

# Research Plans on High-Gradient Structures for HALF

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# Outline



- 1. Introductions on NSRL and HALF**
- 2. Research activities at NSRL**
- 3. Research plans on high-gradient structures**

- ❑ **First National Lab in China(1983)**
- ❑ **It is an key part of University of Science and Technology of China (USTC)**

## Hefei Light Source (HLS)

- ❑ **First synchrotron radiation facility in China(1989)**



First-term (1984-1991)



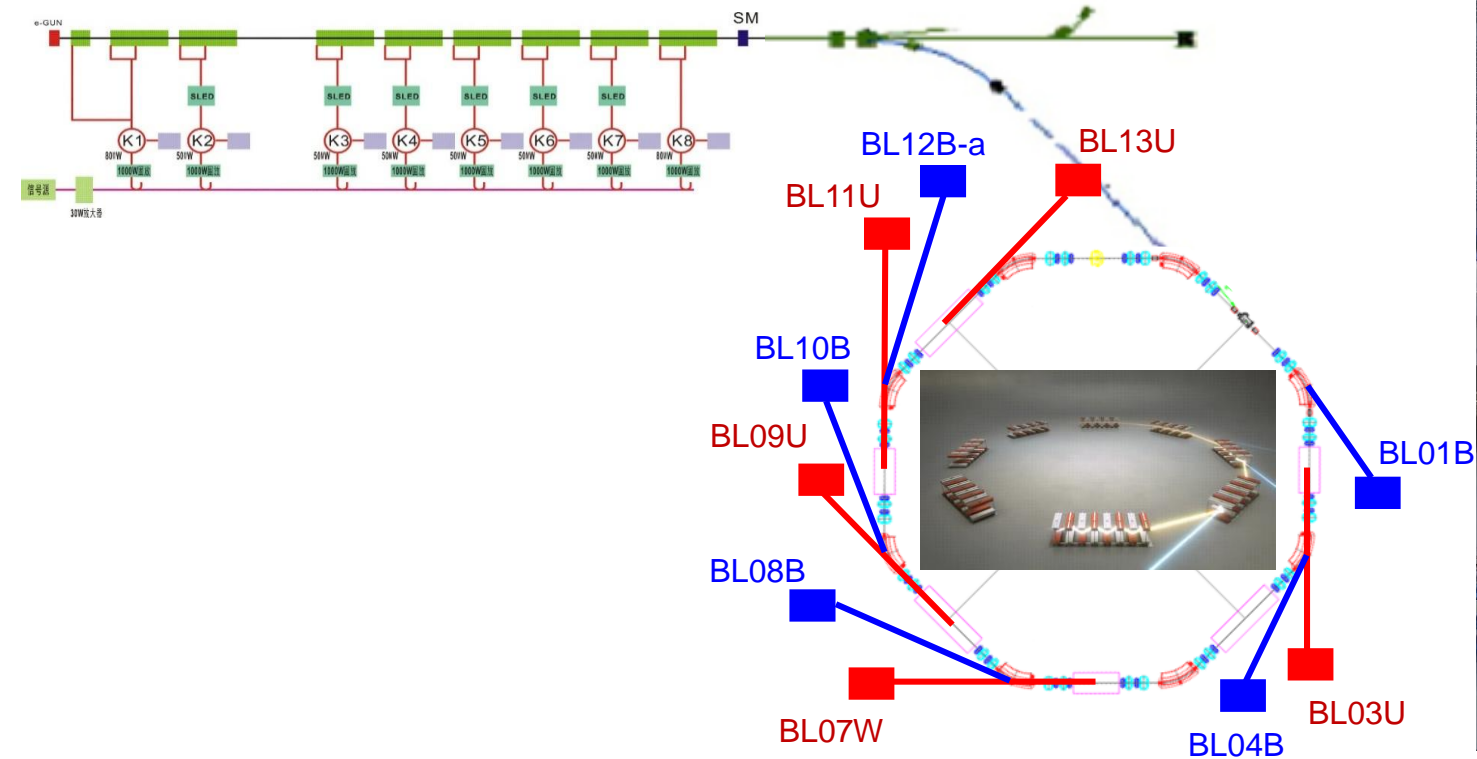
Second-term (1998-2004)



Major Upgrade (2009-2014)



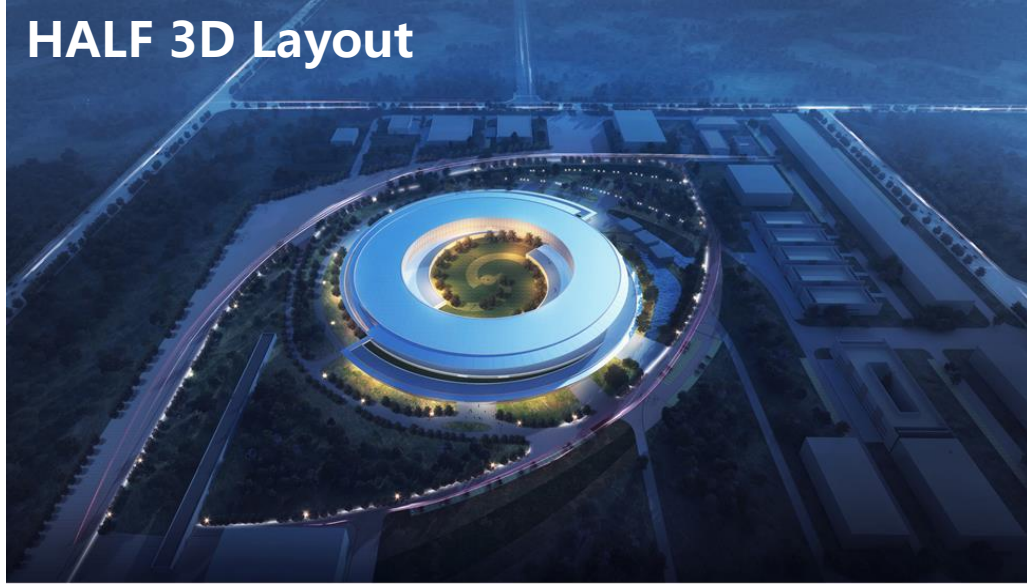
# Hefei Light Source (HLS)



