X-band structure progress at SINAP

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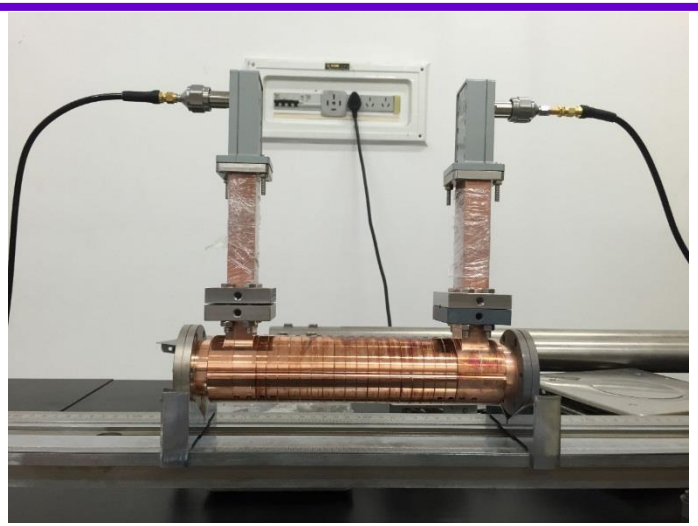
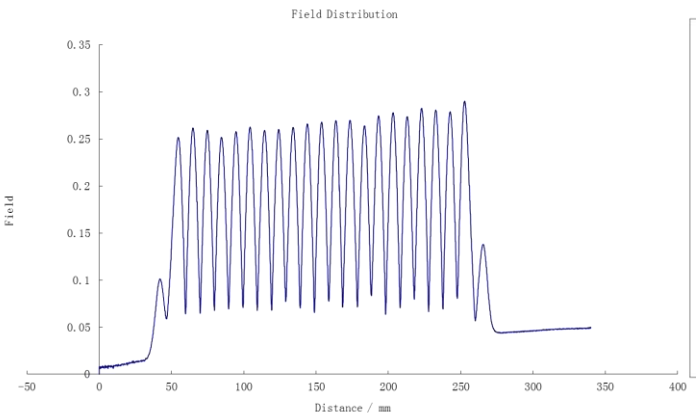
Outline

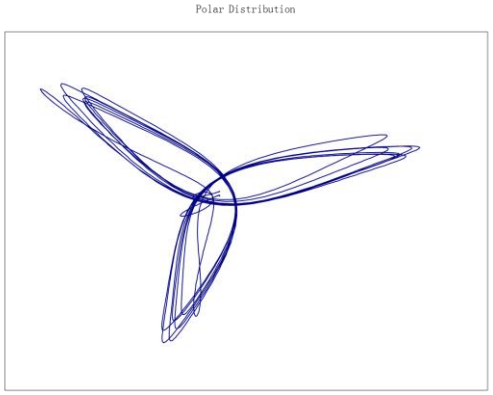
- RF conditioning results of deflector
- X-band development for SXFEL
- X-band test platform preparation
- Summary

