Laser Power and Pulse Energy

	Micro-Pulse	Gun			Laser necessary		Laser project	
		Q.E.	Q_{bunch}	I_{mean}	P_{mean}	E_{pulse}	P_{mean}	E_{pulse}
ELBE nominal	13 MHz	1%	77 pC	1 mA	0.47 W	36 nJ	0.8 W	60 nJ
high bunch charge	1 MHz	1%	1 nC	1 mA	0.47 W	470 nJ	1.0 W	1 µJ

Cs_2Te cathode requirements

parameter	previously	necessary	international
Q.E.	0.2-0.5 %	>1 %	>4.5 %
Life time	?	1.2 kC 330 h @ 1mA (8 weeks)	1.2 kC 450 h @ 750 µA
Dark current	Small		wie Cu
average current density		32 mA/cm^2 @ r = 1 mm	21 mA/cm^2
damage by Laser		32 W/cm^2 @ r = 1 mm	6 W/cm^2
heat load		1 W	
electric field strength	22 MV/m	50 MV/m	125 MV/m

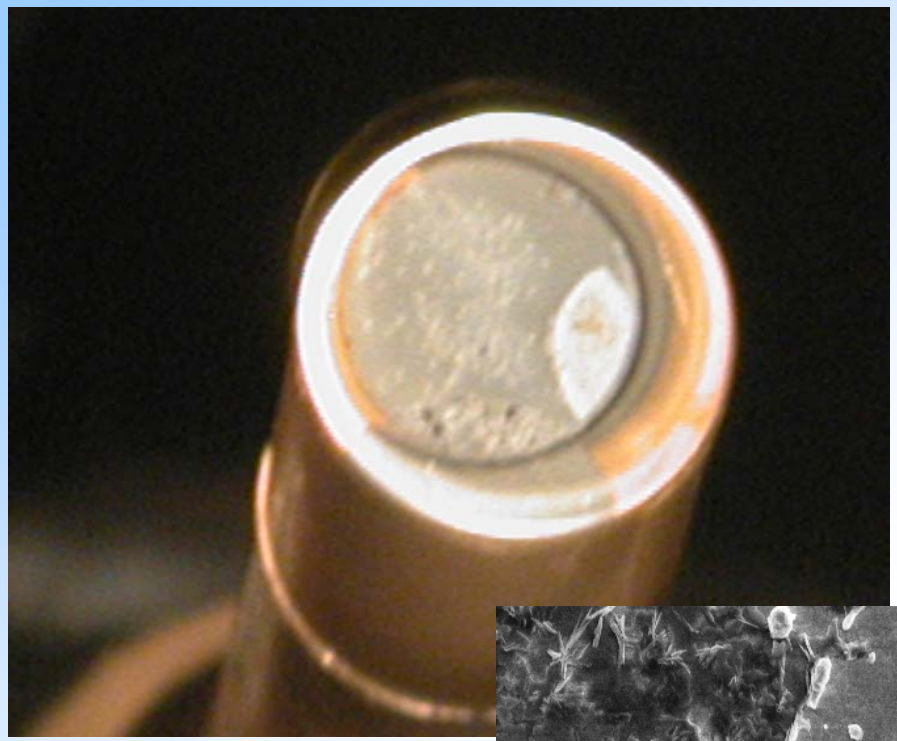
problems with the first SRF-Gun

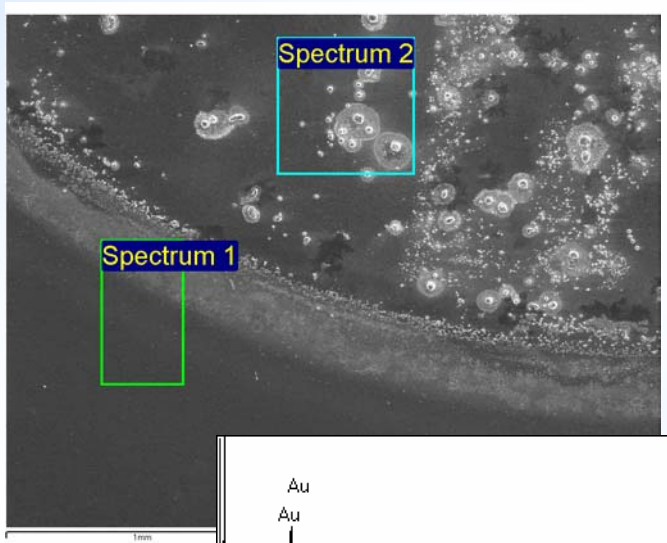
transfer of cathode into the gun-resonator was very difficult,
specialist needed