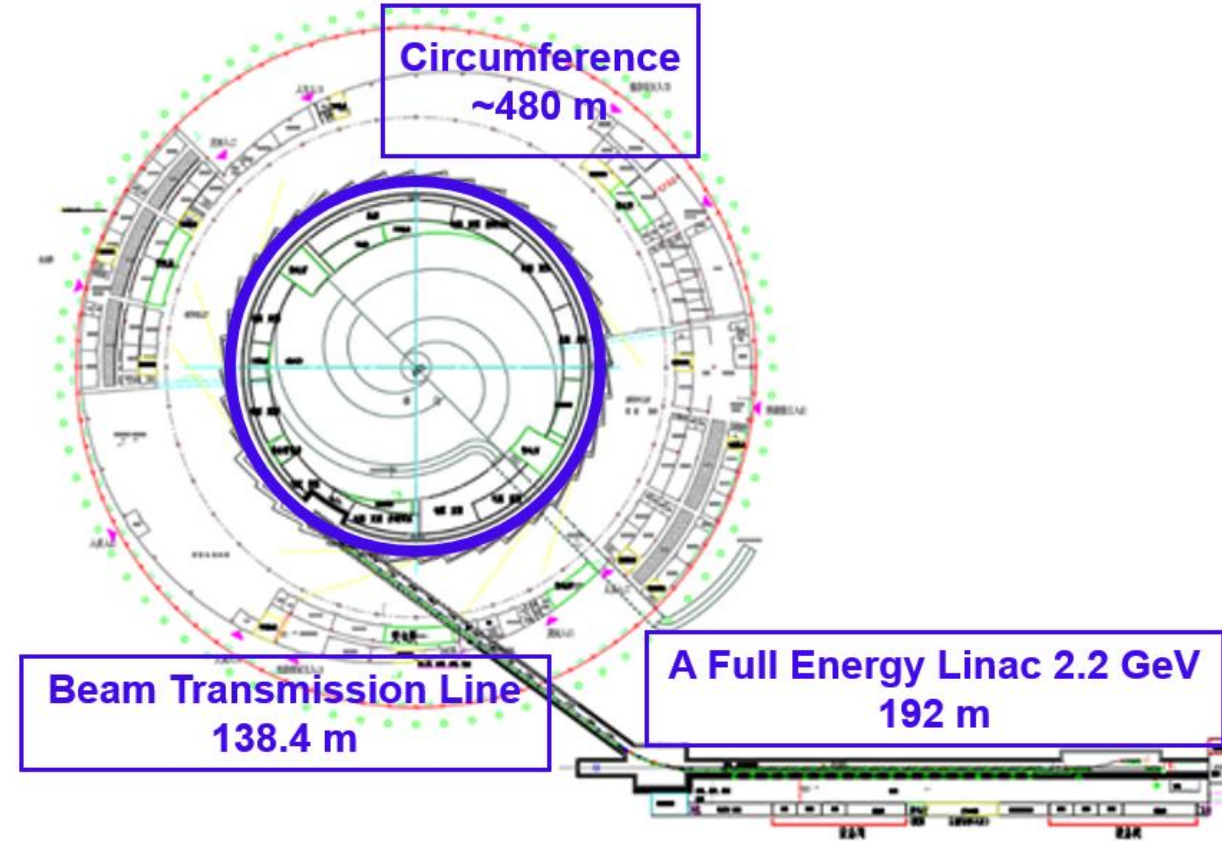
- At 2018.07, HLS maintains within 1% at 360 mA in top-up mode, indicating it has reached operation ability of 3<sup>rd</sup>-generation synchrotron radiation source

