Broadband observation of crustal activities using a laser-strainmeter network

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A laser strainmeter can measure deformation of the ground by sensing distance between two separated points based on the optical interferometer with reference to wavelength of light, enabling to detect small strain changes over wide frequency range [1]. Its advantages are high resolution with a long baseline, resonance-free response of optical reference, and low-drift detection using a stable wavelength of the laser, as compared to a conventional strainmeters using a mechanical reference.

To establish accurate and broadband observations of regional crustal activities, we constructed laser strainmeters at three underground sites in Japan, Kamioka (Gifu Pref.), Inuyama (Aichi Pref.), and Funagira (Shizuoka Pref.), and operate them as a strainmeter network. At Kamioka site, two laser strainmeters with baselines of 100m and 1500m are in operation [2, 3]. At Inuyama and Funagira sites, a 30-m strainmeter and a 400-m one are also in operation, respectively [4]. These strainmeters clearly detect earth tides, and their amplitudes are consistent with the calculations based on tidal force, the standard Earth's model, and the topographic effects around the sites. Coseismic strain steps were observed by the strainmeter network as common signals of the crustal activities and they were consistent with strain changes expected from the fault parameters.

At low frequencies, local disturbances of the site, such as changes in temperature, air pressure, and ground water level, have an effect on long-term strain changes and limit the detectability of the strainmeter network. In the presentation, we discuss the low-frequency performance of the laser strainmeters and the detectability of the strainmeter network for monitoring crustal activities.

References

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