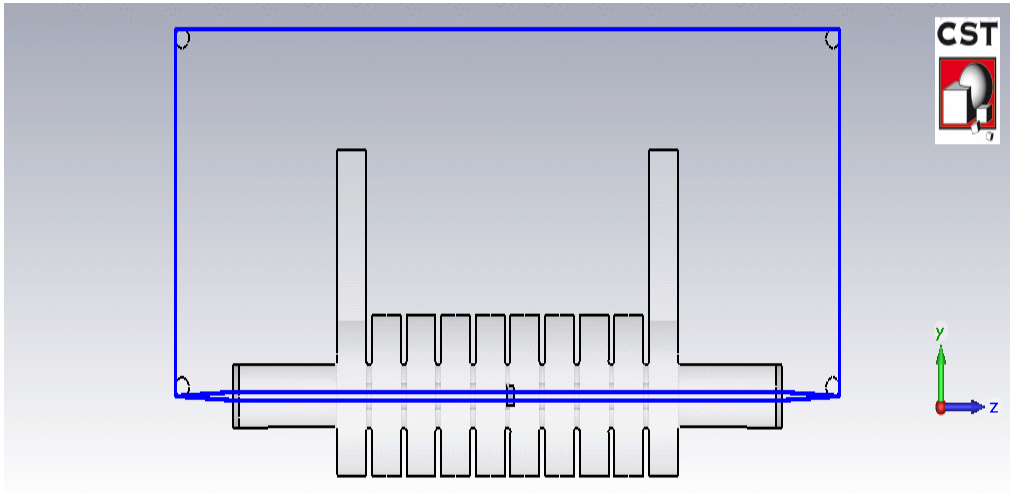
RF conditioning results of deflector

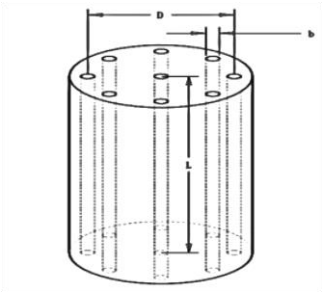
Field measurement and tuning results





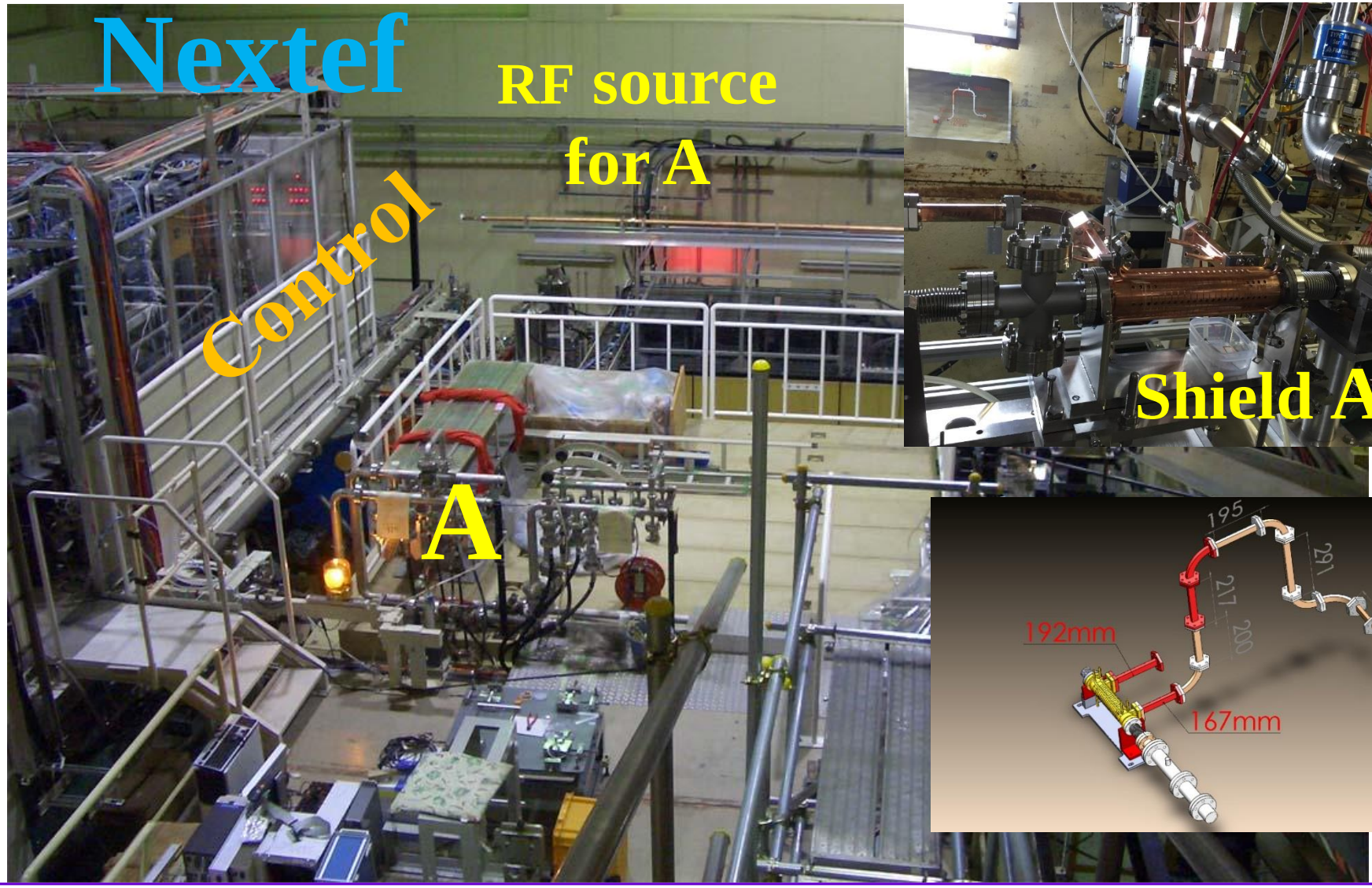






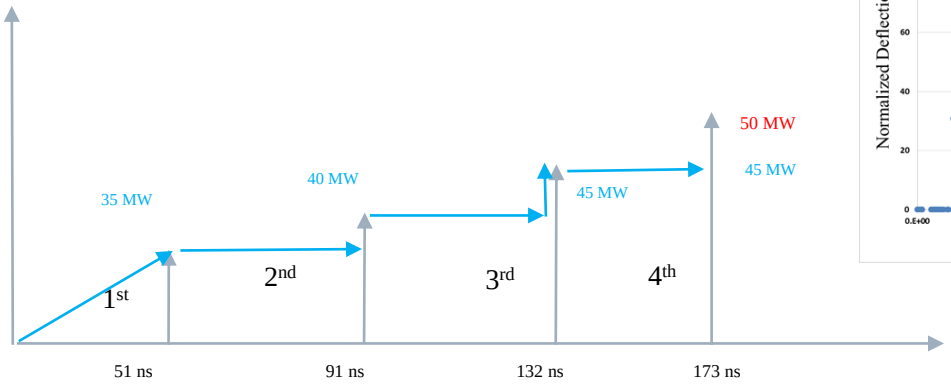
The cage, with several metal wires surrounded on the carrier which could be scrip or Teflon, the performance affected by Diameter(D) Length(L) metal diameter(b) and Number(N)

