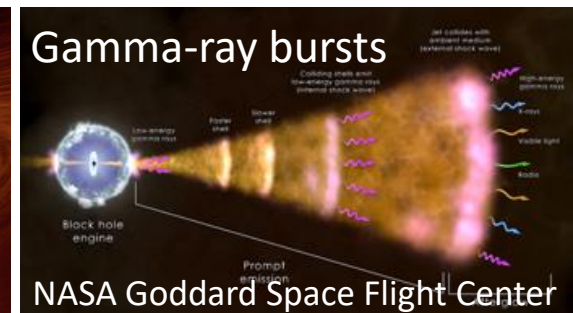
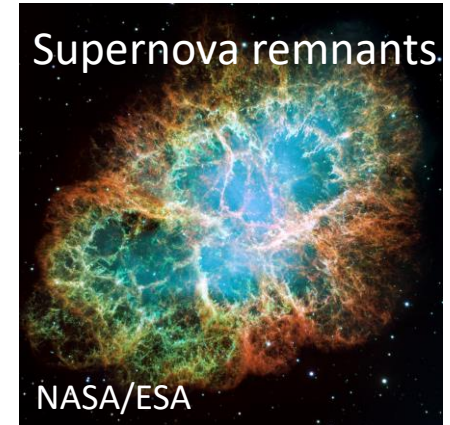
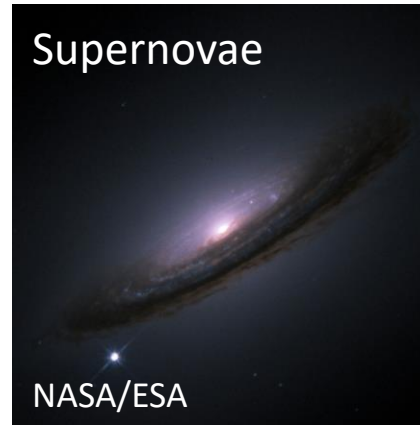
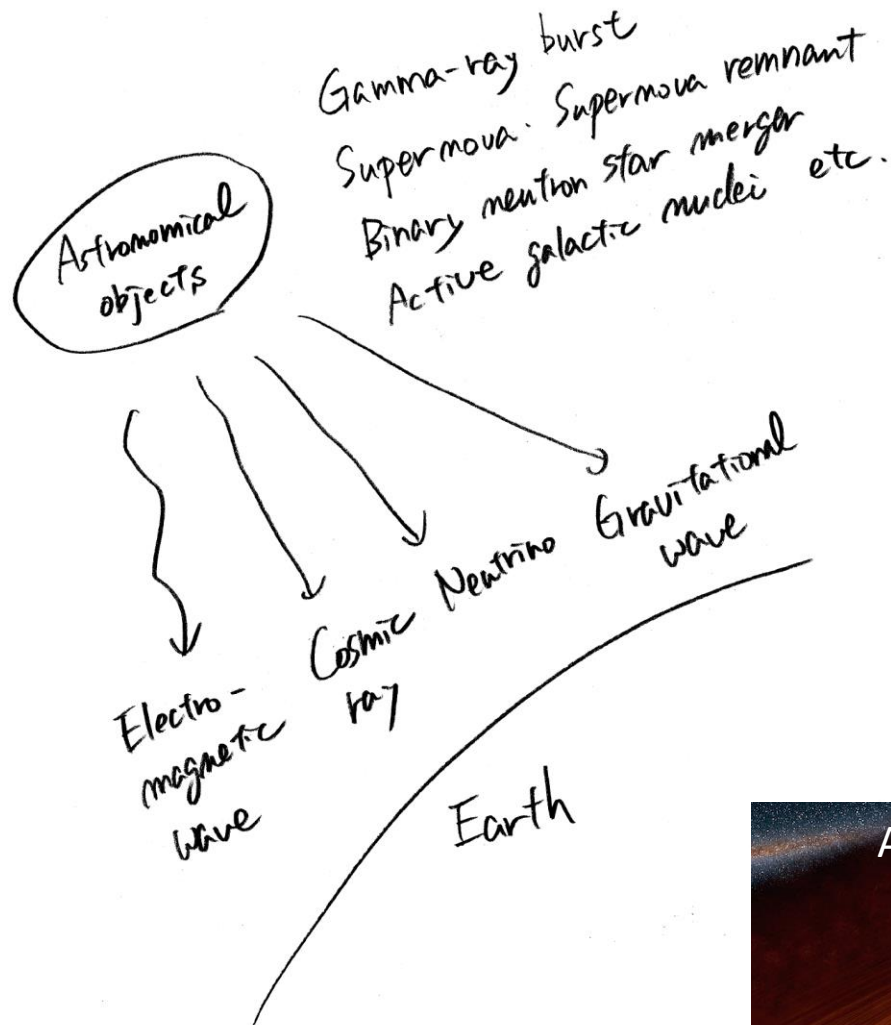


