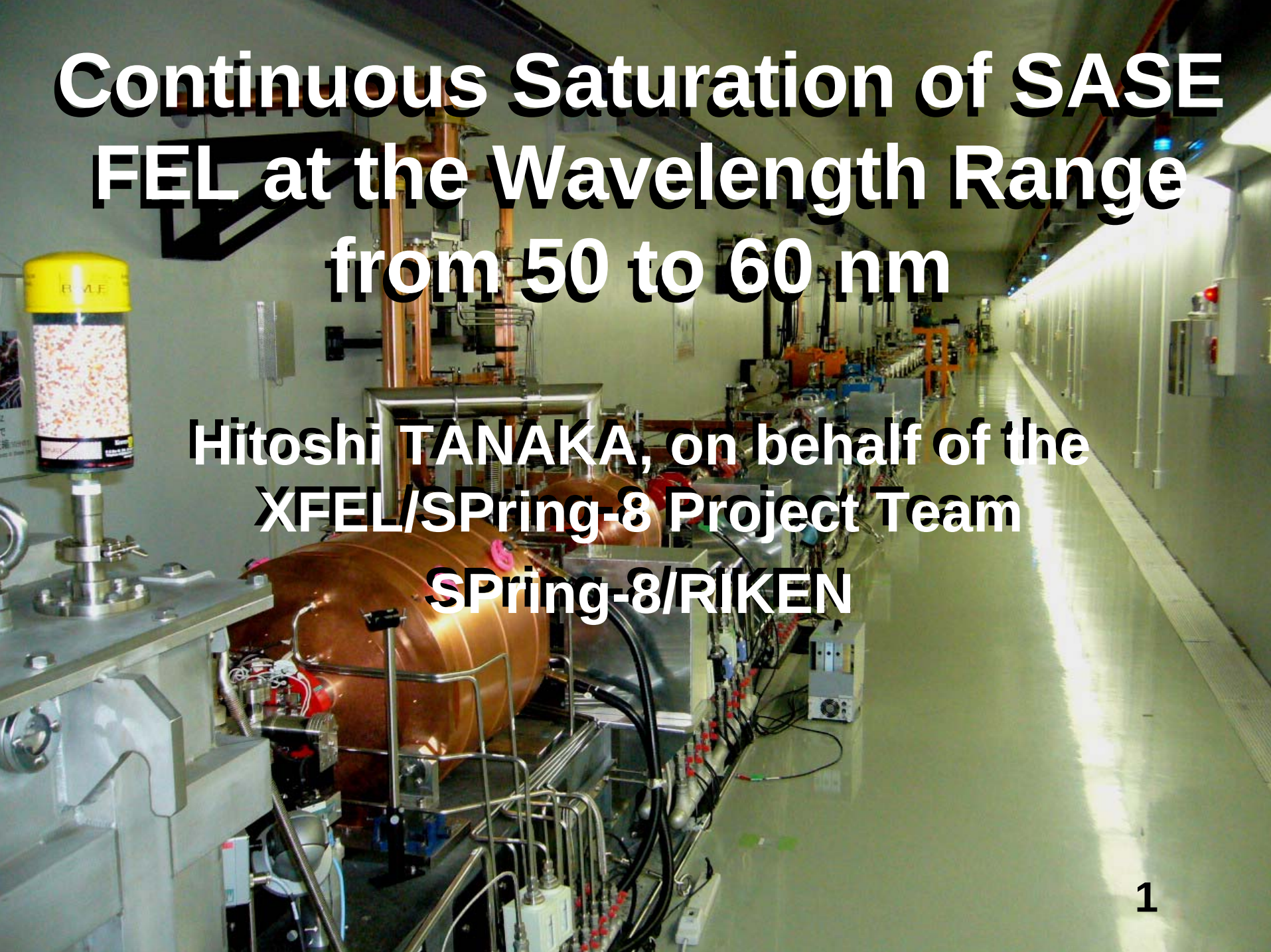


Continuous Saturation of SASE FEL at the Wavelength Range from 50 to 60 nm

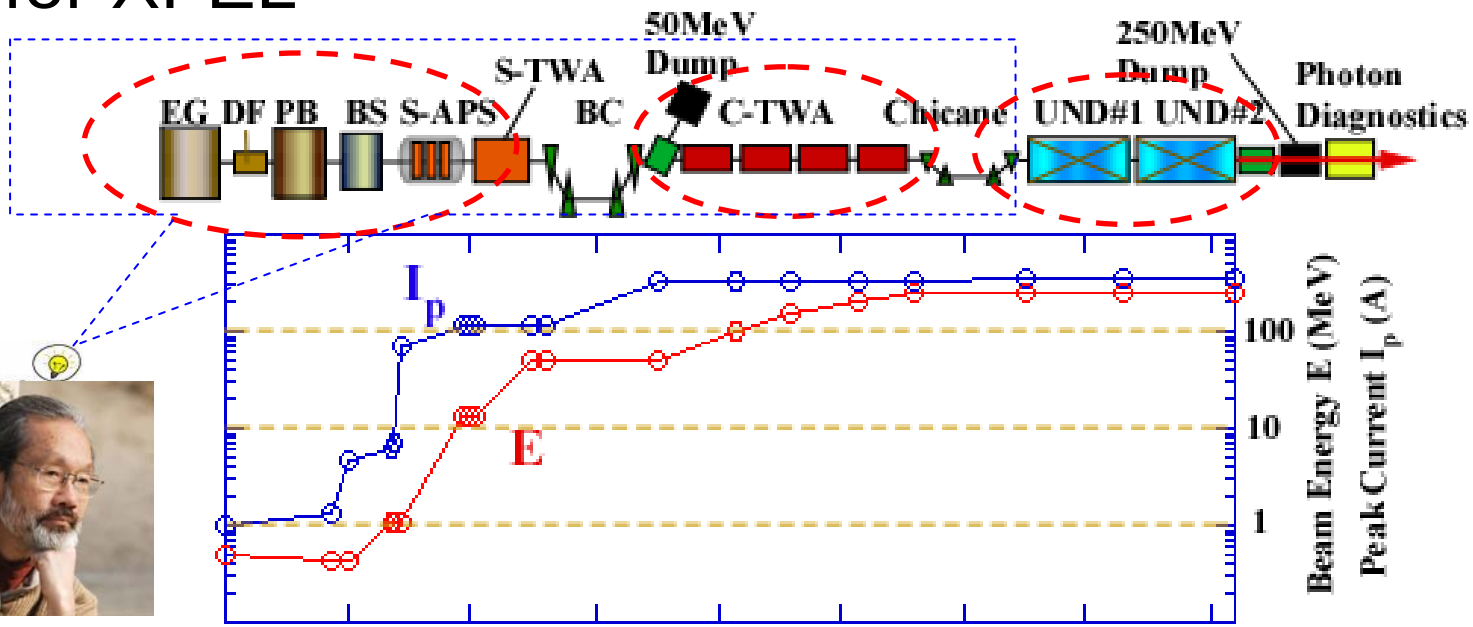
Hitoshi TANAKA, on behalf of the XFEL/SPring-8 Project Team

