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.

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.

- Laser interferometric gravitational wave detectors
  - Current status of TAMA project
  - Systematic analysis of TAMA monitoring signal
  - Search for continuous gravitational waves from unknown pulsars
  - Study of the next-generation laser interferometer, LCGT
- Space laser interferometer
  - Space laser interferometer DECIGO
  - DECIGO pathfinder
  - Small size detector SWIM
- Study of the precise measurements
  - Laser stabilization using optical fiber
  - Study of magnetic levitation
- Study of the thermal noise
  - Study of the thermal noise in a space interferometer
  - A new analysis method for the thermal noise caused by an inhomogeneous distributed loss

references

[1] Kazuhiro Yamamoto, Masaki Ando, Keita Kawabe, and Kimio Tsubono: Theoretical approach to thermal noise caused by an inhomogeneously distributed loss: Physical insight by the advanced modal expansion, Phys. Rev. D (2007) in press.

[2] Tomomi Akutsu, and the TAMA Collaboration, Results of the search for inspiraling compact star binaries from TAMA300's observation in 2000-2004, Phys. Rev. D **74**-12 (2006) 122002.