1.1 Tsubono Group

Research Subjects: Experimental Relativity, Gravitational Wave, Laser Interferometer

Member: Kimio TSUBONO and Masaki ANDO

The detection of gravitational waves is expected to open a new window into the universe and brings us a new type of information about catastrophic events such as supernovae or coalescing binary neutron stars; these information can not be obtained by other means such as optics, radio-waves or X-ray. Worldwide efforts are being continued in order to construct detectors with sufficient sensitivity to catch possible gravitational waves. Now the detection of the gravitational waves is one of the biggest challenges in the field of physics and astronomy.

TAMA300 is a 300-m baseline laser interferometric gravitational wave detector constructed in Mitaka. We started the operation of the detector in 1999. The achieved sensitivity, $h \sim 3 \times 10^{-21}/\sqrt{\mathrm{Hz}}$ at 700Hz to 1.5kHz, is sufficient to catch possible gravitational wave events in our galaxy. We can operate the detector for over 24 hours stably and continuously, and have accumulated over 3,000 hours data. We are now analyzing the obtained data searching for the gravitational waves from coalescing binaries, supernovae and pulsars. We are expecting to start the Japanese large-scale laser interferometer, LCGT, soon.

A space laser interferometer, DECIGO, was proposed through the study of the gravitational wave sources with cosmological origin. DECIGO could detect primordial gravitational waves from the early Universe at the inflation era. We have just stared the theoretical and technical investigation for the realization of the DECIGO space detector.

We summarize the subjects being studied in our group.

- Ground based laser interferometric gravitational wave detectors
  - Current status of TAMA project
  - Study of the next-generation laser interferometer, LCGT
  - Caltech 40-m laser interferometer
- Space laser interferometer
  - Space laser interferometer, DECIGO
  - DECIGO pathfinder, DPF
  - Small size detector, SWIM
- Development of a gravitational wave detector using magnetic levitation
  - Gravitational wave detector using superconducting magnetic levitation
  - Experiments using permanent magnets
- Study of the precise measurements
  - Laser stabilization using optical fiber
  - Laser interferometer using squeezed light

references

[1] Masaki Ando, Seiji Kawamura, Shuichi Sato, Takashi Nakamura, Kimio Tsubono, Akito Araya, Ikkoh Funaki, Kunihito Ioka, Nobuyuki Kanda, Shigenori Moriwaki, Mitsuru Musha, Kazuhiro Nakazawa, Kenji Numata, Shin-ichiro Sakai, Naoki Seto, Takeshi Takashima, Takahiro Tanaka, *et al.*, DECIGO pathfinder, Class. Quantum Grav. **26** (2009) 9 184013.

[2] Kakeru Takahashi, Masaki Ando and Kimio Tsubono, Stabilization of Laser Intensity and Frequency Using Optical Fiber, Journal of Physics: Conference Series **122** (2008) 012016.