

# Japanese e-VLBI network OCTAVE

National Astronomical Observatory of Japan (NAOJ)

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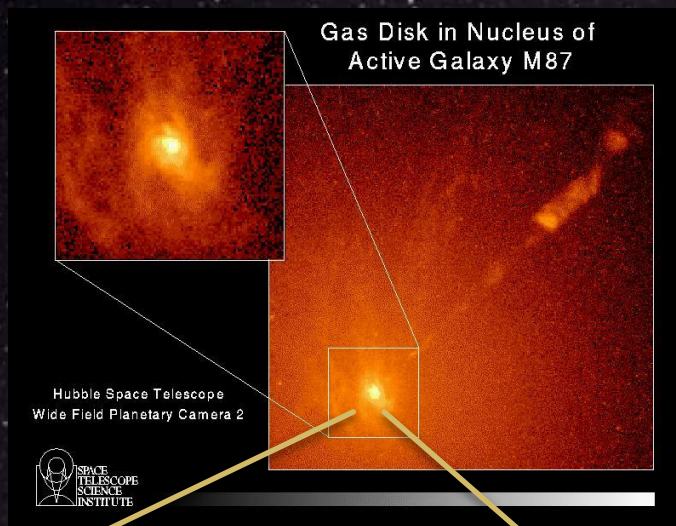
and OCTAVE Team

(JAXA, NICT, GSI, Yamaguchi, Gifu, Tsukuba, Hokkaido Univ.)

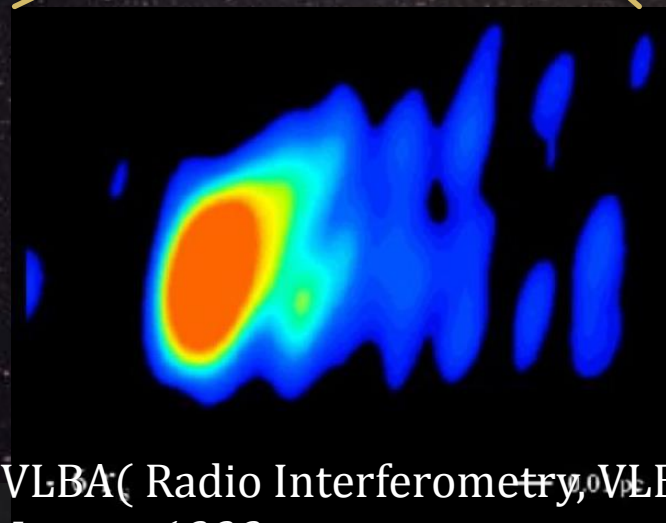
# Contents

- ◇ Radio Astronomy and VLBI
- ◇ OCTAVE Network and the Resent Scientific Result
- ◇ Future Works

