

---

# Status of Cathode System in FZR

— Photocathode preparation and  
test of the cathode cooling system

Rong Xiang

FZ Rossendorf, Dresden



Forschungszentrum  
Rossendorf

Mitglied der Leibniz-Gemeinschaft

Radiation Source ELBE

---

# Cathode System in SRF Project

1. Preparation chamber
2. Transport chamber
3. Cathode cooling system



# What we need ?

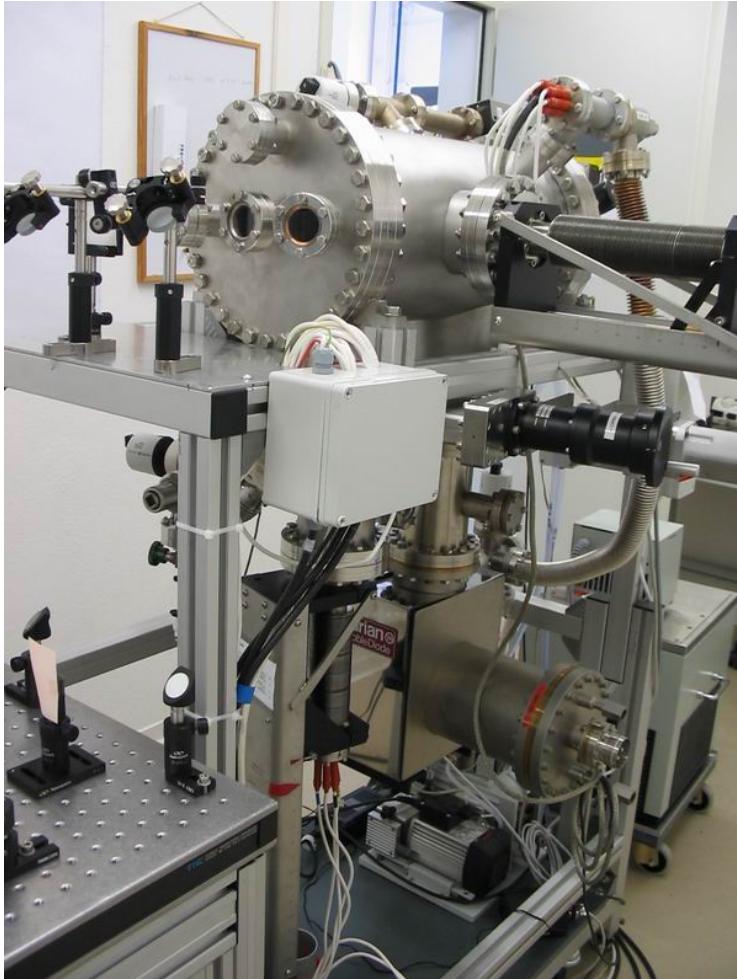
---

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



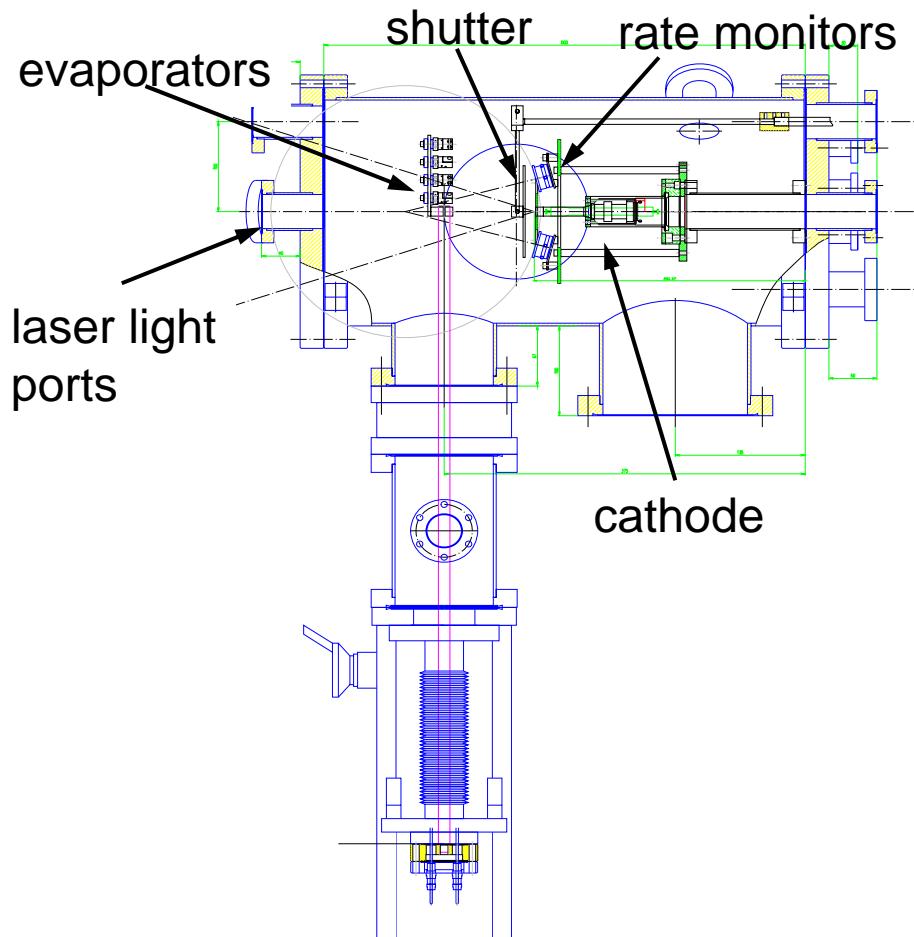