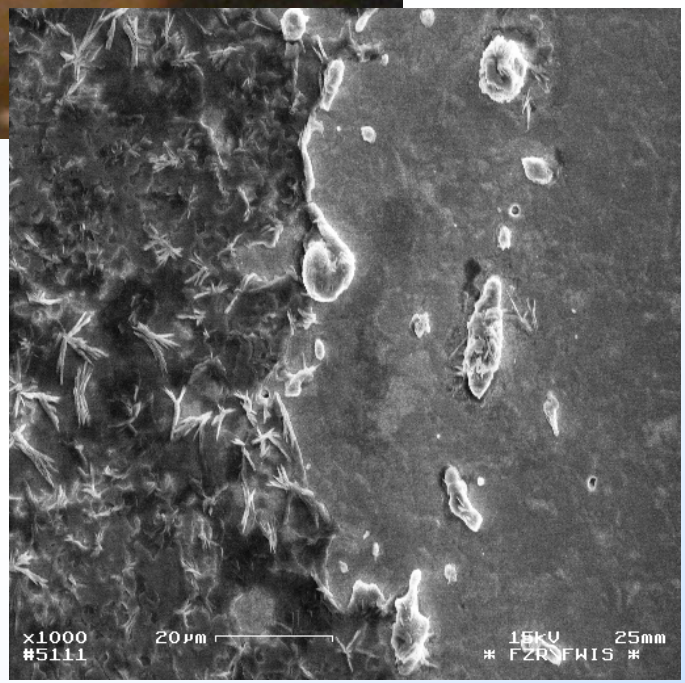
Only one cathode available, whether good or not

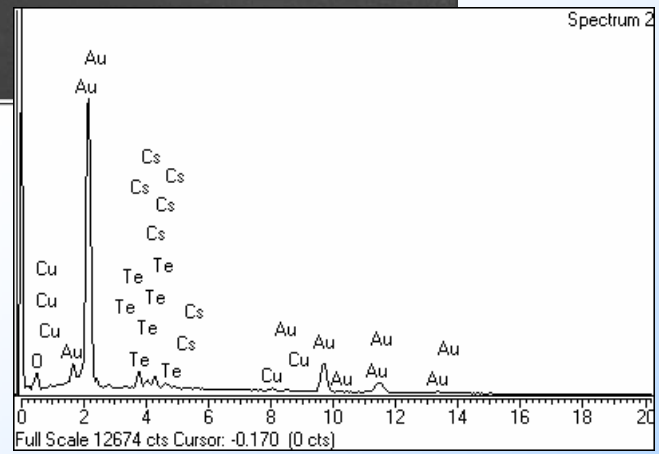
quality of cathodes:
small quantum efficiency,
inhomogeneous photo layers,
position failures during deposition.

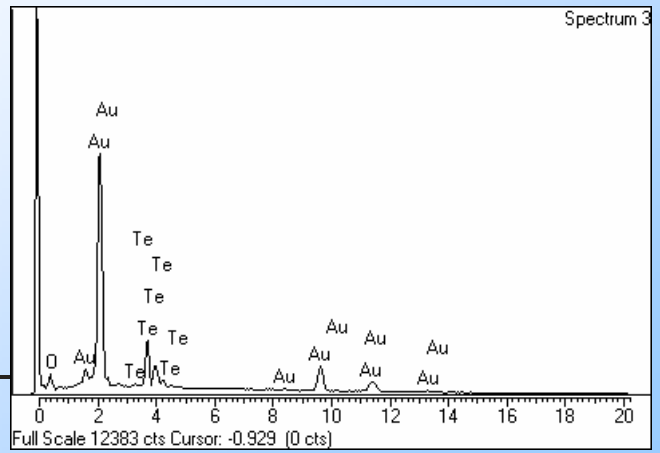
Präperation chamber:
bad vacuum during evaporation,
Bad mechanical adjustment,
Unfavourable evaporators,
evaporation process not reproduceable