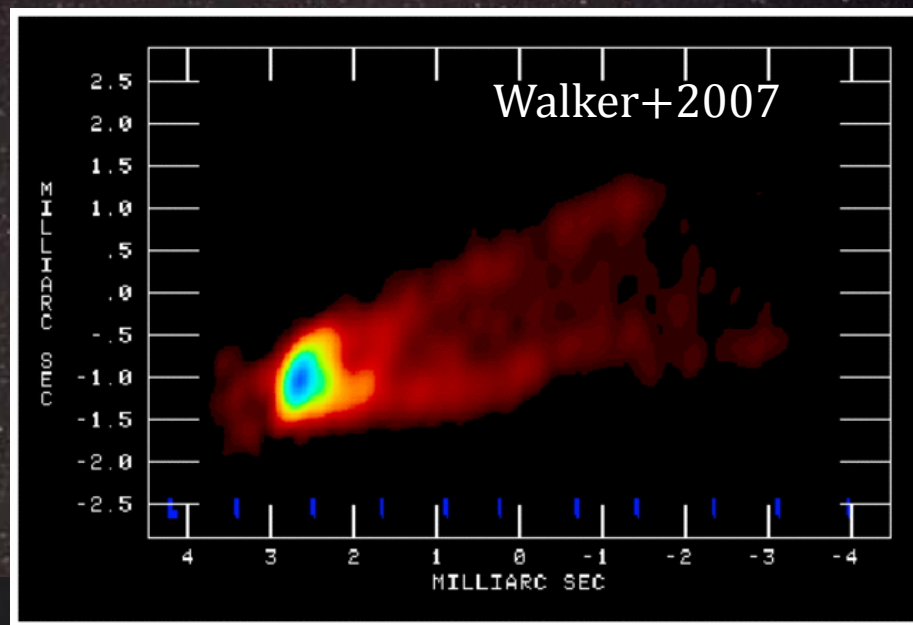
# HST (OPTICAL) *Harms + 1994*



M87



VLBA (Radio Interferometry, VLBI)  
*Junor + 1999*





# Key Specification of Telescopes

◇ Resolution  $\lambda/D$

◇  $\lambda$ : wavelength

◇ D: Diameter

1 $\mu$ m / 2.4m

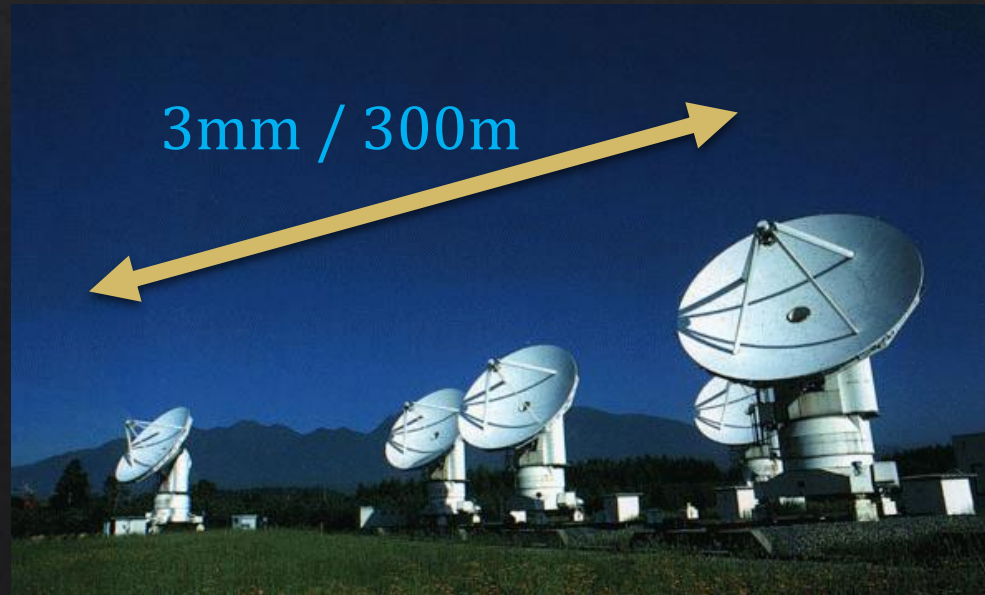


<http://asd.gsfc.nasa.gov/archive/hubble/>

3mm / 45m



3mm / 300m

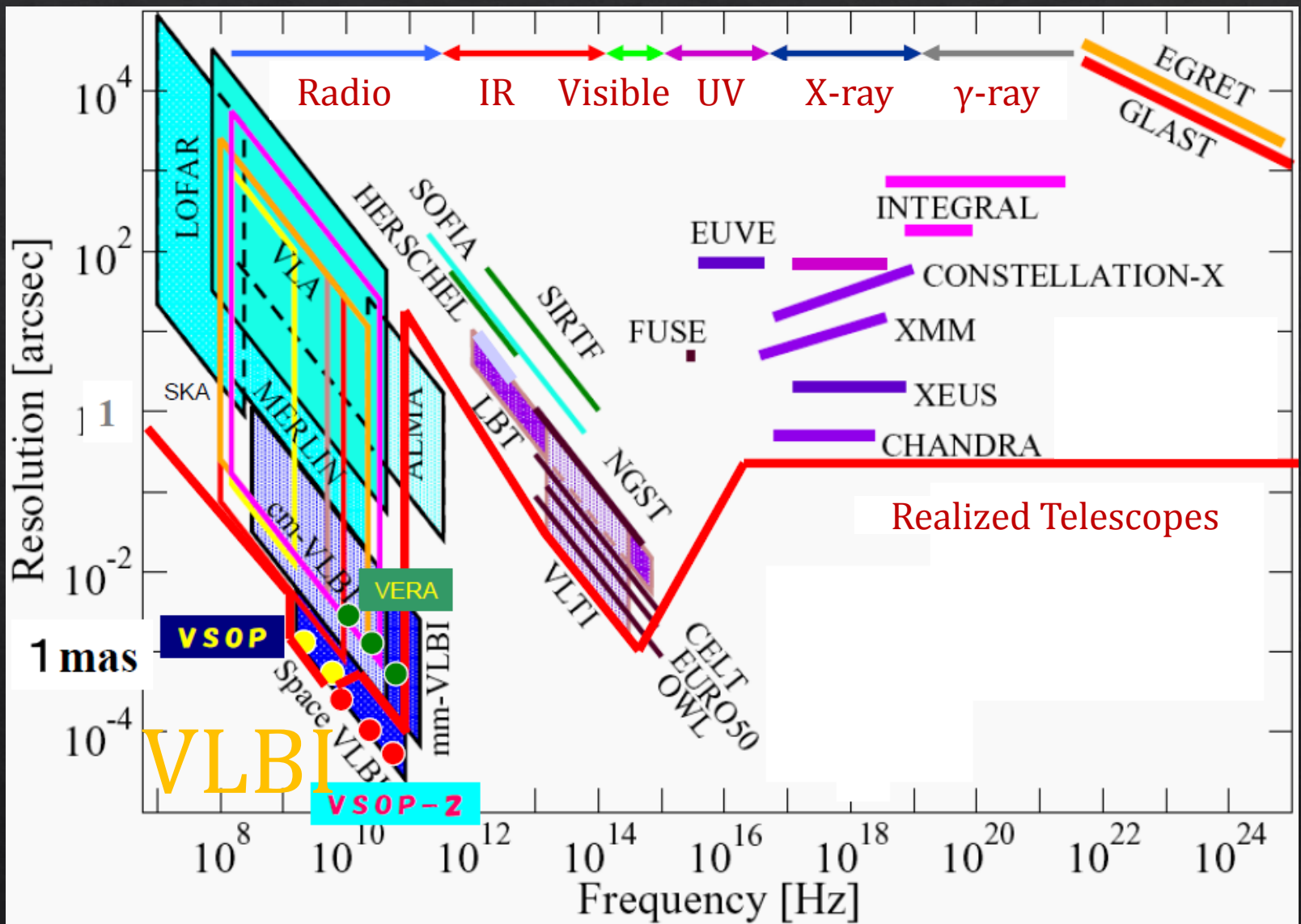


