STATUS OF TAMA300

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THE TAMA300 PROJECT
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Development of TAMA300 is in progress. The best strain sensitivity ever obtained is $5 \times 10^{-21}/\sqrt{\mathrm{Hz}}$ in a frequency region from 700Hz to 1.3kHz. In a data run held in August, 2000, more than 160 hours of data was obtained. We are presently working on vibration isolation systems and optical systems in order to make TAMA300 more sensitive and stable.

1 Status of TAMA300

1.1 Project status

TAMA300 [1] is a laser interferometric gravitational wave detector constructed on the campus of the National Astronomical Observatory in Mitaka, Tokyo. TAMA project was started in 1995. After having finished installation and shakedown of the most part in 1999, efforts for improvement of the sensitivity and the stability have been performed. Project's initial term of five years was completed in March, 2000, and now the project is in the middle of extended period of two years.

1.2 Interferometer configuration

The current optical configuration of TAMA300 is a Fabry-Perot Michelson interferometer with baseline length of 300 m [2] (Fig. 1). An injection-locked Nd:YAG laser with the output of 10 W is employed as a light source. After filtered by a mode cleaner cavity with the length of 10 m, the incident beam is injected into the two arm cavities. In order to hold the interferometer at its highest sensitivity, the longitudinal position of the four test masses and the beamsplitter are controlled with frontal (Schnupp) modulation scheme. The modulation for the length control is also used for mirror alignment control with reflective wave-front-sensing technique. In addition, slow ($\lesssim$ 1Hz) feedback systems have been implemented to compensate drifts of the beam direction, optical path lengths, and the mirror alignment.

1.3 Current detector status

Since the first locking of the full interferometer has been established in May, 1999, the sensitivity of the interferometer was continuously improved. The current best noise level in displacement ever obtained is $1.5 \times 10^{-18}\,\mathrm{m}/\sqrt{\mathrm{Hz}}$ in a frequency region from 700Hz to 1.3kHz (Fig. 2). This corresponds to strain sensitivity of $5 \times 10^{-21}/\sqrt{\mathrm{Hz}}$. The present sensitivity-limiting noises were mostly identified. Two noises are dominating the noise spectrum in the observation band (currently from 50Hz to 5kHz). One is optical length disturbance induced by the mirror alignment control systems. The other is "Michelson noise", i.e. the noise that also appears in the front mirror Michelson. A part of this noise comes from the scattering on the surface of input optics. Besides the noises that appears in the power spectrum, nonstationary noise events has been observed. It was identified that some of the nonstationary noises originated from the laser source; the number of theses events was very sensitive to the laser pumping current.

With the current sensitivity, TAMA300 is capable to detect a binary coalescence which would occur in our Galaxy. The expected SNRs for gravitational waves from inspiraling binaries were estimated from the interferometer noise spectrum and calculated chirp signals [2,3]. TAMA would detect a gravitational wave signal with SNR of about 30 in case of a coalesense of an equal 1.4 $M_\odot$ binary at the Galactic center.

Overall functionality of the detector has been examined by past observation runs. The most recent data run was held in August, 2000 with a period of two weeks. The total amount of data exceeds 160 hours. The longest stretch of continuous locking was more than 12 hours. Since seismic motion in the day time makes locking stretch shorter, the run was mainly carried out in the night time. We have also tried in several days full time operations, and achieved 23 hours of operation in a day.

1.4 Future Plan

We are presently working on the improvement of the detector sensitivity and stability. Installation of actively-controlled air springs to the bottom of the vibration isolation systems and modification of the test mass suspension system have already performed. These improvement will allow us not only to operate the interferometer more stably in the day time, but also to reduce the noise introduced by the alignment control systems. Replacement of mode-matching optics is also planned in order to eliminate undesirable fringes induced by the surface scattering on the lenses. An observation with a period of several months follows these improvements.

References

1. K. Tsubono, in *Proc. First E. Amaldi Conference on Gravitational Wave Experiments*, Frascati(Roma), June 1994, (World Scientific, 1995) p.112
2. M. Ando et al, (to be published).
3. H. Tagoshi et al, *Phys. Rev. D* (printing).

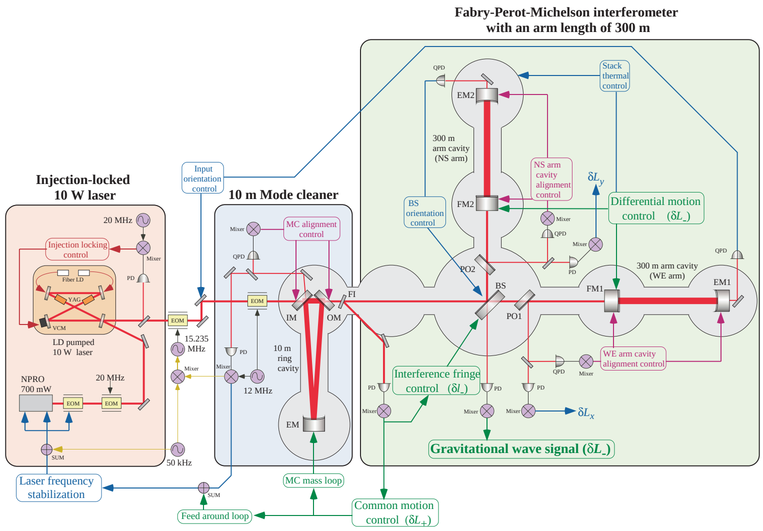

Figure 1. Detector configuration of TAMA300.

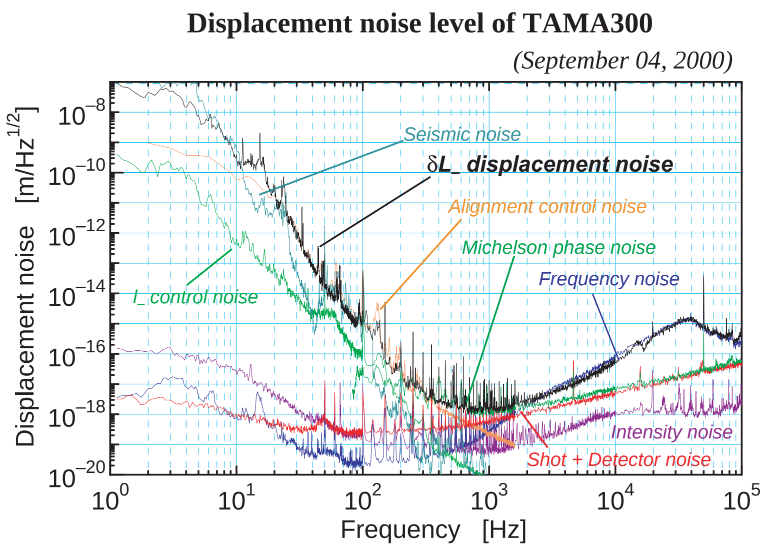

Figure 2. Current displacement noise level of TAMA300. Identified noise sources are also drawn together.