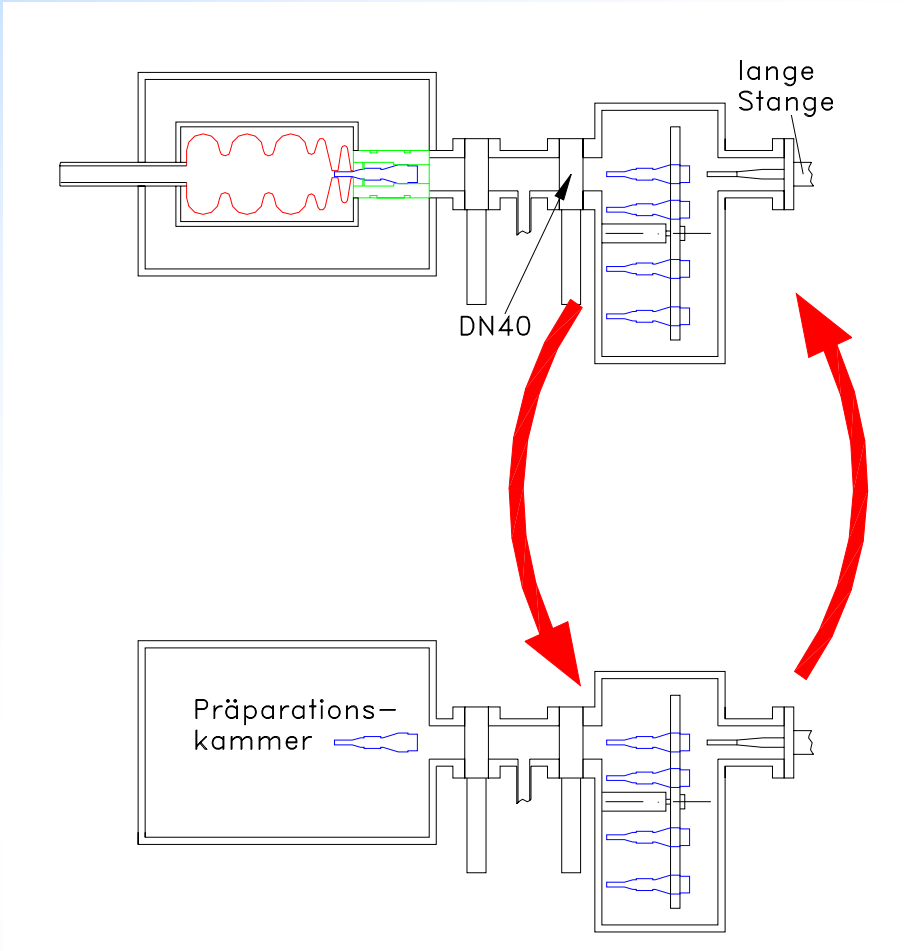




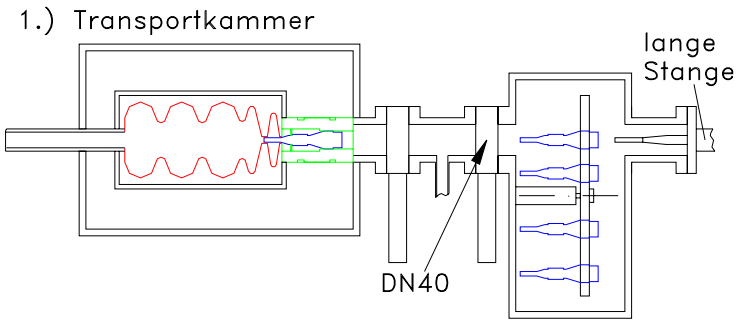


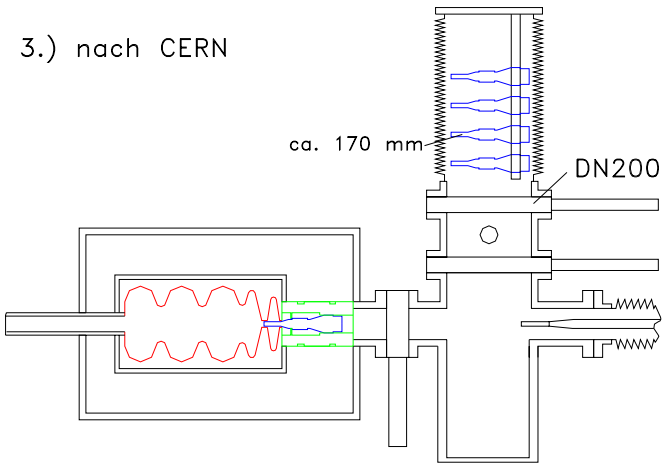
Strahlungsquelle ELBE

Logistics and Transportation Chamber



Advantage:
Cathode need not moved through the chamber





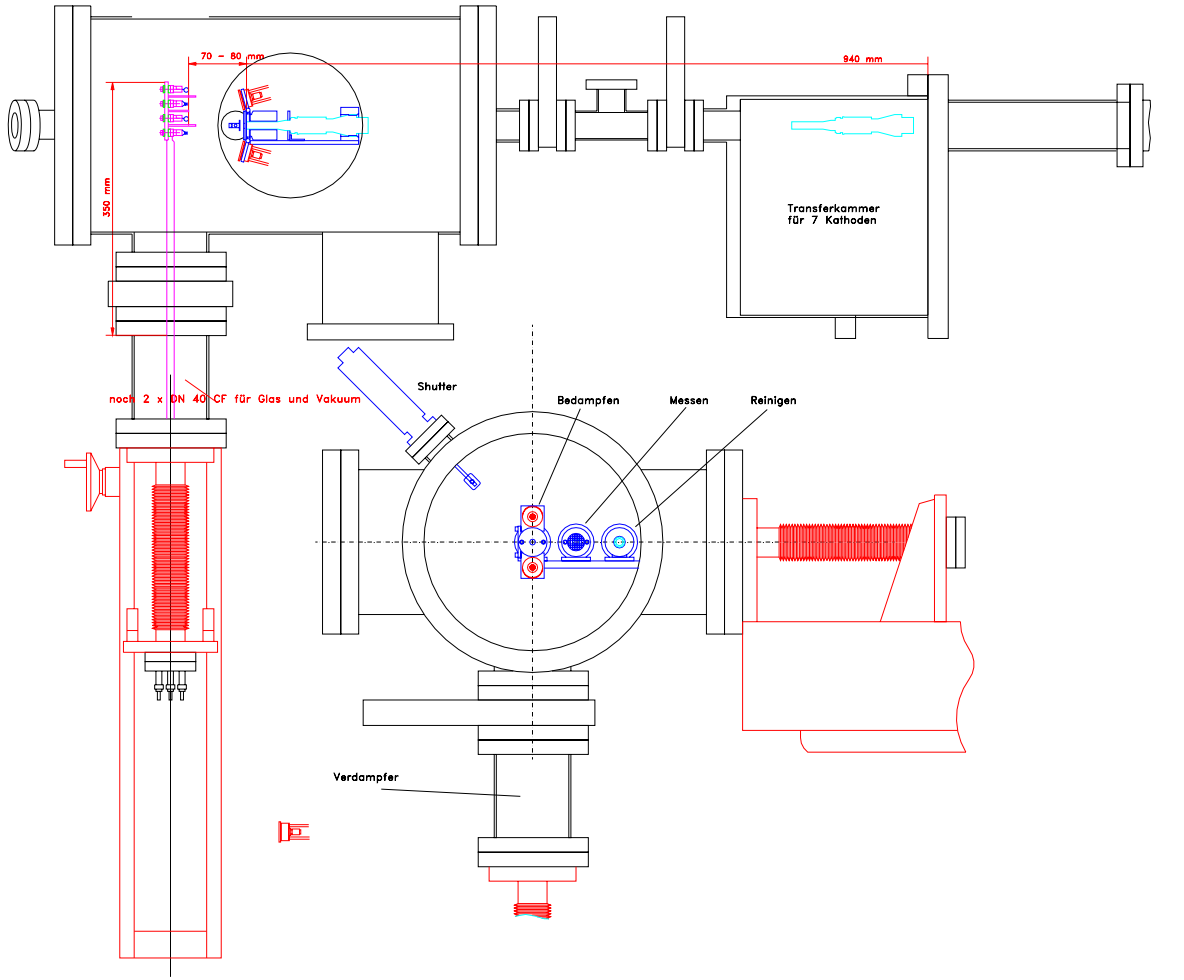
2 transportation chambers with ion pumps

drawback:
long translator rod (1.2 m)

open questions:
Short transfer path length
precise movement
into the cavity
additional manipulator
and exchange chamber ?

Modifications:
DN40,
More compact,
High precision translator

Preparation Chamber



Open the chamber for modification or repair only
Cathode and evaporator exchange using valves without

mechanical accuracy of all components

Functions

- cathode exchange
- vacuum generation and measurement
- evaporation of Te and Cs
- Measurment of quantum efficiency
  - Laser scan
  - collection electrode with homogenous electric field
  - cathode mounting (thread)
- Ion beam cleaning
  - cathode fitting
  - ion source
- Additional possibilities? Diagnostics ?

Cs_2Te layer preparation technology

Up to now:

first Te evaporation, ca. 20 nm

then Cs up to maximum photo current (10 nm ?)

