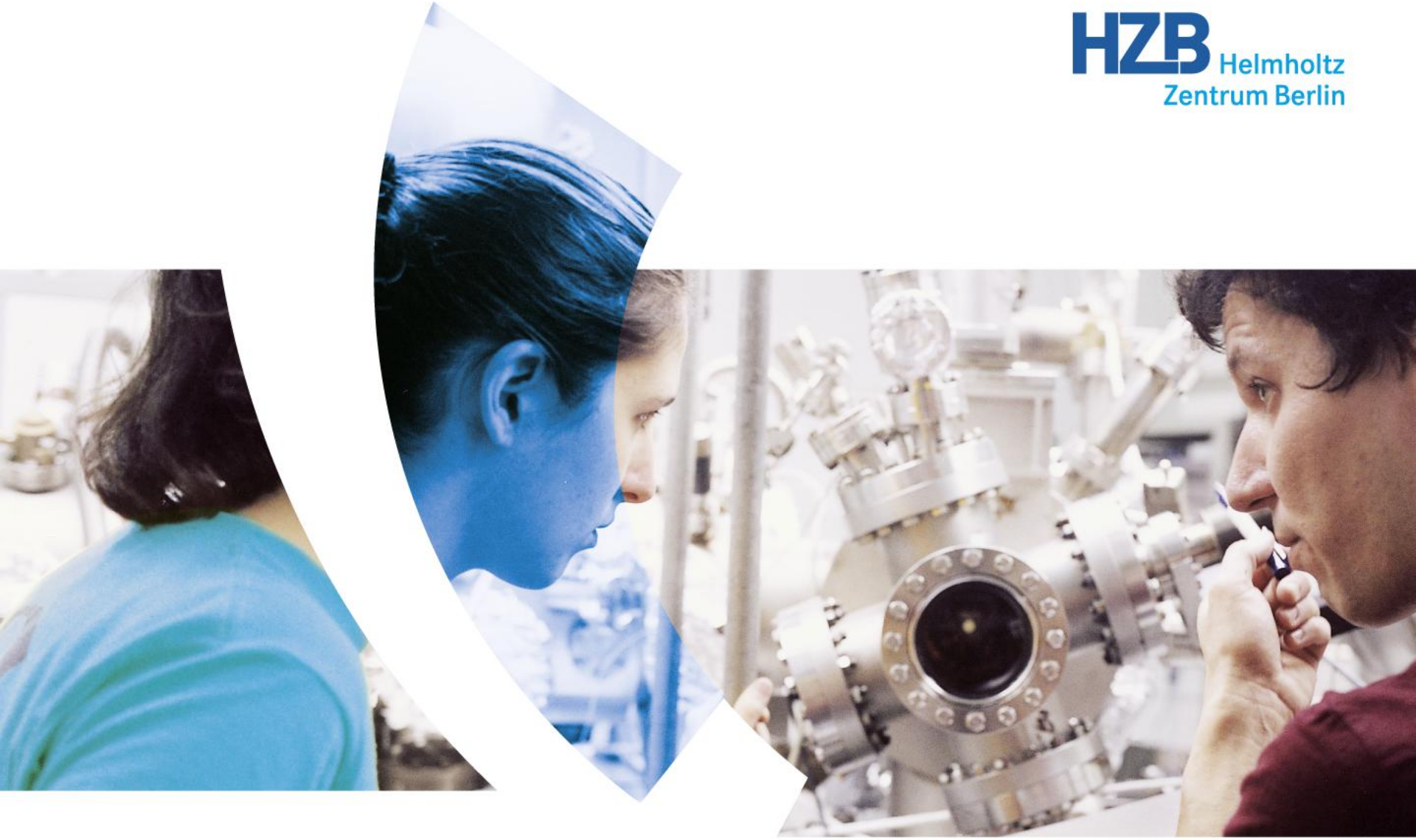
HZB Helmholtz Zentrum Berlin



# EMITTANCE MEASUREMENTS
# GERMAN-RUSSIAN COLLABORATION

# EMITTANCE MEASUREMENTS

## Goal

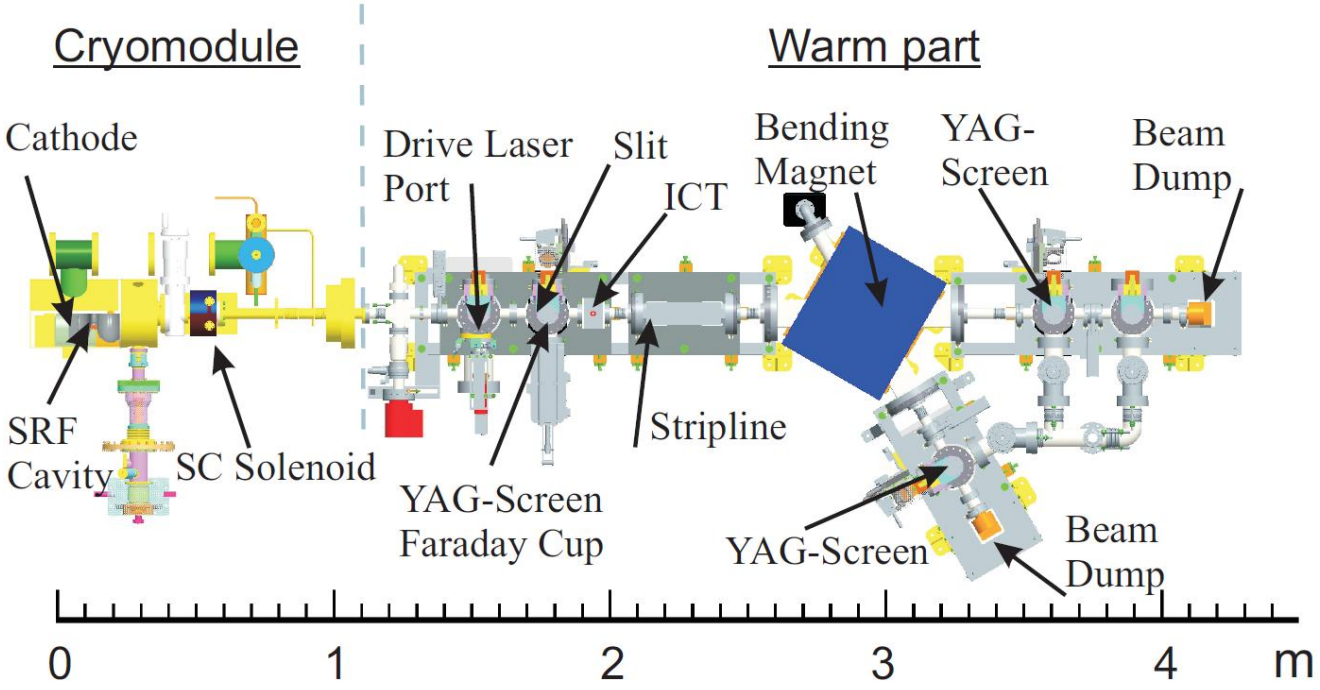
- Document emittance and QE evolution during all parts of cathode lifetime

## Steps

- Measure post gun emittance of current gun prototype („gun0“) for BERLinPro with installed slit mask
- Support Susanne Schubert‘s work at BNL with in-situ QE and emittance measurements of the prepared cathodes
- Magnetic mirror based emittance meter

# EMITTANCE MEASUREMENTS

Measure post gun emittance of current gun prototype („gun0“) for BERLinPro with installed slit mask :



