

New Electrostatic Separator for K1.8 Beam Line

Design Guideline

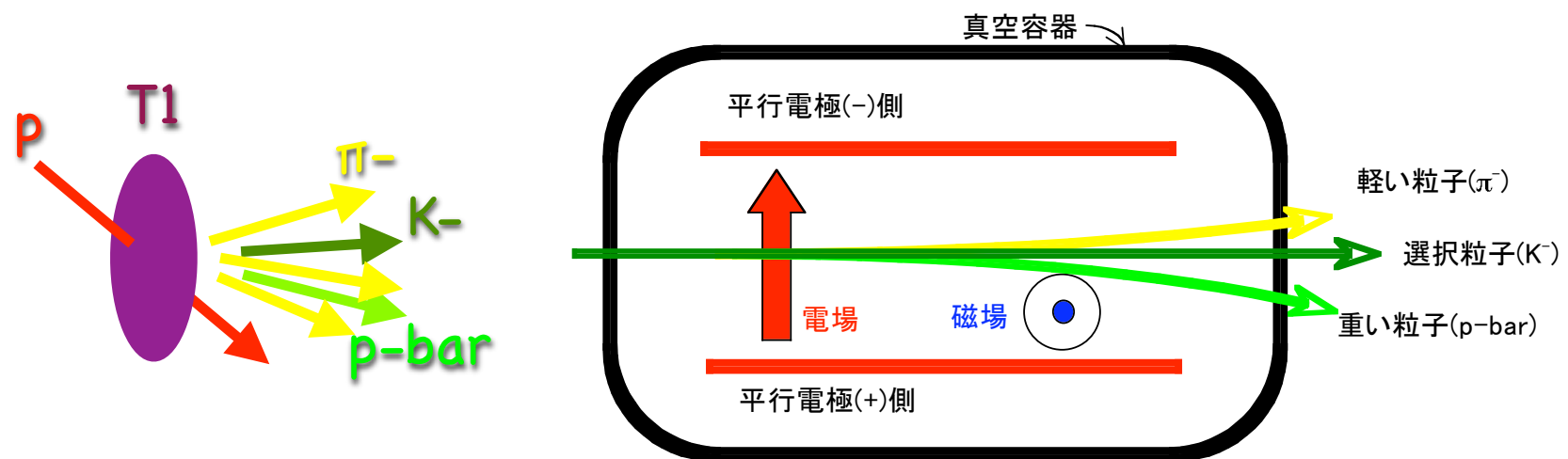
- **Radiation hardness**
- **Reduce unexpected electric discharge**

Improvement and optimization on ...

- Vacuum Chamber
- Electrode
- C.W. HV generator
- Assembling

Beam Instrumentation Workshop
2007.5.11
by M.Minakawa & M.leiri

Separator - I



Separator -2

$$y = \frac{eEl^2}{2pc\beta}$$

$$y' = \frac{eEl}{pc\beta}$$

$$\Delta y' = \frac{eEl}{pc} \left(\frac{1}{\beta_W} - \frac{1}{\beta_U} \right) \approx \frac{1}{2} \frac{eEl}{p^3 c^3} (m_W^2 - m_U^2)$$

$$E = 75 \text{ [kV/cm]}$$

$$l = 6 \text{ [m]}$$

$$p = 1.8 \text{ [GeV/c]}$$

$$y' : \pi \quad 25.08 \text{ [mr]}$$

$$K \quad 25.92 \text{ [mr]}$$

$$p \quad 28.19 \text{ [mr]}$$

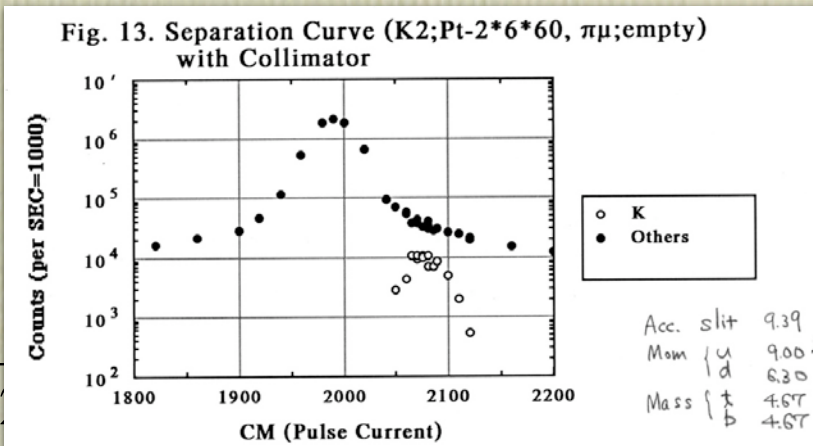
π -K vertical displacement at MS : 3.5 [mm]

Separator -2

$$y = \frac{eEl^2}{2pc\beta}$$

$$\Delta y' = \frac{eEl}{pc} \left(\frac{1}{\beta_W} - \frac{1}{\beta_U} \right) \approx$$

y'



longer l : **Kaon decay**

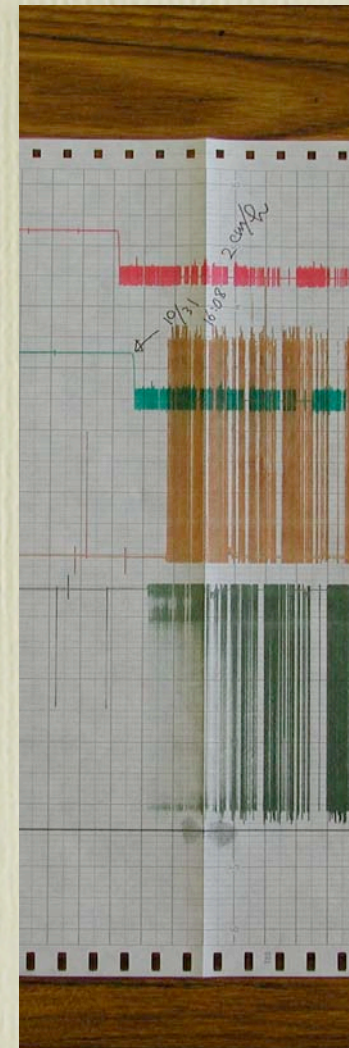
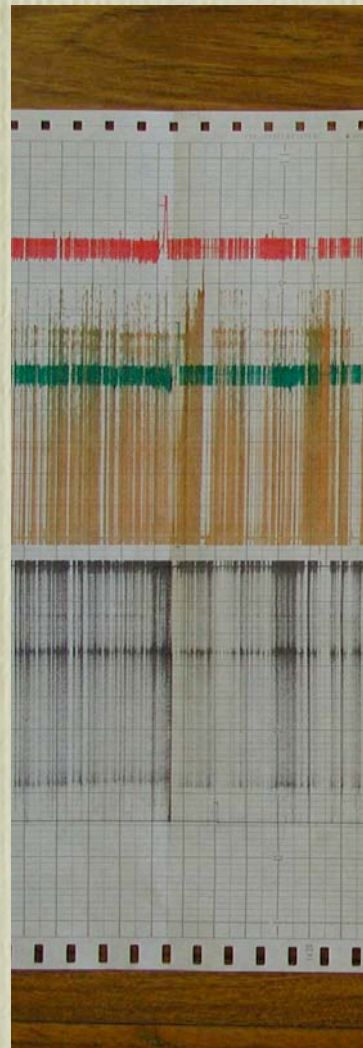
larger E : **stability, transmission efficiency**

sharp vertical image at MS : **small acceptance (secondary beam intensity)**

π -K vertical displacement at MS : 3.5 [mm]

