Development of a long baseline laser-extensometer for observation of slow-slip events

Akio Katsumata[1]; Takeyasu Yamamoto[2]; Nobuo HAMADA[3]; Sumio Yoshikawa[3]

[1] Meteorological Research Institute, JMA; [2] MRI; [3] JMA

We are developing a long-baseline laser-extensometer to observe crustal deformation, especially that due to short-term and long-term slow-slip events. We constructed a 200m long Michelson interferometer and started test observation. The outline of the system and obtained data in a test observation are explained.

In an Michelson interferometer, a length change of one wavelength in a several hundred meters baseline corresponds to strain of 10^{-9}, which is comparable to resolution of bore-hole-type instruments. We expect to have long-term stability from the long baseline. To have a long-term stability, it is necessary to make all of components to have such stability. The main components of the interferometer are a laser, optical parts, and the beam path.

We use an iodine-stabilized Ne-Ne laser produced by Neoark. The laser has a stability of 10^{-12}, which is enough to keep a stability of 10^{-9}. The laser-beam is split into reference and measurement beams. Length change between a beam-splitter and a reflector for the reference beam has a direct effect on the result of the measurement. To reduce effect of thermal expansion, the beam-splitter and the reflector are mounted on a plate made of supper-invar. The beam-path is evacuated to a pressure less than 10^{-1} Pa so that the air pressure change would have negligible effect on the length of beam-path.

We started a test observation in December 2007. Crustal deformation due to the earth-tide was observed with the laser extensometer.

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