New:

Te and Cs simultaneously

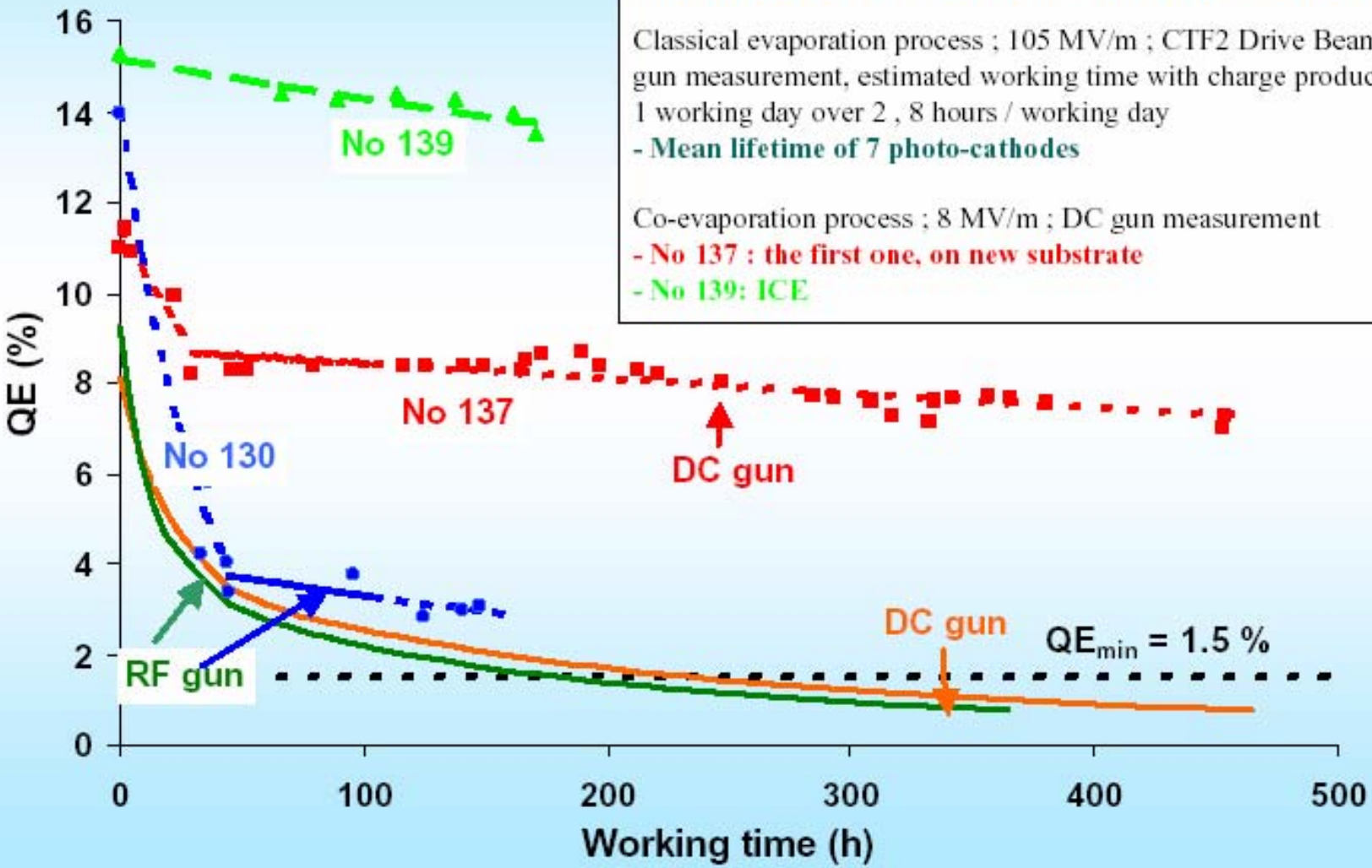
Co-evaporation

Gain in QE

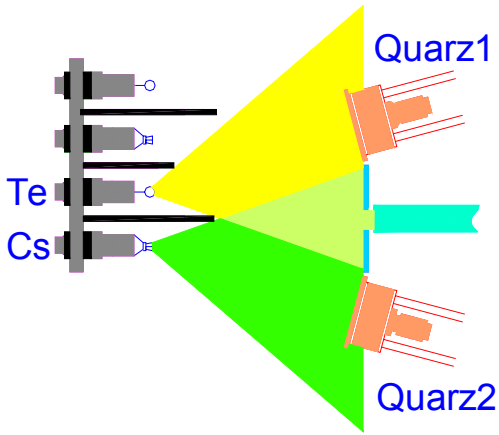
Classical evaporation process ; 8 MV/m ; DC gun measurement
- **Mean lifetime of 6 photo-cathodes, including high charge test**

Classical evaporation process ; 105 MV/m ; CTF2 Drive Beam RF gun measurement, estimated working time with charge production : 1 working day over 2 , 8 hours / working day
- **Mean lifetime of 7 photo-cathodes**

Co-evaporation process ; 8 MV/m ; DC gun measurement
- **No 137 : the first one, on new substrate**
- **No 139: ICE**