# 1. Preparation Chamber

---



- ✓ Design
- ✓ Manufacture
- ✓ First test, optimize
- ✓ Clean room building
- Clean
  - Assemble
  - Experiment
  - Production (July 2006)

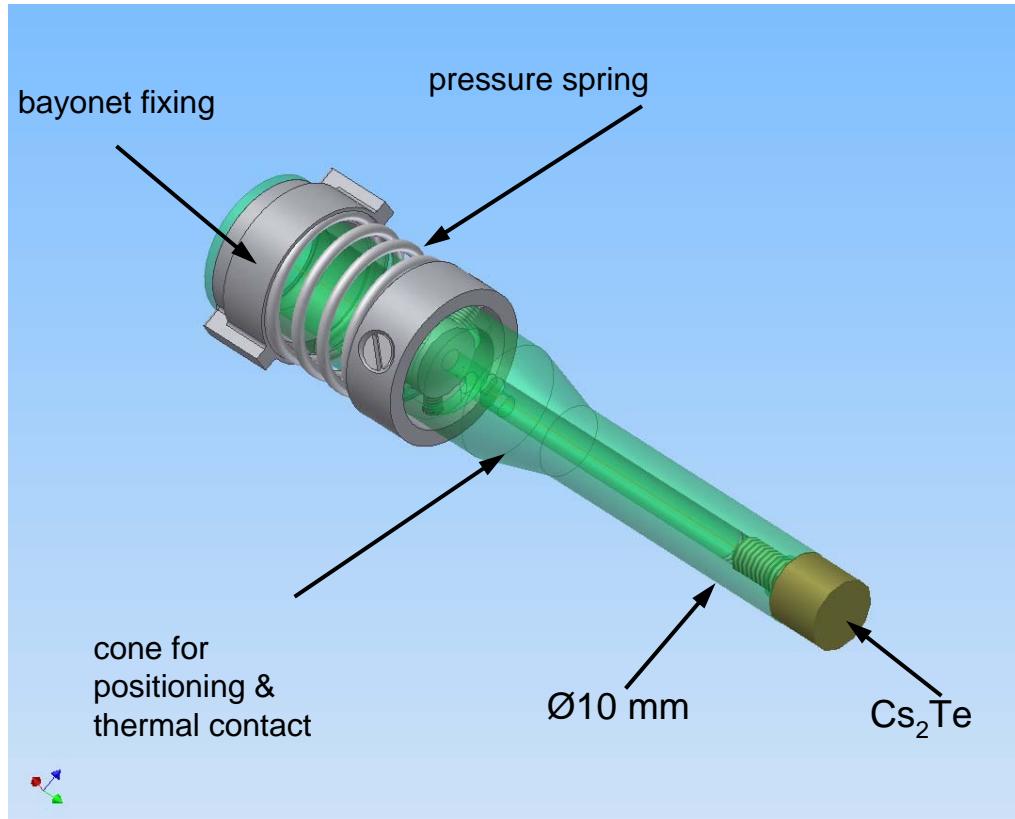
# Preparation System



- Ultra high vacuum ( $10^{-11} \sim 10^{-9}$  mbar )
- Cathode holding  
Halogen-light heating  
Ion-beam cleaning
- Co-evaporation of Te and Cs
- Measurment of quantum efficiency  
QE during deposition  
Life time  
Distribution scan