SPring-8/RIKEN

Contents

1. Significance of saturation at the test accelerator
2. Lasing Performance
3. Key improvements
4. Normalized slice emittance
5. Summary

SASE saturation achieved at the test accelerator can only prove the compact SASE source valid for XFEL



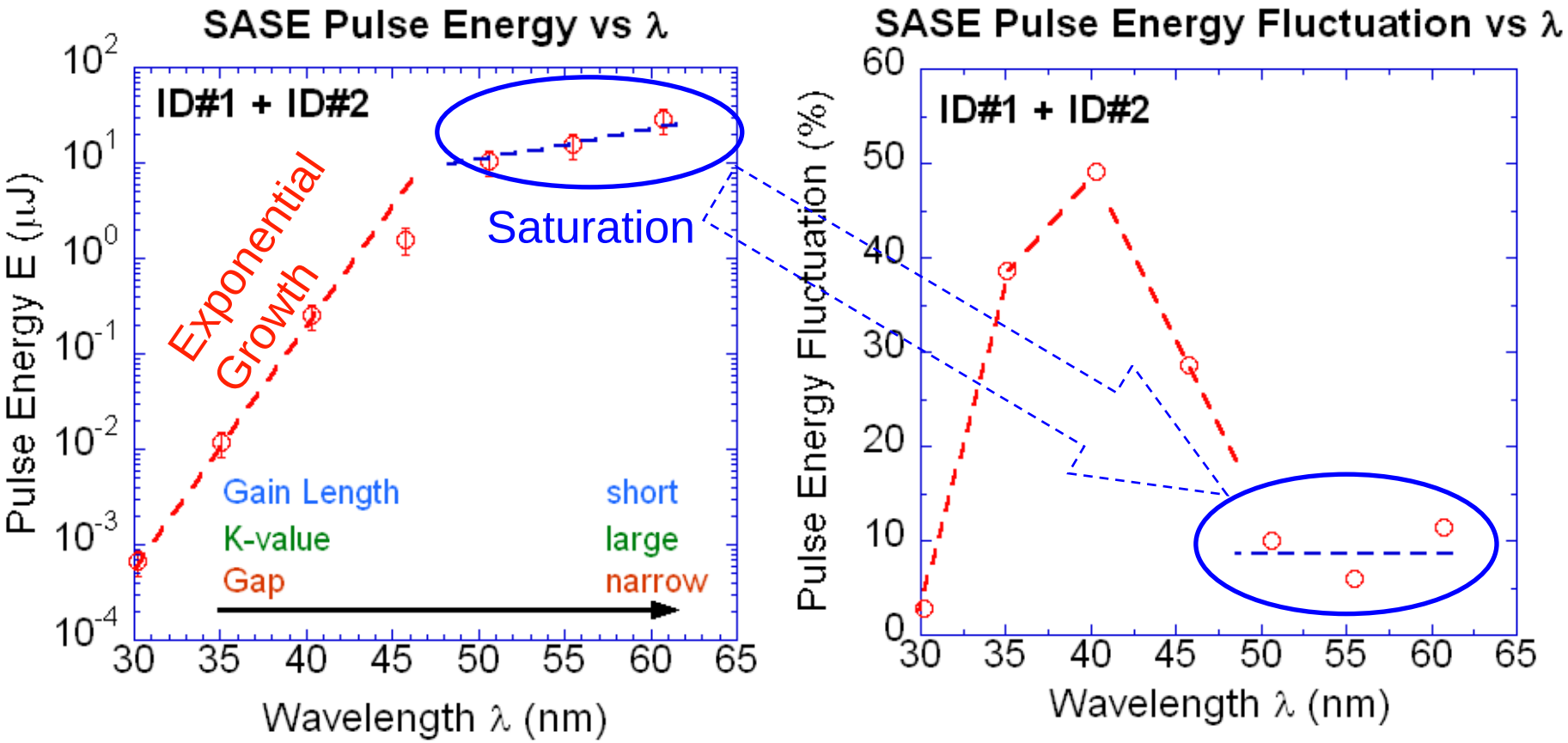
Contents

SASE Performance at Saturation

Item	Achieved Performance
Wavelength	50~60 nm
Repetition Rate	≤ 20 Hz
Pulse Energy	~30μJ@60nm
Pulse Energy Fluctuation(STD)	~10%
Laser Size (FWHM)#	~3mm
Pointing Stability#	~5% to the beam size
Averaged Spectrum Width (FWHM)	0.6%