Separator -3

@K2

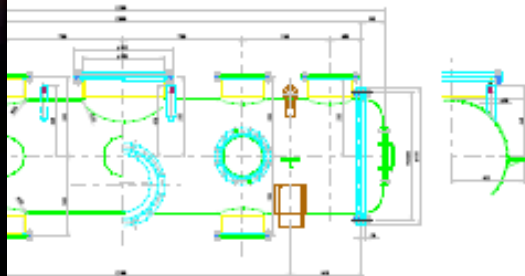
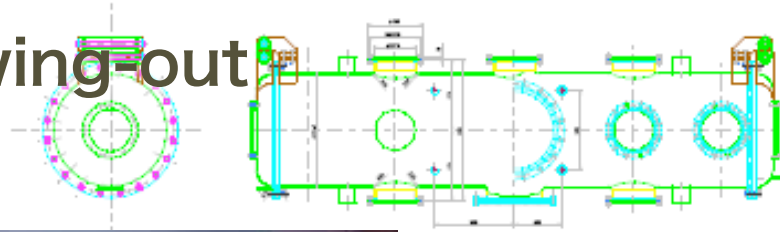


Vacuum Chamber- I

item	KEK-PS	J-PARC	note
O.D. of Chamber	$\phi 800$	$\phi 695.2$	JIS750-standard
Junction of branch pipes	Welding max. R11	Drawing-out $\geq R30$	relieve local field
Polishing	Mechanical Buffing	Buffing & Electropolishing	reducing electric discharge
Vacuum seal	Rubber O-ring	Metal O-ring	radiation-hard

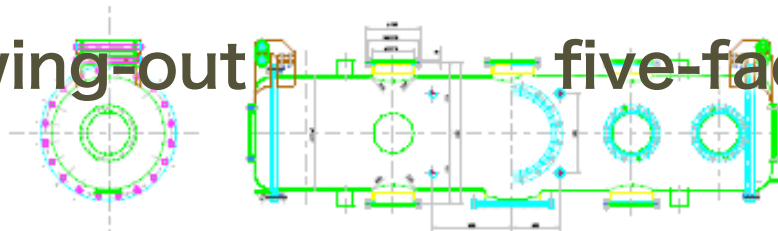
Vacuum Chamber-2

Drawing-out



Vacuum Chamber-2

Drawing-out five-face processing



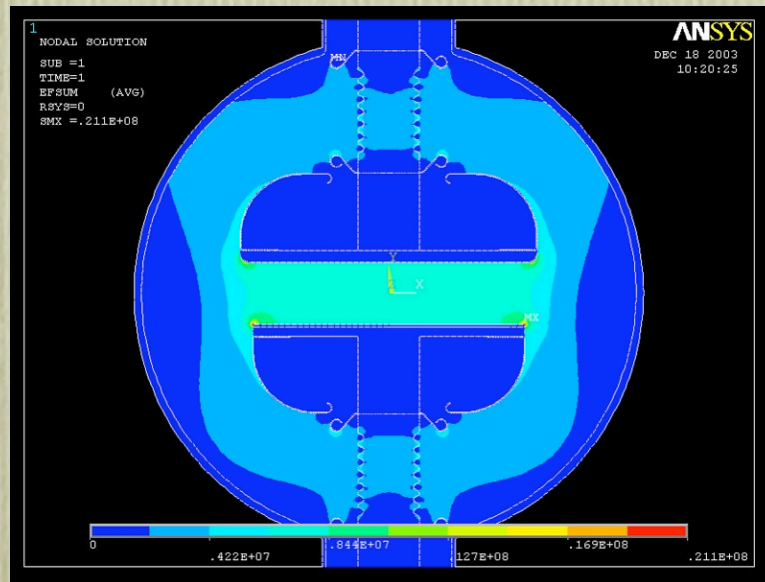
Vacuum Chamber-2



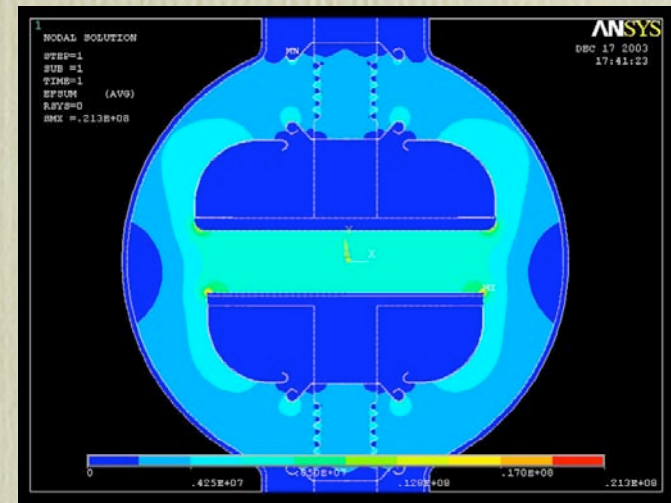
Electrode- I

Smaller figure of Vacuum Chamber ($\phi 800 \rightarrow \phi 695.2$)

- Ceramic-base length : 198mm $\rightarrow$ 154mm
- Distance btwn Electrode & Chamber : 115mm $\rightarrow$ 76mm