マルチメッセンジャー天文学
に向けた機能強化
Improvements for
multi-messenger astronomy

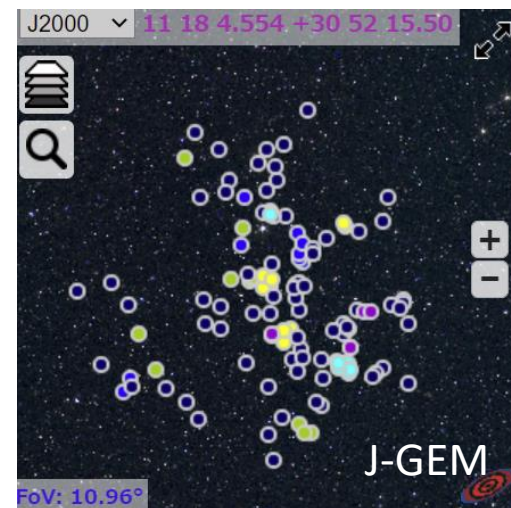
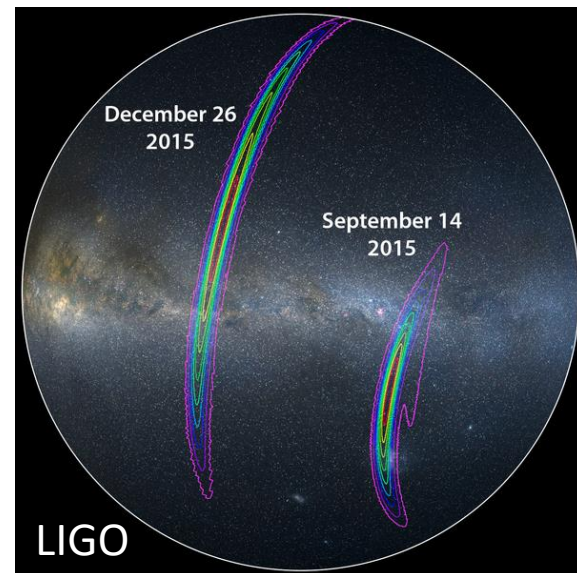
Nozomu Tominaga
(NAOJ DoS)

Multi-messenger astronomy



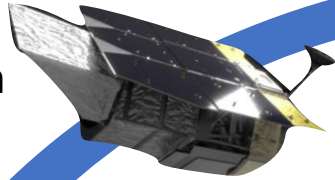
Requirements for multi-messenger astronomy

- Gravitational waves ($\sim 10\text{-}100\text{deg}^2$)
- Neutrinos ($\sim \text{several deg}^2$)
- Flowchart
 1. Alert from multi-messenger signals
 2. Follow-up in $<1\text{day}$
 3. Data reduction and analysis
 4. Report in $<1\text{day}$
- Requirements
 - Flexible operation
 - Immediate data access



