First Lasing at SCSS Test Accelerator

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- First observation of SASE signal at 49 nm, in SCSS Prototype Accelerator, June 20~, 200
Where is SPring-8?
XFEL Project at SPring-8/RIKEN

SCSS-XFEL has been approved in January 2006
8 GeV, 0.8 A, SASE-FEL
Construction 2006-2010, at SPring-8
Beam commissioning ~2010

8 GeV SPring-8

250 MeV Test Accelerator
SCSS Test Accelarator

- C-band Accelerator
- 50 MW Klystron x 2
- Acc Structure 1.8 m x 4
- 250 MeV

- Undulator 4.5 m x 2 unit
- 15 mm period
- 4 mm gap
## SCSS & X-ray FEL Beam Parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Prototype</th>
<th>X-ray FEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beam Energy</td>
<td>$E$</td>
<td>0.25</td>
</tr>
<tr>
<td>X-ray Wavelength</td>
<td>$\lambda$</td>
<td>60</td>
</tr>
<tr>
<td>Beam Emittance</td>
<td>$\epsilon_n$</td>
<td>2</td>
</tr>
<tr>
<td>Bunch Length</td>
<td>$\Delta z$</td>
<td>100</td>
</tr>
<tr>
<td>Transverse Beam Size</td>
<td>$\sigma_{x,y}$</td>
<td>100</td>
</tr>
<tr>
<td>Peak Current</td>
<td>$I_p$</td>
<td>1</td>
</tr>
<tr>
<td>Charge per bunch</td>
<td>$q$</td>
<td>0.3</td>
</tr>
<tr>
<td>Undulator Parameter</td>
<td>$\lambda_u$</td>
<td>15</td>
</tr>
<tr>
<td>Length</td>
<td>$K$</td>
<td>1.3</td>
</tr>
<tr>
<td>Length</td>
<td>$L$</td>
<td>10</td>
</tr>
<tr>
<td>FEL Saturation Length</td>
<td>$L_{sat}$</td>
<td>20</td>
</tr>
</tbody>
</table>
CeB₆ Thermionic Gun provides stable beam.

Beam Profile
CCD Image
Scale 10 mm

500 kV Gun
50 MeV Injector Out

250 MeV Compressor
Undulator Input
Undulator Output
First Lasing at SCSS Prototype Accelerator.

- The first lasing: 49 nm
- E-beam energy: 250 MeV
- Bunch charge: 0.25 nC
- Bunch length: (< 1 pse)
- Peak Current (> 300 A)

- At moment spectrum width 0.5 nm is dominated by e-beam energy fluctuation ~ 0.2%. 
First Lasing at SCSS Prototype Accelerator.

- The first lasing: 49 nm
- E-beam energy: 250 MeV
- Bunch charge: 0.25 nC
- Bunch length: (< 1 pse)
- Peak Current (> 300 A)

- Laser pulse length has not yet measured, (will be ~ 100 fsec).
- Peak power estimation assumed 1 psec width.
SASE Beam Profile and Interference Fringe

- SASE Beam
- Diameter 1 mm

- Double Slit
- Width 100 µm, Separation 400 µm

SASE (1 shot, bunching condition)

Spontaneous radiation (debunching condition, 100 shots)
First Lasing at SCSS Prototype Accelerator.

June 15, 2006
Thank you very much!