

BEPcii SRF SYSTEM OPERATION STATUS

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Abstract

Two cavities of 499.8MHz have been operated for BEPCII since 2006. The maximum beam power is over 120kW for both cavities. In collision mode, Helium gas pressure only increases with beam current in one cavity. Beam tests have been taken to search for the reason, such as measuring HOM power, optimizing orbit. A brief introduction of the research is given below.

INTRODUCTION[1]

BEPCII[2] is a double ring e⁺/e⁻ collider and also a SR light source. Typical parameters achieved of SRF system is listed in table 1. Two Superconducting Cavities, East and West cavity are installed at the outer Rings of electron Ring (BER) and positron ring (BPR), and respectively symmetric beside the beam crossing point. In SR mode, e⁻ beam runs along the outer Rings. In collision mode, e⁺ and e⁻ beam are separated in vertical crossing, as shown in Fig. 1 and Fig. 2. Both beams are injected with full energy.

Table 1: Typical operation parameters achieved

Parameters	Collision mode BER & BPR	SR mode BSR
Beam energy (GeV)	2×(1.89~2.0)	2.5
Beam current (mA)	2×750	250
Bunch number	2×(80~88)	160
RF voltage (MV)	1.65 /Ring	1.90
Beam power (kW)	2×120	92
U ₀ (KeV)	121~152 / Ring	334
f _{rf} (MHz)	499.8	499.8
Circumference (m)	237.53 /Ring	241.13
Harmonic number	396 /Ring	402
α _p	0.0237	0.0142
Cavity numbers	2×1 /Ring	1
Cavity detune angle	-12° /cavity	0°
Coupler DC bias (kV)	+1.5	+1.5

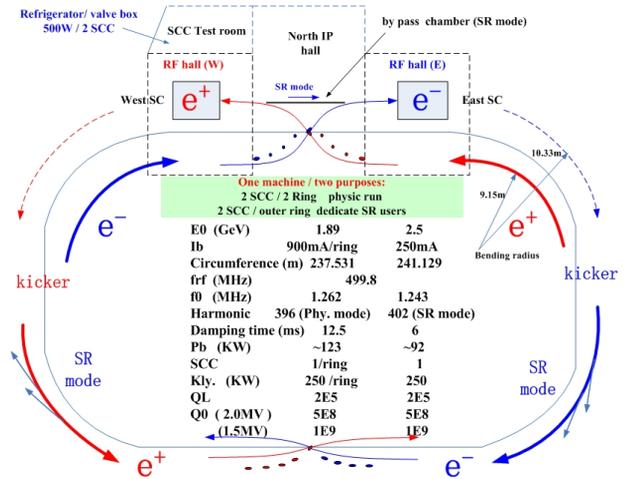


Fig. 1: Two SRF stations of BEPCII.

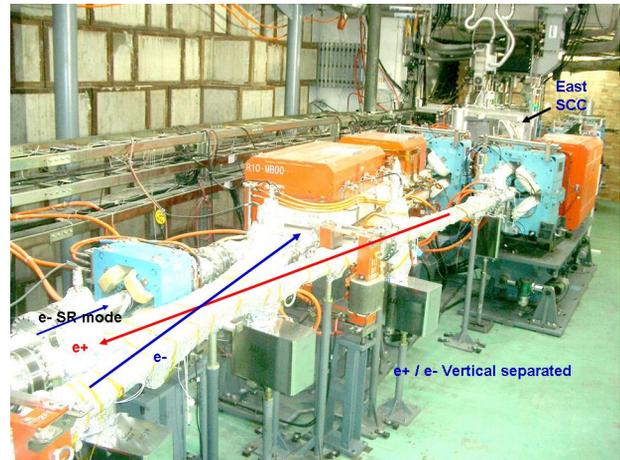


Fig. 2: Beam crossing nearby cavities.

RECENT OPERATION

From Sep. 2010 to Jul. 2011, the operation of SRF system of BEPCII is shown in table 2.

Table 2: Operation status of SRF of BEPCII

E ₀ (GeV)	1.89/Ring	2.0/Ring	2.5
Run days	180	29	102
Beam curr.(mA)	2*750	2*750	250
Beam power(kW)	2*100	2*120	92
RF voltage (MV)	2*1.60	2*1.65	1.90

Beam Current and RF Power

Every cavity has been matched by 120KW maximum beam power under the collision beam of 2.0GeV@750mA/88bunches. A peak Luminosity of $6.5E32cm^{-2}s^{-1}$ was achieved in May,2011. The history of west cavity power is shown in Fig. 3.