# A new project - Hefei Advanced Light Facility (HALF)

HALF 3D Layout



**Hefei Advanced Light Facility (HALF)**  
**-4<sup>th</sup> generation synchrotron**  
**radiation source**

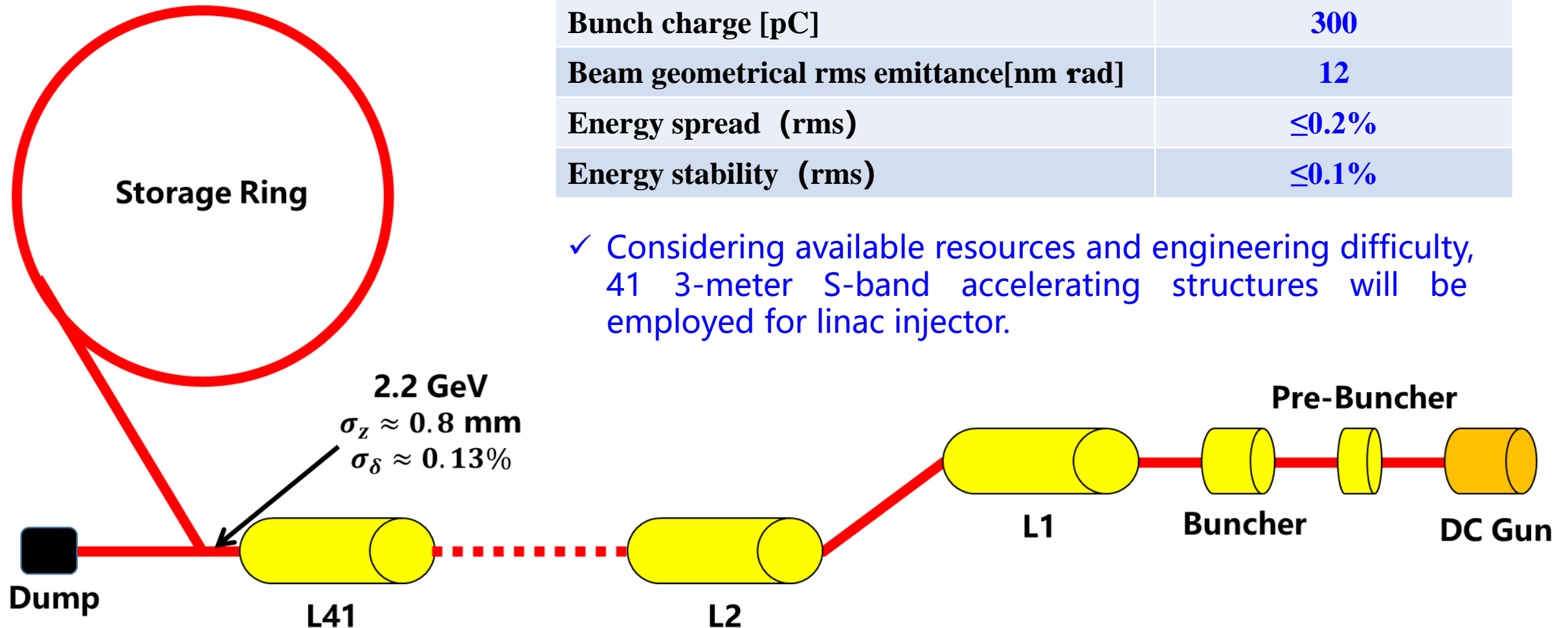


- ❑ HALF is fully funded by National Development and Reform Commission
- ❑ ~366 million Euros
- ❑ 2023.09-2028.12

