

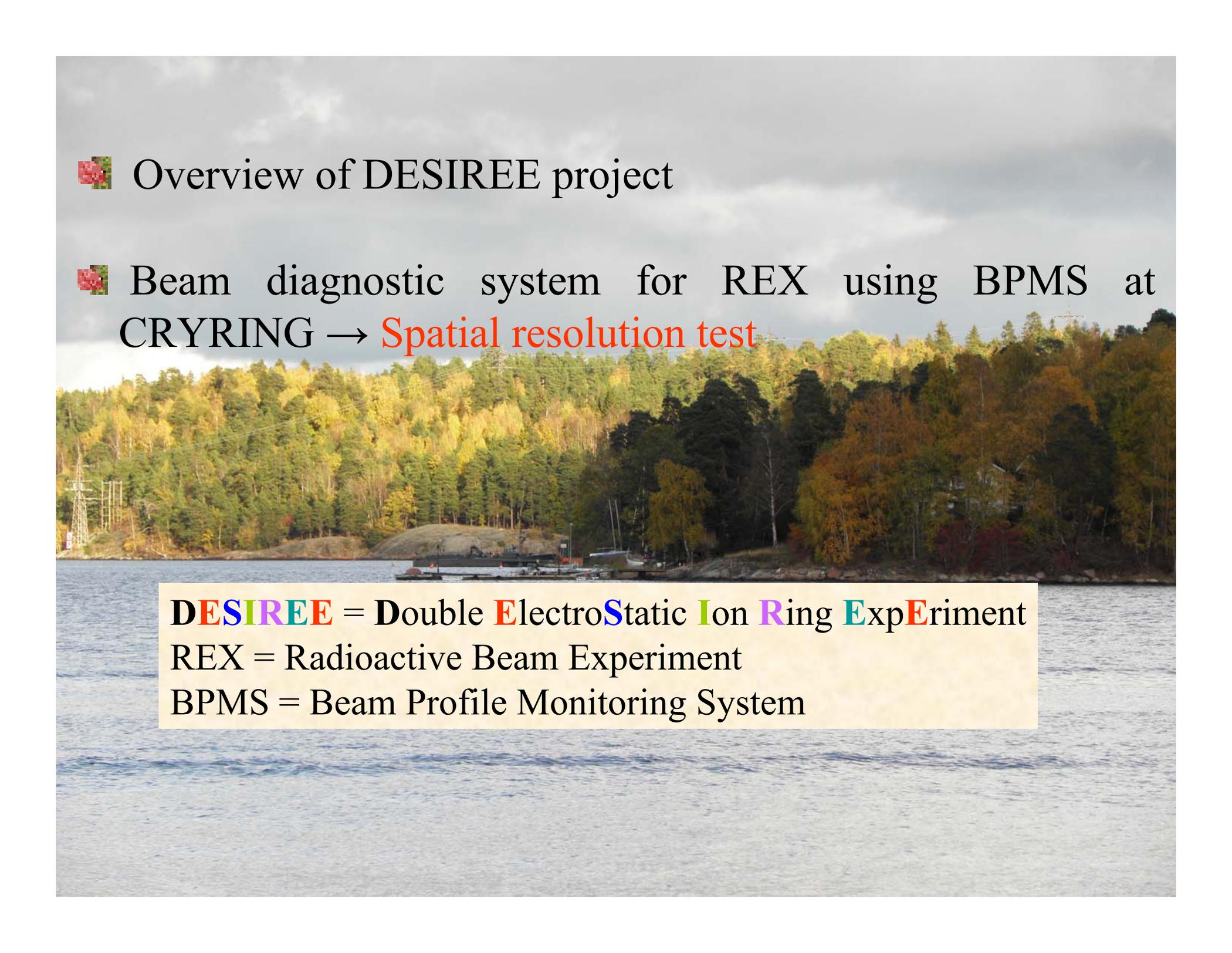


Workshop on Low Current, Low Energy Beam Diagnostics'  
November 23-25<sup>th</sup> 2009, Großsachsen, Germany