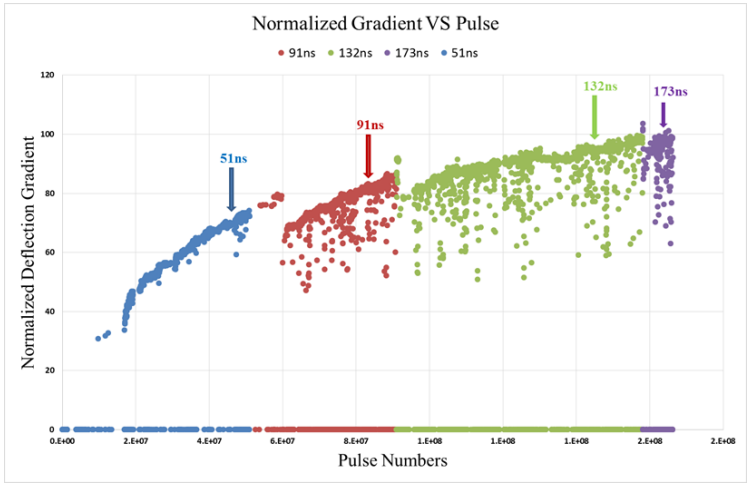
Installation on SHIELD-A



Operation Plan

4 stages operation





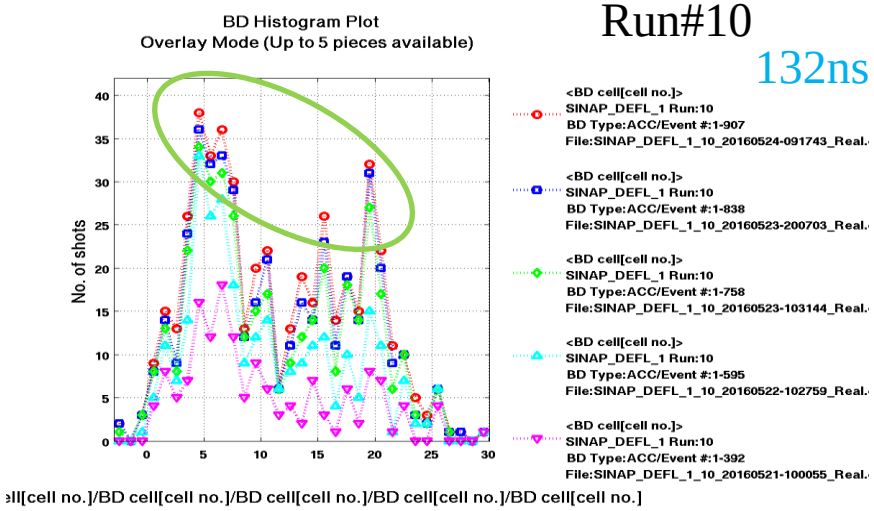
Start from 51ns, final power 50MW @173ns

Planed operation time 6-8 weeks, 6 weeks operation up to 45MW @132ns

4 June started 173ns operation, end operation 30 June, final power at 45MW

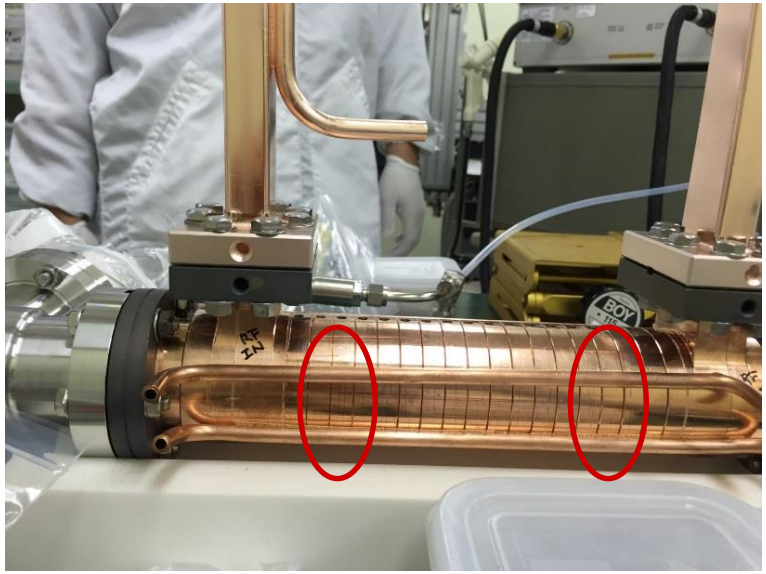
Lots of breakdown prevent power increasing

