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Development of a laser strain gradiometer for the observation of slow earthquakes

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New schemes of observing crustal deformation were considered to detect slow earthquakes with duration of about 200 s to 1 day, which have not been easily observed. Displacement caused by slow earthquakes was analyzed in terms of point dislocation in an infinite homogeneous medium. The amplitude and the spatial scale of the background motion were also calculated by the model known as the New Low Noise Model and the observations by laser strainmeters. Comparing the expected deformation by slow earthquakes with the calculated background motion, we found that the current observation systems do not have potential to observe them but we can observe them by measuring strain gradient of deformation. We developed a prototype instrument for directly measuring the strain gradient. Its temperature dependence and the noises of photodetectors were measured in our laboratory. Then the noise of the interferometer was measured at Nokogiriyama Observatory, ERI. Its noise was composed of the unknown noise which have $1/f^2$ spectrum and the noise caused by convection of the air. $1/f^2$ noise was coupled with the asymmetry of the interferometer. These noises were compared with the spectra of slow earthquakes and the background motion. It was suggested that with less asymmetry and a vacuum chamber, lengths of baselines should be more than 300m. Reduction of the $1/f^2$ noise will be required to detect slow earthquakes with realistic instruments. We present the current situation in reducing the noises and the prospect about observing strain gradient at one place.

Keywords: strainmeter, laser interferometer, slow earthquake