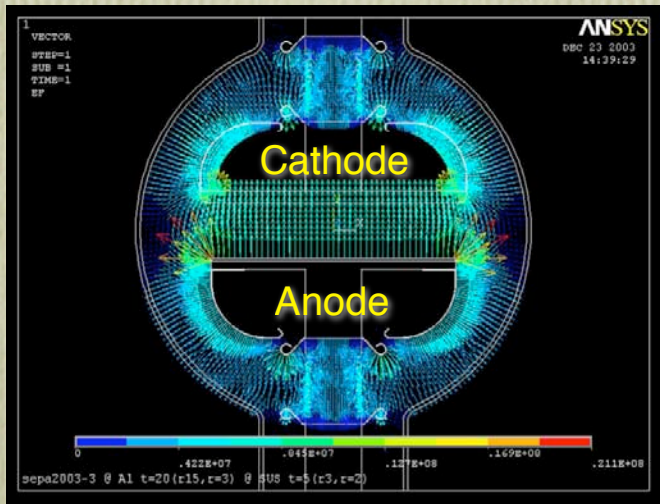
KEK-PS



J-PARC

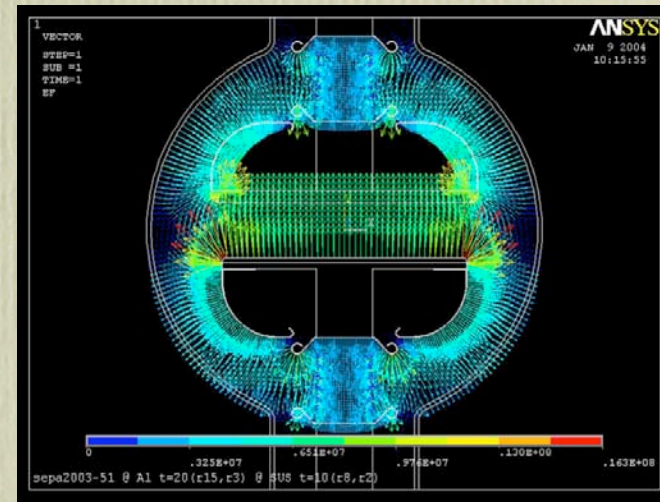
Electrode-2

Electric field around rim → Thickness and R of Anode(SUS)



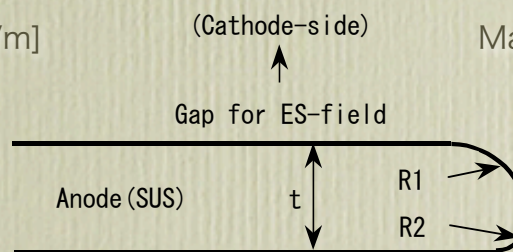
KEK-PS
($t=5$, $R1=3$, $R2=2$ [mm])

Max. E : 2.11×10^7 [V/m]



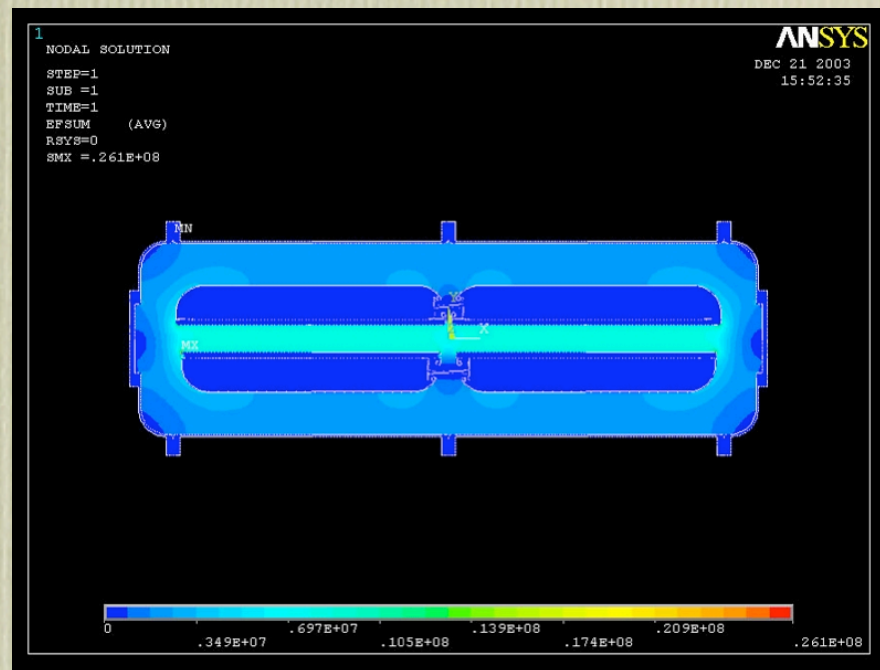
J-PARC
($t=10$, $R1=8$, $R2=2$ [mm])

Max. E : 1.63×10^7 [V/m]