Breakdown Position Analysis Results



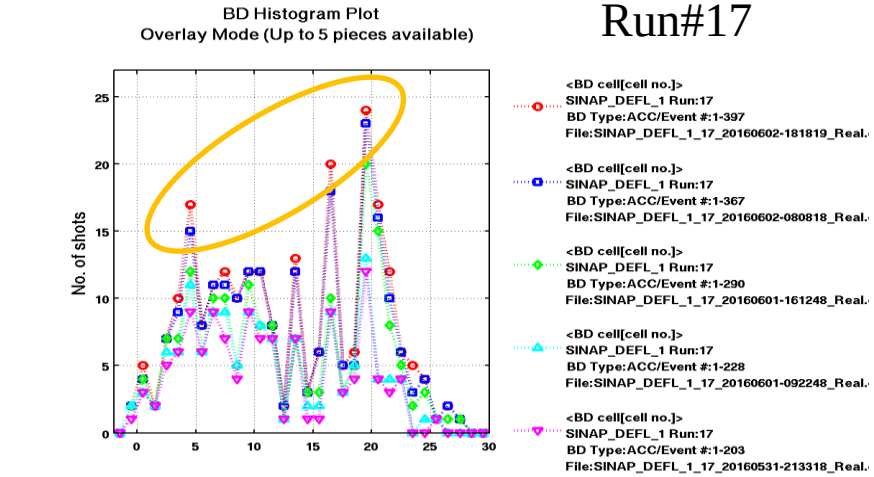
Run#10

132ns Running



132ns Running

Run#17



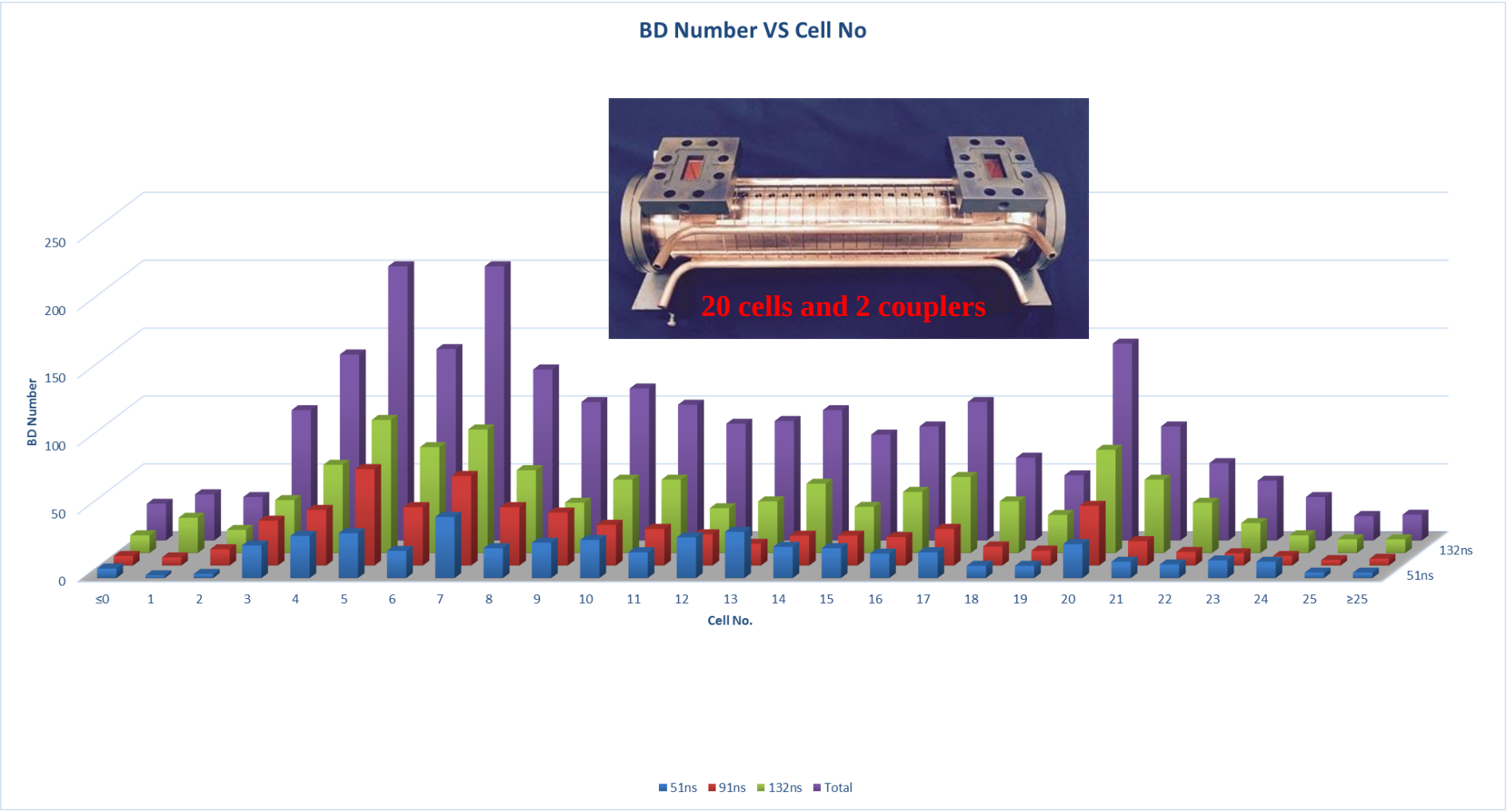
Population of breakdown cell as processing

