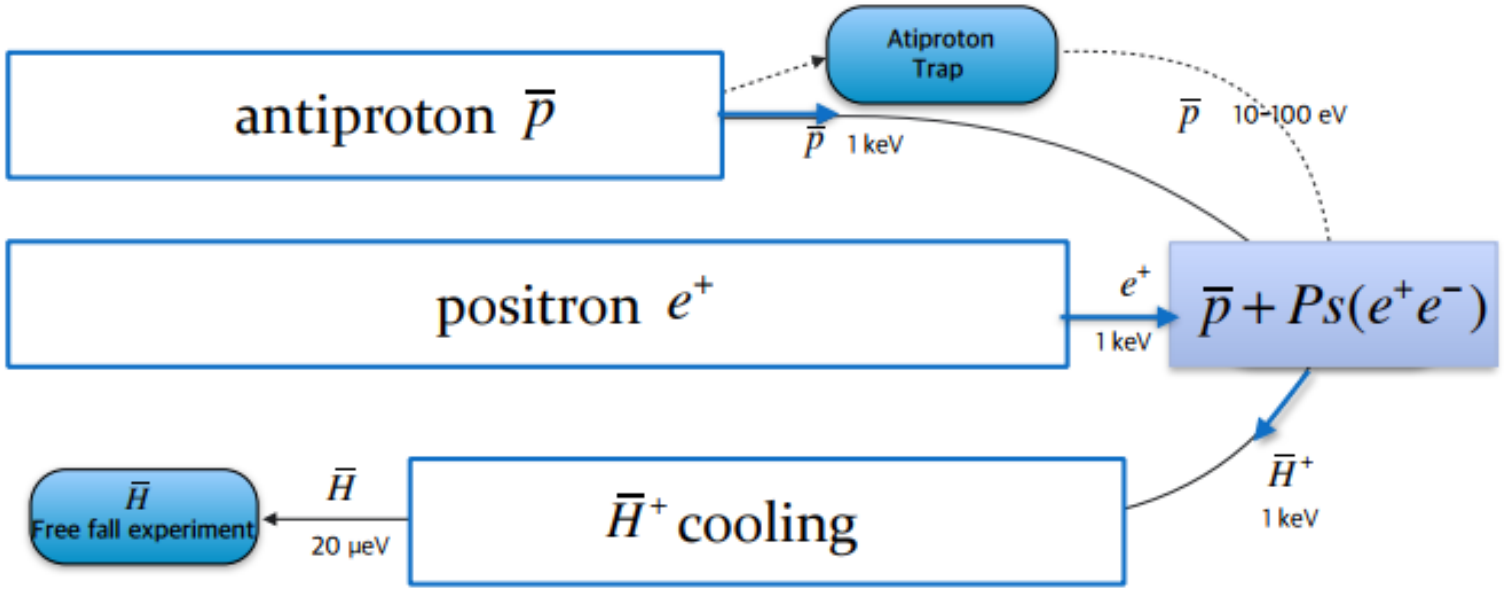
Electron gun system
For GBAR antiproton trap