Co-evaporation – 2 deposition rate monitors



Stöchiometrie

$$R = \frac{N_{Cs}}{N_{Te}} = \frac{2}{1}$$

Calibration

Te, Cs separate

$$f_1^{Te} = \frac{s_1^{Te}}{s_c^{Te}}, \quad f_2^{Te} = \frac{s_2^{Te}}{s_c^{Te}}$$

$$f_1^{Cs} = \frac{s_1^{Cs}}{s_c^{Cs}}, \quad f_2^{Cs} = \frac{s_2^{Cs}}{s_c^{Cs}}$$

Preparation

$$\dot{\eta}_{Te} = \frac{1}{D}\left(\dot{\eta}_1 f_2^{Cs} - \dot{\eta}_2 f_1^{Cs}\right)$$

$$\dot{\eta}_{Cs} = \frac{1}{D}\left(\dot{\eta}_2 f_1^{Te} - \dot{\eta}_1 f_2^{Te}\right)$$

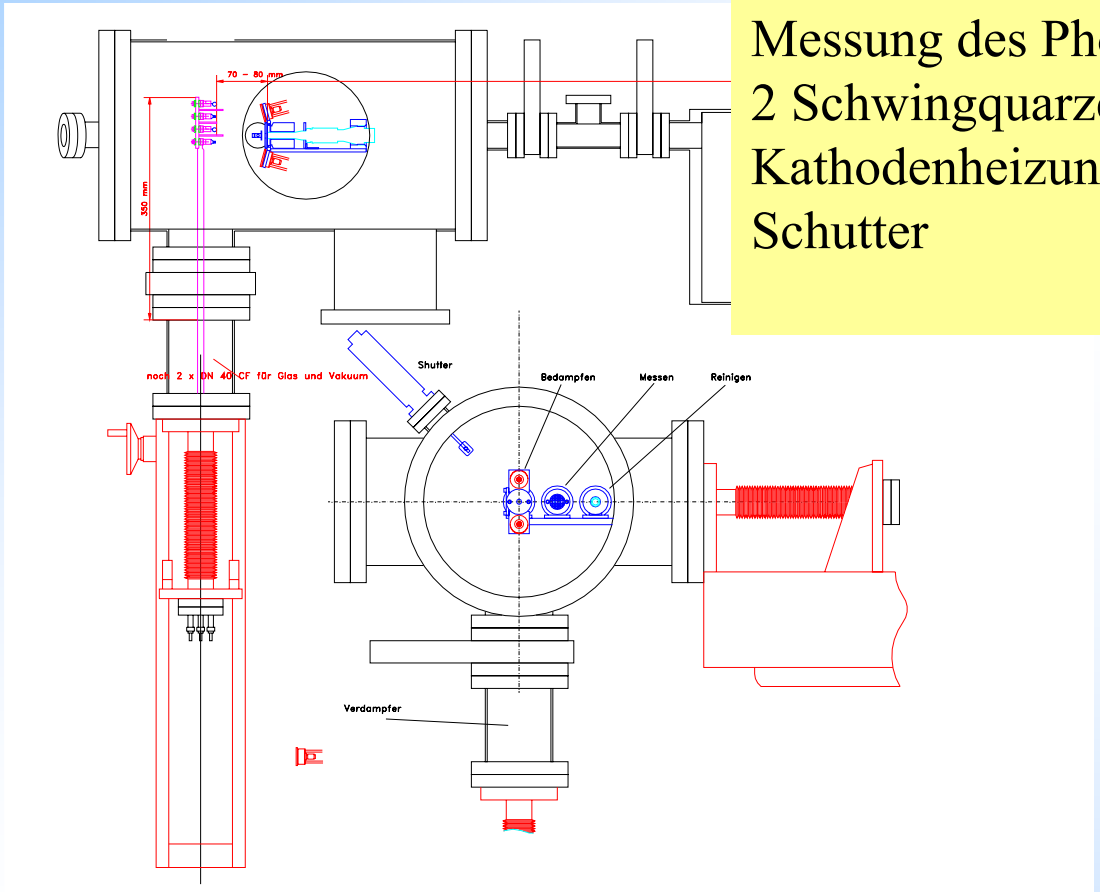
$$D = f_1^{Te} f_2^{Cs} - f_2^{Te} f_1^{Cs}$$