▽ → △ → ◇ → □ → ○

Lots of breakdowns in upstream cells

Further processing, appeared breakdowns in the downstream

Breakdown Position Analysis Results

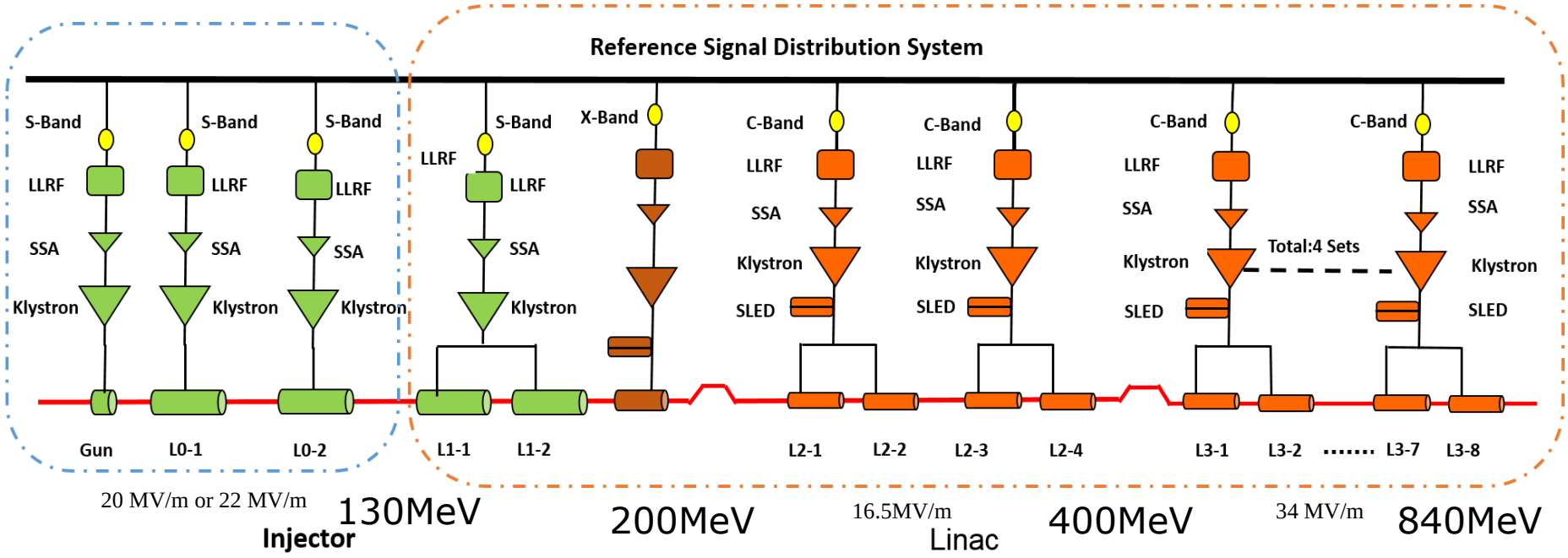


X-band development for SXFEL

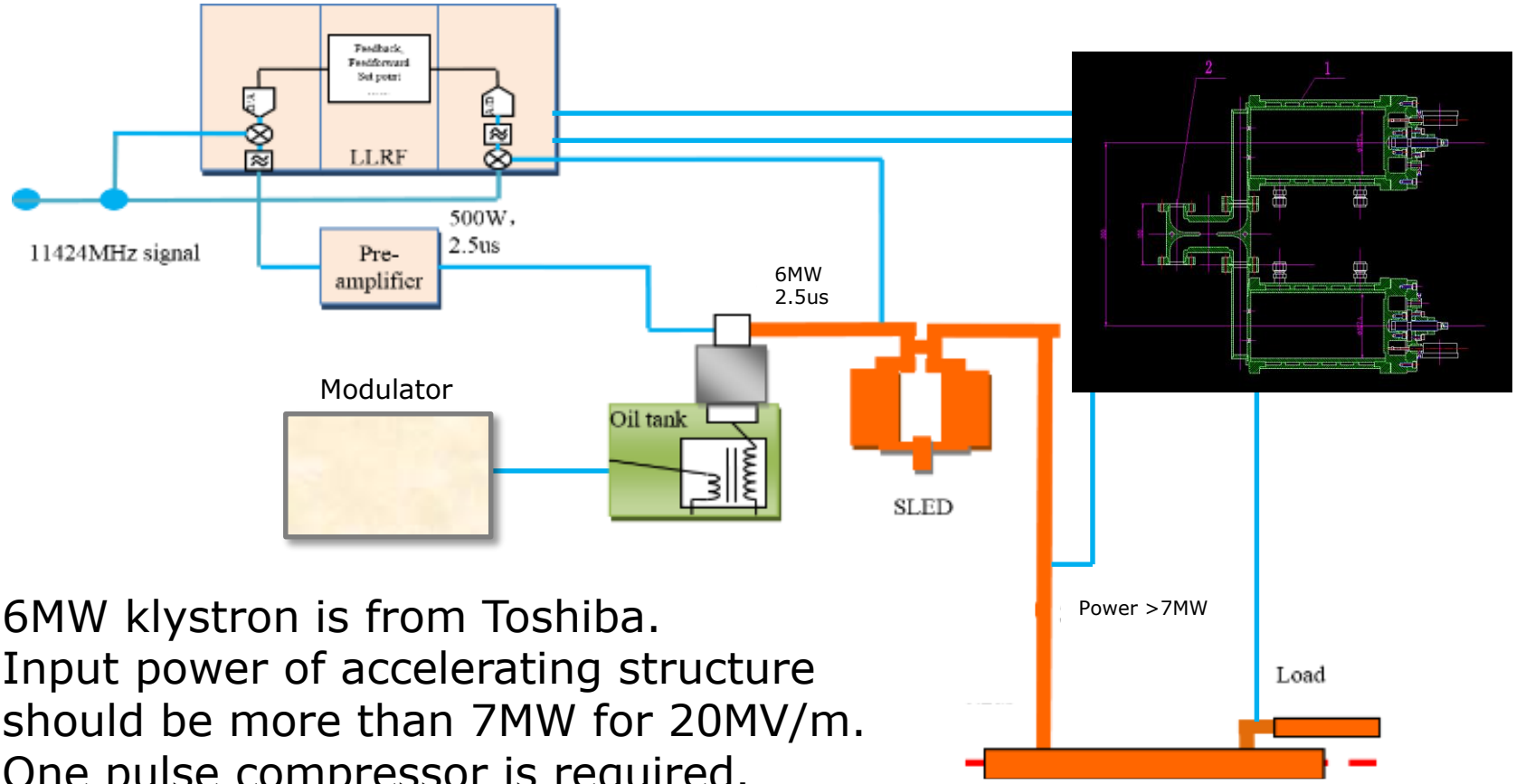
Shanghai Photon Science Center at SINAP

Layout of SXFEL RF system

1. 6 C-band RF units, 40MV/m target, and 34MV/m in Phase I operation.
2. 1 X-band RF units as linearizer, including SLED and accelerating structure.
3. 4 S-band RF units.



