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The Evolution of KAOS, a Multipurpose Active Optics System for EUV/Soft X-Rays

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KAOS is the flagship optics of FERMI, the first - and presently only - fully seeded Free Electron Laser facility in the world. The name stands for Kirkpatrick-Baez Active Optical System, and it has been entirely developed in-house. After progressive revisions and upgrades, it presently empowers three out of six beamlines at FERMI, and it also serves two beamlines at FLASH, Hamburg (DiProI, LDM, MagneDyn; FL23 and FL24). Although KAOS grounds on the well-established concept of Kirkpatrick-Baez mirrors, the challenges it addressed and the needs it was built for, ultimately produced a unique system with unique features: a versatile curvature control, a broad spectral range ($100\text{ nm} < \lambda < 1\text{ nm}$), and a large demagnification power ($>80\times$). These features made KAOS an essential and mandatory tool to access the new class of scientific investigations addressed by FERMI, becoming a standard in time resolved spectroscopies, holography, and diffraction. In addition, it also enabled non-custom pump-probe spectroscopy correlation, and made the first realization of transient-grating in the XUV possible. The simple and clean mechanical design combined with the assiduous attention to online wavefront diagnostics did the rest in determining the success of KAOS over time. This contribution aims at telling how KAOS was born and grew up, showing how wavefront sensing made it work at the best, and how it will face the future challenges.

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