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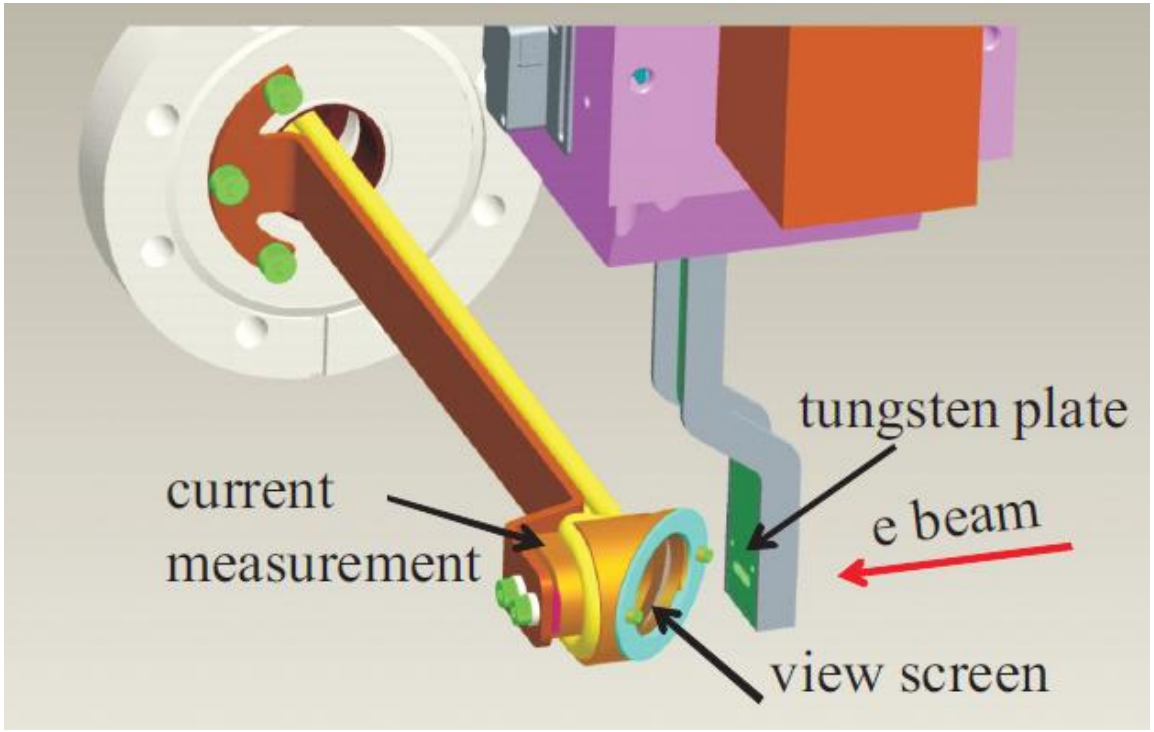
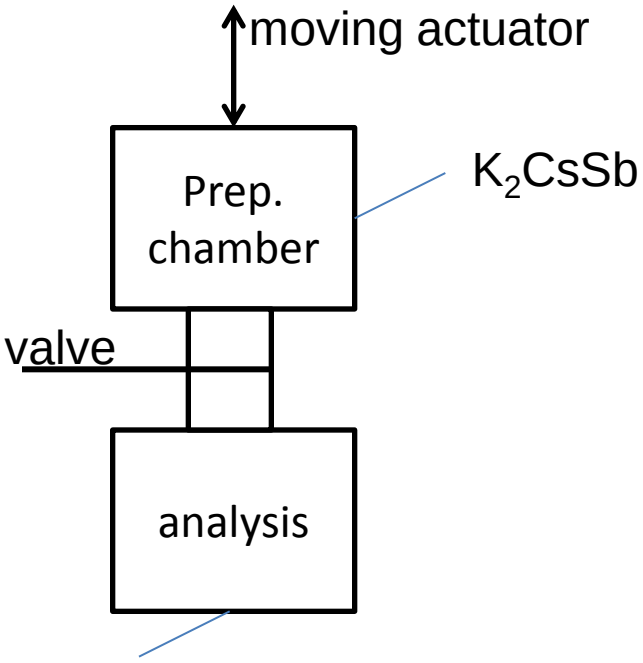



Barday, R. *et al.* Beam size and intensity diagnostics for a SRF photoelectron injector. *IBIC* (2012).