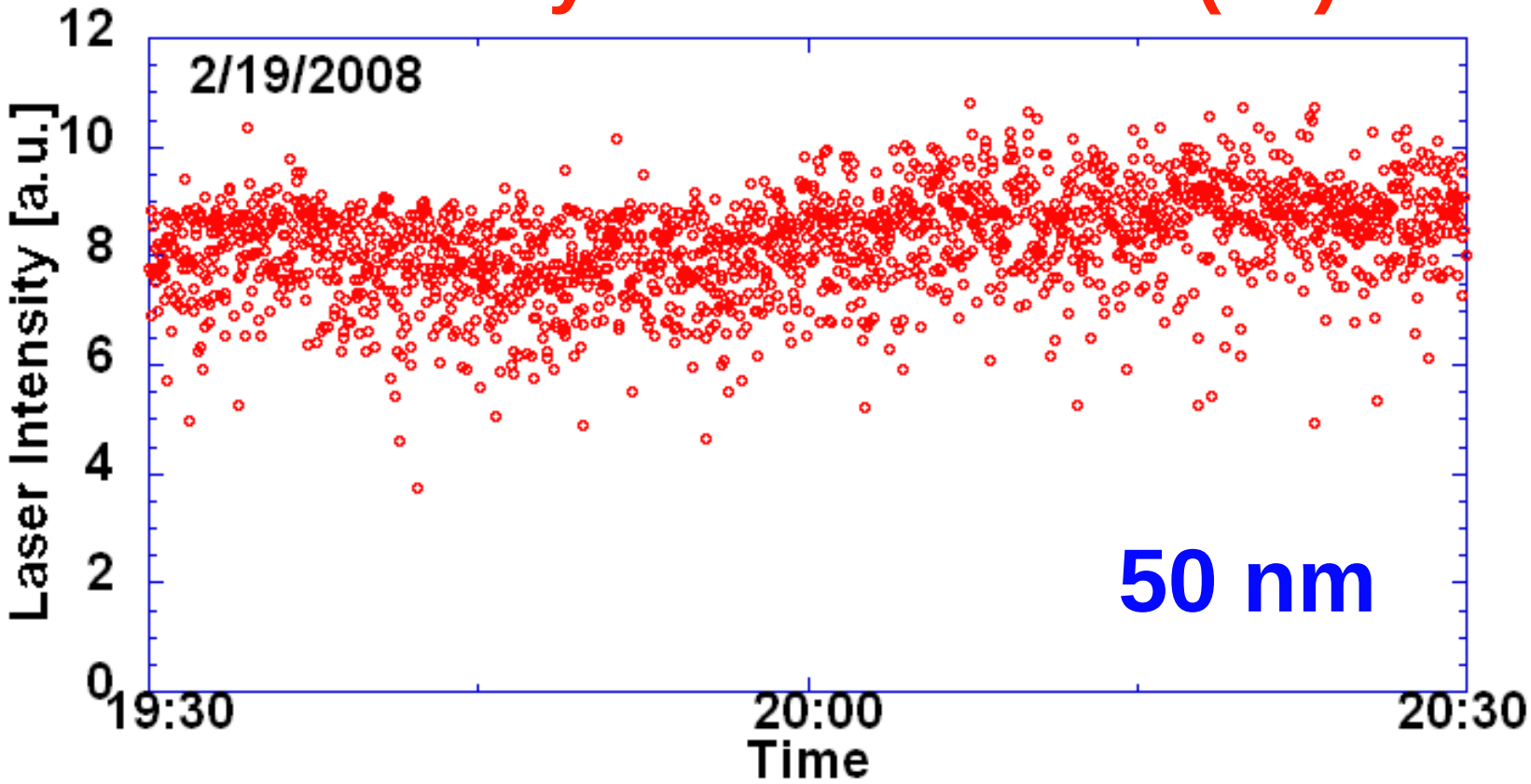
10m downstream location of the source point