# A Full Energy Linac Injector

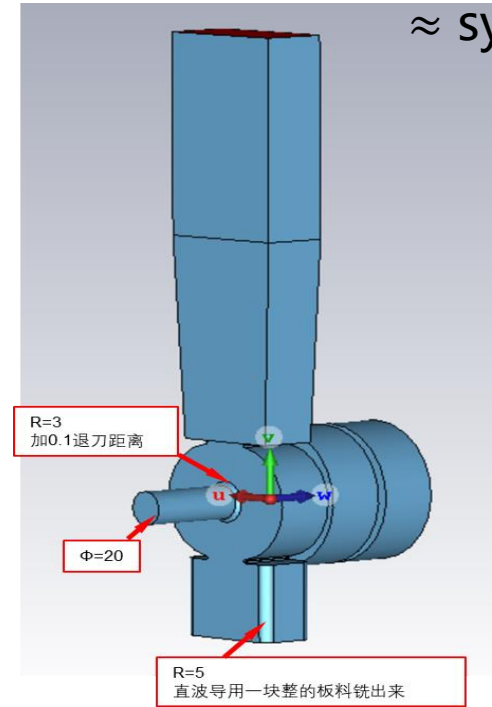
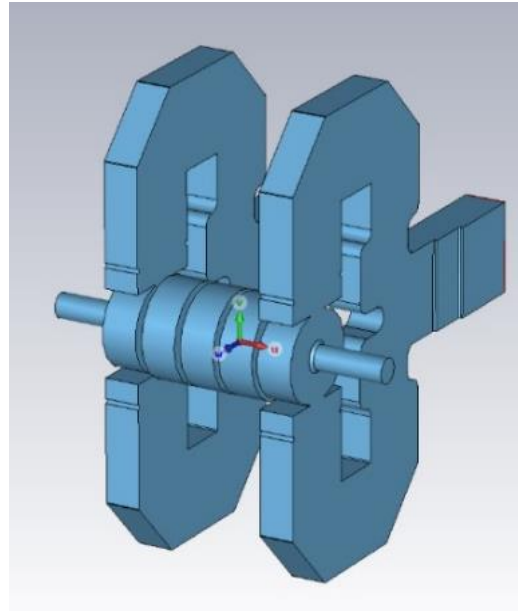
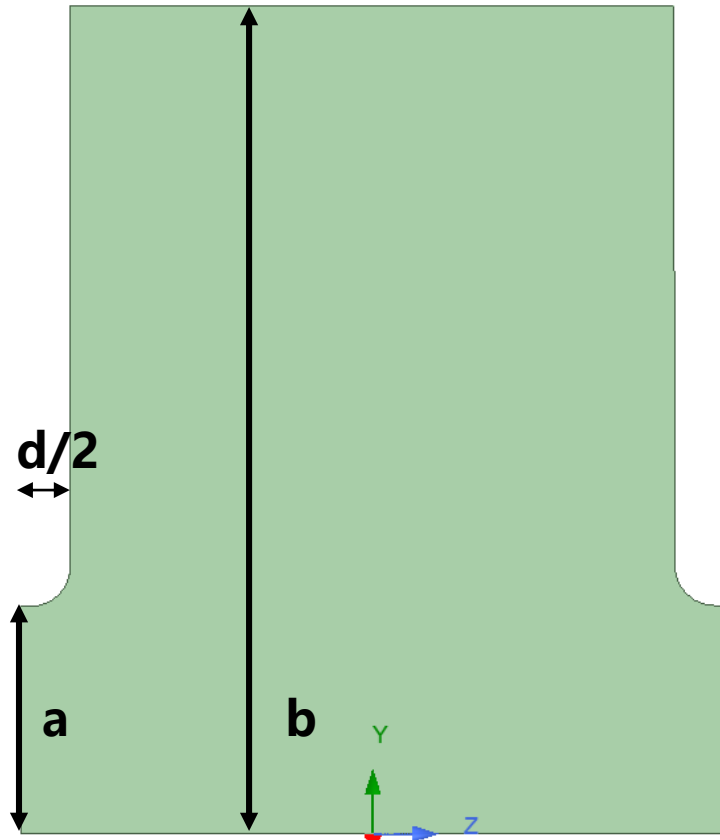
Linac Injector Parameters	Design Target
Energy [GeV]	2.2
Bunch charge [pC]	300
Beam geometrical rms emittance[nm rad]	12
Energy spread (rms)	$\leq 0.2\%$
Energy stability (rms)	$\leq 0.1\%$