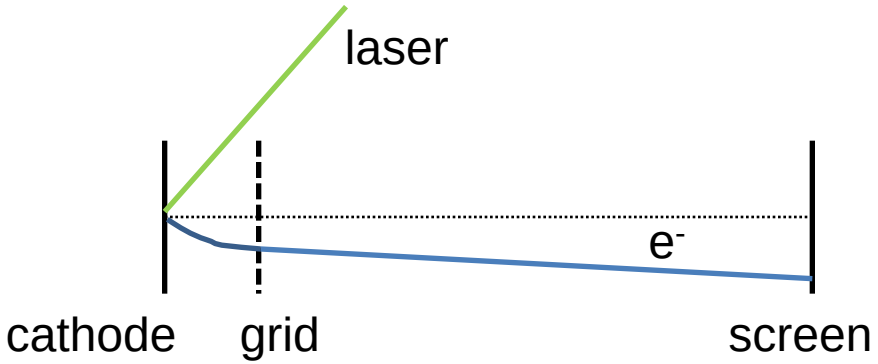
# EMITTANCE MEASUREMENTS

Support Susanne Schubert‘s work at BNL with in-situ QE and emittance measurements of the prepared cathodes :




Xray sprectroscopy, ion scattering

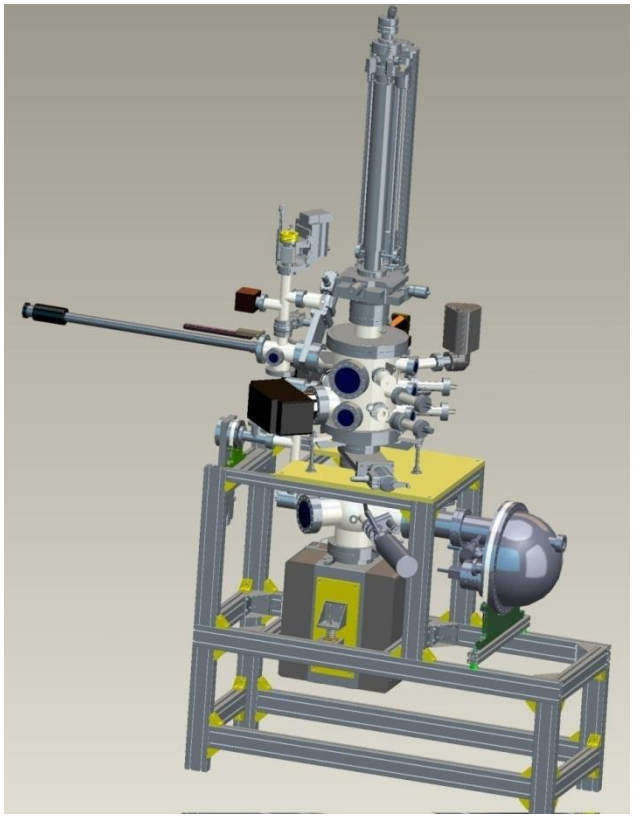
**Idea:**
Emittance measurement similar to Theo Vecchione‘s work