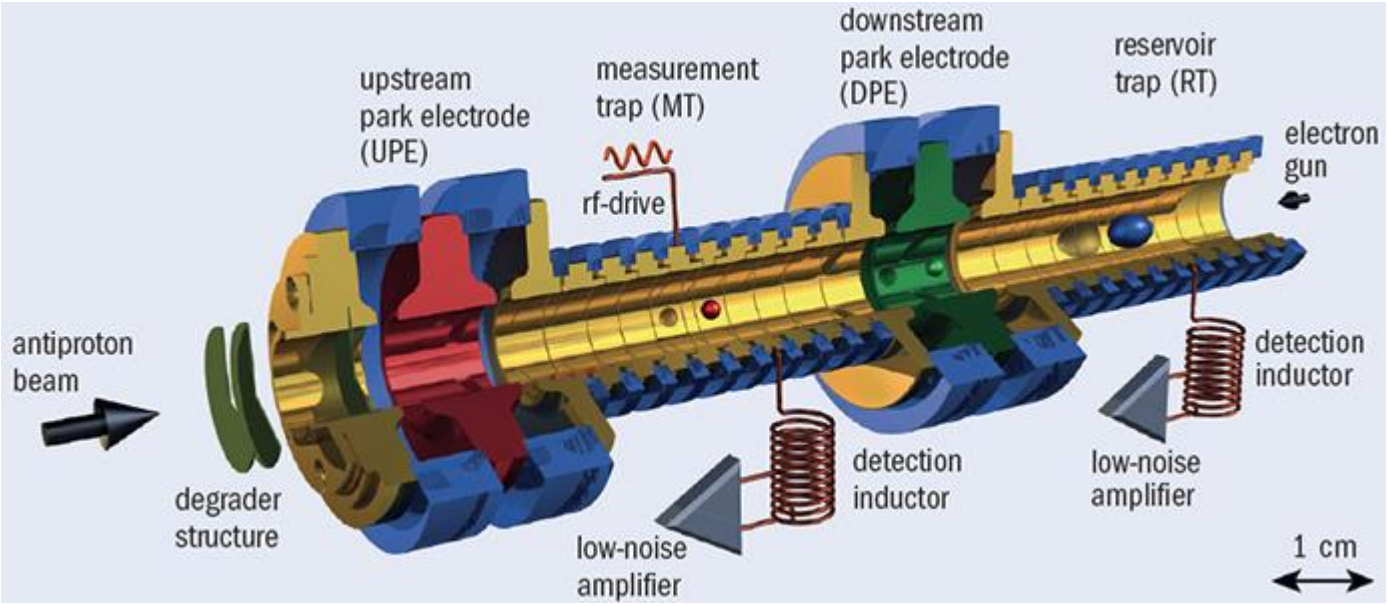
GBAR Project



GBAR은 반 수소의 자유 낙하 실험에 의해 반물질의 중력 특성을 측정하는 프로젝트

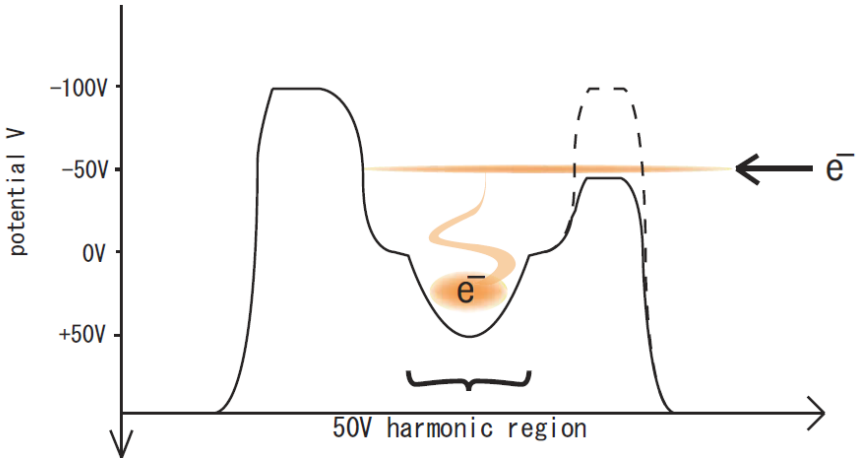
반 양성자 트랩의 목적은 반 수소의 생산성을 증가시키는 것입니다.