Saturation of SASE Amplification

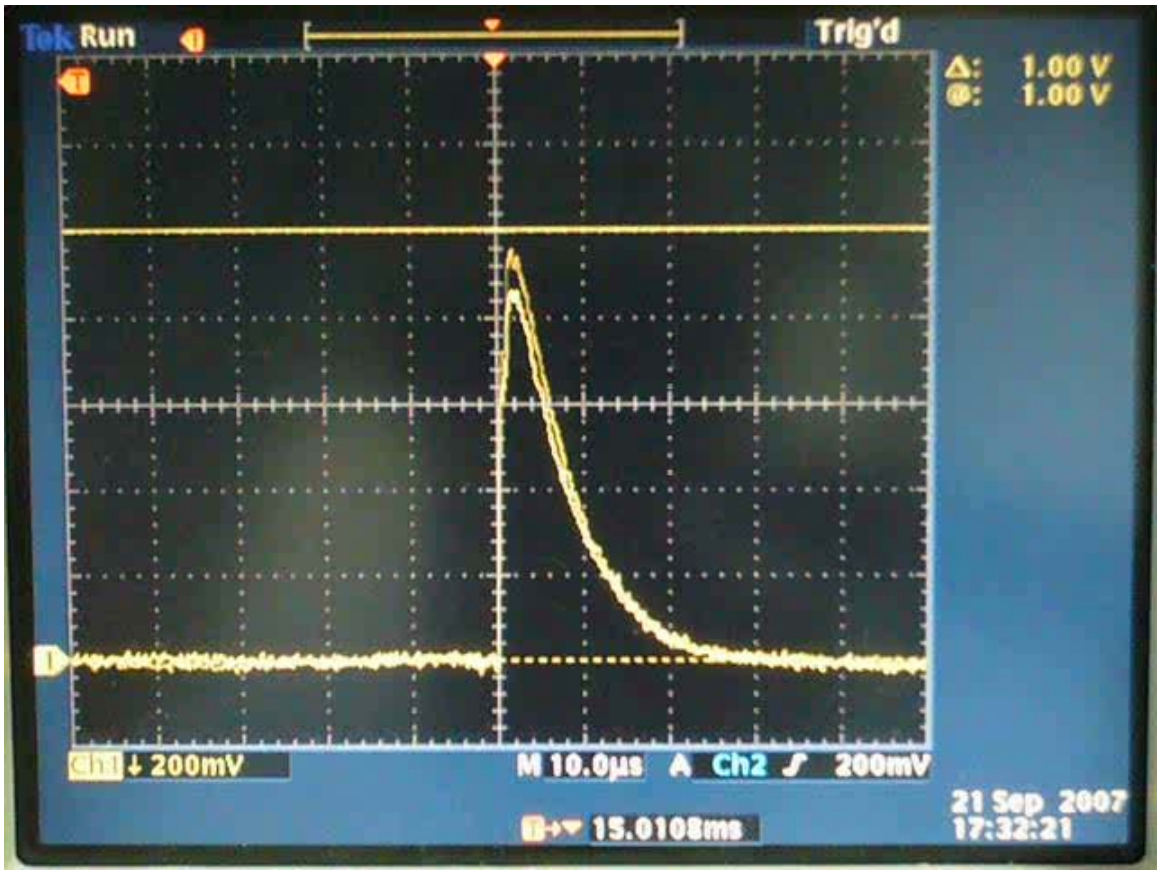


Stability of SASE Intensity

Intensity variation = 11%(1σ)

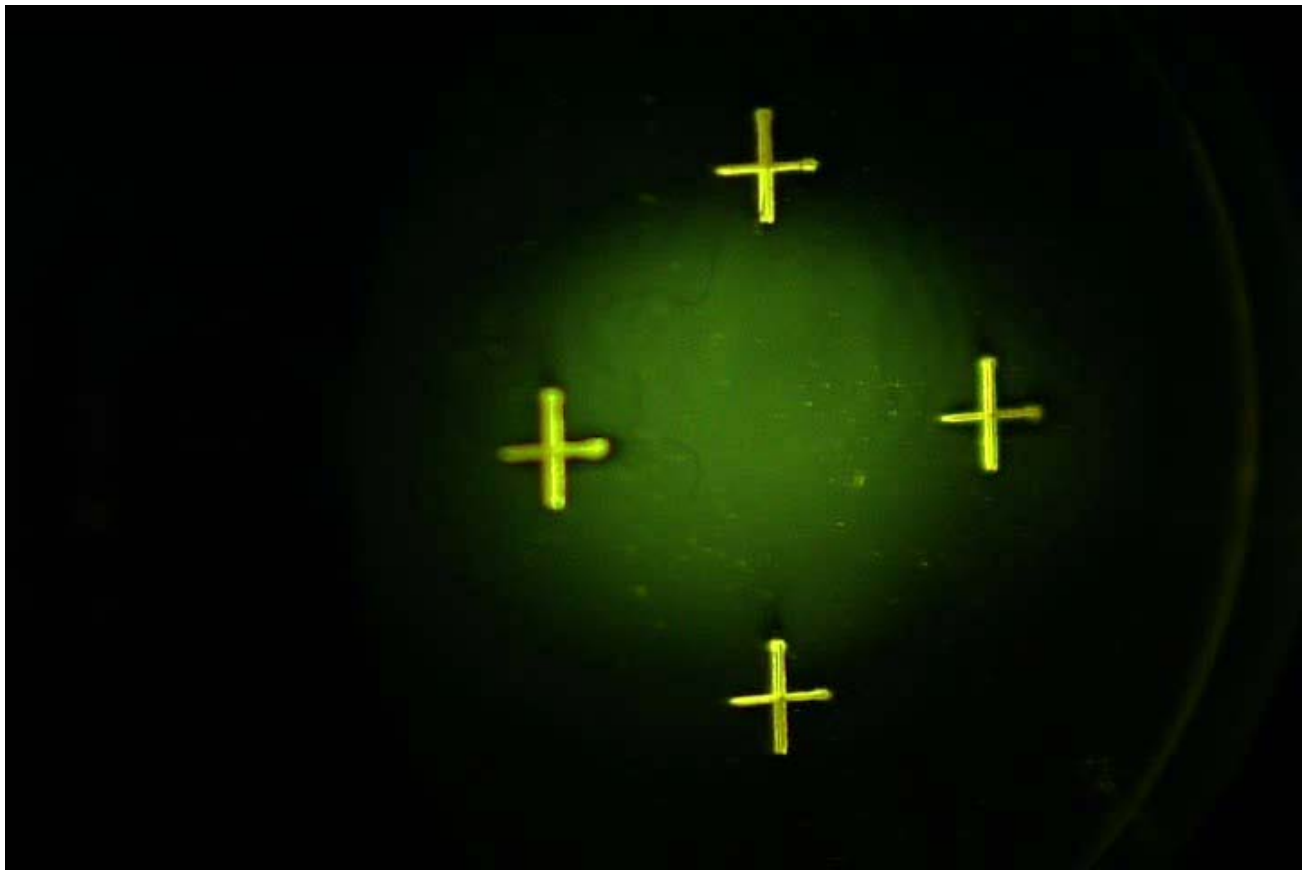


Stability of SASE Intensity (con't)