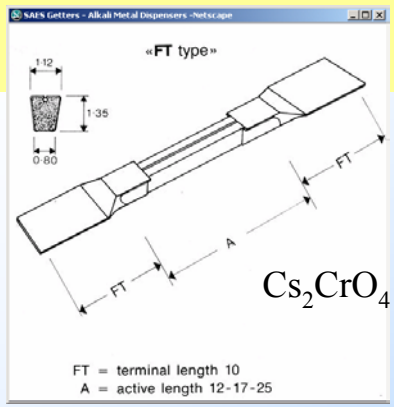
$$R = \frac{N_{Cs}}{N_{Te}} = \frac{M_{Te}}{M_{Cs}} \frac{\dot{\eta}_{Cs}}{\dot{\eta}_{Te}}$$

$$s = \frac{1}{\rho_{Cs2Te}} \int dt \left(\dot{\eta}_{Te} + \dot{\eta}_{Cs}\right)$$

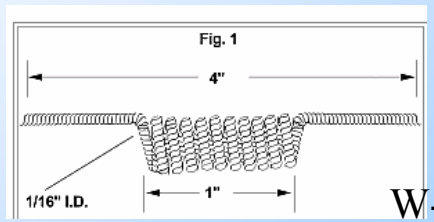
Bedampfung

Verdampfer für Te, Cs
Kathodenhalter
Blende (Lage und Größe des Cs_2Te-Flecks)
UV-Licht
Messung des Photostroms
2 Schwingquarze zur Schichtdickenmessung
Kathodenheizung und Temperaturmessung
Schutter