# VLBI (Very Long Baseline Interferometry)



Japanese VLBI,  $D=2000\text{km}$

# Resolution of telescopes



High  
Resolution



# Key Specification of Telescopes

## ◇ Sensitivity

$$= \frac{kS \phi_1 \phi_2}{\sqrt{T_1 T_2}} \sqrt{2BT}$$

Source Flux

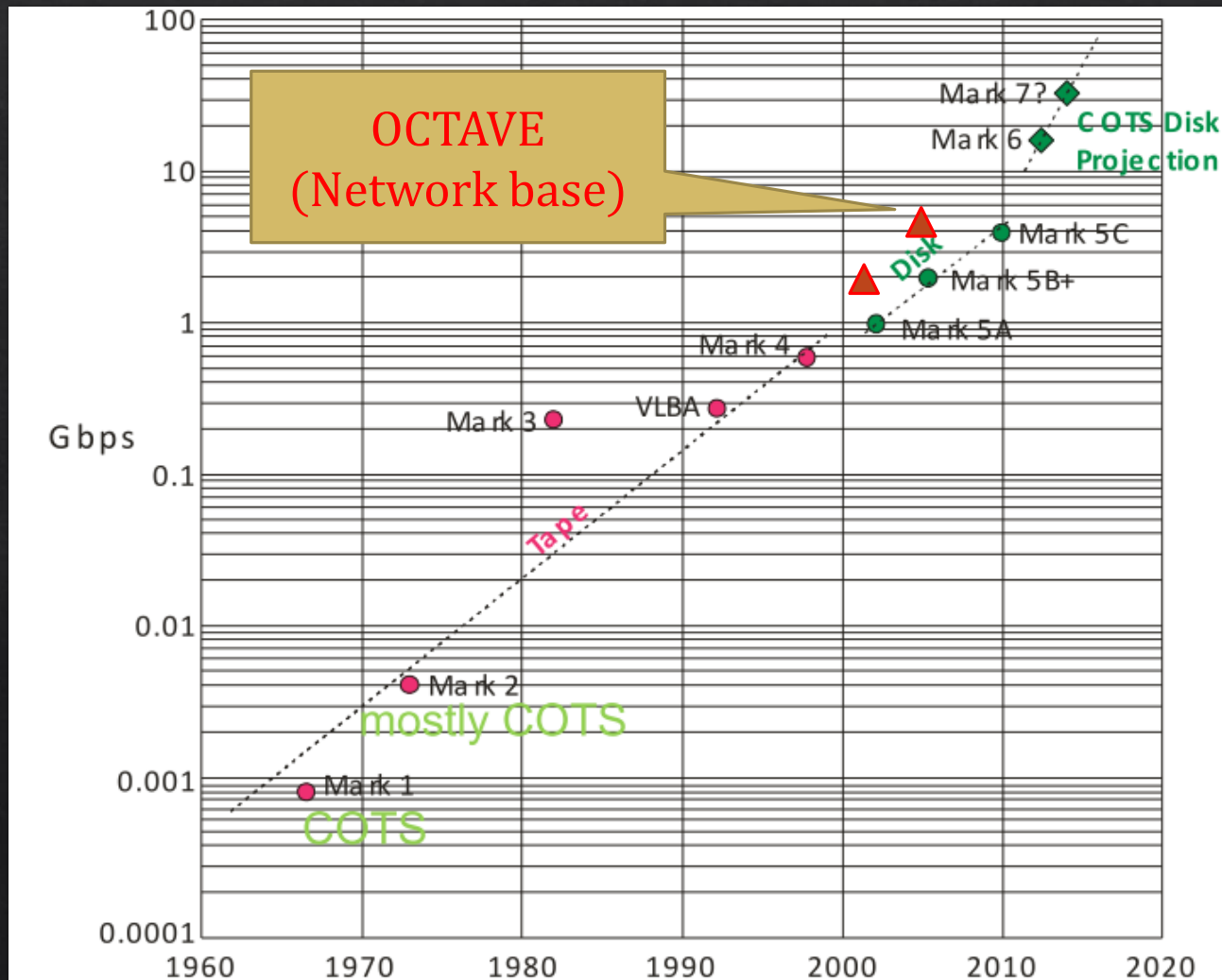
Antenna Diameter of Station 1,2

Integration Time

Receiver noise