Trap System



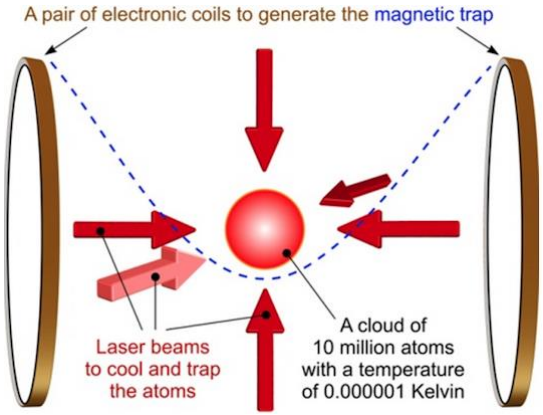
전기장을 이용해 입자를 가두는 장치

-> 빔의 에너지 감소
-> 여러 개의 빔을 축적 / 압축

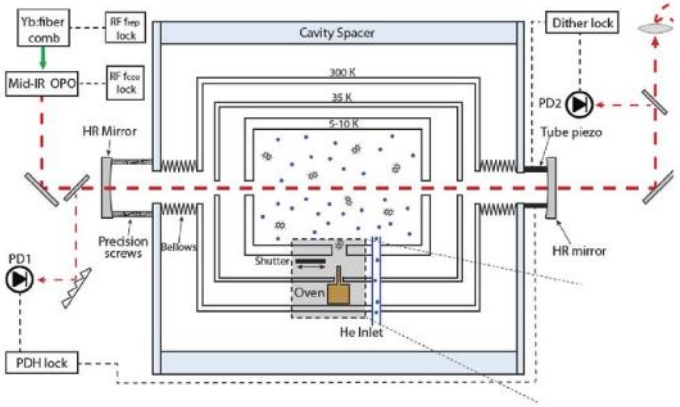


Cooling method

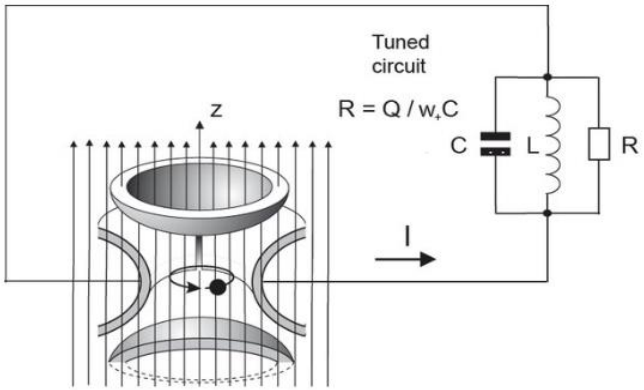
1. Laser cooling



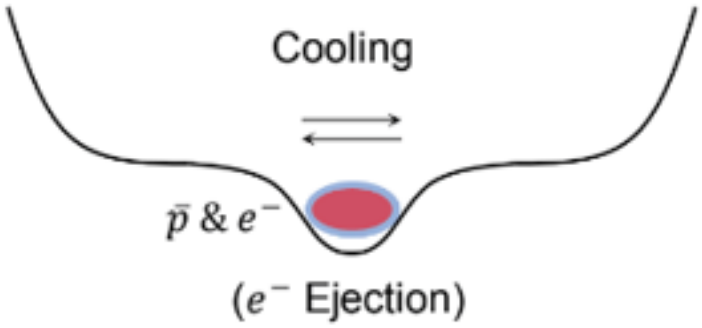
2. Buffer gas cooling -> 양전자



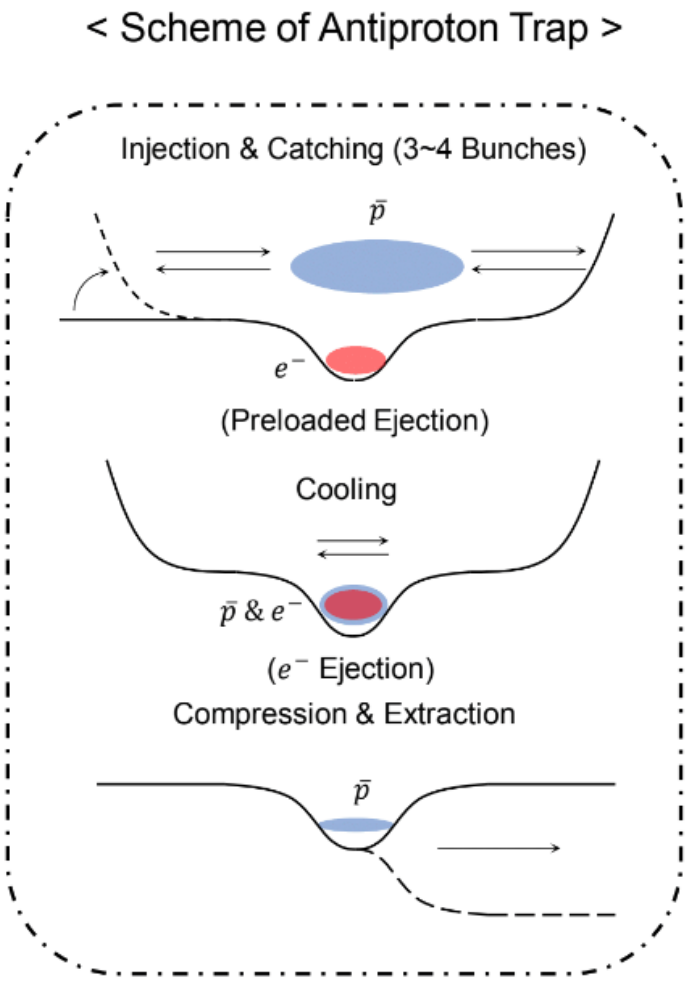
3. Resistive cooling



4. Electron cooling -> 반 양성자



Electron beam cooling?



- Reduces beam emiitance
  (better energy resolution)
- Reduces momentum spread
  (higher luminosity for experiments)
- Compensation of various heating effects
  acting on a circulating beam

Rutherford Scattering

$$2\tan\left(\frac{\theta}{2}\right) = \frac{2Z_1 Z_2 e^2}{4\pi\epsilon_0 \Delta p v b}, \qquad Z_1 = Q(ion) Z_2 = -1(e^-)$$

Energy Transfer

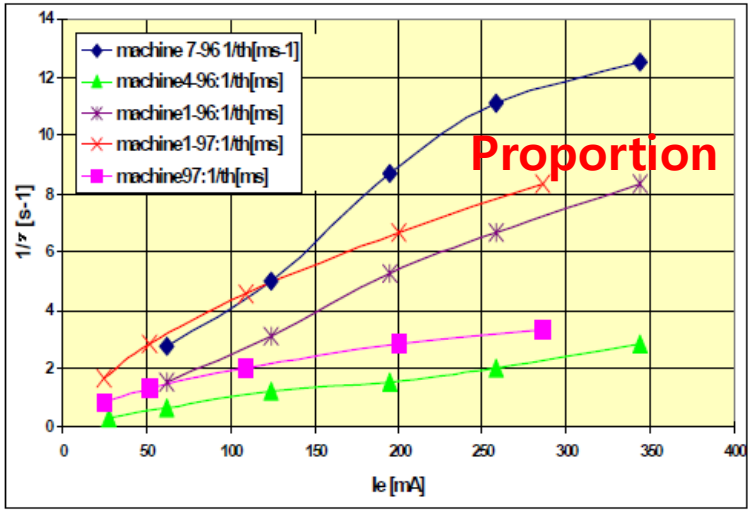
$$\Delta E(b) = \frac{(\Delta p)^2}{2m_e} \cong \frac{2Q^2 e^4}{(4\pi\epsilon_0)^2 m_e v^2} \frac{1}{b^2}$$

Electron beam cooling?

Important electron beam characteristics

- Energy / Intensity
- Device length / Align

In the proposed accumulation scheme, the newly injected ion beam has to have its dimensions reduced in less than 100 ms by the electron cooling device in order to free space for a next pulse. Three parameters play a role in reducing the cooling time, they are; the electron beam intensity, the length of the electron cooling device itself, and the relative difference in angle between the electron and ion beams.

