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 like supernova or coalescing binary neutron stars which 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 U.S.A. LIGO(Laser Interferometer Gravitational-Wave Observatory) project 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 operation of the interferometer to obtain the first data of the possible signals. 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 and so on.

We summarize the subjects being studied in our group.

- Laser interferometric gravitational wave detectors
  - Development of the TAMA300 detector
  - Alignment control of the TAMA300 detector
  - Alignment control of the 10-m mode-cleaner
  - Design and fabrication of the control system for the TAMA300
  - Power recycling of the 3-m Fabry-Perot type gravitational wave detector
  - New scheme of the signal extraction for the power recycling
  - Power recycling experiment at the Caltech 40-m interferometer
- Space gravitational wave experiment
  - Study of the space laser interferometer
- Experimental study of the relativity
  - Measurement of the space anisotropy
- Study of thermal noise
  - New estimation method of the thermal noise of the mirrors used in the interferometers
  - Study of the thermal noise due to the inhomogeniously distributed loss
  - Measurement of the intrinsic Q-value of the low-loss materials
- Study of the precise measurement
  - Development of the low-frequency vibration isolation system
  - Development of the non-contacting supporting system for the mirrors
  - Development of a high-sensitive tilt meter using laser interferometer
  - Development of a comb-electrode actuator