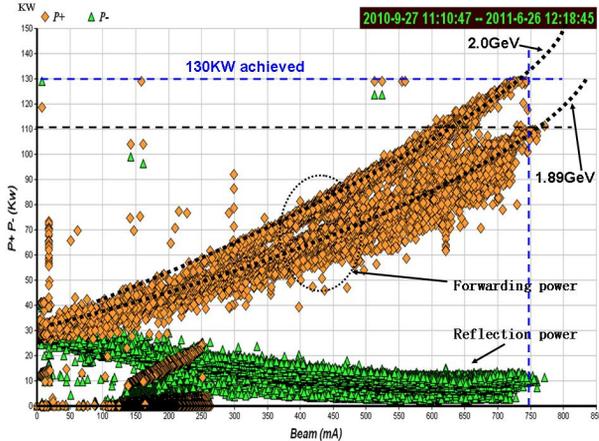


Fig. 3: The Beam power for the last nine months.

Beam Loading Detune

Under e+ beam of 1.89GeV@700mA, as shown in Fig. 4, the detune frequency of beam loading is -10kc by measuring the tuner position change of West cavity at 1.5MV, which is close to the theory value of -11kc.

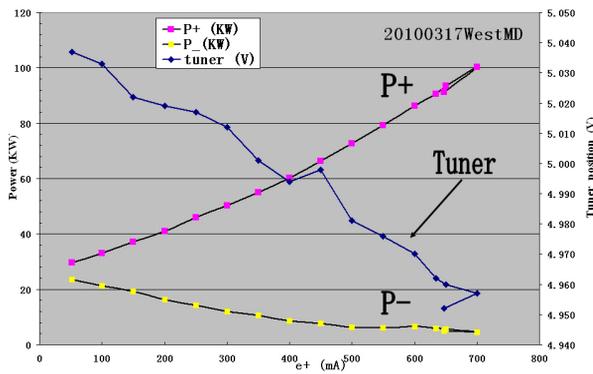


Fig. 4: Detune frequency of West SC under beam loading.

Coupler Bias Voltage

Since 2007, +1.5kV bias voltage has been added on the inner conductor of coaxial coupler for both cavities to suppress the vacuum trip and arc, which is shown in Fig.5. The maximum temperature of a ferrite on the doorknob reached 46°C at 120kW due to a RF leakage nearby inner conductor, even though it is under air-cooling.

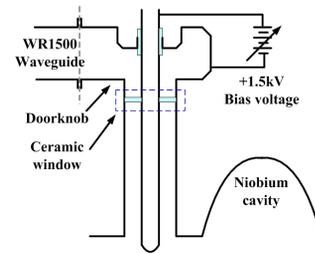


Fig. 5: Coupler with DC bias voltage.

UNKNOWN HEAT SOURCE[3]

Under e- beam, an unknown heat about 60W has been found in East cavity, which only occurs in collision mode and not in SR mode (Fig.2 and table 3). The heat results in the Helium gas pressure of East cryostat increasing, and limiting e- current higher. Input coupler and Q0 slope are not the source according to the test data in Table 3. HOM power and SR light are suspected.

Table 3: GHe pressure of East cryostat in different modes

East cav.	SR mode	Collision mode	note
e- (mA)	480/2.0GeV	750@1.89GeV	
bunches	160	80 or 160	
GHe (bar)	1.217	1.2510	pressure
RF power	~90kW	~100kW	
Vc (MV)	1.6	1.6	
GHe flow	4.5g/s	6.5g/s	

HOM Power

The additional heat doesn't depend on HOM power by testing different beam patterns of 80 and 160 bunches at 1.89GeV collision mode, as shown in Fig.6.

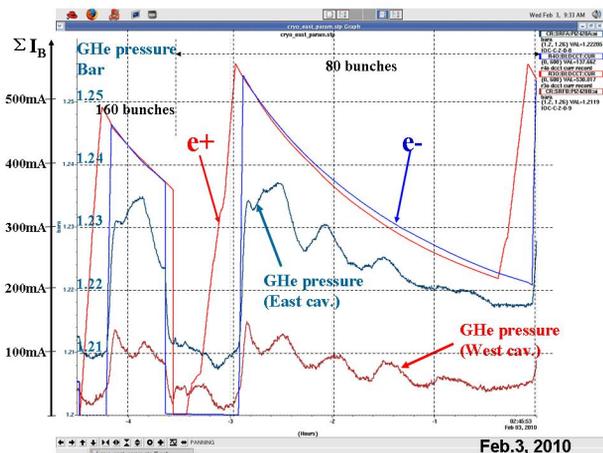


Fig. 6: GHe pressure at 80 and 160 bunches.