- ✓ Considering available resources and engineering difficulty, 41 3-meter S-band accelerating structures will be employed for linac injector.

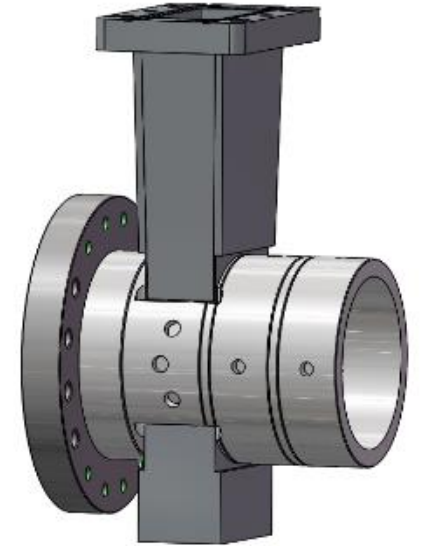




# 3-meter S-band Accelerating Structure



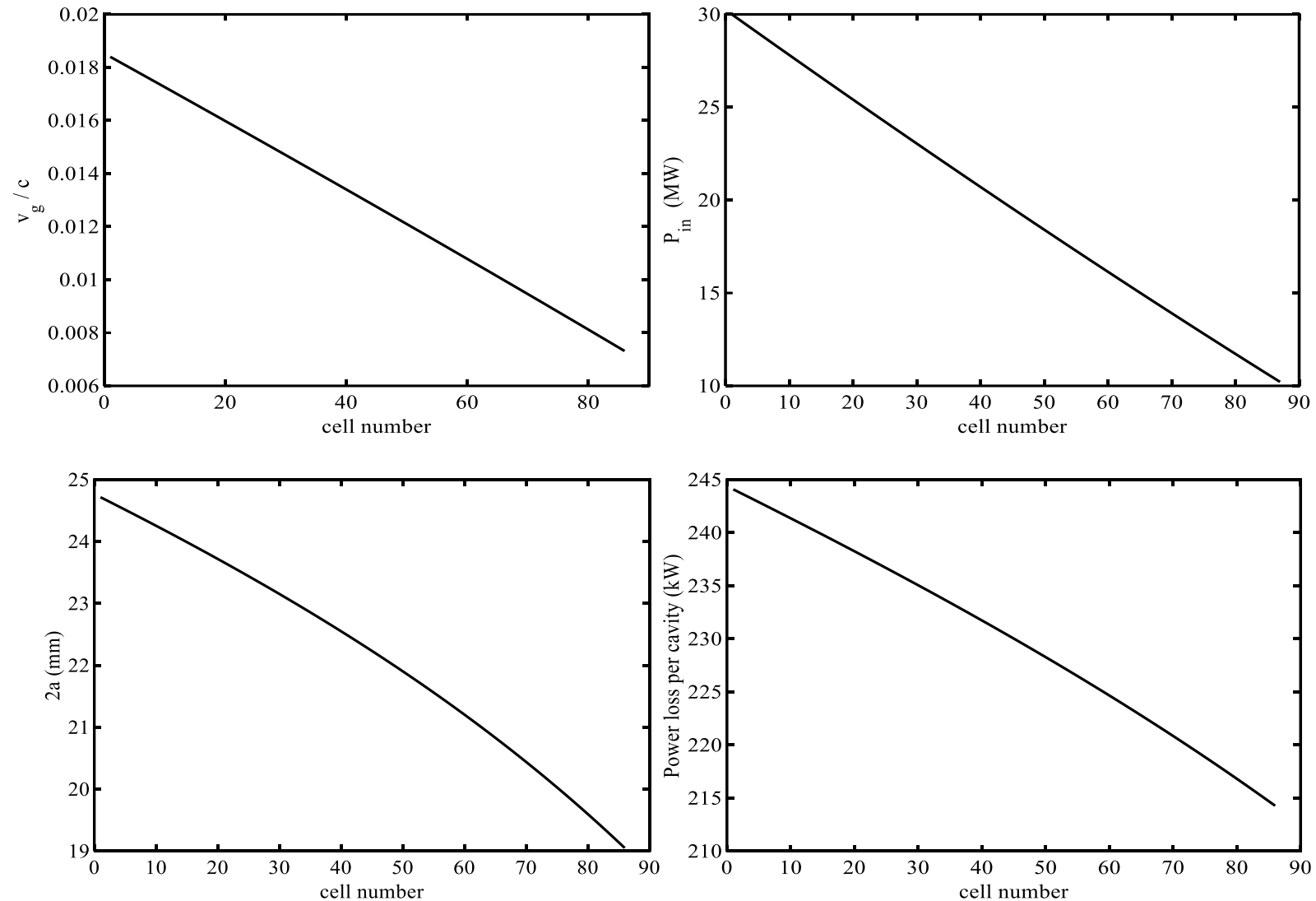
single port + shorted end  
 $\approx$  symmetrical powered