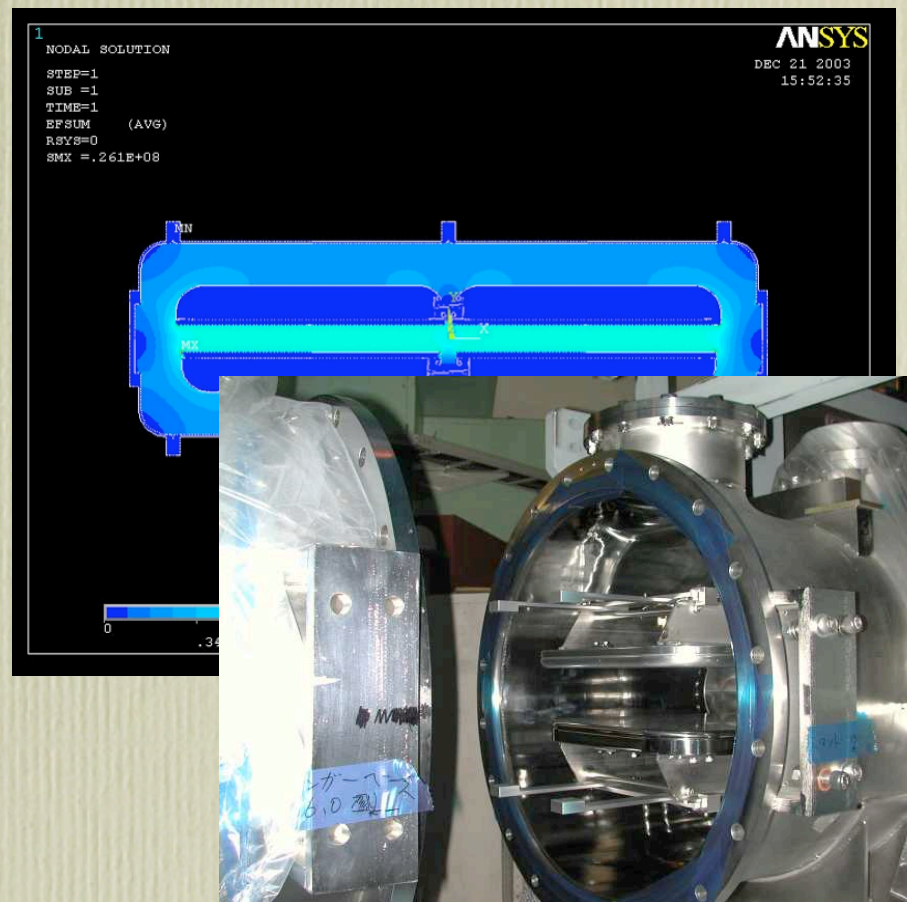
Electrode-3

Connection

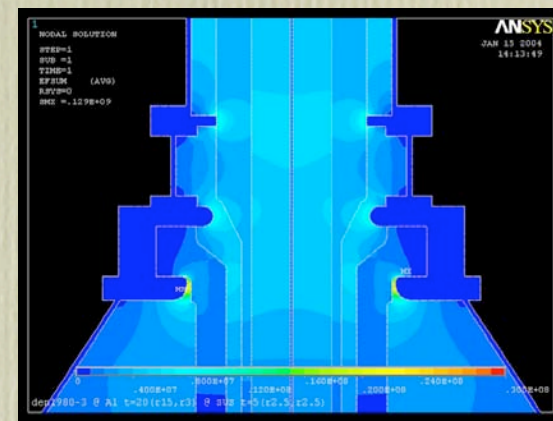
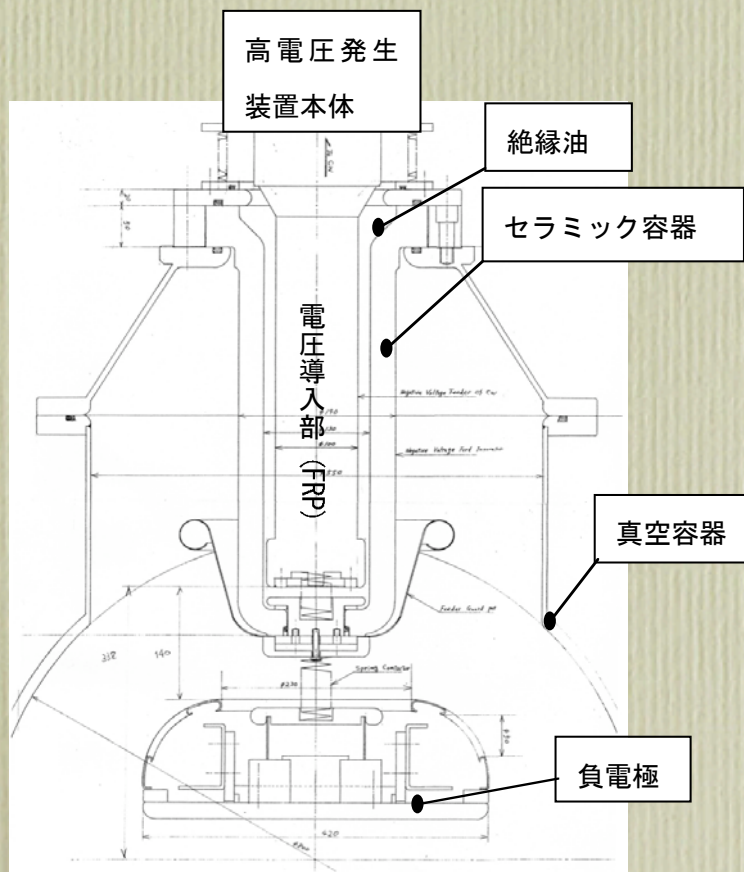