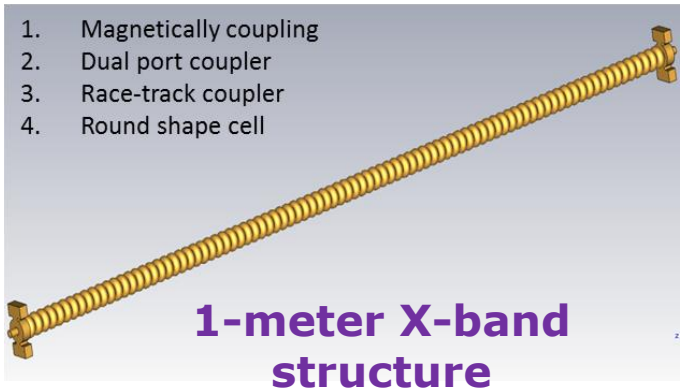
Layout X-band RF unit for SXFEL

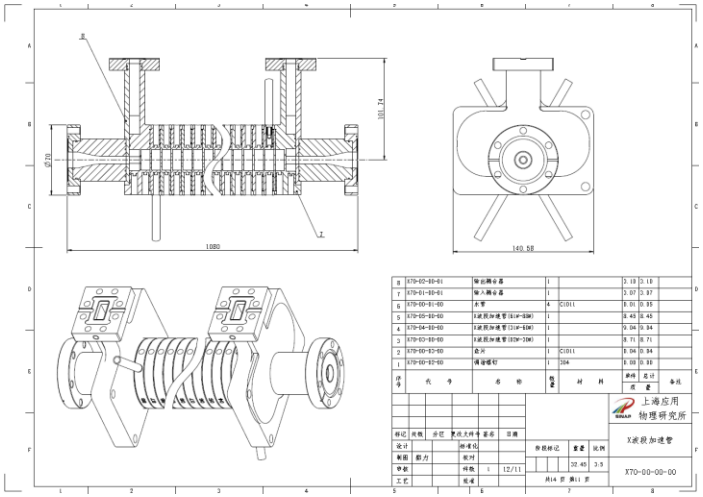


1. 6MW klystron is from Toshiba.
2. Input power of accelerating structure should be more than 7MW for 20MV/m.
3. One pulse compressor is required.
4. LLRF is based on MTCA, Phase stability should be better than 0.36 degree, and amplitude should be better than 0.04%.

Current status of X-band accelerator technology

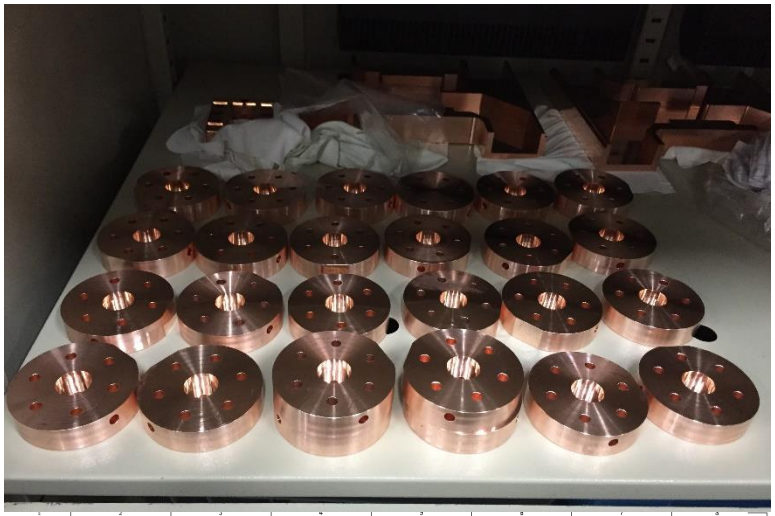
1-meter X-band accelerating structure for SXFEL has been designed, and start fabrication recently.

