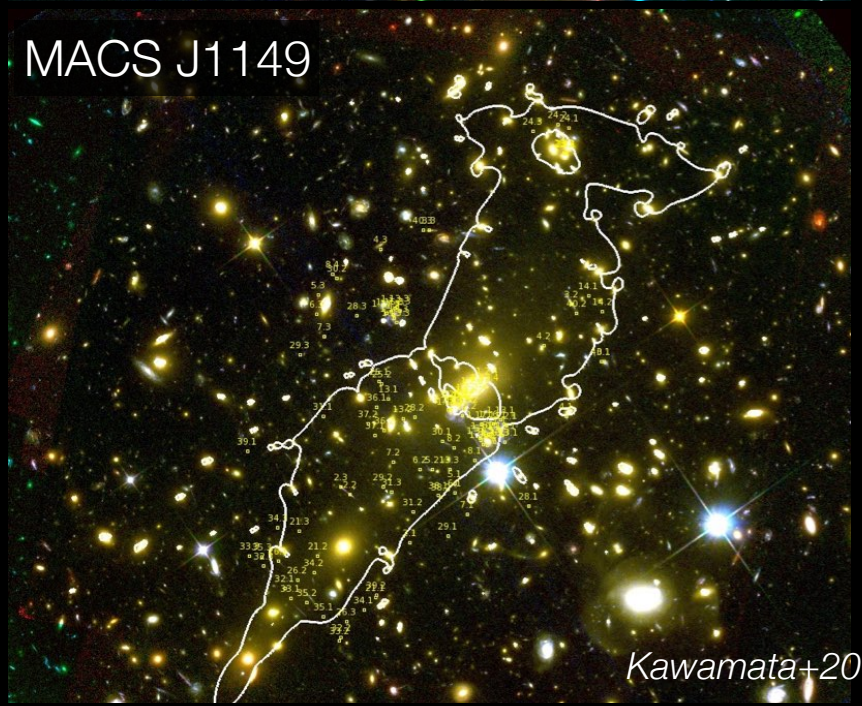
GLAFIC TEAM'S MASS MODELS

Hubble Frontier Field clusters

Shimasaku's group
Galaxy formation/evolution
(see Kawamata's talk later)



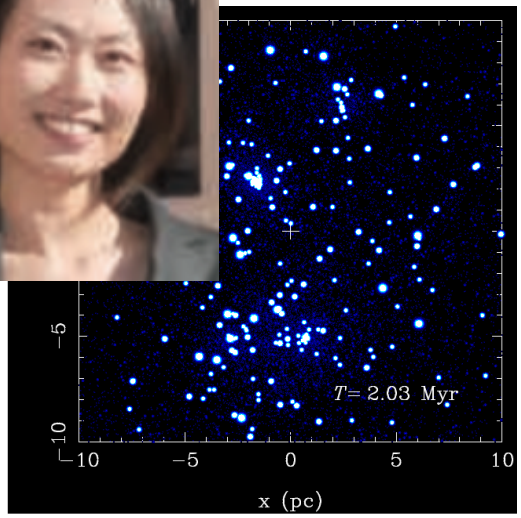
Critical curves for a z=8 source
Positions of multiple images