SASE Pointing Stability

λ=50nm

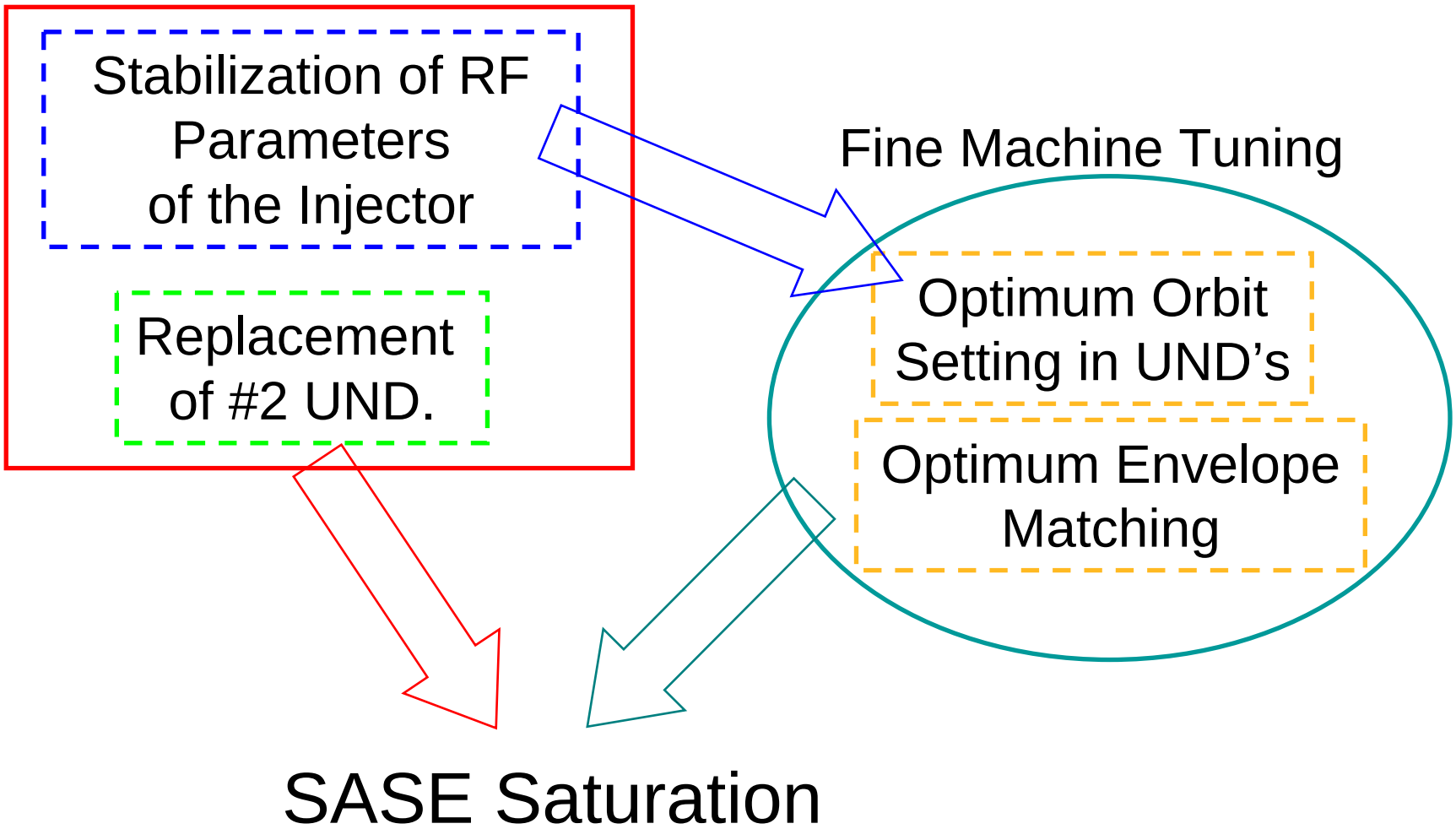


10mm

Contents

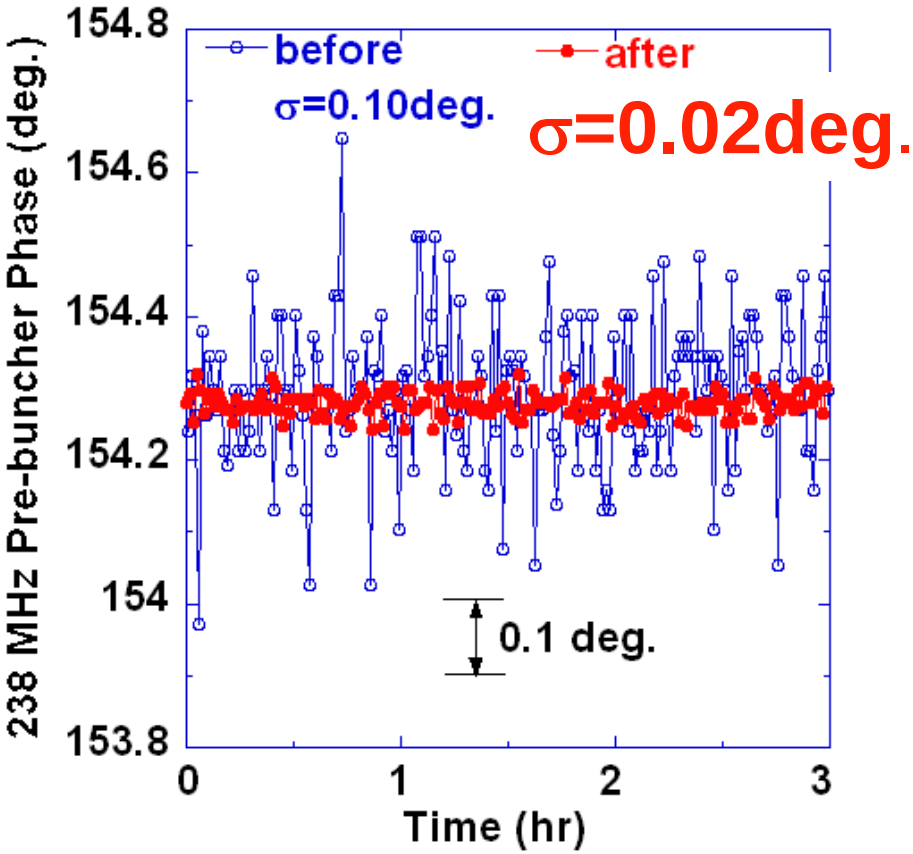
1. Significance of saturation at the test accelerator
2. Lasing Performance
3. Key improvements
4. Normalized slice emittance
5. Summary

