1 Tsubono Group

Research Subjects: Experimental Relativity, Experimental Gravitation, Gravitational Wave Physics, 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. Now the detection of the gravitational waves is one of the biggest challenges in the field of physics and astronomy. In U.S.A. LIGO(Laser Interferometer Gravitational-Wave Observatory) project(4-km interferometer) is in progress under the collaboration of Caltech and MIT. Also in Europe French-Italy collaboration team has started the VIRGO project; they are constructing 3-km interferometer in Pisa, Italy.

In Japan we are constructing a 300-m arm-length laser interferometer (TAMA300) in Mitaka. We have already finished the construction of the tunnels and the buildings to hold the vacuum pipes and vacuum chambers. Also we have completed the installation of the optical system of the interferometer into the vacuum chamber. We are now improving the sensitivity of the detector by refining the system. From next year we plan to start the long-term operation of the interferometer to obtain the first data of the possible signals. We have already operated the interferometer for several days and obtained preliminary data. We are now analyzing these data using matched filter technique.

At the University of Tokyo, we are mainly engaged in the study of the vibration isolation and the control of the laser interferometer. Using a 3-m prototype laser interferometer in our laboratory, we are developing techniques of alignment control, fringe control, mirror suspension, recycling scheme, vibration isolation and so on.

We summarize the subjects being studied in our group.

- Laser interferometric gravitational wave detectors
  - TAMA project
  - New signal extraction scheme with harmonic demodulation
  - Suspension point interferometer for vibration isolation
  - GEO600 project
- Space gravitational wave experiment
  - Study of the space laser interferometer
- Experimental study of the relativity
  - Test of the space isotropy
- Study of thermal noise
  - Estimation of thermal noise by a direct measurement of the mechanical conductance
  - Study of the thermal noise due to the inhomogeniously distributed loss
  - Measurement of the intrinsic Q of low-loss materials
- Study of the precise measurement
  - Development of the low-frequency vibration isolation system (SAS)