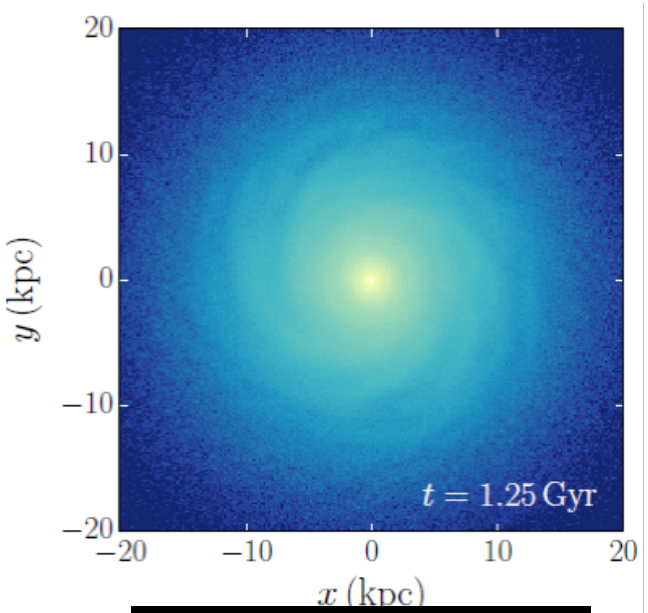


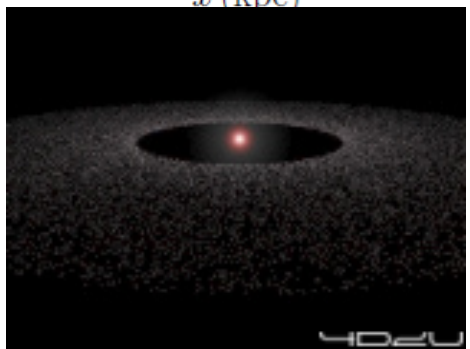
Kawamata+2016

Michiko FUJII

Computational Astronomy, N-body simulation



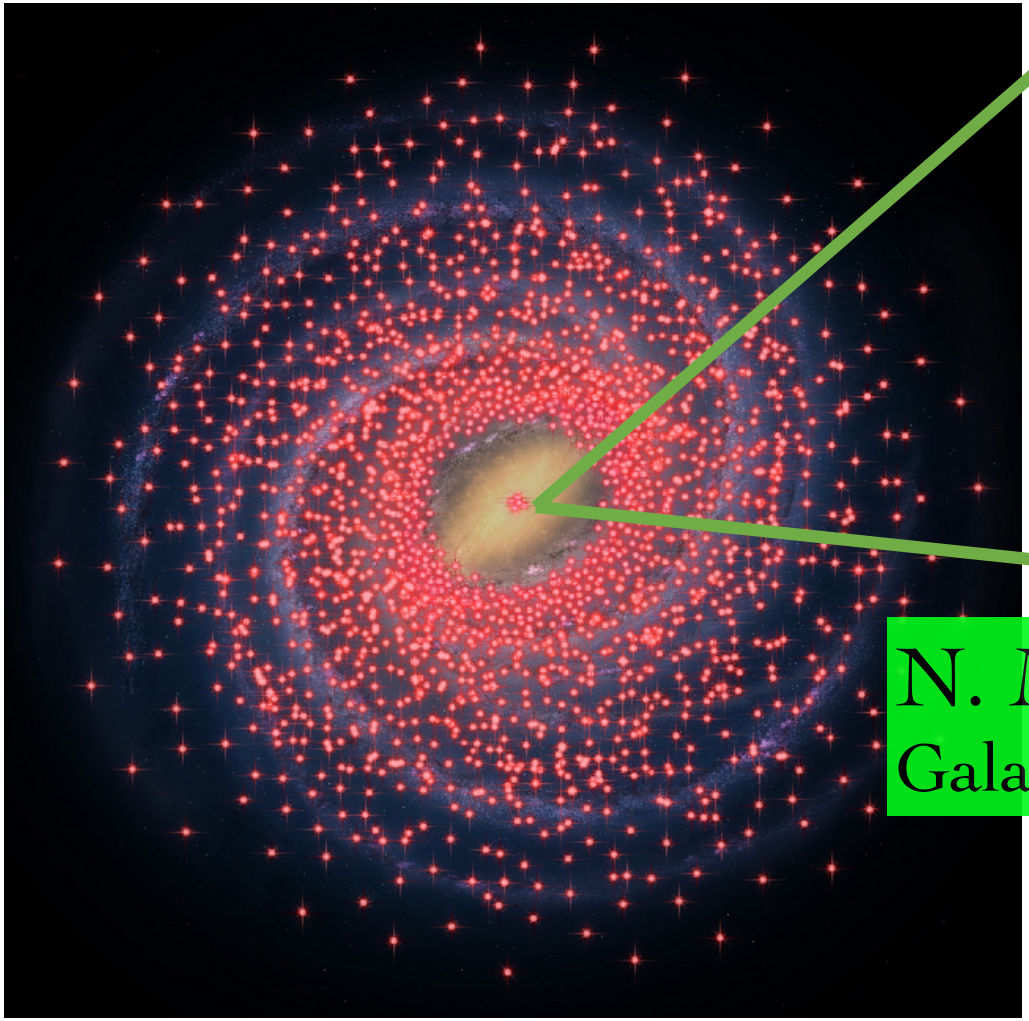


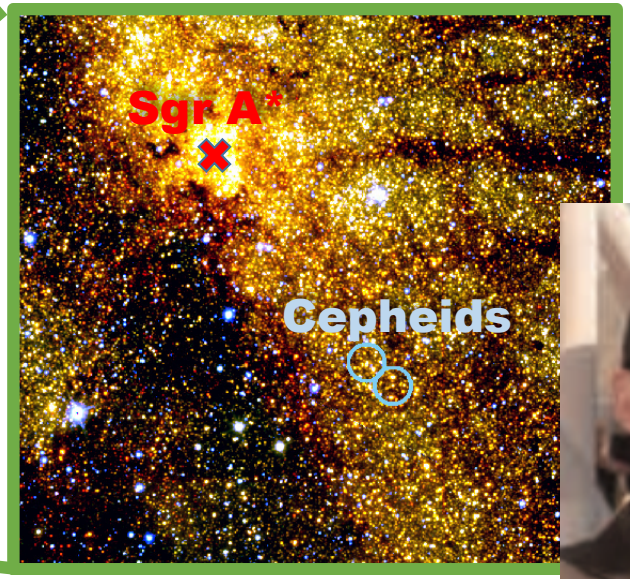


- **Formation and Evolution of Star Clusters**
  - From star forming regions to young star clusters
  - Massive clusters
  - Formation of binary black holes in star clusters
  - Gravitational waves from binary black holes
- **Dynamical Evolution of Disk Galaxies**
  - Formation and evolution of bars and spiral arms
  - Coevolution of galaxies and supermassive black holes