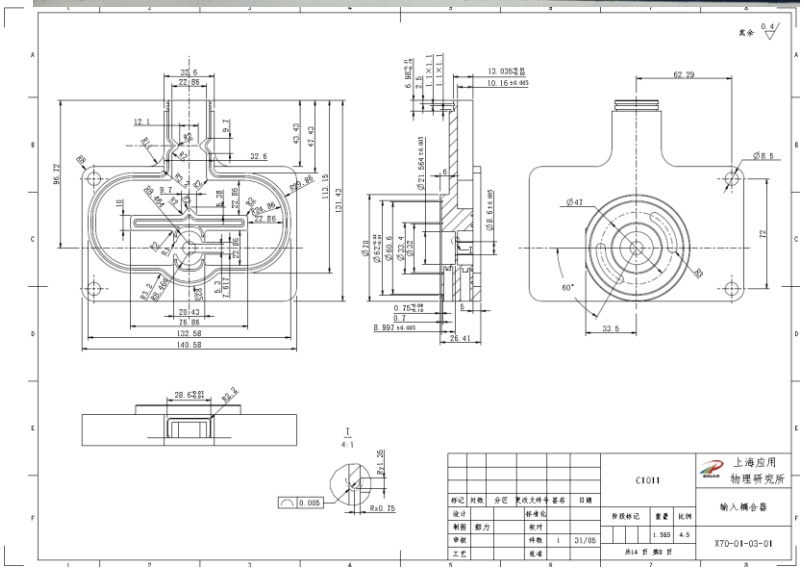


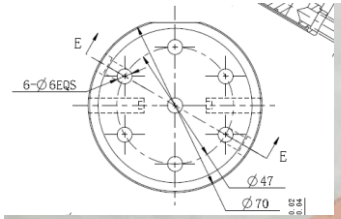


Frequency	11424MHz
Phase advance	4π/5
Cell No.	89+2
Effective length	944.73mm
Cell length, d	10.497mm
Iris thickness, 2a	1.5 mm
Diameter, 2b	23.379~22.556 mm
Ratio of elliptic radius, b_a	1.8
Aperture, a_r	4.3~3.05.mm
Group velocity, Vg/c	3.45%~1.12%
Shunt impedance, R	93.93~125.62MΩ/m
Attenuation factor, τ	0.61
Filling time, t_f	150 ns
Sc	4.14~2.33 MW/mm^2
Emax/E0	2.68~2.02
Hmax/E0	2.68~2.39 mA/V
Input power, P_{in}	52MW @65MV/m 80MW @80MV/m
Two-Klystrons units	34 @65MV/m 51 @80MV/m