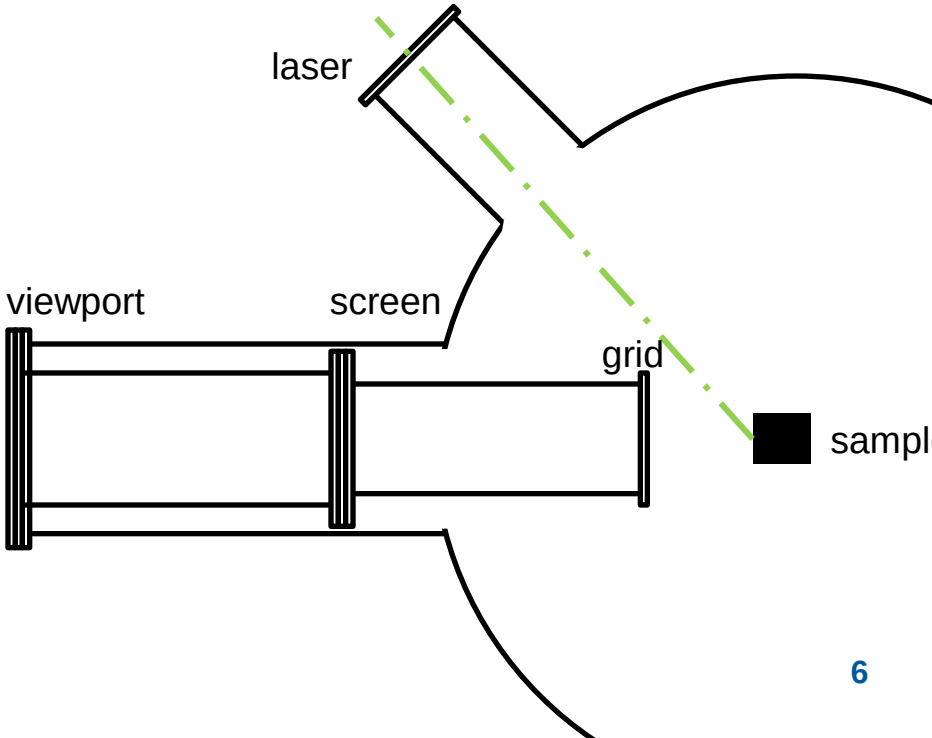



Vecchione, T. *et al.* A low emittance and high efficiency visible light photocathode for high brightness accelerator-based X-ray light sources. *Applied Physics Letters* **99**, 034103 (2011).

# EMITTANCE MEASUREMENTS

Support Susanne Schubert‘s work at BNL with in-situ QE and emittance measurements of the prepared cathodes :





# EMITTANCE MEASUREMENTS

Support Susanne Schubert‘s work at BNL with in-situ QE and emittance measurements of the prepared cathodes :

**Questions:**

How large need the beam be to resolve it at the screen? A few mm?

How to commission device in Berlin?

How accurately can we align the sample and the grid?

Additional comments?

# GERMAN-RUSSIAN COLLABORATION

Involves:

