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## **From 80 nrad to 35 nrad: active damping control achieves sub-50-nrad stability in SHINE's beamline mirror system**

*Thursday 18 September 2025 16:40 (1 hour)*

The Shanghai High Repetition Rate XFEL and Extreme Light Facility (SHINE) extends over 3.1 kilometers in length. Its surrounding environment –including rivers, metro lines, and elevated roadways –results in significantly stronger ground vibrations compared to similar facilities worldwide. To investigate the correlation between ground vibrations and angular vibrations induced on optical components, as well as evaluate system performance under site-specific vibration conditions, a prototype mirror chamber system was constructed and the methods for angular vibration measurement were developed. Through theoretical calculations and experimental verification, the transfer function from ground vibrations to mirror vibrations was determined. Measurements revealed angular vibrations of approximately 45 nrad in the experimental hall and 80 nrad in the beamline transportation tunnel during daytime operations. To enhance mirror stability, an active damping control system was implemented. This intervention successfully reduced angular vibrations in the beamline tunnel from 80 nrad to 35 nrad under daytime conditions, demonstrating significant improvement in vibration suppression.

### **Footnotes**

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**Author:** Dr LIU, Fang (ShanghaiTech University)

**Co-authors:** Mr YUAN, Haoran (ShanghaiTech University); Mr HE, Shjing (ShanghaiTech University); Mr CHEN, Nuo (ShanghaiTech University); LI, Wei (ShanghaiTech University)

**Presenter:** Dr LIU, Fang (ShanghaiTech University)

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