Courtesy by Dr. Jian Pang



# 3-meter S-band Accelerating Structure

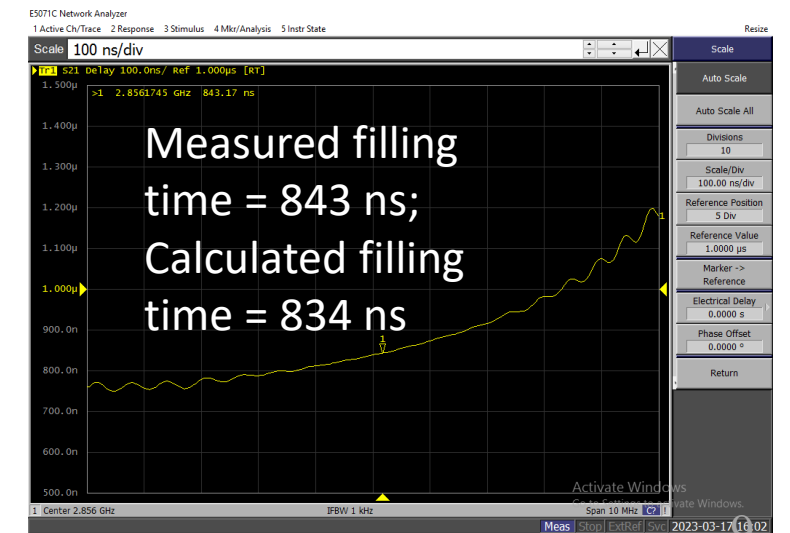
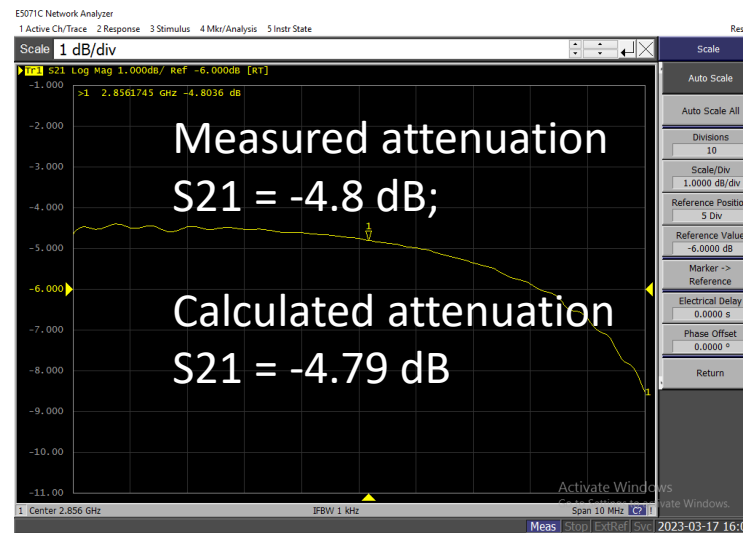
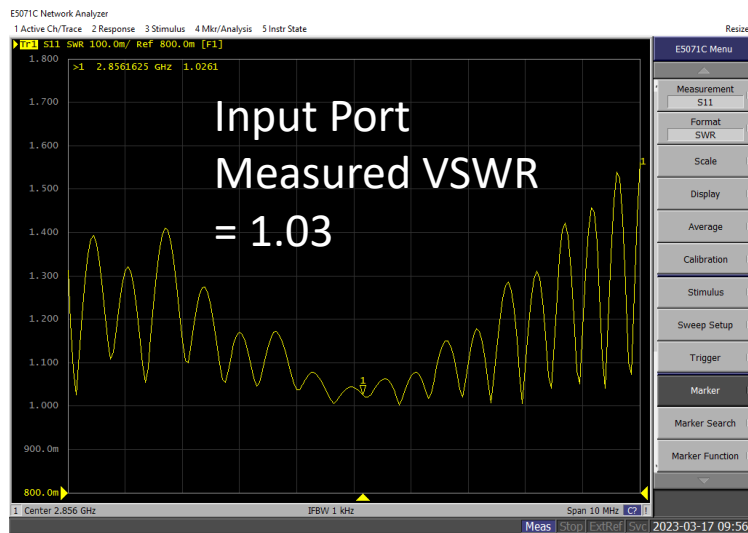
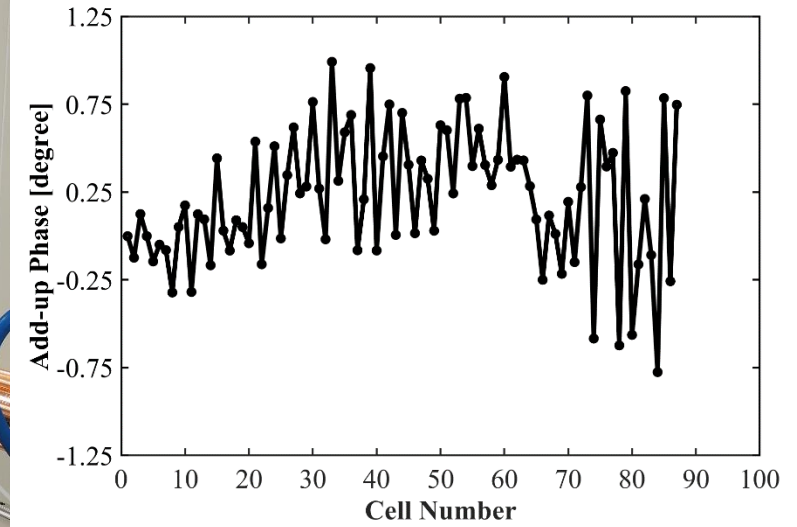
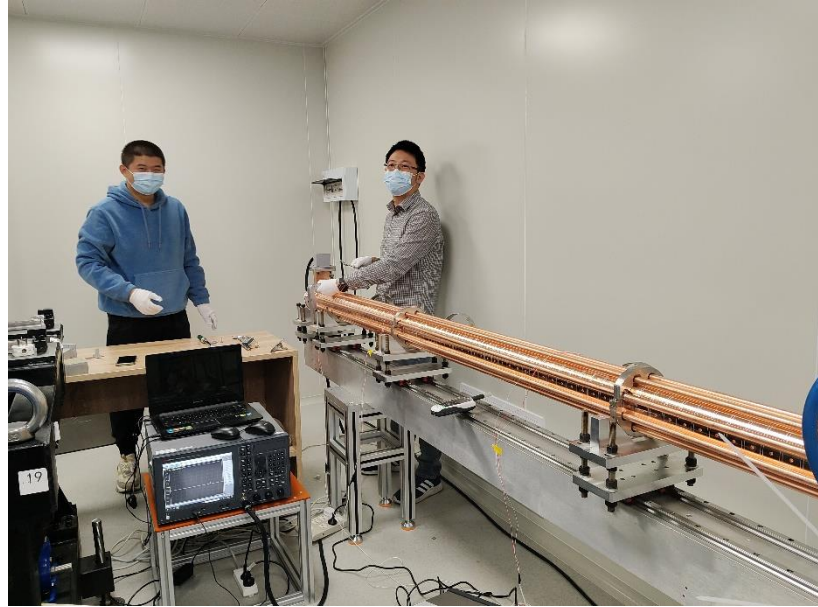