**bandwidth**

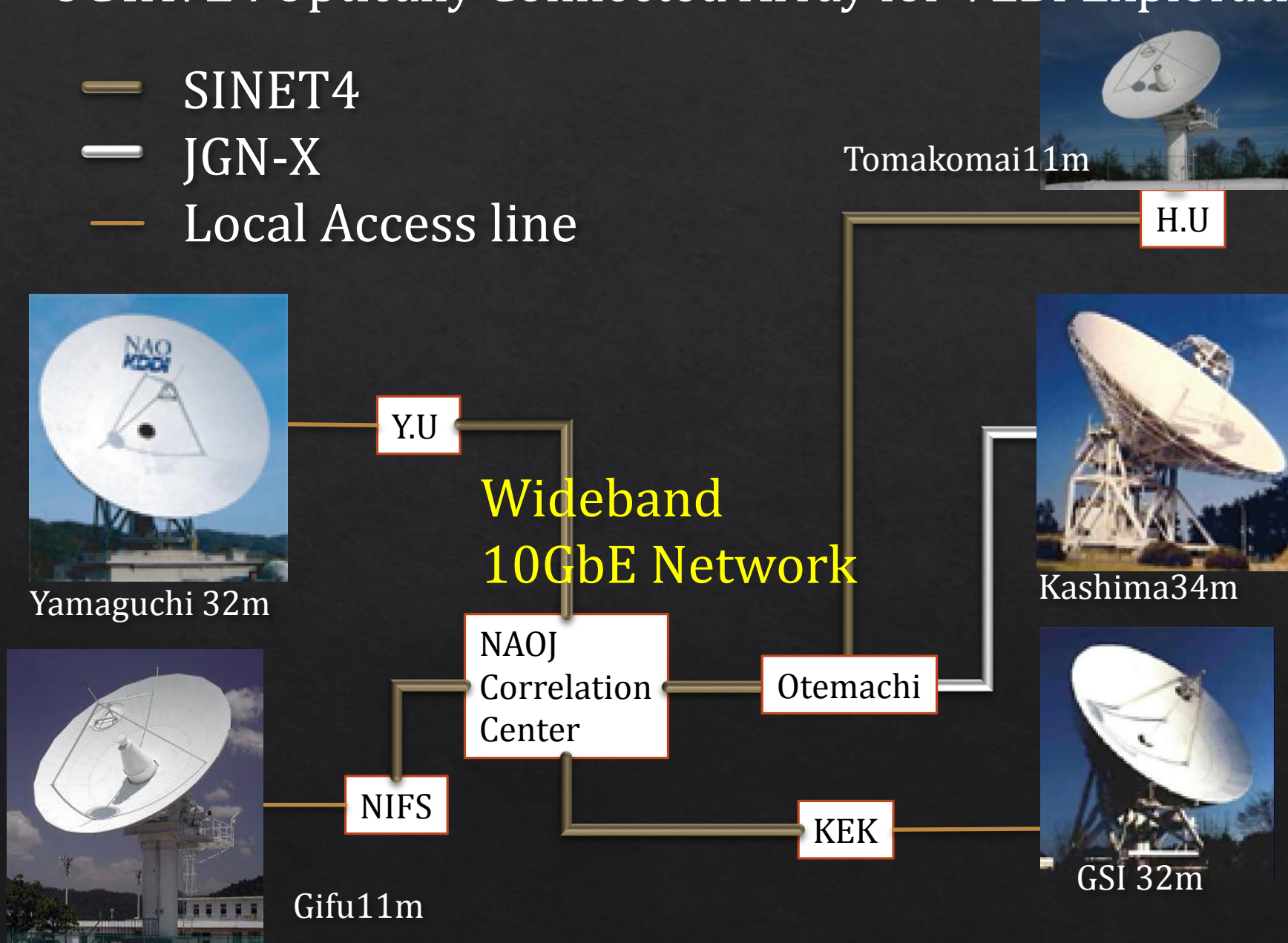
# Recoding rate capability vs time





# OCTAVE : Optically Connected Array for VLBI Exploration

- SINET4
- JGN-X
- Local Access line



# Key features of OCTAVE

- ◇ Broadband
  - ◇ Weak sources
- ◇ Real time (Unique in the world)
  - ◇ Agile and light operation
    - ◇ transient/burst radio sources
    - ◇ survey observations