# Cathode plug

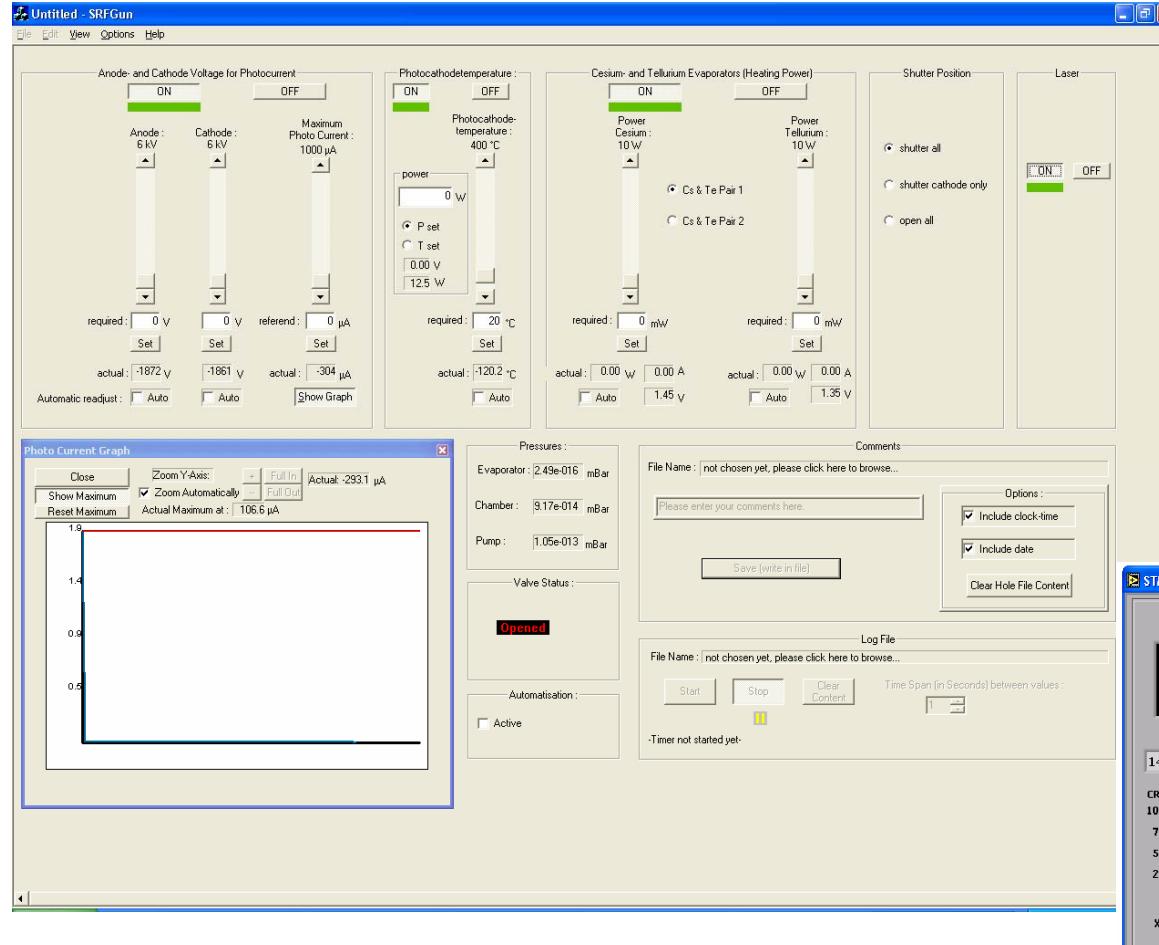
---



Cathode plugs are made of Cu or Mo

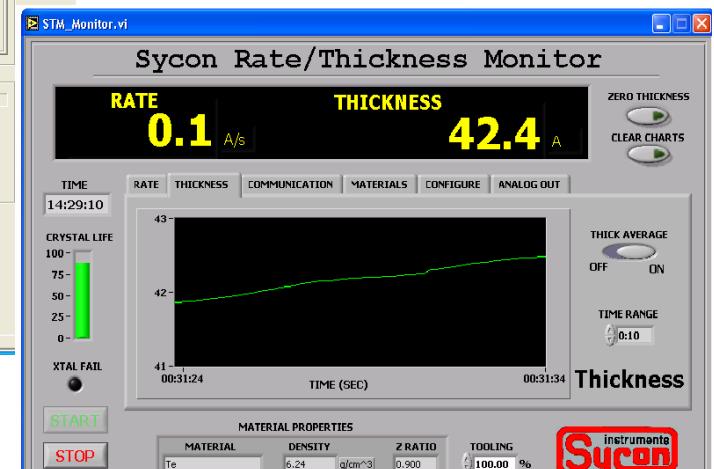
Manual Polishing result:  
average roughness: 17.2 nm  
(analyzed by Dektak8 profiler)

