# Present state of the EUV-FEL light source for future lithography

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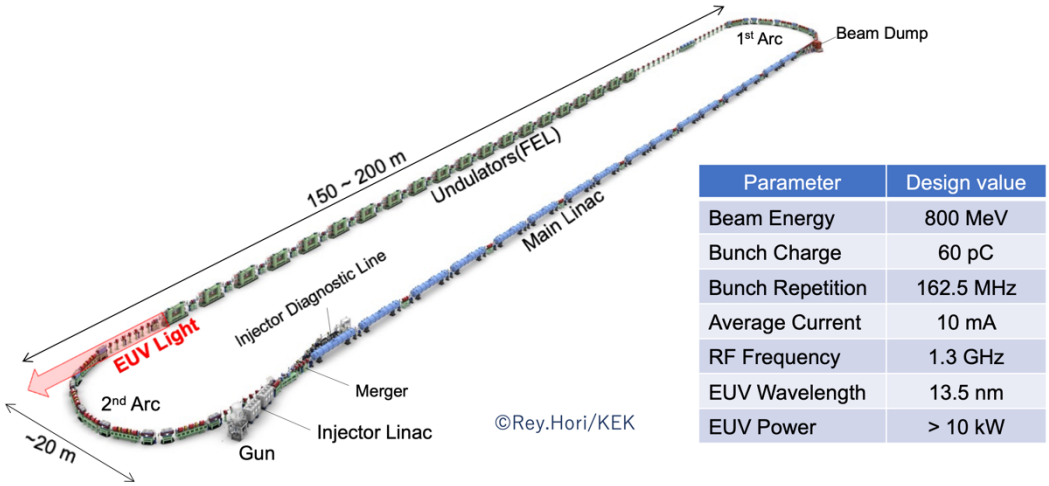
In EUV lithography, high volume manufacturing already started using a laser-produced plasma (LPP) source of 250-W power at 13.5 nm. However, development of a high-power EUV light source is still very important to overcome the stochastic effects for a higher throughput and higher numerical aperture (NA) in future. The required EUV power for the 3-nm node and beyond at the maximum throughput of future scanners is estimated to be more than 1 kW. We have designed and studied an EUV-FEL light source based on ERL for future lithography. This light source offers many advantages such as high EUV power (> 10 kW) without tin debris, upgradability to a Beyond EUV (BEUV) FEL for finer patterning, polarization controllability for high-NA lithography, low electricity consumption and cost per 1-kW EUV power or scanner, as compared to the LPP source. Proof of concept (PoC) of the EUV-FEL light source using an IR-FEL constructed in the Compact ERL (cERL) at KEK is also in progress. In this talk, I will present the present state of the EUV-FEL light source.




| Parameter | Design value |
|---|---|
| Beam Energy | 800 MeV |
| Bunch Charge | 60 pC |
| Bunch Repetition | 162.5 MHz |
| Average Current | 10 mA |
| RF Frequency | 1.3 GHz |
| EUV Wavelength | 13.5 nm |
| EUV Power | > 10 kW |

Figure 1: Illustration and design parameters of the EUV-FEL light source

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**Presenting Author**

Norio Nakamura is a professor and leader of the beam dynamics and magnet group in Accelerator Division VI (Light Source division) of the Accelerator Laboratory at High Energy Accelerator Research Organization (KEK). His main research subject is advanced light sources such as ERL-based FELs and next-generation synchrotron radiation sources. He received his Ph. D in Physics from the University of Tokyo. He worked at the KEK Photon Factory from 1987 to 1996 and then at the Synchrotron Radiation Laboratory of the Institute for Solid State Physics in the University of Tokyo from 1996 to 2011.