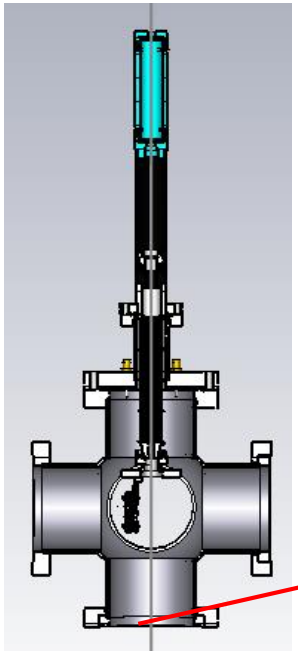


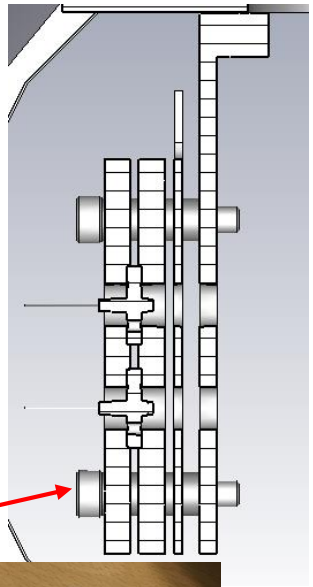
the gain becomes less pronounced. This can be explained by the fact that the increased space charge in the electron beam makes it more difficult to align the two beams over twice the length of the original set-up. Despite all the

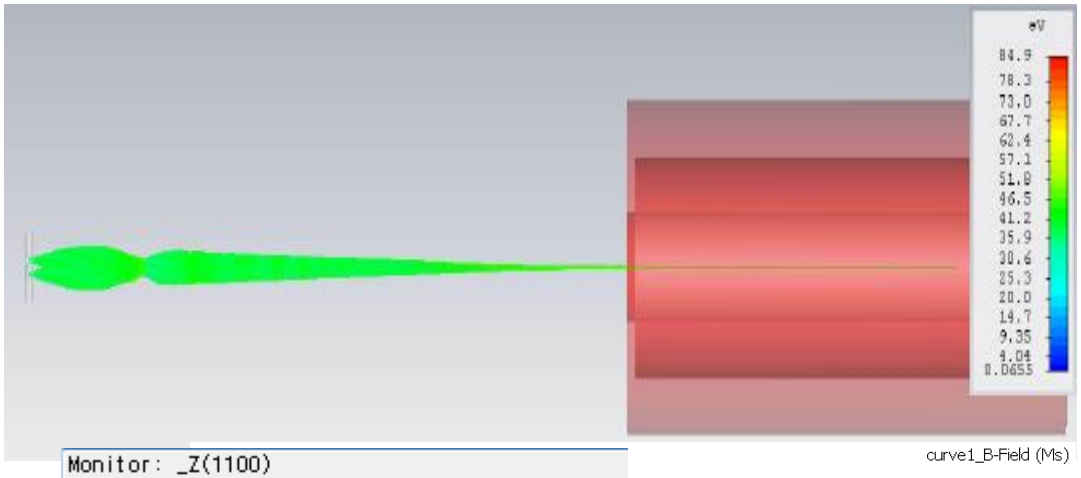
	입자	에너지	전자빔
Fermilab	Proton	200MeV -> 115MeV	1-3A / 110KeV
Lanzhou	Stannum(Sn)	82.8MeV	~135mA / 2KeV
(HIRF)	Carbon	414.4MeV	~44mA / 3.7KeV
LEIR	Plumbum(Pb)	856.8MeV	~1A / 2.5KeV
Musashi	Anti-Proton	~10KeV -> 10~100eV	500uA / 50eV
Gbar	Anti-Proton	~1KeV -> 10~100eV	~mA / 50eV