Helmholtz Centres **Berlin** and **Dresden**-Rossendorf

**Mainz** University

Inst. for nuclear physics at Lomonossov University, **Moskow**

Polytechnical University **St. Petersburg**

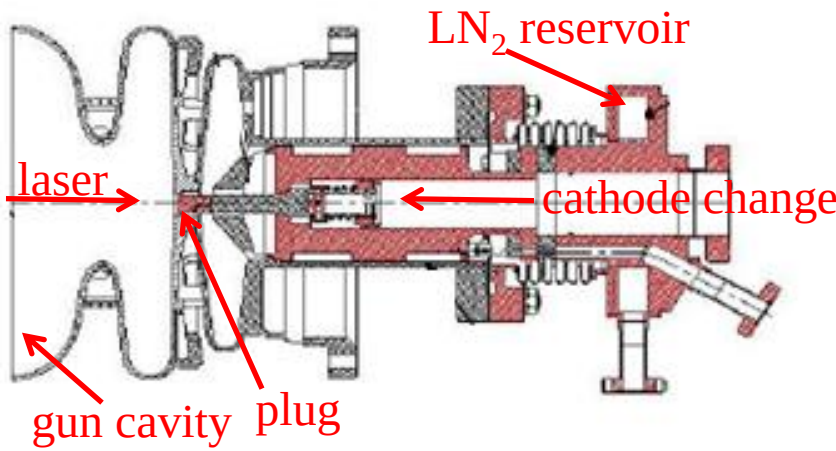
**Work Items:**

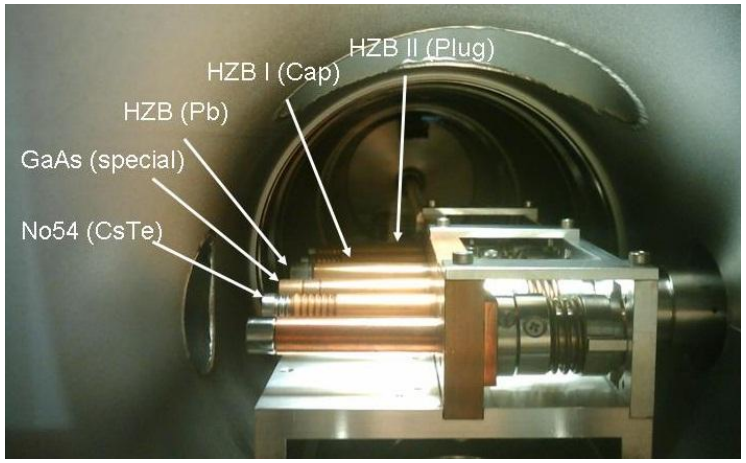
- Modelling and initial measurements of $K_2CsSb$ emission, retarding field energy analyzer
- Operational testing in DC and SRF gun, response time measurements, cathode transport system

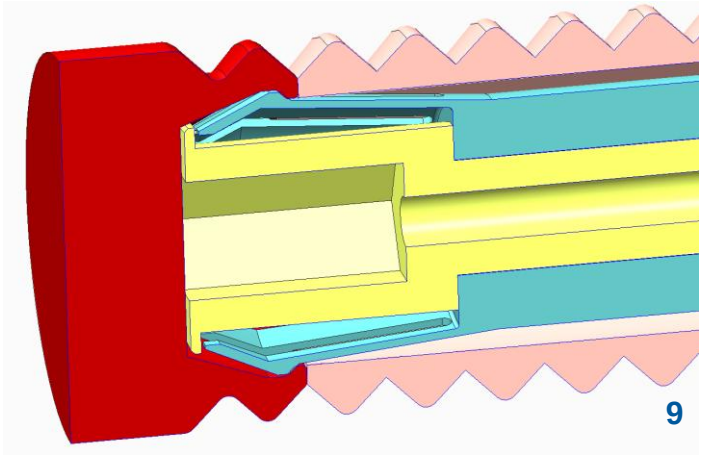
# GERMAN-RUSSIAN COLLABORATION

Cathode transport system

- load-lock to preparation chamber and insertion chamber at the gun
- Battery powered pumping
- Standardized cathode plug in participating gun projects
- **Idea** : integrated QE & emittance measurement