  - Galaxy formation
- **Formation of Planets**
  - Formation and dynamical evolution of planets in star clusters
  - Evolution of planetesimals

Drawing the map of the Milky Way

- Cepheids as tracers of obscured regions in the MW discovered by infrared observations





N. Matsunaga

Galactic dynamics & stellar evolution

Matsunaga et al. (2011, Nature 477, 188)
Matsunaga et al. (2016, MNRAS 462, 414)

Totani's group
cosmology, galaxy, and high energy phenomena

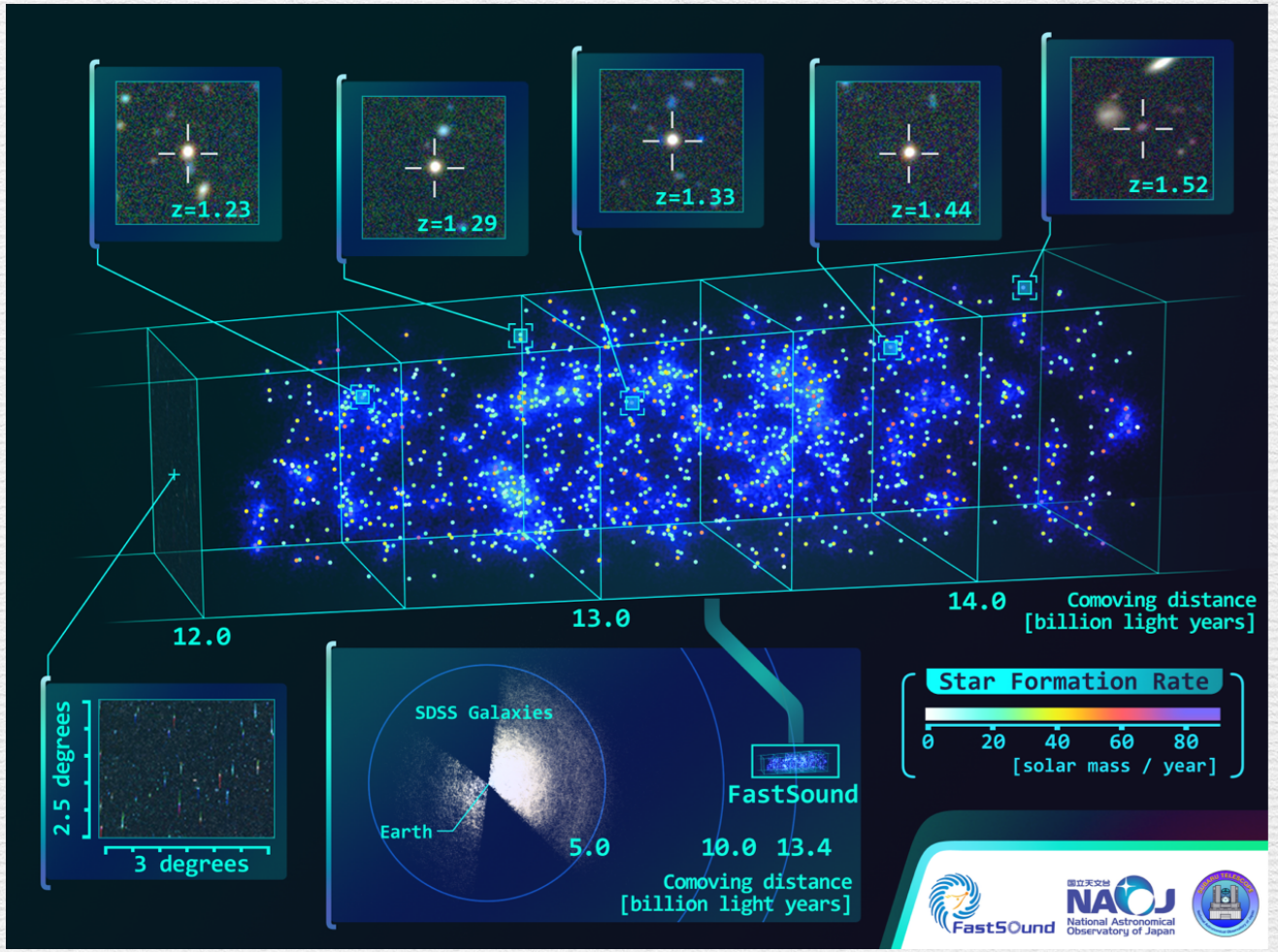
FastSound: the largest volume galaxy redshift survey at $z > 1$ using Subaru Telescope FMOS spectrograph (NIR)