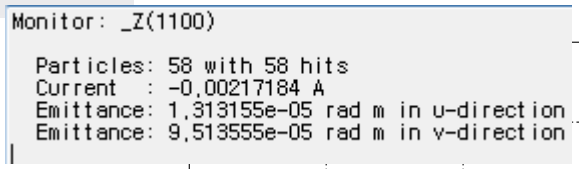
Electron Gun system

CST Tracking Simulation

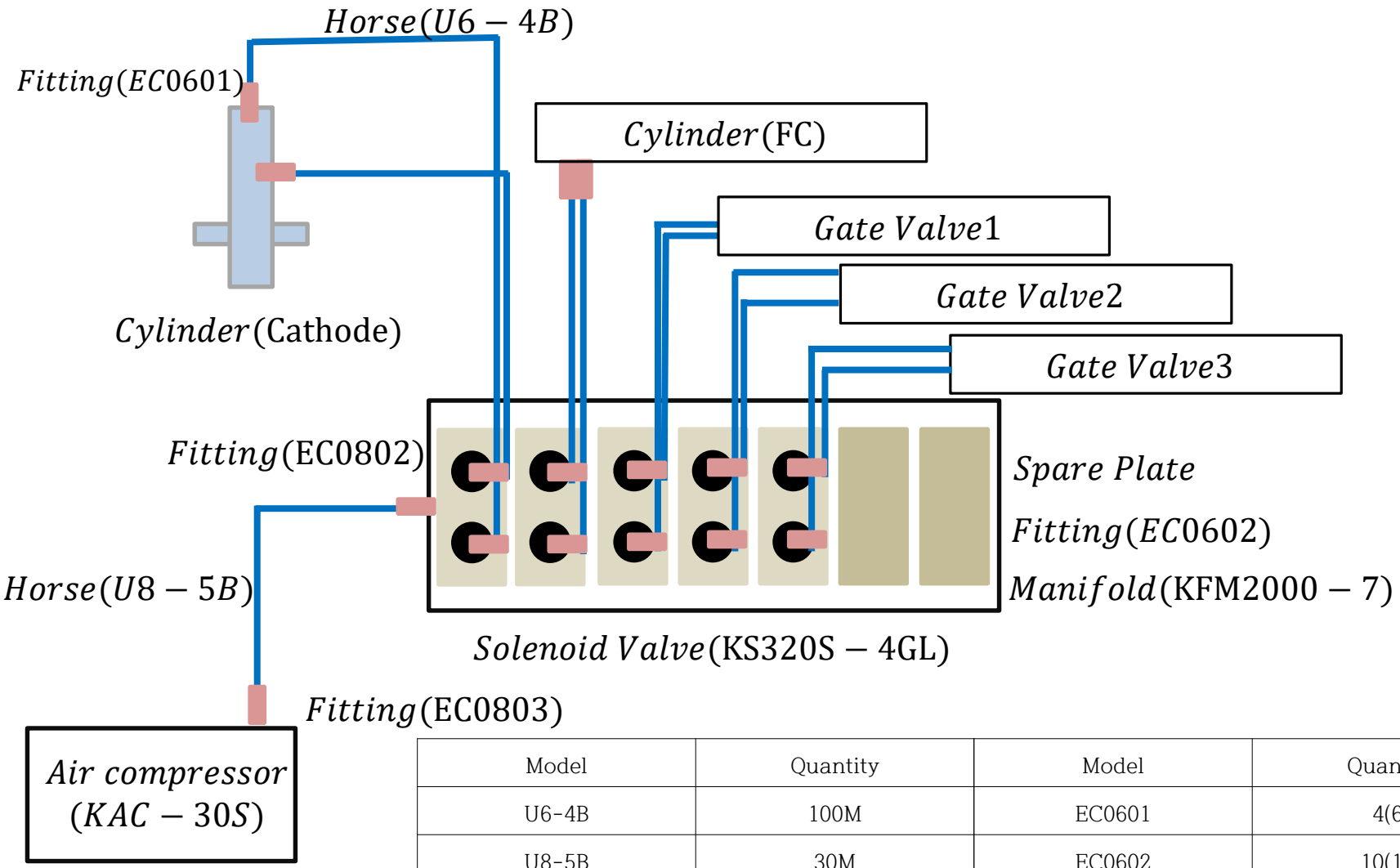






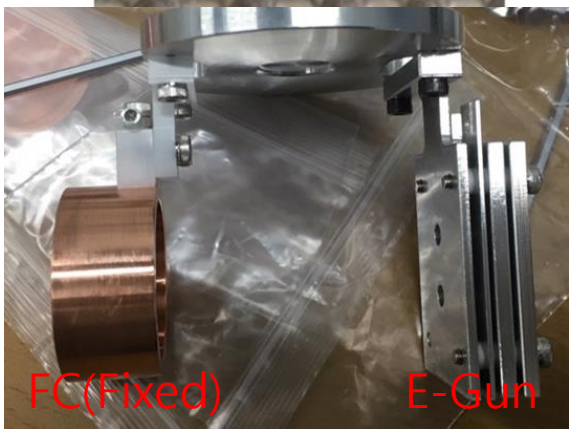


Electron Gun system

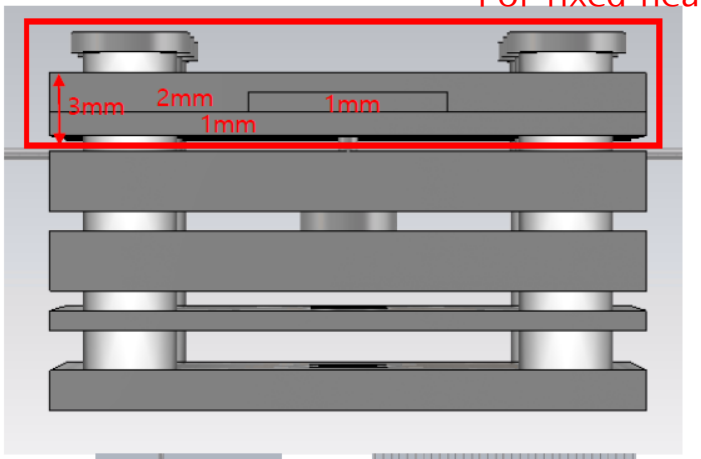


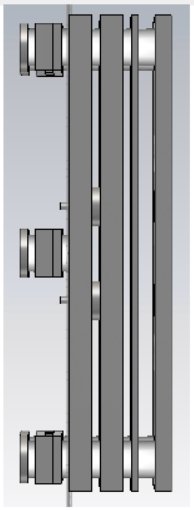
Model	Quantity	Model	Quantity
U6-4B	100M	EC0601	4(6)
U8-5B	30M	EC0602	10(14)
KMF2000-S.P	2	EC0802	1(2)
KMF2000-7	1	EC0803	1(2)
KS320S-4GL	5(7)		