Electrode-3

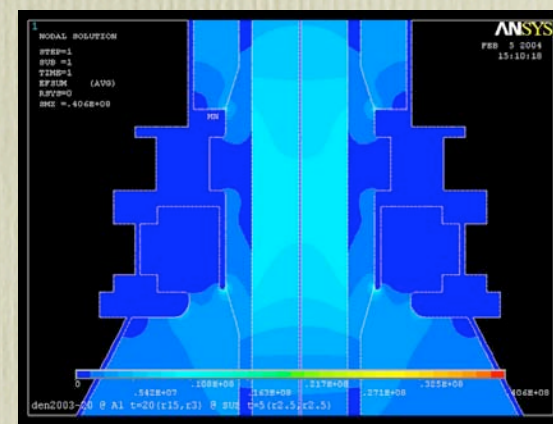
Connection



CW-HV Power supply - I



KEK-PS



J-PARC

CW-HV Power supply - I



J-PARC

CW-HV Power supply - I



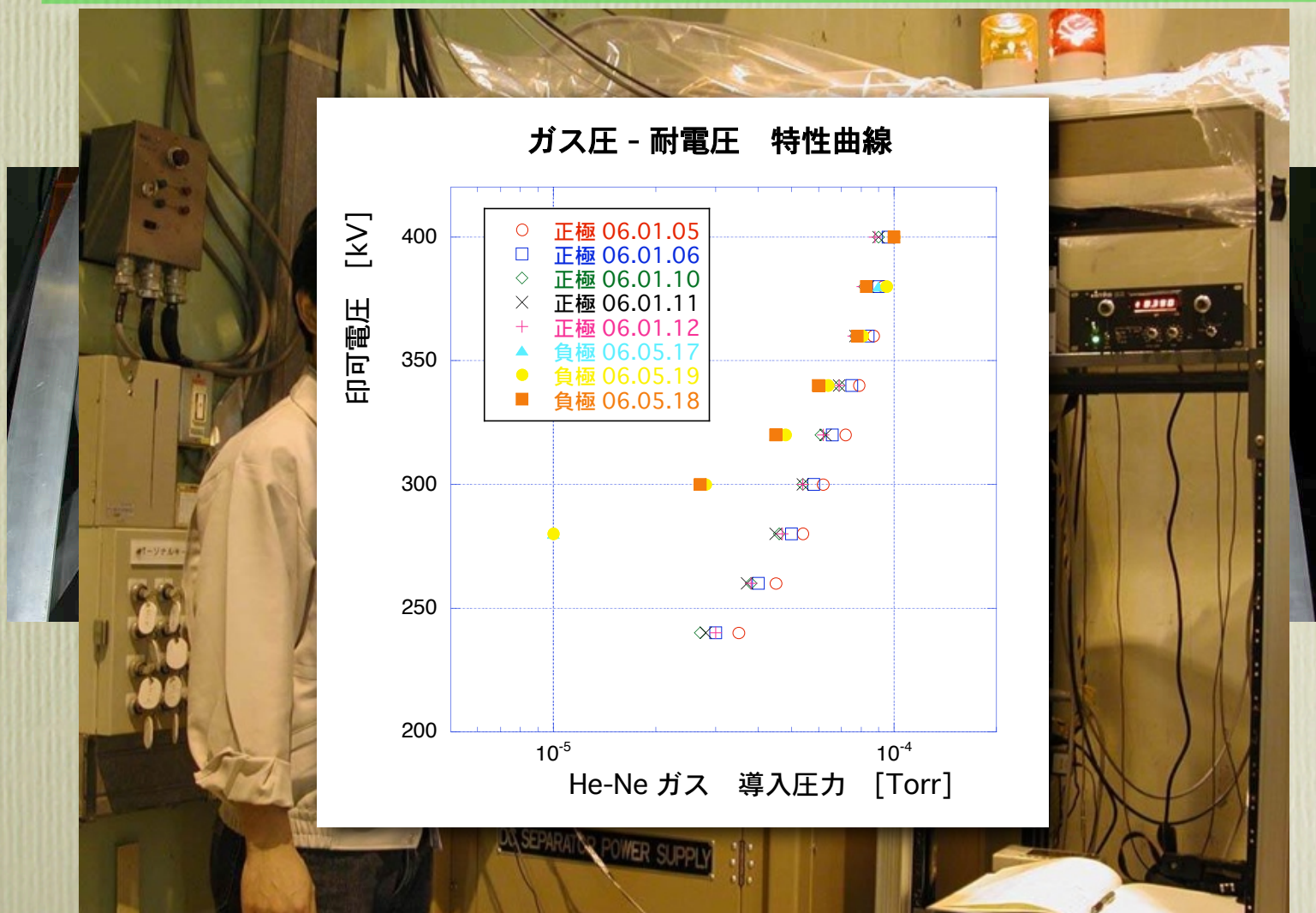
CW-HV Power supply -2



CW-HV Power supply -2



CW-HV Power supply -2



Assembling- I



Assembling- I

(3)KEK担当教官検査

測定日H16.12.14

(検査担当 家入先生、皆川先生)

(測定具操作山田純平、澤田、トランシット斉藤、操作指揮山田、鈴木)

SUS電極(下) 平面度

49.6								49.8
49.8								49.9

操

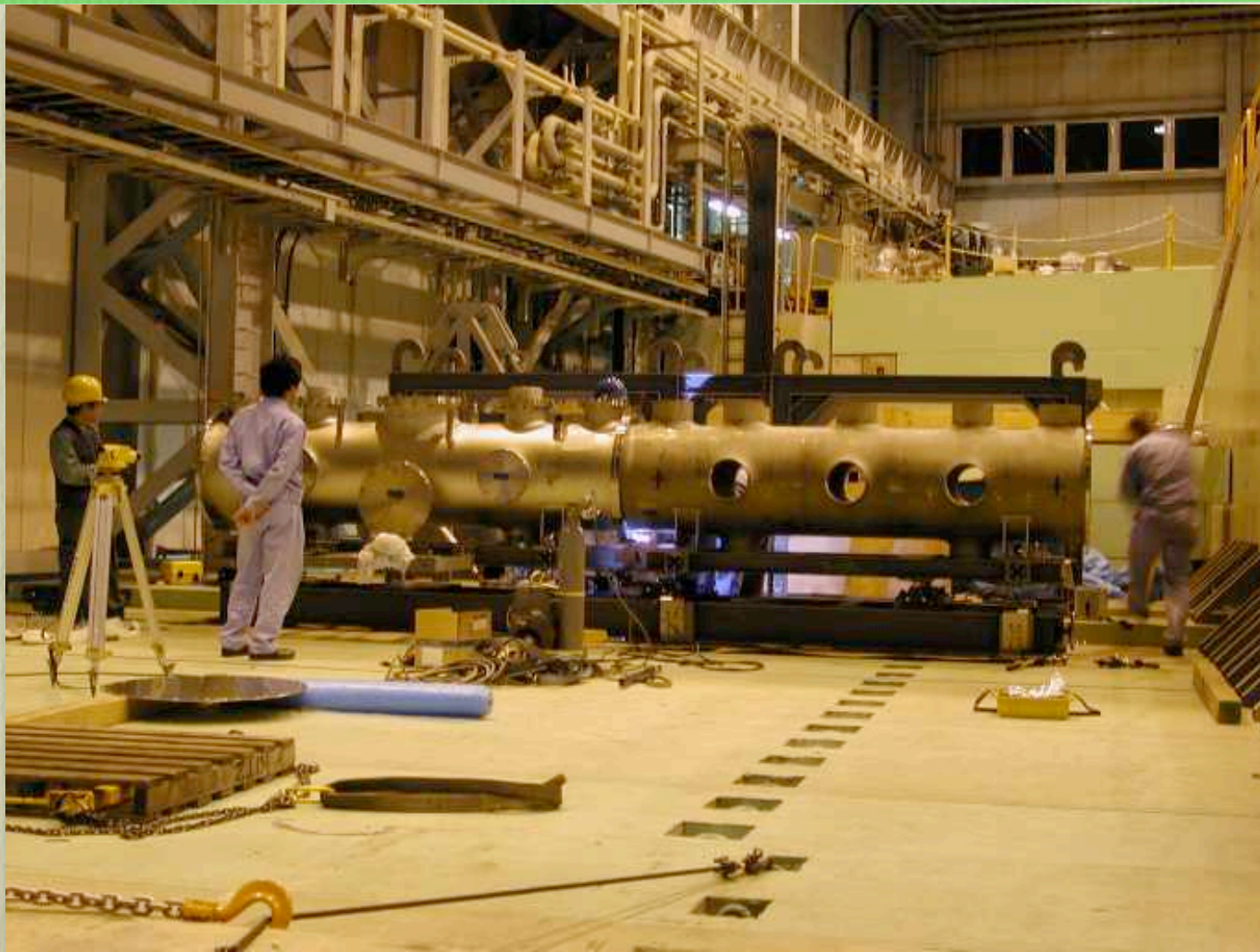
AI電極(上) 平面度

+0.02	+0.18	+0.27	+0.21		+0.34	+0.20	+0.10	+0.01
-0.06	+0.12	+0.25	+0.18		+0.05	-0.06	-0.11	-0.09
-0.08	+0.02	+0.19	+0.07		+0.07	-0.11	+0.04	+0.14