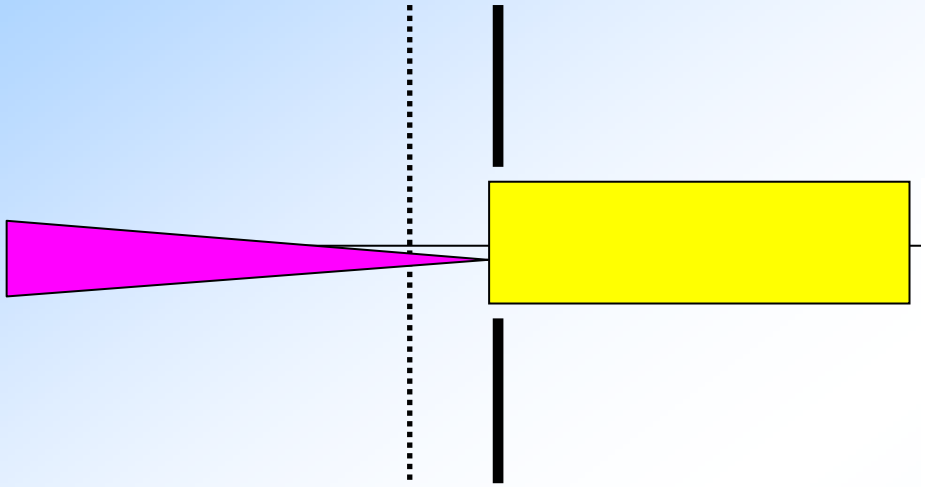


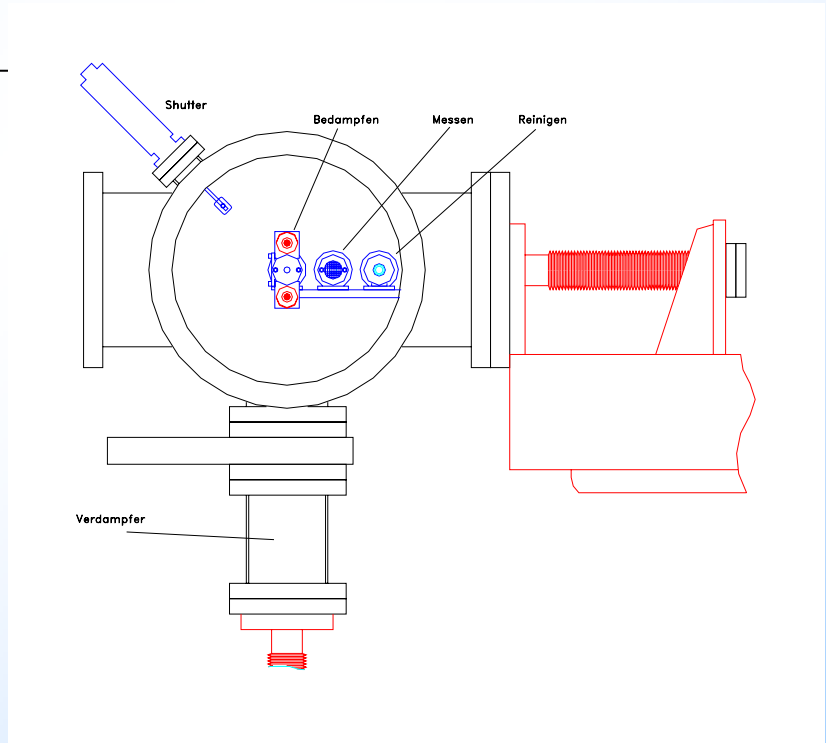
Cs_2CrO_4 und Gettermaterial



W-Spirale für Te

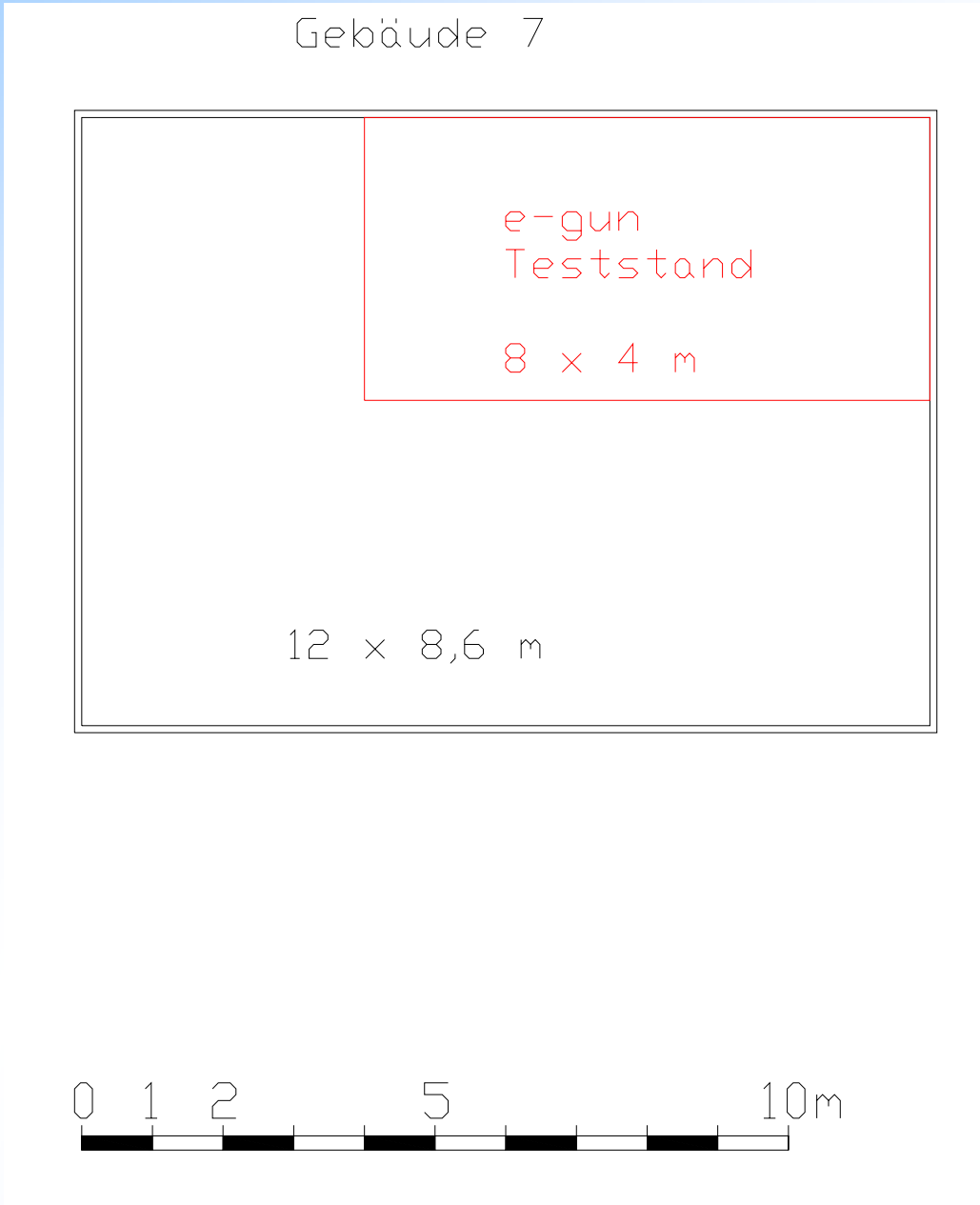
Messung der Q.E. - Laserscan





Funktionsgruppen

- Kathodenwechsel
- Vakuumerzeugung und Messung
- Bedampfung
- Messung der Quantenausbeute
  - Laserscan
  - Absaugelektrode mit homogener Feldverteilung
  - Kathodenhalter
- Ionenstrahlreinigung
  - Kathodenhalter
  - Ionenquelle
- Was noch ? Diagnostik ?


Gebäude 7
e-gun
Teststand
8 x 4 m
12 x 8,6 m
0 1 2 5 10m