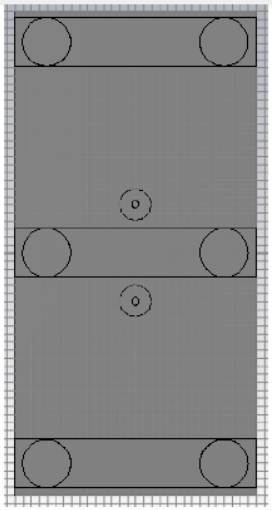
Electron Gun product



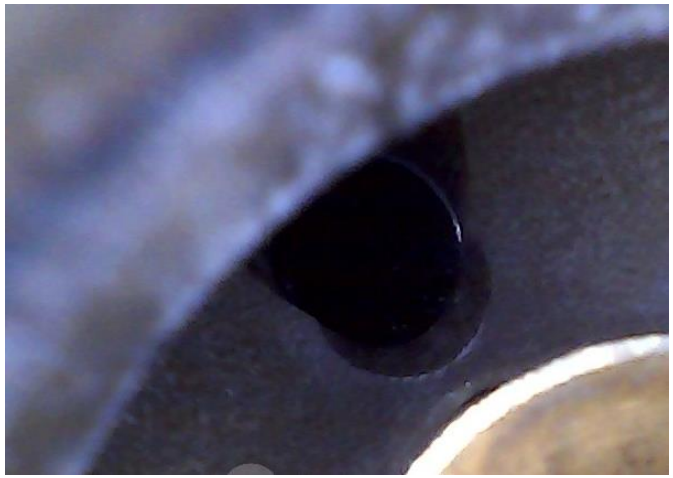
For fixed heater

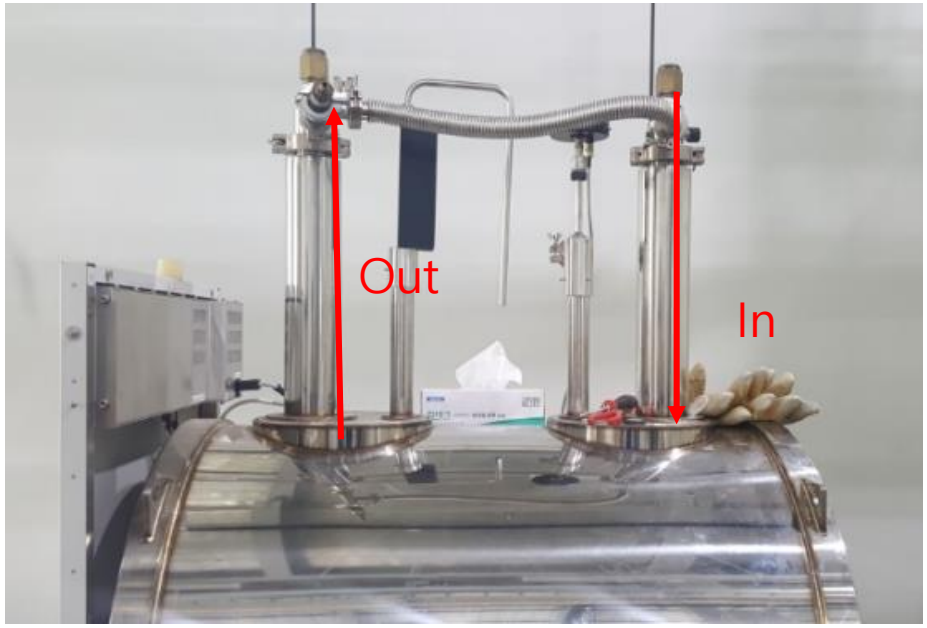






KU Magnet

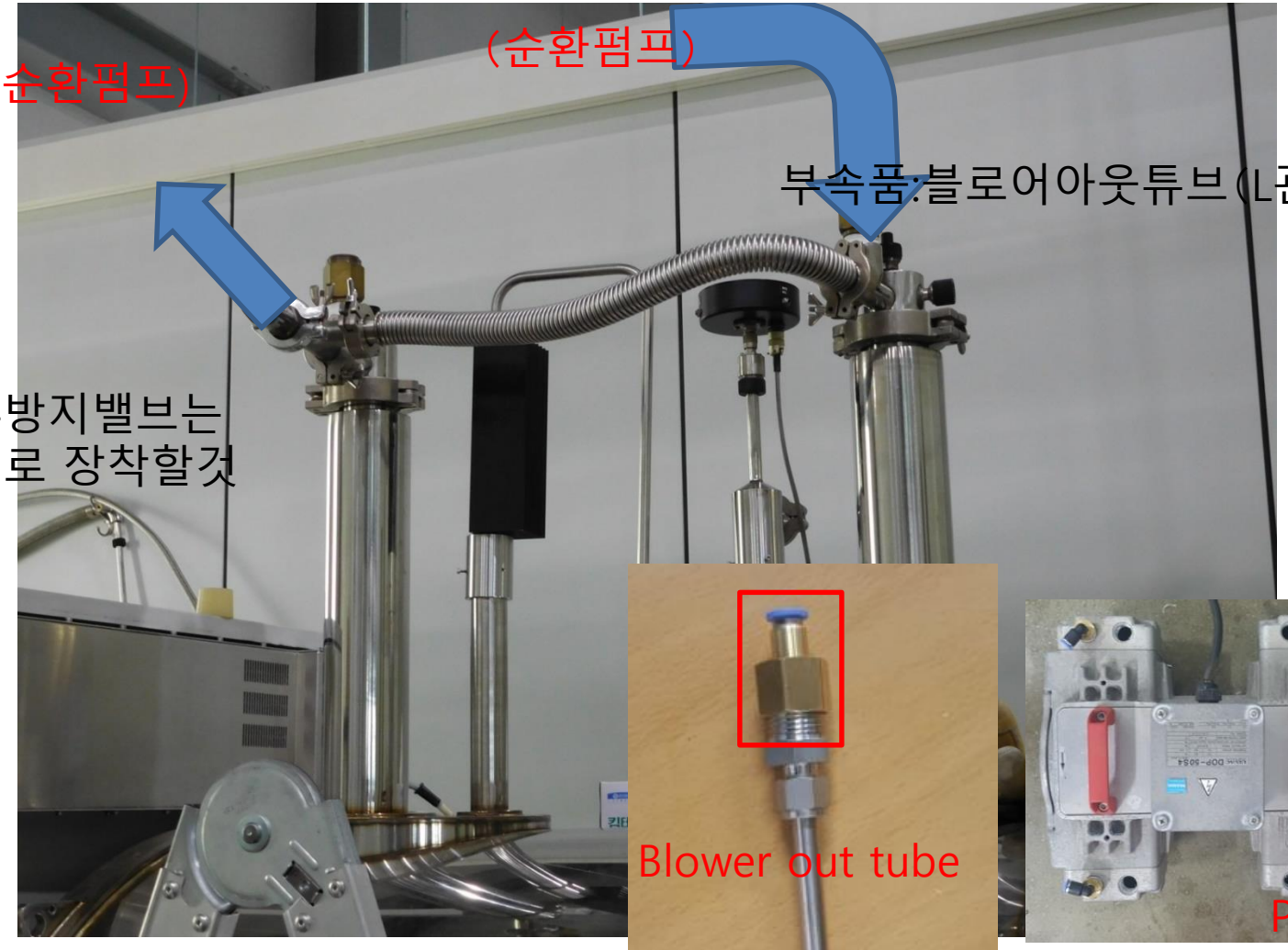




- 헬륨/질소 없음 (얼음제거)
  센서 부착은 완료

1. 내부 공기 순환을 통해 수증기 제거
2. 진공 / Leak Test(He)
3. 헬륨/질소 채우기
4. 자화
5. 자석 Field map 측정

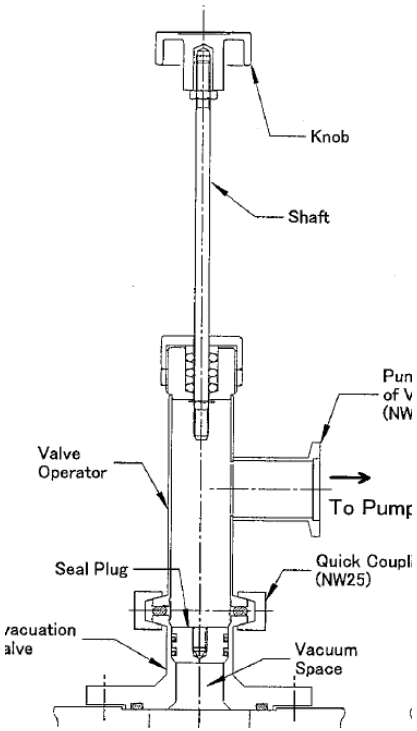
고려대실시1 헬륨 챔버 내부의 건조 ← 상기1)③의 냉결에 대한 대책 및 대응



KU Magnet

고려대실시 2　단열 진공조의 진공 배기　←　이 모든 작업은 실온으로 되돌린 상태에서, 단열 진공조의 진공 체크를 위해서라도 진공 배기가 필요。