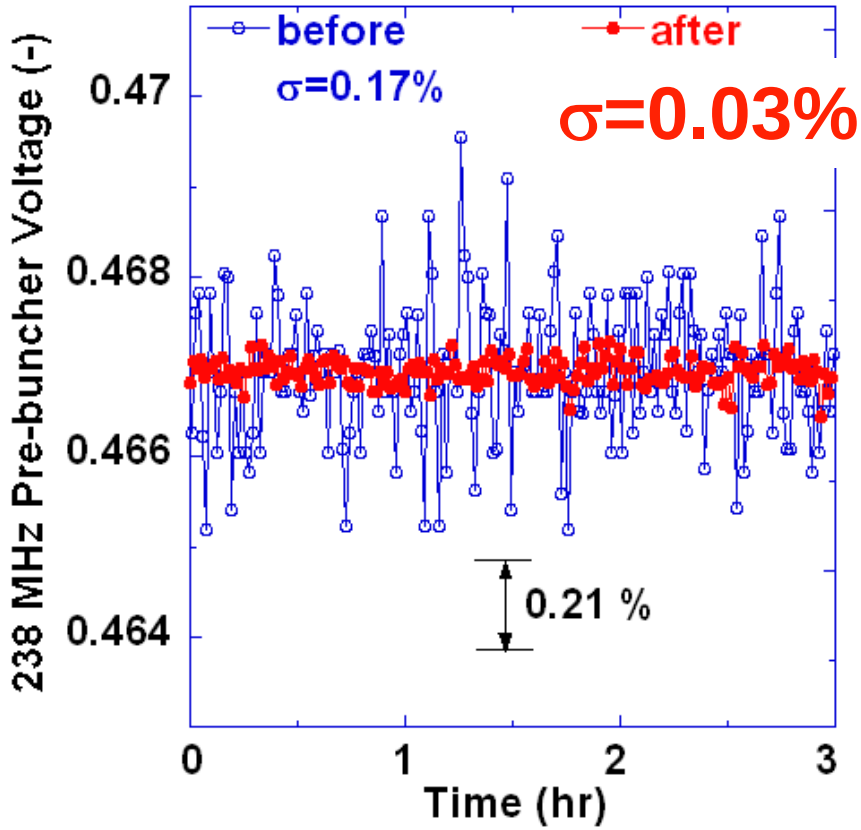
How to Achieve Saturation



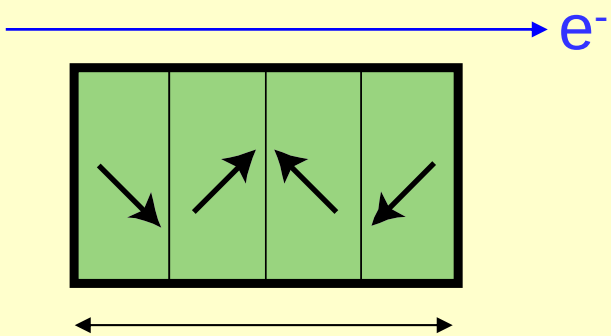
Injector RF Parameter Stabilization

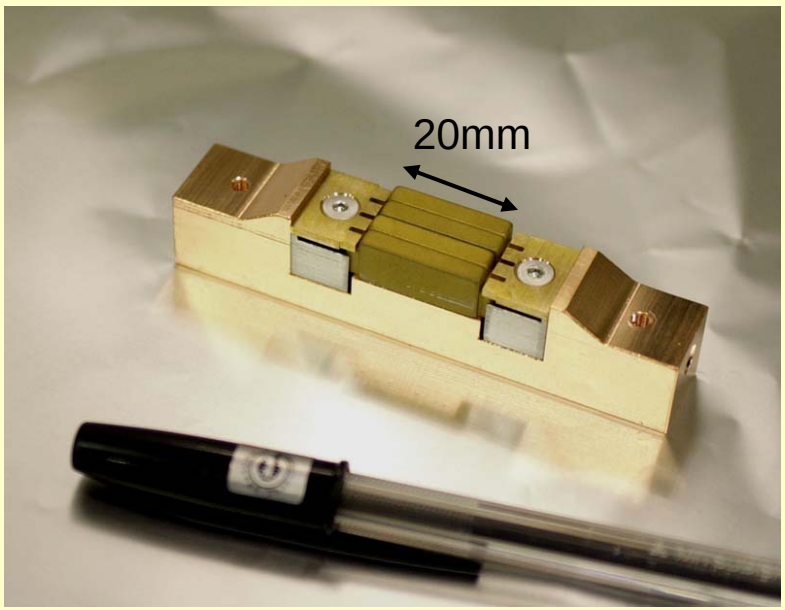
Achieved stabilities almost satisfy the requirement for XFEL !