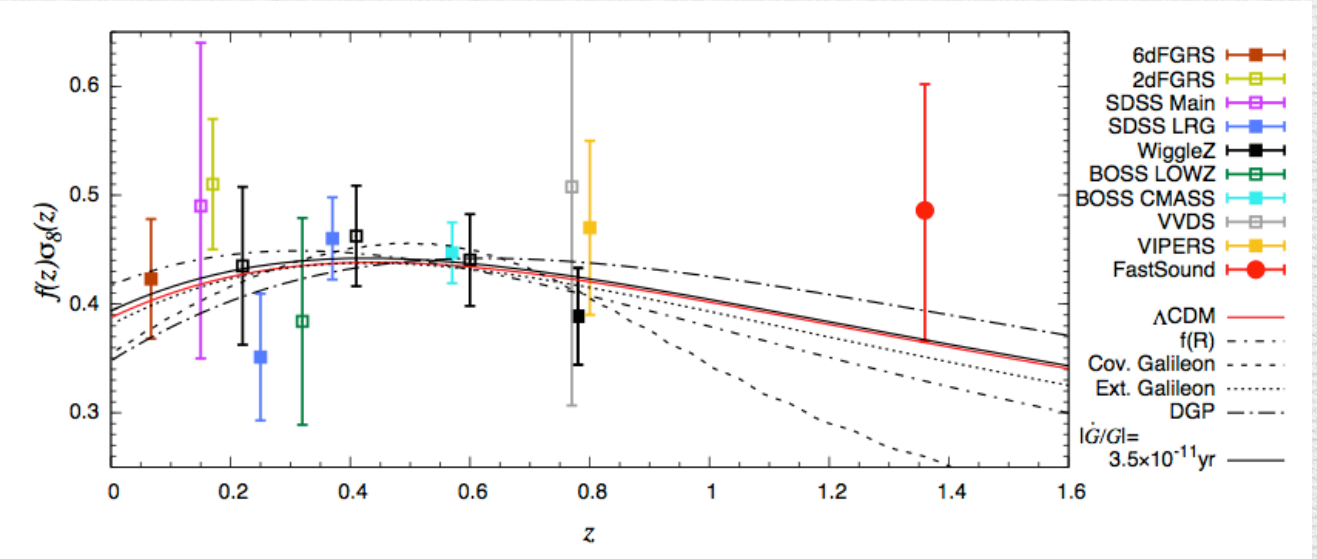
~4,000 redshifts at $1.2 < z < 1.5$ in 20 deg^2