Facilities for MMA

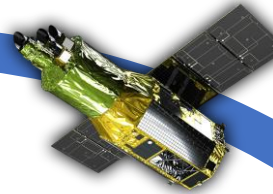
Roman



JWST

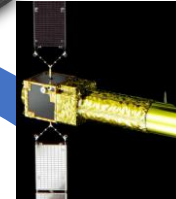


XRISM

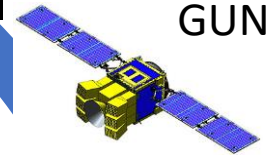


GREX-PLUS

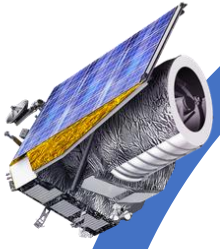
LAPYUTA



High-z
GUNDAM



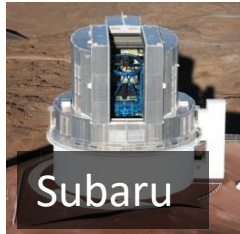
Euclid



Rubin/LSST



Subaru



TMT



ATC



Chelenvok Telescope
Array



CfCA



国立天文台
NAOJ
National Astronomical
Observatory of Japan

ADC



ALMA



KAGRA



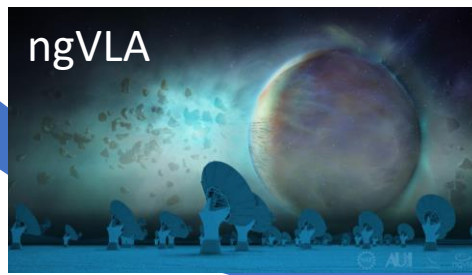
IceCube



SKA



ngVLA



Super Kamiokande
Hyper Kamiokande



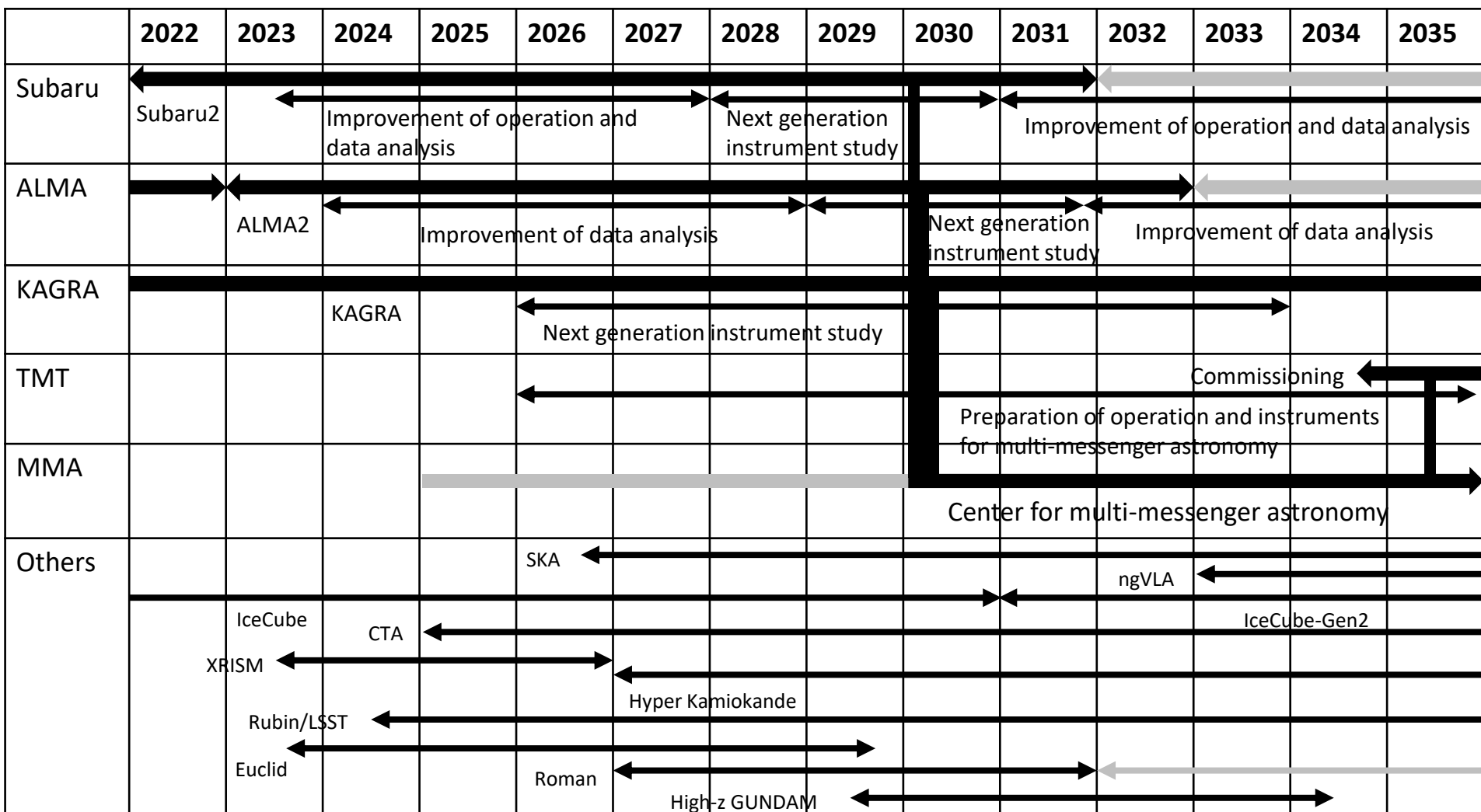
Telescope array



Expectations for NAOJ

- **Effective use** of large-scale cutting-edge astronomical research facilities
 - Subaru2 (HSC/PFS/ULTIMATE), ALMA2, KAGRA, ADC, CfCA, ATC, TMT
- **Improvements of current facilities**
 - Flexible operation
 - Immediate data access and analysis
 - Fast and stable network
 - Efficient archive system, in particular on time series
 - Preparation and coordination over projects
- **Sufficient infrastructure** (network, room, power, and A/C)
- **Increase staff members (and system engineers)** working on multi-messenger astronomy in each project
- Only NAOJ can lead the multi-messenger **astronomy**.
- Coordination with other instruments
 - Rubin/LSST, SKA, ngVLA, Euclid, Roman, IceCube-Gen2, HK, CTA, XRISM, High-z GUNDAM, LAPYUTA, GREX-PLUS, TA
- Development of new large-scale facilities if necessary

Plan



Expected science outcomes

- Nature of gravitational wave sources
- Nature of neutrino sources
- Origin of metals
- Origin of cosmic rays
- Searches for new particles
- Validation of fundamental laws of physics
- Basis to clarify unknown unknowns