# Control system



Control program

"SRFgun"



Quartz thickness monitor STM-1



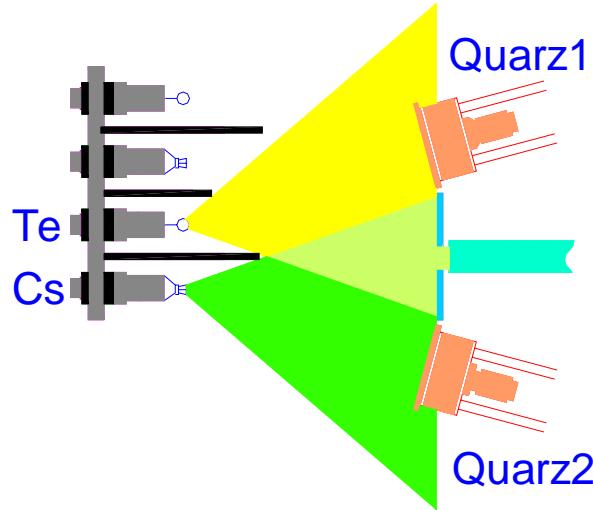
Forschungszentrum  
Rossendorf

Mitglied der Leibniz-Gemeinschaft

Radiation Source ELBE

24.11.2005

# Co-evaporation



Stoichiometric

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

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

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

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

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

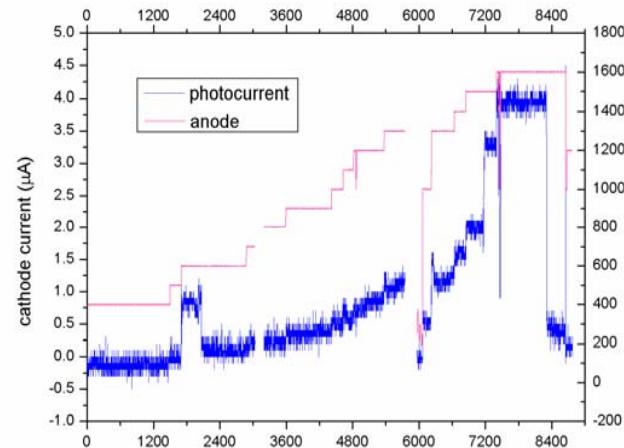
$$R = \frac{N_{Cs}}{N_{Te}} = \frac{M_{Te}}{M_{Cs}} \frac{\dot{\eta}_{Cs}}{\dot{\eta}_{Te}}$$

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

# First test in new chamber

---

No.	Sub.	Thick. Te	Thick. Cs	Cs/Te	
				PIXE	RBS
#05-05-31	Cu	10 nm	20 nm	0.55	0.44
#05-06-16	Cu	10 nm	68 nm	\	1.9
#05-06-22	Si	10 nm	70 nm	1.6	\
#05-06-23	Si	10 nm	46 nm	0.8	0.8



# Our homepage

activities in FZR - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Favorites Search

Address http://www.fz-rossendorf.de/projects/CARE/index.files/page0002.htm Go Links

Photocathodes in Photoinjectors

**CHARGE PRODUCTION**

Homepage  
Photocathodes  
**Activities**  
Reports  
Useful links

**Research Activities in JRA2**

**Forschungszentrum Rossendorf**

The photocathode preparation laboratory at FZR has been built to produce the Cs<sub>x</sub>Te photocathode for the SRF gun project and to research the photocathode properties.