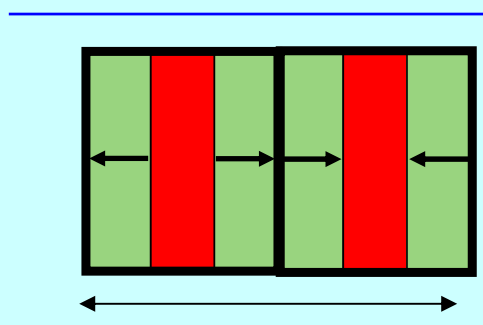


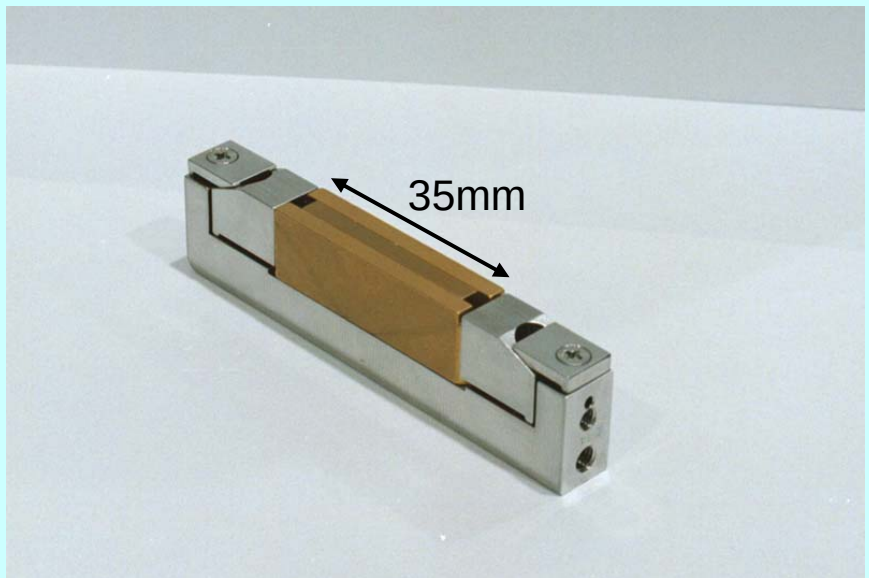
Modification of the Magnetic Design





45-deg. inclined Halbach





Hybrid

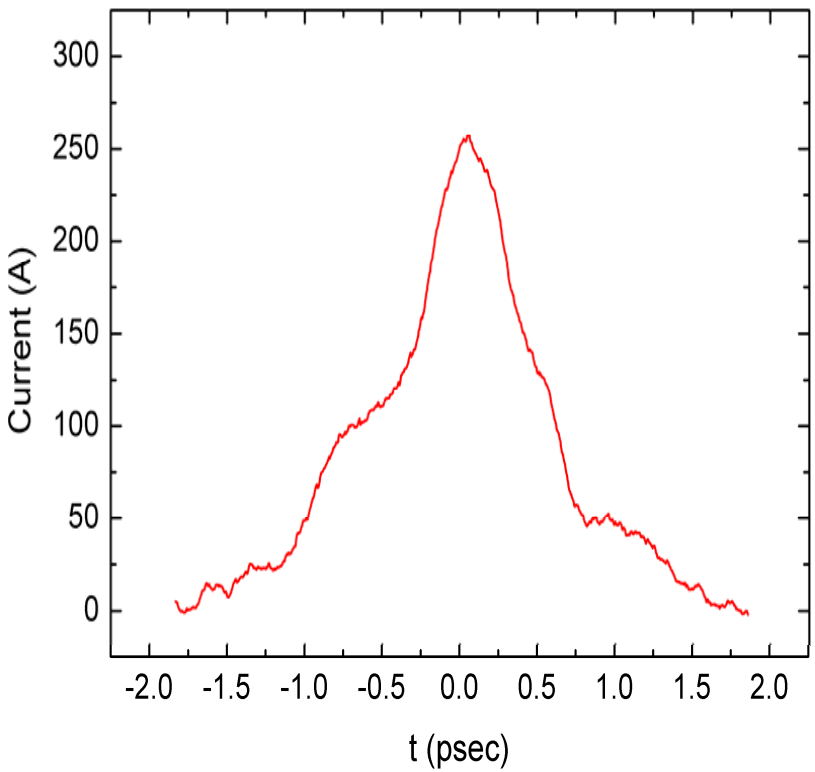
Contents

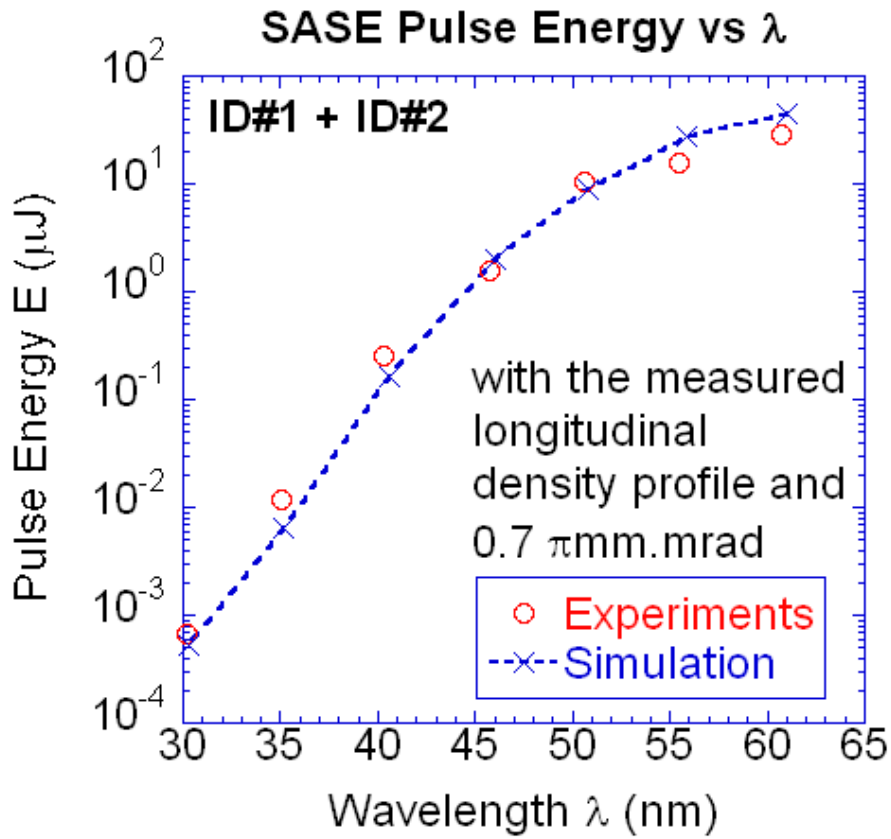
1. Significance of saturation at the test accelerator
2. Lasing Performance
3. Key improvements
4. Normalized slice emittance
5. Summary

Evaluation of Slice Emittance

The normalized emittance at the lasing slice is estimated to be 0.7πmm.mrad !