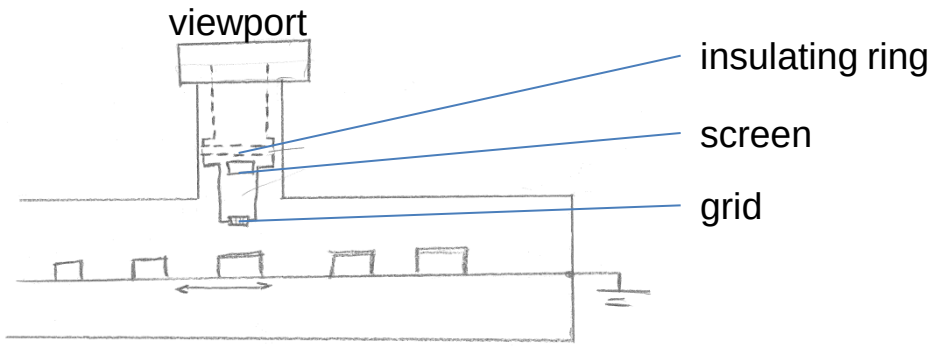


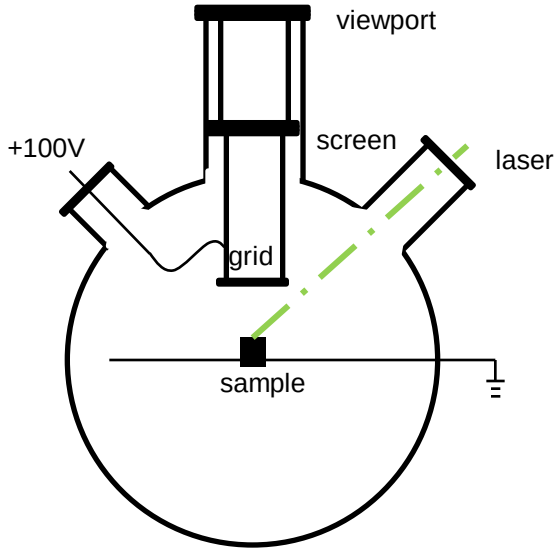



# GERMAN-RUSSIAN COLLABORATION

**Idea** : integrated QE & emittance measurement in cathode transport chamber



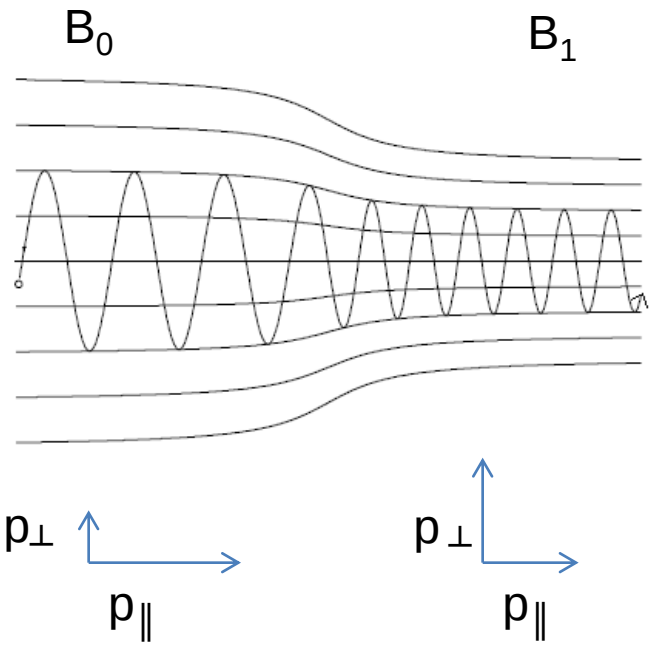
# EMITTANCE MEASUREMENTS

Magnetic mirror based emittance meter:

**Concept:**

$e^-$ bunch in a magnetic guiding field compresses if field strength increases (and vice versa)