[Logbook](#)   
[Status report July, 2005](#)   
[Calibration](#)

<http://www.fz-rossendorf.de/projects/CARE/>



**Forschungszentrum  
Rossendorf**

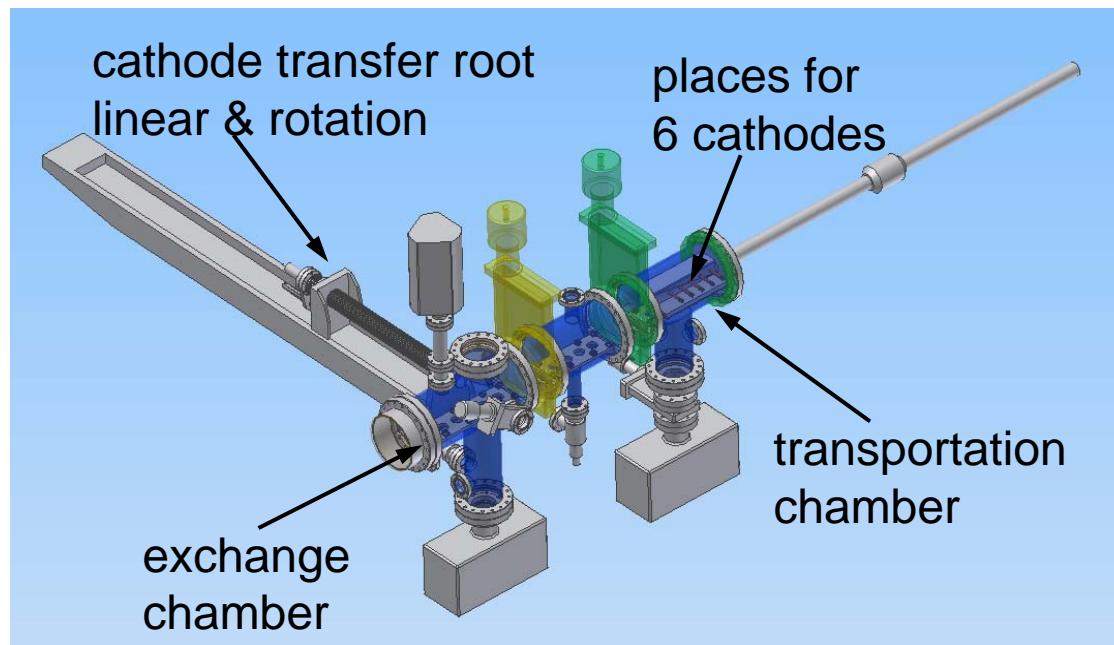
Mitglied der Leibniz-Gemeinschaft

**Radiation Source ELBE**

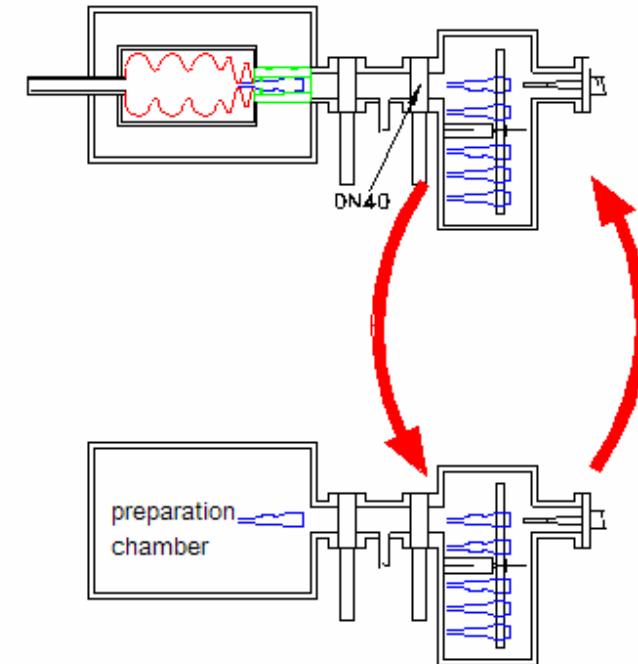
24.11.2005

## 2. Transport Chamber

---



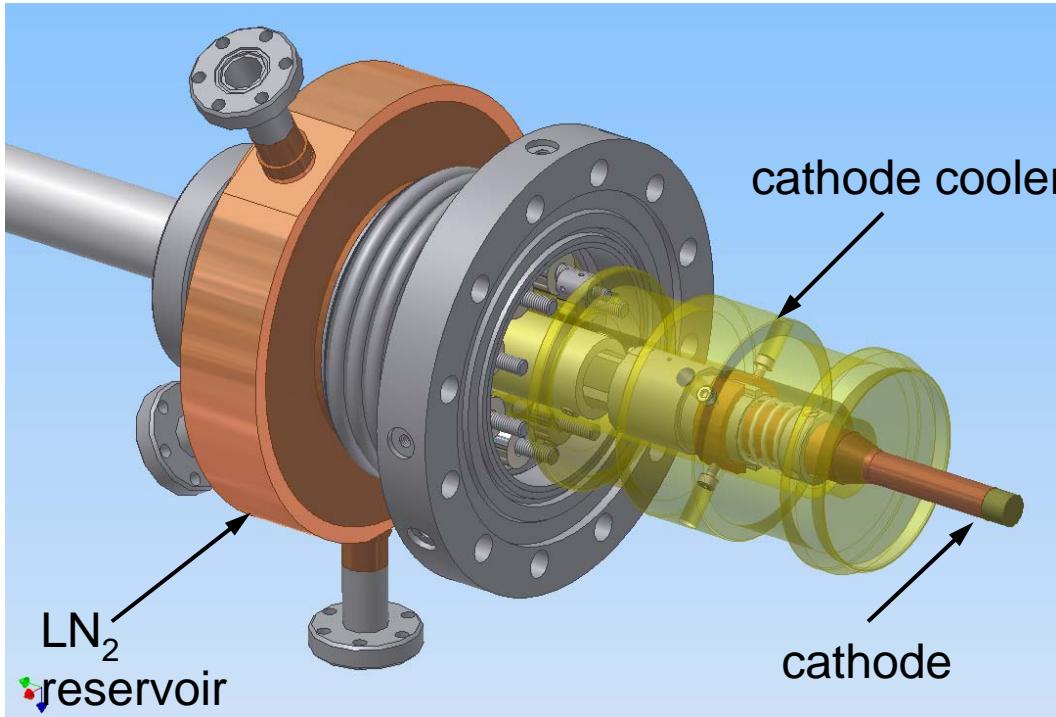
- ✓ Design
- ✓ Manufacture
- First test, optimize
- Clean
- Assemble



Minimum particle generation during exchange  
Six cathodes can be stored and transferred  
Accurate adjustment

### 3. Cathode cooling system

---

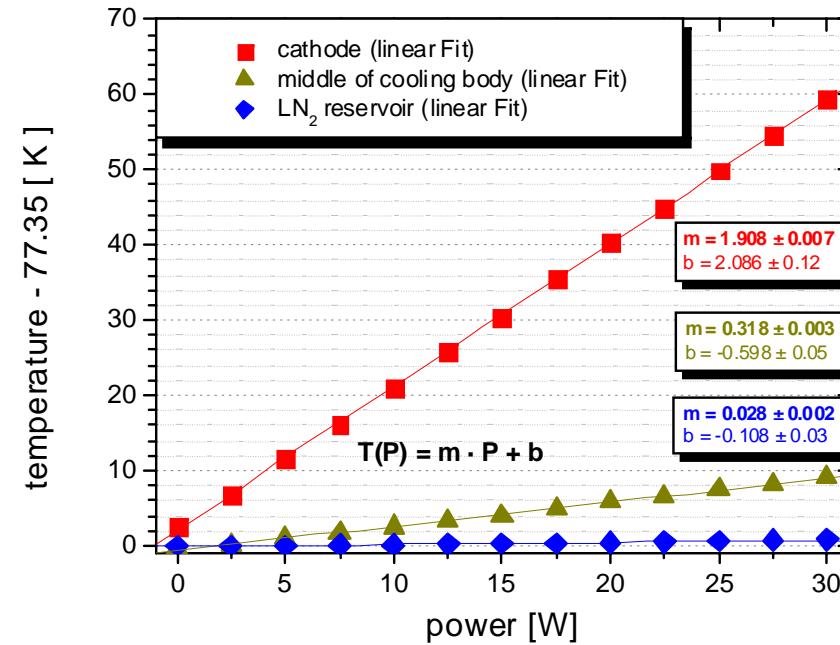


- ✓ Design
- ✓ Manufacture
- ✓ First test, optimize
- Final assemble

# Test of the cathode cooling system



Measured temperatures via power input



30 W power input to the photo cathode burdens the cavity with **only 31 mW**.

(F. Staufenbiel, et al., SRF2005)

---

---

---

## Next work

- Finish construction of preparation chamber  
(clean, assemble, vacuum...)
- Solidify preparation technology  
(control, measure, calibrate...)
- Finish the test of transport chamber  
(optimize, clean, vacuum, portable...)



---

---

---

---

---

# Thank you!



Forschungszentrum  
Rossendorf

Mitglied der Leibniz-Gemeinschaft

Radiation Source ELBE

24.11.2005