Measured Density Profile





Summary

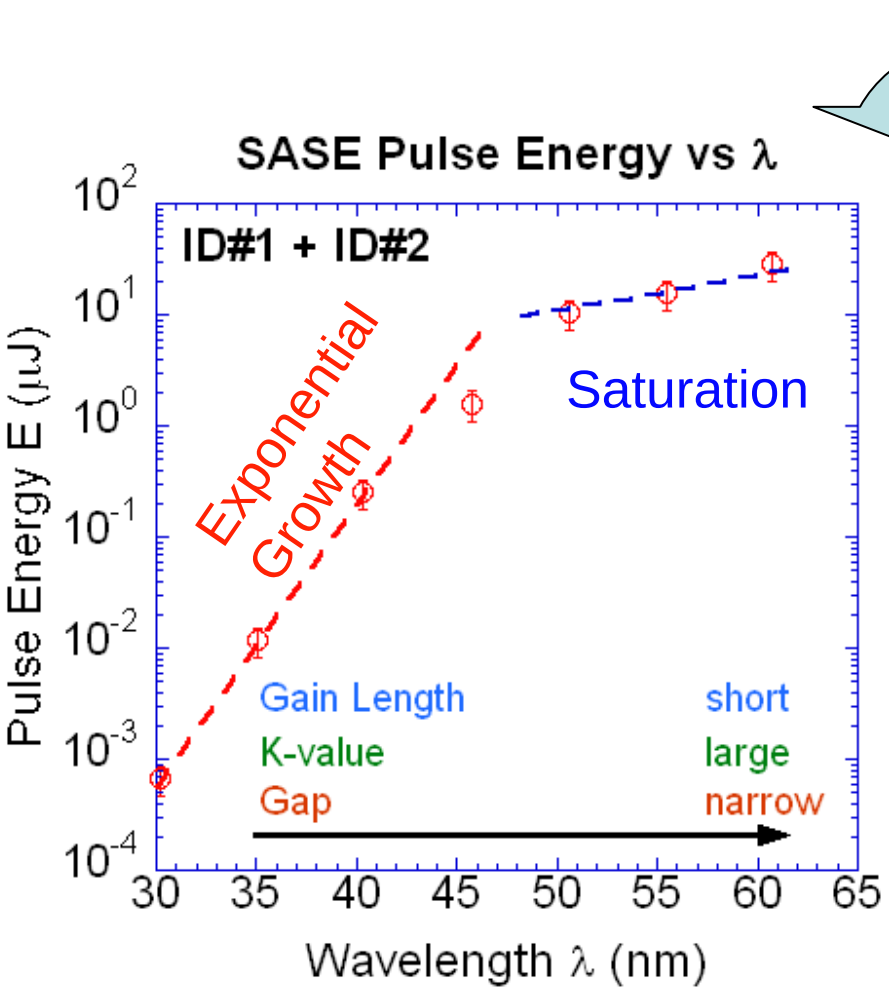
- The achieved **continuous saturation of the SASE FEL** and the **estimated slice emittance of 0.7 πmm.mrad** support the expected high performance of the X-ray compact SASE source

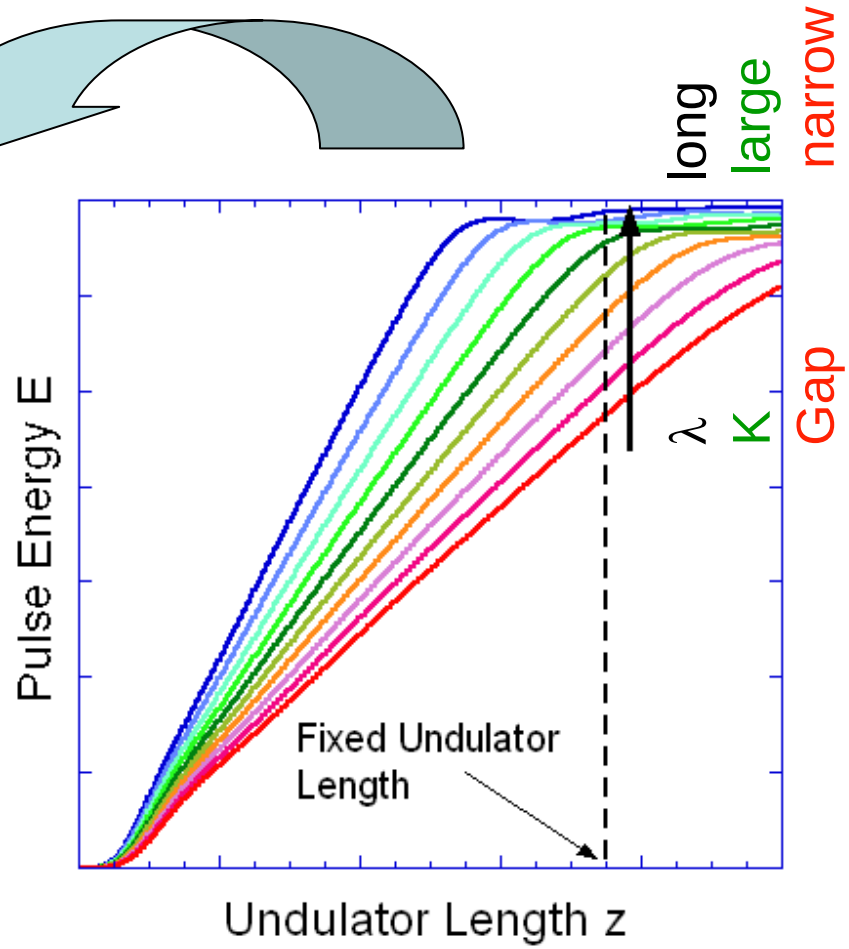
User experiments using the stable SASE have been started since Oct. 2007 and **the first result was published on APL**

Related Contributions

MOPC031 Status of X-ray FEL/SPring-8 Machine Construction
MOPC010 Injector System for X-ray FEL at SPring-8
MOPC018 Seeding the FEL of the SCSS Test Accelerator
MOPD010 Design of XFEL facility in Harima
TUPC023 Design of the Transverse C-band Deflecting Structure
TUPC075 Development Status of Beam Diagnostic System
TUPC143 Precise RF Control System
THPC146 Beam Halo Monitor
THPP137 Development of Vacuum Components

Supplement 1: Interpretation of the Measurement





Supplement 2: Raw Data of Density Profile

Time Resolution ~5 fs