4) Pump the vacuum space down to a pressure between 1 and 10 Pa (10^{-2} –10^{-1} Torr). This should take about 1 hour. Then switch over to the high vacuum pump and leave the system pumping for several hours. The pressure should reach 10^{-2} Pa (10^{-4} Torr) or better. The evacuation using the high vacuum pump should be continued over night at least.

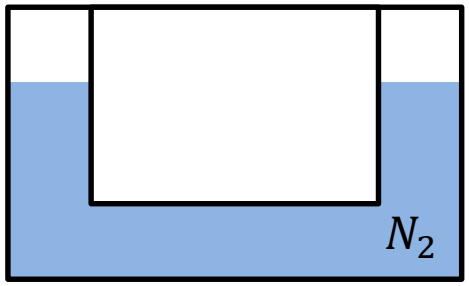


EBIS SC Magnet

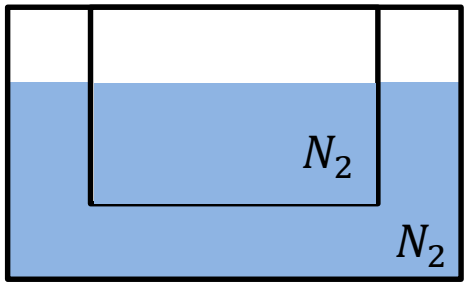
-> 정민실업 제작

KU Magnet

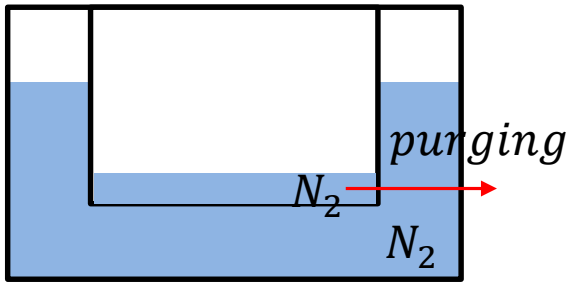
1)



