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First trial of scraper out-coupling in Kyoto University Free Electron Laser

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Kyoto University Free Electron Laser (KU-FEL) achieved a record high extraction efficiency of 9.4% [1]. For further increase of the extraction efficiency, reduction of the optical cavity loss or increase of the FEL gain is required [2]. One possible way to reduce the optical cavity loss while keeping the reflection bandwidth of the cavity mirror is changing the out-coupling way from current hole-coupling to scraper out-coupling with an insertable mirror which has been implemented in JAERI-FEL [3]. By changing the hole-coupling mirror having a 1-mm diameter hole in its center to a mirror without the hole, the total optical cavity loss can be largely reduced. Then out-coupling of the intracavity power to the outside cavity is performed by an insertable scraper mirror. For this purpose, an insertable scraper mirror has been introduced in KU-FEL. By changing the out-coupling way, the optical cavity loss of the KU-FEL was reduced from 3.9 to 2.2% at the wavelength of 11 micro-m. In a test experiment, the optical cavity loss could be controlled from 2.2 to 19% by changing the insertion amount of the scraper mirror.

Footnotes

[1] H. Zen et al., Appl. Phys. Express 13, 102007 (2020).
[2] R. Hajima, Atoms 9, 15 (2021).
[3] R. Nagai et al., Nucl. Instrum. Meth. A 475, 519-523 (2001).

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Author: ZEN, Heishun (Kyoto University)

Presenter: ZEN, Heishun (Kyoto University)

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