

1.1 Tsubono Group

Research Subjects: Experimental Relativity, Gravitational Wave, Laser Interferometer

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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.

In 2010, a new science project, LCGT (Large-scale Cryogenic Gravitational wave Telescope) was approved and funded by the Leading-edge Research Infrastructure Program of the Japanese government. This underground telescope is expected to catch gravitational waves from the coalescence of neutron-star binaries at the distance of 200Mpc.

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 summarize the subjects being studied in our group.

- Ground based laser interferometric gravitational wave detectors
 - LCGT has started !
 - Design of LCGT interferometer
- Space laser interferometer
 - Space laser interferometer, DECIGO, DECIGO pathfinder, DPF
 - FP cavity for DPF
 - DPF gradiometer in space
 - Study of the effect of the residual gas
 - SWIM _{$\mu\nu$}
- Development of a gravitational wave detector using magnetic levitation
 - Data analysis for the background gravitational waves
 - Generation of the mimic data for gravitational wave analysis

- High sensitive laser interferometer using non-classical light
 - Generation of the squeezed light
- Development of the ultra stable laser source
 - Laser stabilization using a cryogenic cavity
 - Study of the cavity support
 - Study of the cryostat design
- Gravitational force at small distances
 - Measurement using torsion-type resonant antenna
 - Measurement by the spectroscopy of the molecule

references

- [1] Masaki Ando, Koji Ishidoshiro, Kazuhiro Yamamoto, Kent Yagi, Wataru Kokuyama, Kimio Tsubono, and Akiteru Takamori: Torsion-Bar Antenna for Low-Frequency Gravitational-Wave Observations, *Phys. Rev. Lett.* **105** (2010) 161101.
- [2] Seiji Kawamura, Masaki Ando, Naoki Seto, Shuichi Sato, Takashi Nakamura, Kimio Tsubono *et al.*, and the DECIGO working group: The Japanese space gravitational wave antenna: DECIGO, *Class. Quantum Grav.* **28** (2011) 094011.