X-band accelerator fabrication

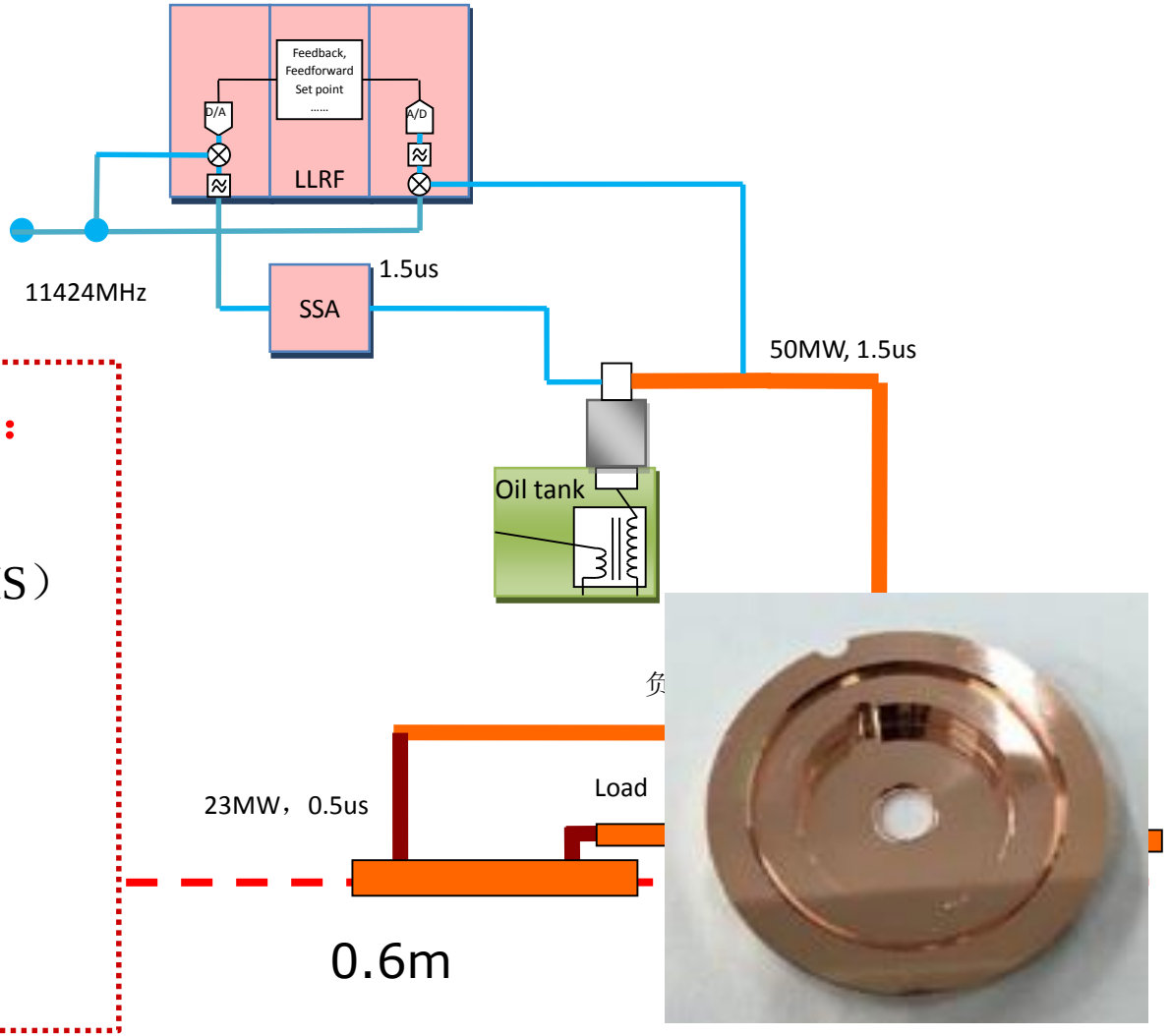






- Mechanical design
- Inner cooling with 6 holes
- Coupler with box and cover

New layout of X-Band TDS for SXFEL upgrading



Specification of SXFEL：

Energy： 1500MeV

Bunch length： 76um（RMS）

Beam size： 36um

Install space： <1.3 m

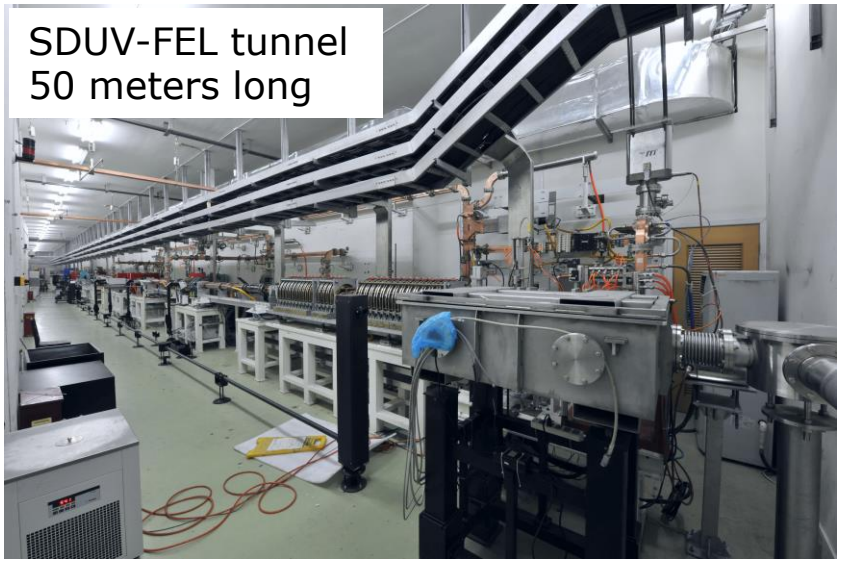
Resolution： 20fs

Deflecting voltage： 30MV

Input power: 20MW

X-band test platform preparation

X-band test platform



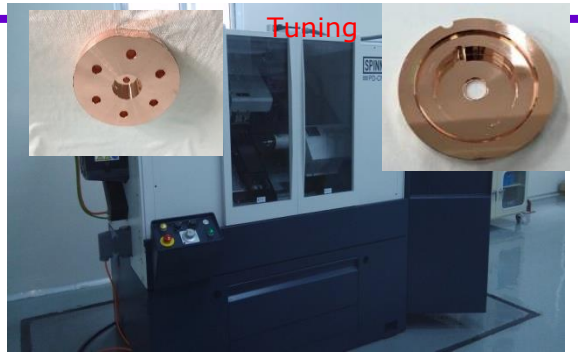
- New progress end of this year
  - Klystron and solid amplifier will prepared
  - Modulator have ordered
  - Pulse compressor
  - Waveguide components, 3db coupler, directional coupler…
- Plan of next year
  - X-band structure fabrication and test

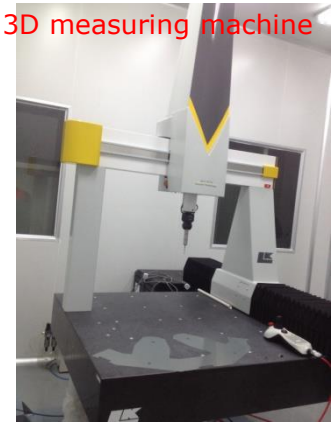
1. First step, one 50 MW X-band high power test platform will be set up the end of this year.
2. In the next year, start X-band accelerating structures fabrication. Prepare waveguide components, such as directional coupler, 3db coupler, regular waveguide…
3. In the last year, SDUV-FEL facility have be remove, and 50m tunnel is dedicated for X-band technology R&D, specially for FEL linac development based on t X-band.
4. One dedicated fabrication workshop almost is constructed, and now Hydrogen furnace prepared.

Dedicated workshop for RF structure fabrication

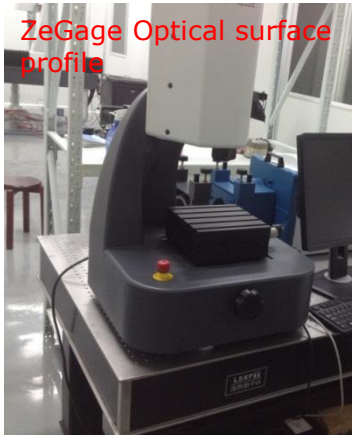

Milling


Tuning


Tuning


3D measuring machine

3D Vision Measuring Machine


ZeGage Optical surface profile

ZYGO DynaFiz dynamic laser interferometer


Vacuum furnace


Baking


Chemical treatment

Hydrogen furnace

Summary

- One good start on X-band technology has been done with deflecting cavity at SINAP.
- One X-band RF units including full components will be used on SXFEL.
- Based on the X-band plan, one dedicated X-band RF system will be set up for R&D of high gradient technology at SINAP.

Acknowledgement

Many thanks to…

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and many other members of KEK contribute to SINAP Deflector test.


Thank you!!!