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, KAGRA (former LCGT)was approved and funded by the Leading-edge Research Infrastructure Program of the Japanese government. The detector is now under construction in KAMIOKA. 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.

- Construction of the KAGRA gravitational wave detector
  - Design of KAGRA interferometer
  - Alignment control
  - Parametric instability
  - Study of cryogenic contacts
- Space laser interferometer, DECIGO
  - Development of DECIGO pathfinder, DPF
  - SWIM$_{\mu\nu}$
  - Study of the effect of the residual gas
- Development of TOBA (Torsion Bar Antenna)
  - Data analysis for the background gravitational waves
  - new type of actuators for TOBA
- Development of the ultra stable laser source
  - Laser stabilization using a cryogenic cavity
  - Prestabilized laser
  - Vibration isolation for cavity
  - Properties of material at cryogenic temperature
- High sensitive laser interferometer using non-classical light
- Gravitational force at small distances
- Study of space isotropy

reference

[1] Koji Ishidoshiro, Masaki Ando, Akiteru Takamori, Hirotaka Takahashi, Kenshi Okada, Nobuyuki Matsumoto, Wataru Kokuyama, Nobuyuki Kanda, Yoichi Aso, and Kimio Tsubono: First Observational Upper Limit on Gravitational Wave Backgrounds at 0.2 Hz with a Torsion-Bar Antenna, Phys. Rev. Lett. **106** (2011) 161101.