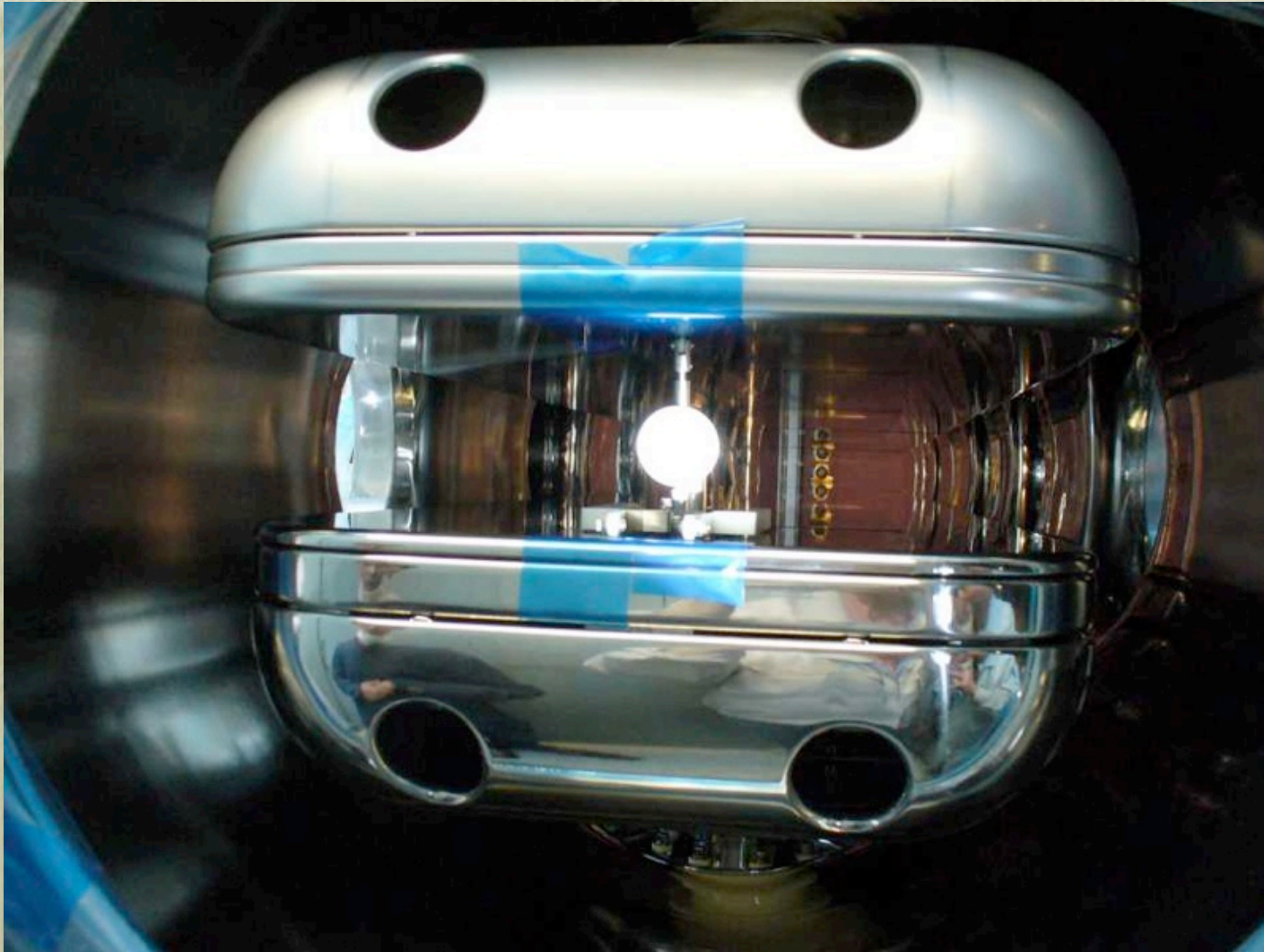
操

(注)測定位置は前頁と同じ

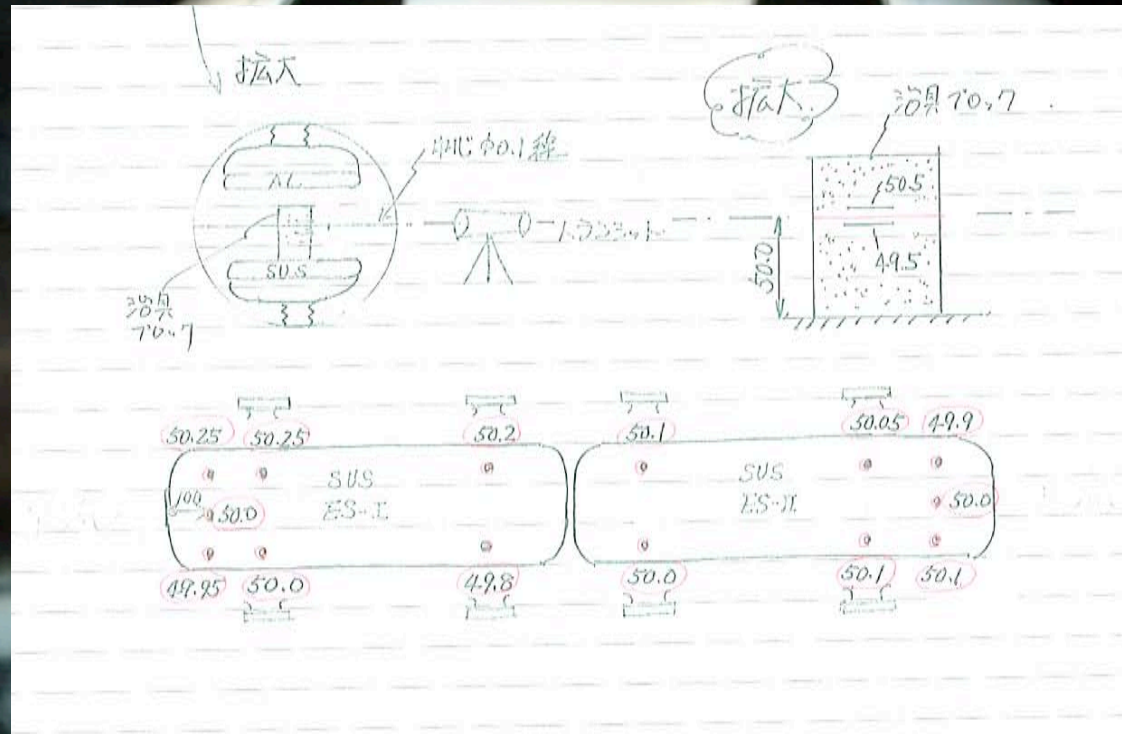
Assembling-2



Assembling-3



Assembling-3

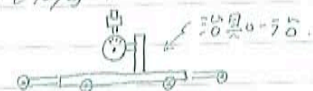


Assembling-3

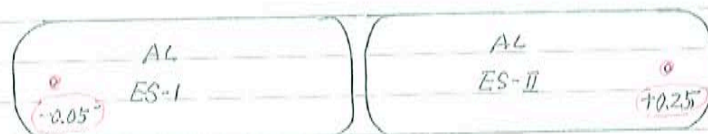
