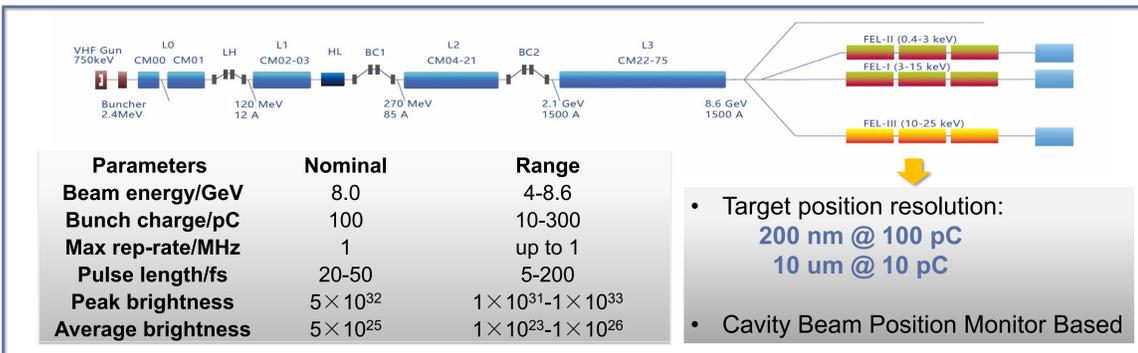


Authors: S. S. Cao, Y. B. Leng, R. X. Yuan, R. T. Jiang

Abstract

SHINE (Shanghai High repetition rate XFEL aNd Extreme light facility) is a newly proposed high-repetition-rate X-ray FEL facility and will be used to generate brilliant X-rays between 0.4 and 0.25 keV. To guarantee the high performance of FEL light pulses, it is required to precisely monitoring the trajectory of the electron bunch. The position resolution of each bunch at the undulator section is required to be better than 200 nm at a bunch charge of 100 pC and 1 μ m at a bunch charge of 10 pC. Since the cavity beam position monitor (CBPM) is widely used in FEL facilities for its unique high resolution and high sensitivity and the output signals of an ideal pillbox cavity are proportional to the resonant frequency, thus the X-band CBPM is preferred because it is expected to obtain better results at low bunch charge compared with the C-band CBPM. Therefore, an X-band CBPM prototype is also developed for SHINE. This paper will focus on the design and production process of the X-CBPM.

Introduction



Motivation

Development of X-band CBPM:

- Choose the cavity parameters with best performance
 - X-band CBPM has a more compact structure
 - Low bunch charge, need higher SNR
 - check the machining techniques of the manufacturers
 - Manufacturing capabilities & efficiency
 - First try, new for us

Design of X-CBPM

Requirements of X-CBPM

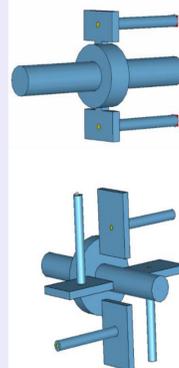
Parameters	Value
Frequency/MHz	11483
Decay time constant/ns	100~200
Qload	3611~7222
Bandwidth/MHz	1.59~3.18
XY crosstalk/dB	<-34

Reference cavity:

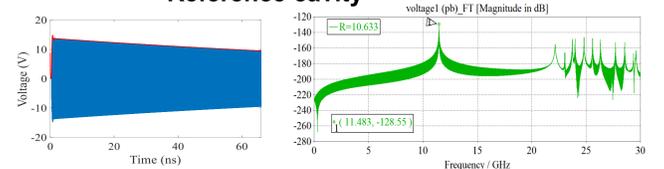
- Freq = 11.483 GHz BW = 1.81 MHz
- Add two additional rectangular waveguides;
- Mainly because of limited space for installation;

Position cavity:

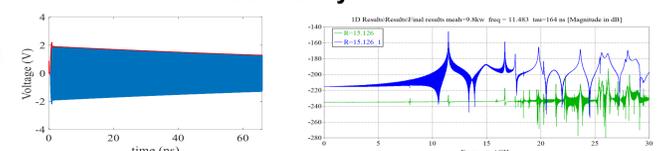
- Freq = 11.483 GHz BW = 1.94 MHz
- Four rectangular waveguides and 4 feedthroughs;
- The distance between reference cavity and position > 60 mm