the first detection of redshift space distortion at $z > 1$

test on gravity theory to study the origin of accelerated cosmic expansion

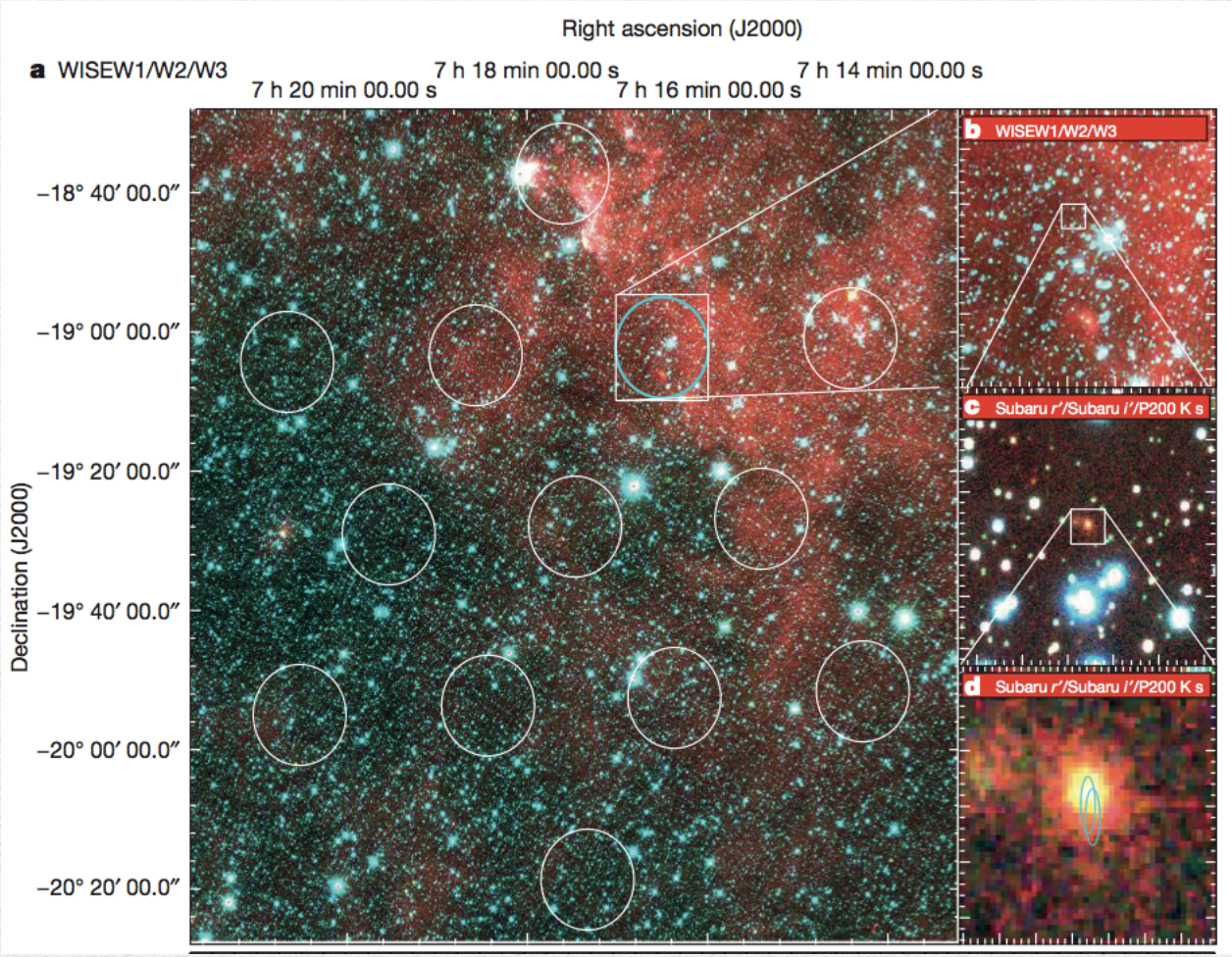
Okumura+'16
PASJ 68, 38





Totani's group
cosmology, galaxy, and high energy phenomena

- fast radio burst (FRB) follow-up by Subaru
- mysterious radio transient with only 1 msec duration
  - dispersion measure implies cosmological distance z~1
- host galaxy identification of FRB 150418 at z = 0.49
  - Subaru data played a crucial role
  - consistent with dispersion measure
  - missing baryon problem solved
  - but dispute… may be an AGN radio flare, needs more observations



Keane+'16
Nature 530, 453