⑨ SUS電極 - AL電極 電極間隔測定

電極間 100mm に対し、溶臭針付ローラを、100にセットし、電極間寸法を確認する。

SUS・AL電極のキズ防止シートは、取り外した為、測定値は、2点とした。



結果

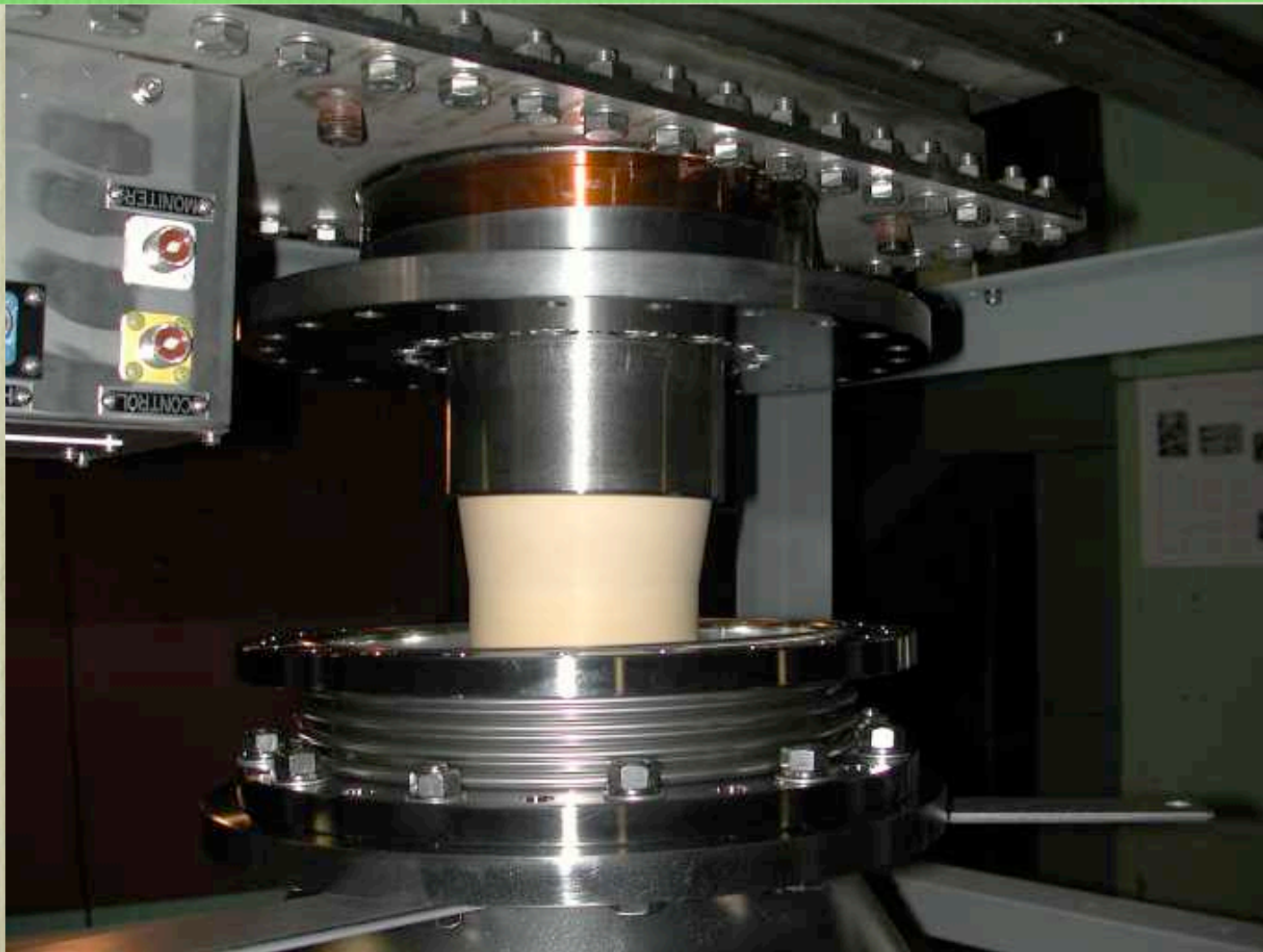


-0.09 (H16 ES-I 平均)

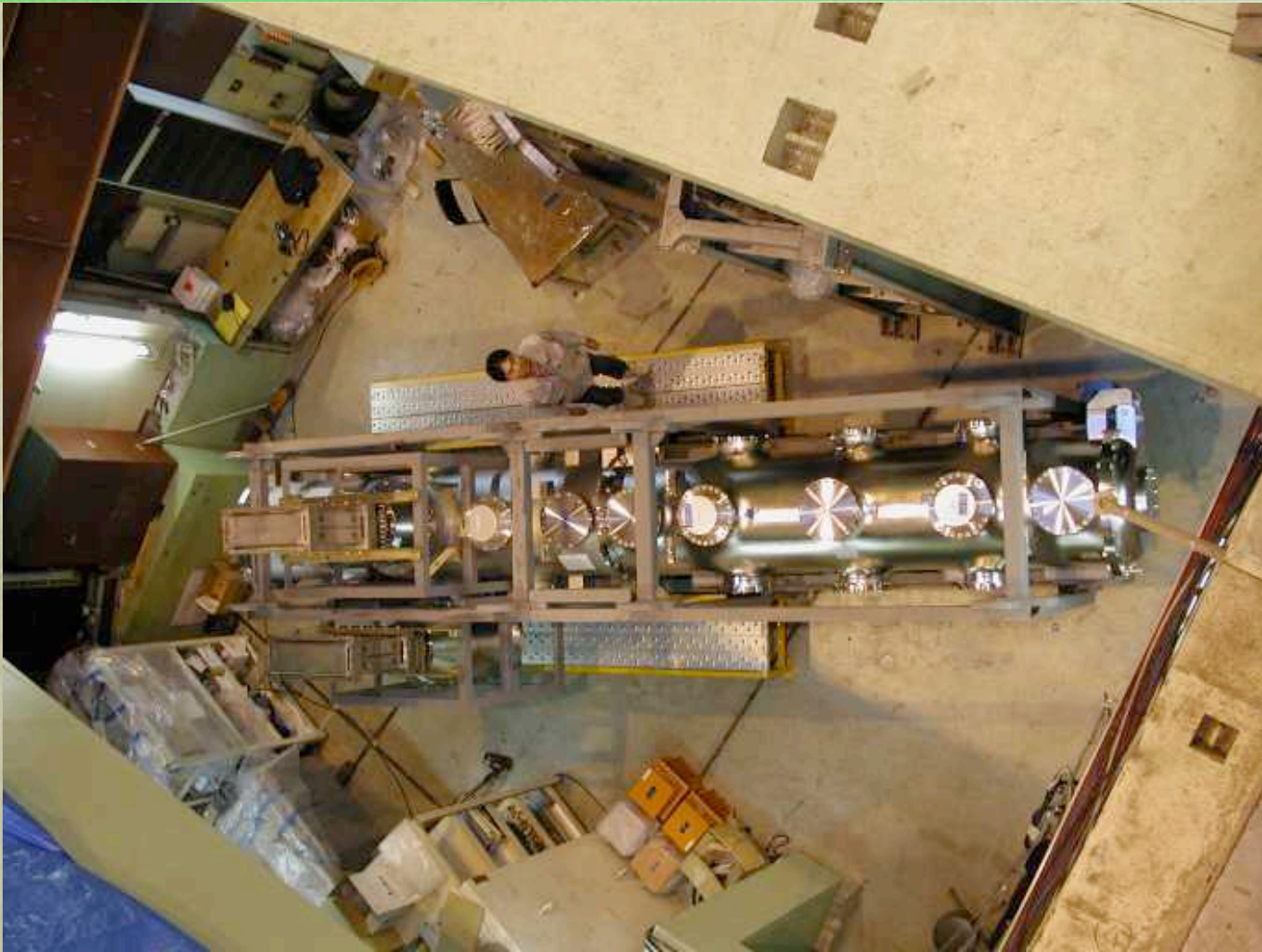
+0.21 (H19 ES-II 平均)