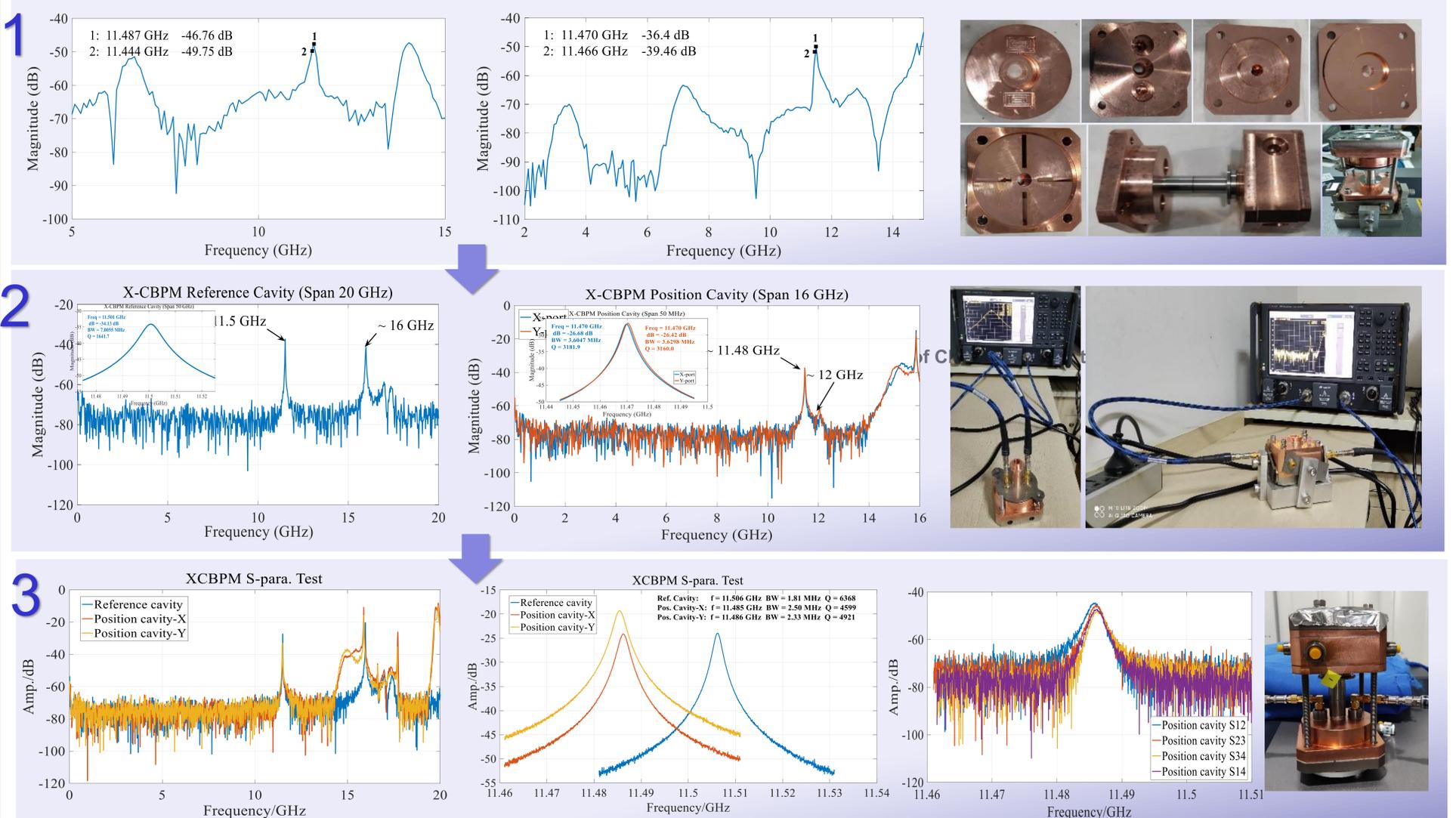
Reference cavity



Position cavity



Development of X-CBPM



Parameters	design	Before brazing	After brazing	Final	Deviation	
Ref.cavity	Freq./GHz	11.483	11.501	11.506	23 MHz	
	BW/MHz	1.81	7.0	1.87	1.81	
	Qload	6344	1647	6147	6368	24
Pos.-X	Freq./GHz	11.483	11.470	11.485	11.485	2 MHz
	BW/MHz	1.94	3.60	2.58	2.50	0.56 MHz
	Qload	5919	3187	4452	4599	1320
Pos.-Y	Freq./GHz	11.483	11.470	11.486	11.486	3 MHz
	BW/MHz	1.94	3.63	2.41	2.33	0.39 MHz
	Qload	5919	3157	4761	4921	998

Conclusion

- An X band cavity BPM prototype has been developed;
- Obtained three test results (before and after brazing, final);
- Good suppression of unexpected modes after brazing;
- Reducing the cavity gap can help obtain effective cold test results before welding.
- Plans are being made to construct two additional X-CBPM and test them in SXFEL as soon as possible.