In scientific operation as an element of JVN (Japanese VLBI network)

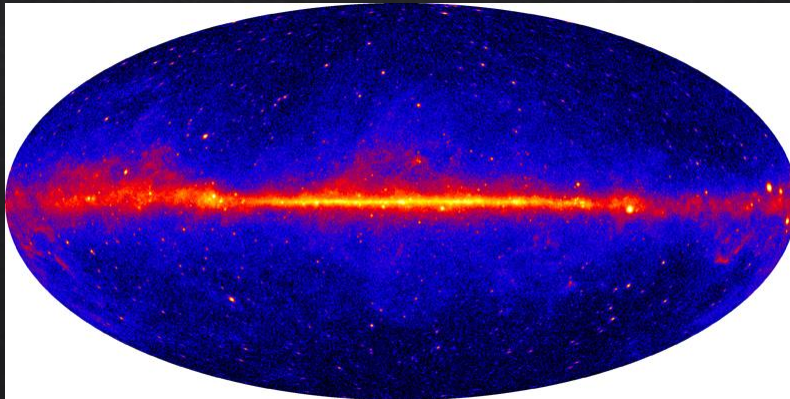
# An example of science results

◇ Niinuma + 2013



# VLBI Observation of *Fermi*/LAT Un-associated Gamma-ray Sources

- Identify the un-identified  $\gamma$ -ray sources using "high sensitivity" VLBI
  - search for new  $\gamma$ -ray emitting VLBI sources





# VLBI observation for Fermi-FoVs

- Obs. Status:

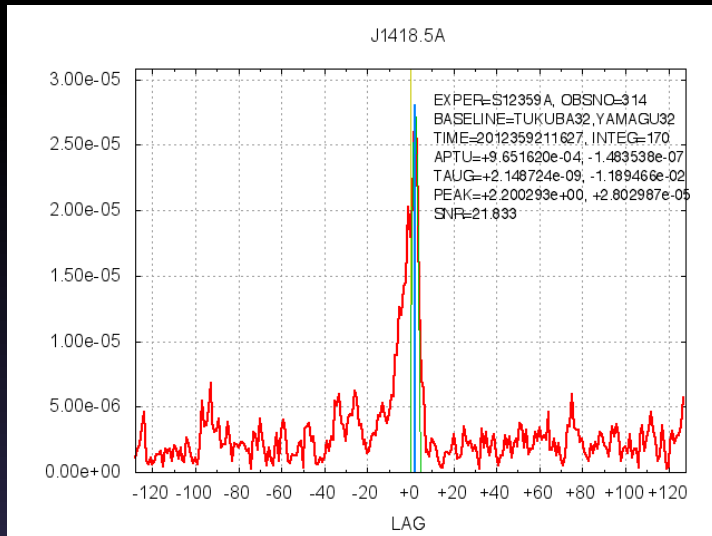
- Date: 2012 Dec 1, 2, 3, 8, 24, total of 70-hrs
- 1-baseline: Yamaguchi - Tsukuba (~800 km)
- Freq. ( $\Delta B$ ): 8.4 (0.512) GHz
- Maximum angular resolution: 9 mili-arcsec
- $T_{\text{int}}$ : 3 min (for every sources)
- $S_{\nu_{\text{min}}}$ : ~ 2 mJy ( $T_{B_{\text{min}}} > 3 \times 10^5$ ) : observations  
(~ 0.8 mJy ( $T_{B_{\text{min}}} \sim 1.4 \times 10^5$ ) : calculation)

- Target:

- We conducted observations for 150 un-IDs  
( = 845 sources which are 70% of all our targets)

\*all  $\delta \geq 0$  deg sources, and several  $\delta < 0$  deg sources

# Detection of new VLBI sources



new VLBI source within Fermi-FoV

- Total of 27 new VLBI sources
  - 17 detections
  - 10 marginal detections
- All VLBI sources were found one by one for each un-IDs
  - These VLBI sources are
    - possible counterpart to each unIDs?
    - $\gamma$ -ray emitting blazars?
  - Further multi- $\nu$  VLBI obs. will be planed to know morphology and radio spectra

Niinuma+2013 won YSA2013

# Future Plans

## ◆ Expansion

### ◆ Bandwidth

- ◆ A/D Convertor

### ◆ Network to the world

- ◆ Korea and East Asia

- ◆ Global

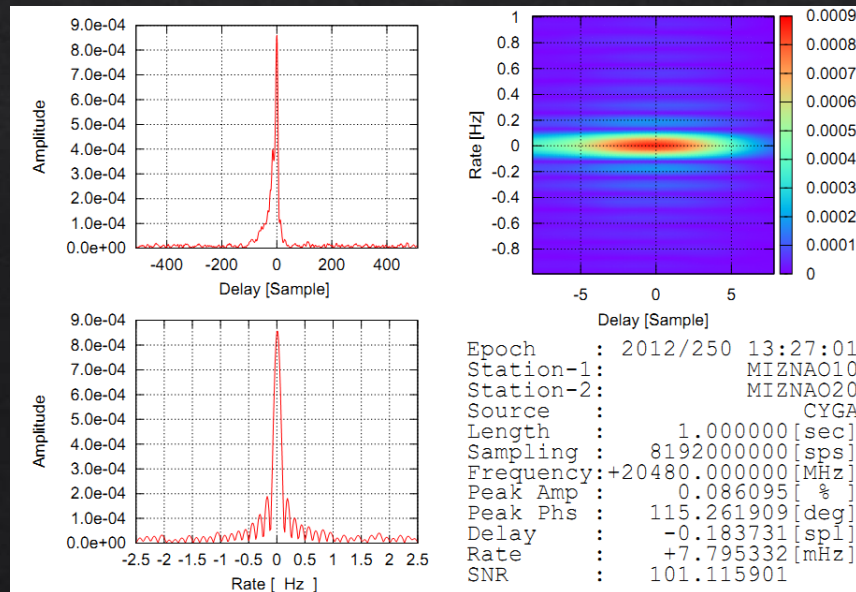
# Wideband AD Convertor

◇ OCTAD (OCTAVE AD)

◇ 8.192Gbps-2bit (16Gbps) -2ch

◇ Evaluation test observation

◇ We need wideband Communication lines.





# International connection

- ◇ To Korea
  - ◇ Korea Japan Joint VLBI Correlator at Daejeon
  - ◇ Center of East Asia VLBI Network



- ◇ To Europe
  - ◇ Noto (Italy) and Yebes (Spain)
  - ◇ Extremely Long Baseline VLBI
  - ◇ In Test observation



# Summary

◇ VLBI

◇ OCTAVE

◇ Future Plans

◇ Our VLBI network has been greatly supported by communication society