各 3H電極の測定値とほぼ同じである。

Assembling-4



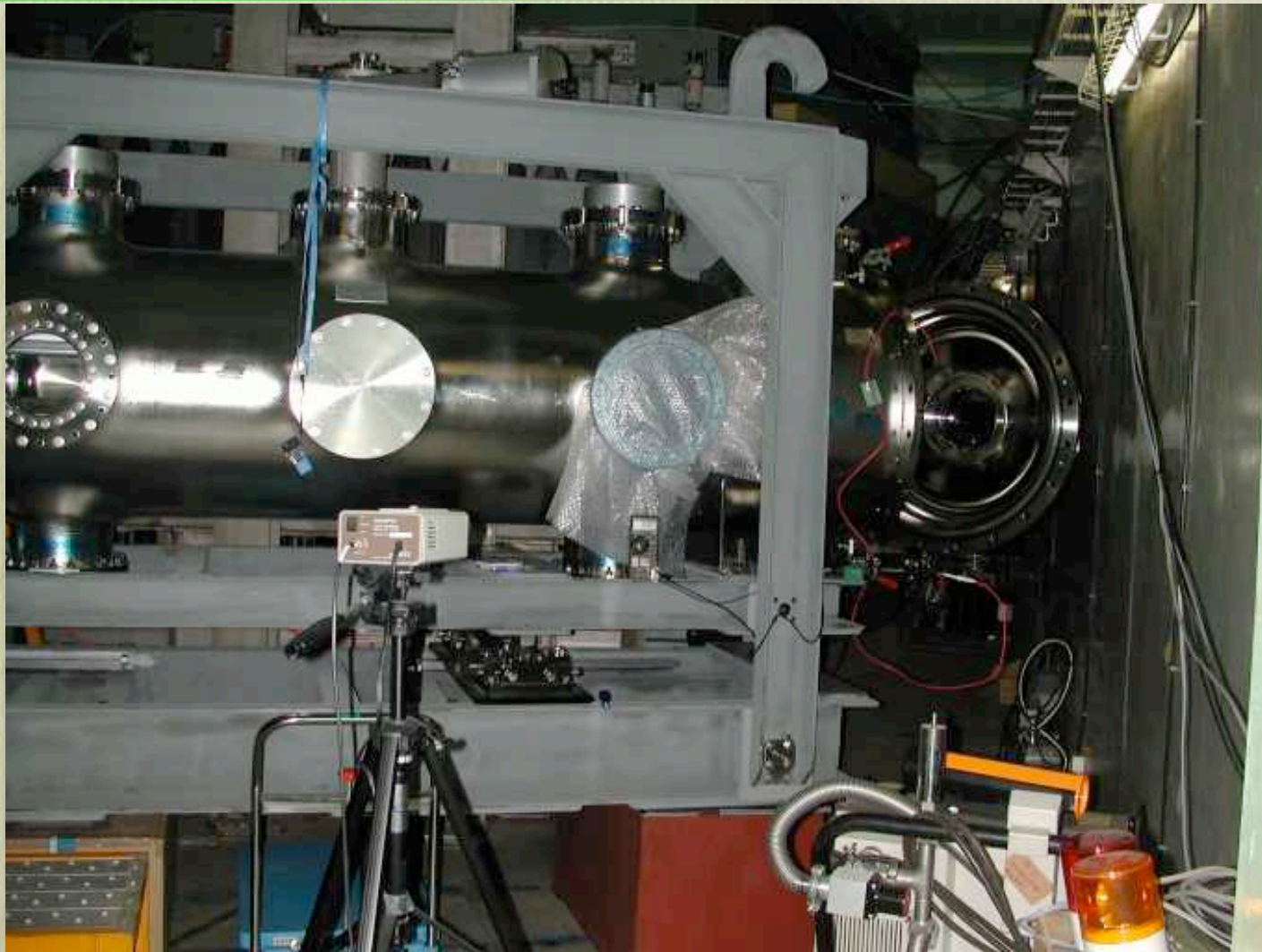
Assembling-4



Assembling-5



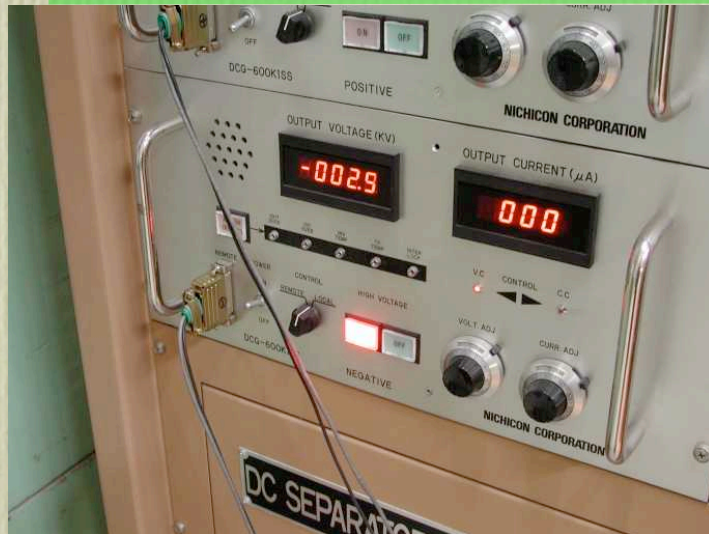
Assembling-6



Assembling-6



Assembling-6



まとめ

真空容器・電極・高電圧発生装置を設計／製作
K1.8ビームライン用の6m長初段ESSの組上げ

設計の指針

- 放射線耐性
- 電界の緩和

今後

- 実機としての真空試験、電圧印可試験、連続運転試験
- 設置ベースの設計製作
- 二段目のESS(K6セパレータ)の整備