measure shift in logitudinal energy in retarding field analyzer



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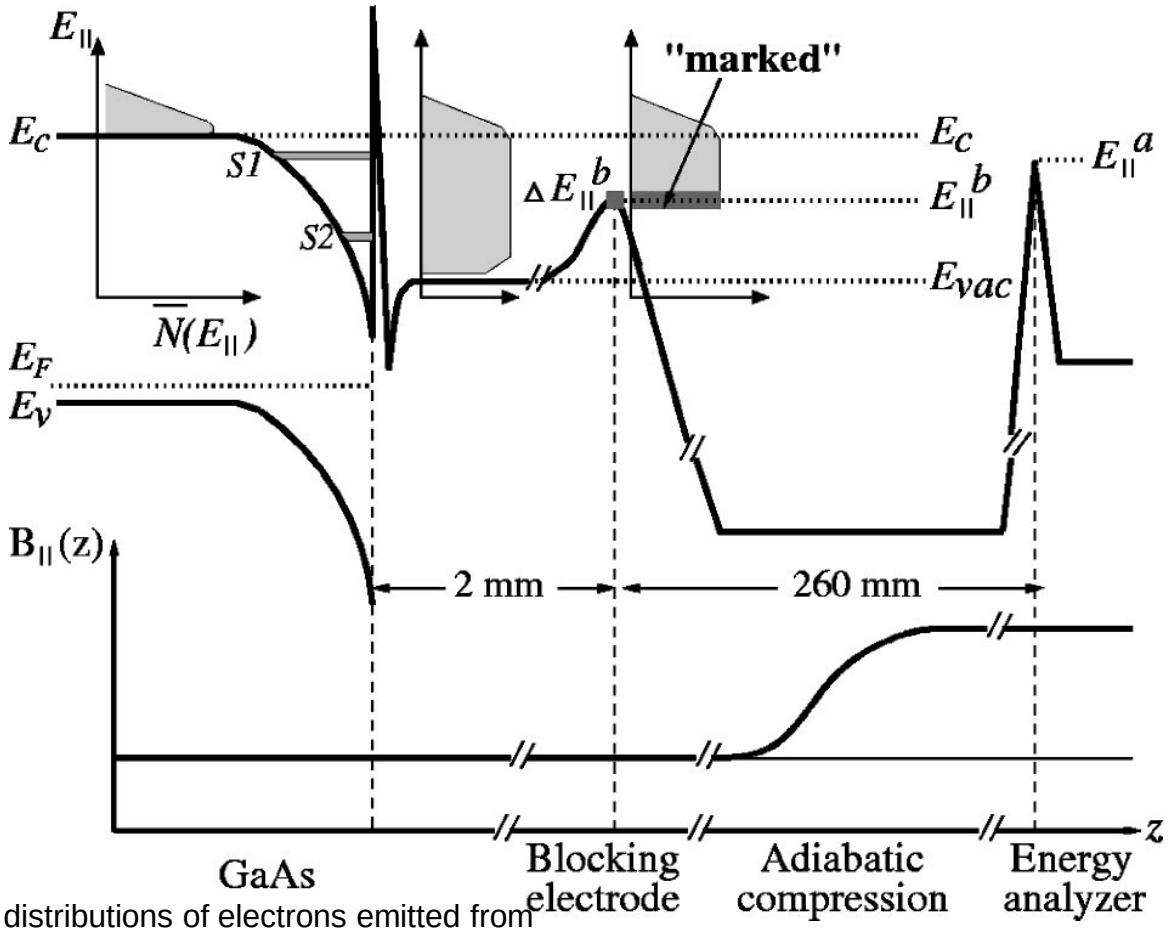
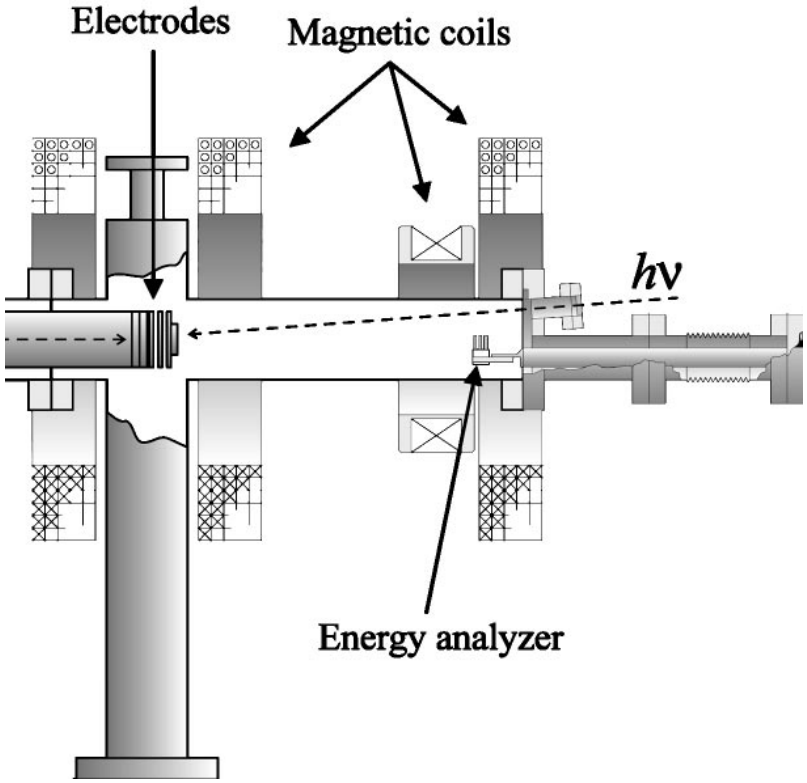



Orlov, D. A. *et al.* Energy distributions of electrons emitted from GaAs(Cs, O). *Applied Physics Letters* **78**, 2721 (2001).

# EMITTANCE MEASUREMENTS

Magnetic mirror based emittance meter:




Pastuszka, S. *et al.* Preparation and performance of transmission-mode GaAs photocathodes as sources for cold dc electron beams. *Journal of Applied Physics* **88**, 6788 (2000).