Parameters	unit	values
frequency	MHz	2856
Type		Constant Gradient
Accelerating Mode		$2\pi/3$
Number of Cells		85+2
Input Power	MW	30
Unloaded Gradient	MV/m	20
Iris Radius a	mm	12.358-9.573
Cell Radius b	mm	41.398-40.796
Cell Length	mm	35
Thickness d	mm	5
Group velocity $v_g/c$		0.0184~0.0073
Attenuation	Np	0.54
Filling time	$\mu s$	0.83
Length	m	3.14

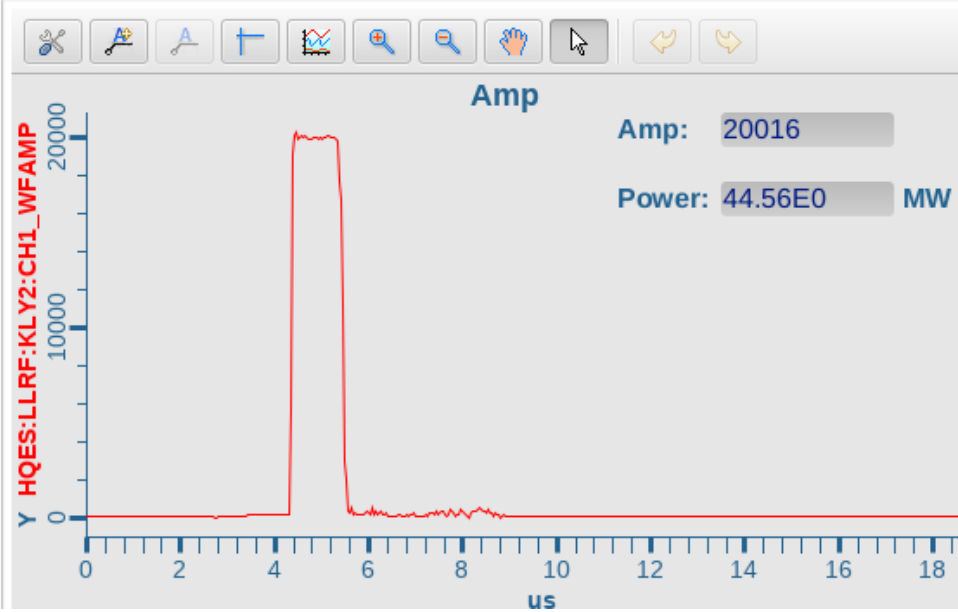
Courtesy by Dr. Jian Pang



# Fabrication and Tests

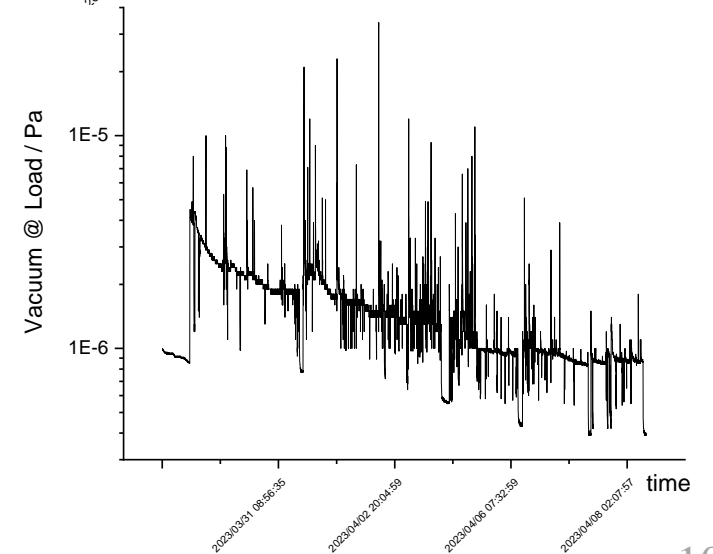
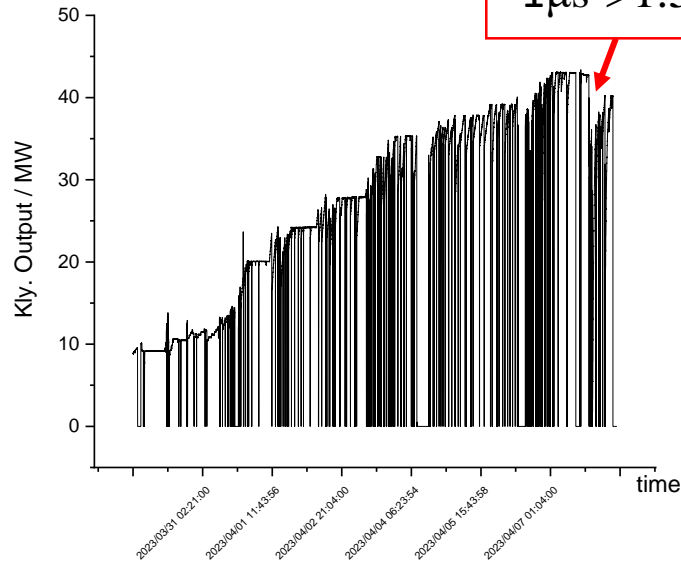
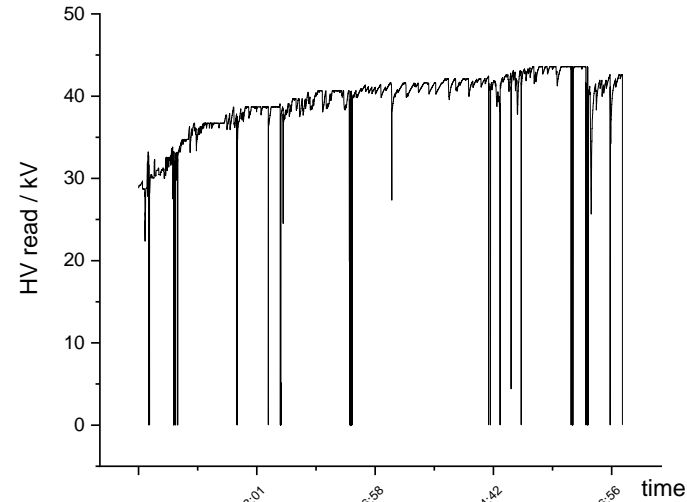


# Preliminary High-power Tests



For a pulse width of  $1.0 \mu\text{s}$ , no breakdowns in 24 hours for output power of klystron  $P_{\text{out}} = 44 \text{ MW}$ , corresponding to a gradient of 23 MV/m.

For a pulse width of  $1.5 \mu\text{s}$ , 11 breakdowns in 22 hours,  $P_{\text{out}} = 44 \text{ MW}$ , the gradient reaches higher than 20 MV/m.