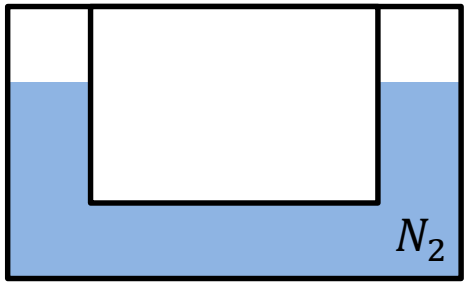
2)



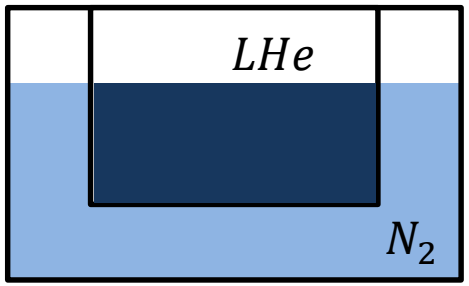
3)



4)



5)



2) Schedule

Day 1	Travel (from Japan to Korea)
Day 2	Vacuum leak check
	Pre-cooling with using L. N2
Day 3	L. N2 discharge
	Pump & Flash
Day 4	L. He cooling
Day 5	Main coil excitation
	* Shim coil excitation is not carried out
Day 6	Travel (from Korea to Japan)

KU Magnet

- 자석 자화 작업 필요장비

메인코일 파워 서플라이(보유)

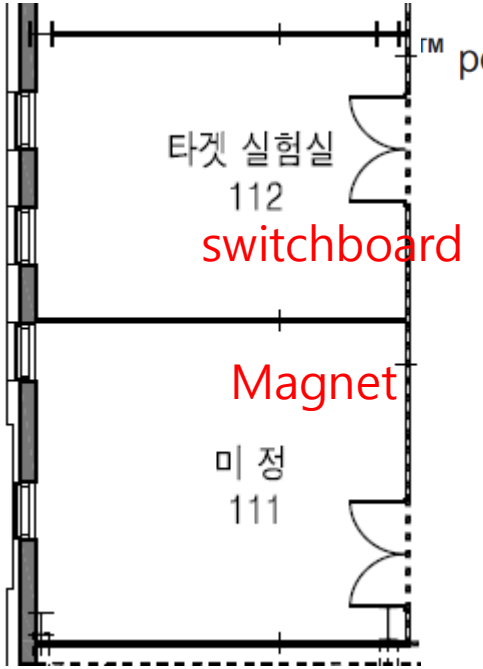
메인 전류 케이블(구매 필요)

심 코일 파워 서플라이(대여 가능or구매)

심 전류 케이블(구매 or 제작필요)

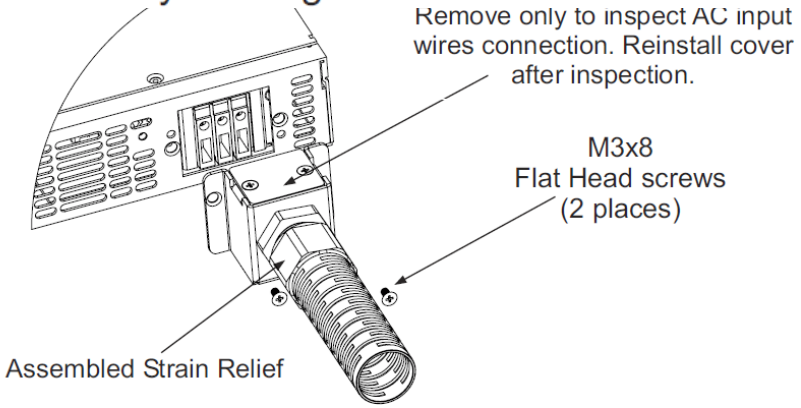
디지털 전압 측정기(보유)

SC Shim Current			
Z1	(A)	≦±20	+2.613
Z2	(A)	≦±20	+2.771
Z3	(A)	≦±20	+4.207
Z4	(A)	≦±20	−6.812
X	(A)	≦±20	+1.779
Y	(A)	≦±20	+2.080
ZX	(A)	≦±20	−2.843
ZY	(A)	≦±20	+0.210
XY (S2)	(A)	≦±20	−0.694
X2−Y2 (C2)	(A)	≦±20	−2.747



™ power supplies the recommended AC cable (customer supplied) is:

25A 250V, 3x12AWG, outer diameter: 9-11mm, rated 60°C min., 3m max. length. Add a non-locking plug approved by the national safety standards of the country of usage.



KU Magnet

Compact, lightweight, low-power, rugged and easy to use

Simultaneously measures all three axes of magnetic field

Range from nT to 20 T

Corrected for temperature drift and non-linearity

- Hall Probe / Handheld kit
  7,655 + 1,695 CHF

매매기준율 환율우대없음

스위스 CHF

9,350
9,350 프랑

대한민국 KRW

10,417,863.50
1,041만 7,863.50 원

Thank You