

## Calibration of A Calorimeter for High Power Soft X-Ray Lasers

### 高出力軟 X 線レーザー用カロリメーターの較正

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Physics of ultra-short pulse x-ray laser ablation is great interest for applications in x-ray optics design, coherent x-ray processing, and so on. In QST, we have been used a plasma x-ray laser, operated at a wavelength of 13.9 nm, a pulse duration of 7 ps and a pulse energy of sub- $\mu$ J, to investigate damage threshold of many materials. However, a question on the dependence of the ablation threshold on the pulse duration still remains. Fortunately, at the Japanese x-ray free-electron laser (FEL) facility, SACLA, the beamline-1 (BL1), which provides FEL light at soft x-ray regions with a pulse duration of 200~300 fs and pulse energy of  $\sim 100 \mu$ J, was started operation for users, recently [1]. For the comparison study of pulse duration dependence using the two lasers, evaluation of pulse energy irradiated on target with high accuracy is required.

A compact calorimeter, which consists of an x-ray charge-coupled device (CCD) and x-ray filters was used to measure the pulse energy of the lasers. A set of x-ray filter was employed as an attenuator to reduced energy of the laser beam before reach to the surface of the CCD. By changing the thickness of the x-ray filters, a wide range energy could be measured by our calorimeter. The sensitivity of the CCD and thickness of the x-ray filters were evaluated at the beam line 11D (BL11D) of the Photon Factory.

In this presentation, the detail calibration of the calorimeter is reported.

[1] K. Togawa *et al.*, Proc. IPAC **2017**, 1209 (2017).