## Advanced Accelerator Techniques Test-stand

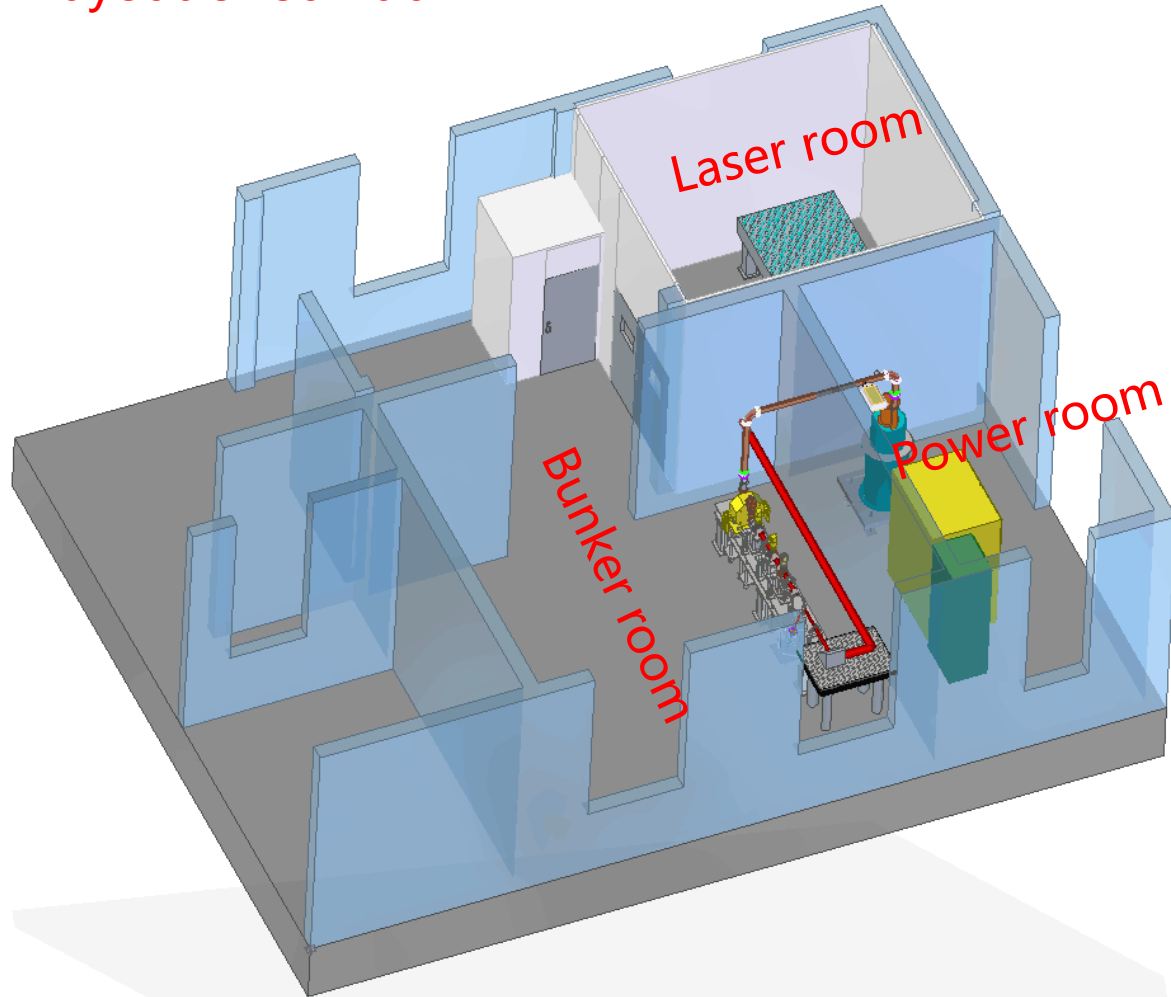


01 ☐ **X-band accelerating structure**: accelerating gradient  $> 80$  MV/m

02 ☐ **C-band photocathode gun**: repetition rate: 100 Hz - 1 kHz, emittance  $< 1$  mm·mrad;

# Resources - laser + bunker room

Layout of our lab



Laser room



Bunker Room





# Resources - Funding & Students

## □ Available Funding on my hands

~1 million Euros, more funding can be expected in the near future.

## □ Available students in my group

2 PhD students are Grade 1.

3 PhD students will join us in this September.

## □ More than 10 Engineers + Technicians are available for operation of laser and fabrication of accelerating structures.

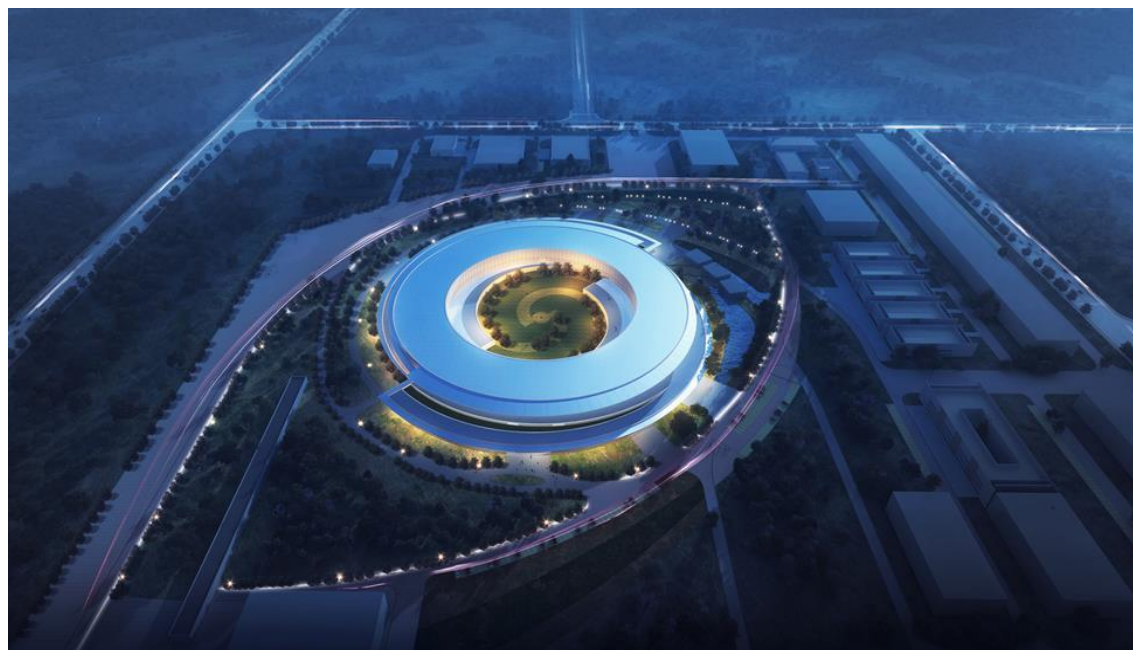


# Expected Collaborations from CERN

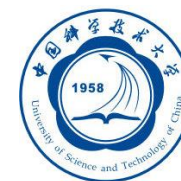


- ✓ **International Collaborations including short-term and long-term visiting for researchers and students;**
- ✓ **An X-band structure with a length of  $< 1$  meter and a gradient of  $> 80$  MV/m can be developed;**
- ✓ **A C-band photocathode gun with a repetition rate of 100 Hz - 1 kHz and emittance  $< 1$  mm·mrad can be developed.**

# Thanks!



Hefei Advanced Light Facility (HALF)



中国科学技术大学  
University of Science and Technology of China