# Diagnostics for DESIREE

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Overview of DESIREE project

Beam diagnostic system for REX using BPMS at CRYRING → Spatial resolution test

**DESIREE** = Double **E**lectro**S**tatic **I**on **R**ing **ExpE**riment

REX = Radioactive Beam Experiment

BPMS = Beam Profile Monitoring System

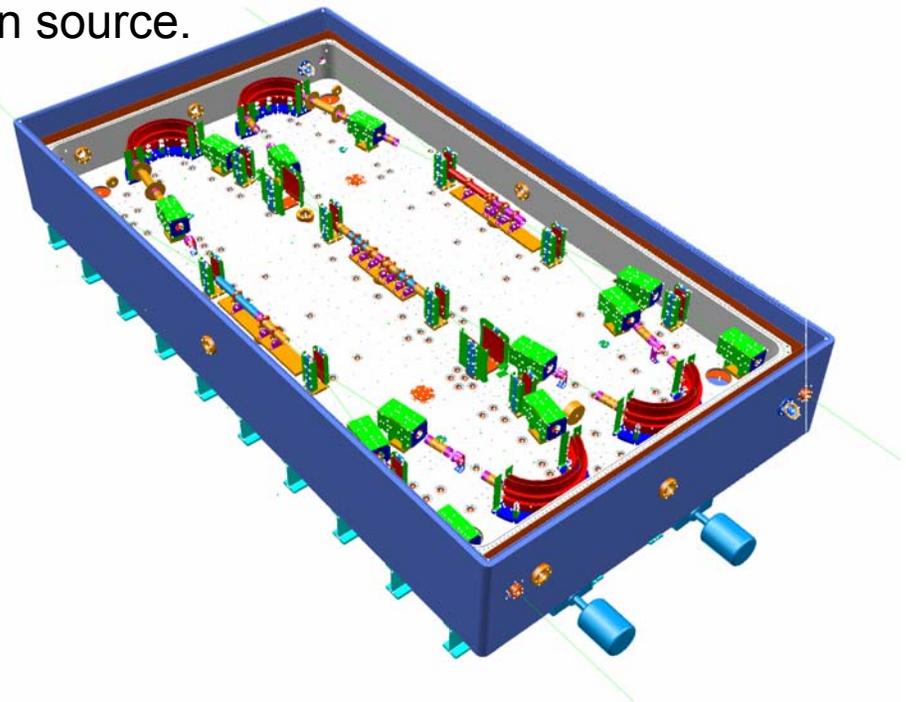
## Overview of Double ElectroStatic Ion Ring ExpEriment (DESIREE)



- Two Rings – same circumference ( $\sim 9$  m) & common straight section ( $\sim 1$  m) for merged beam experiments with ions of opposite charges.
- Ring 1: Lighter ions, Ring 2: Heavier ions

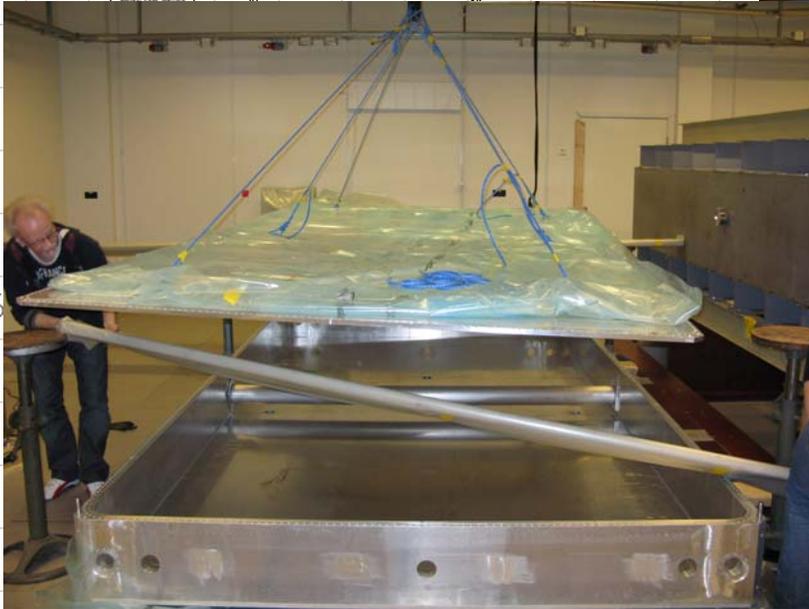
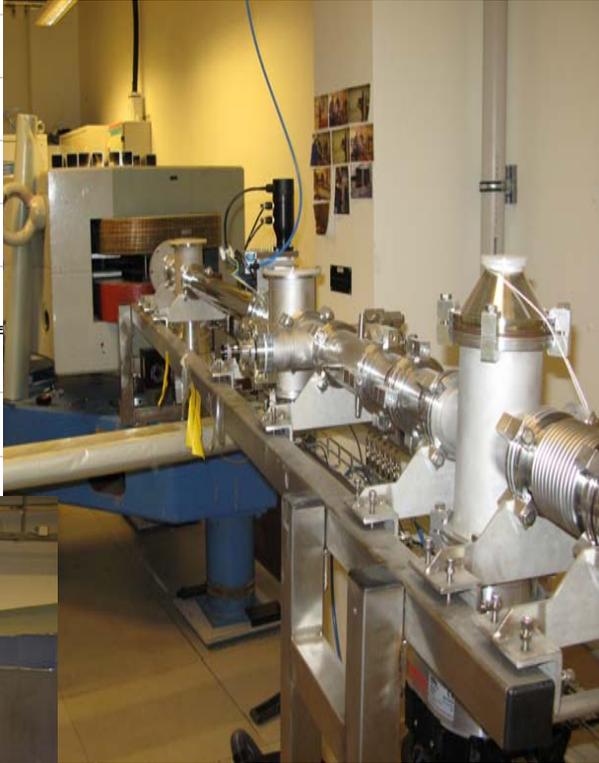
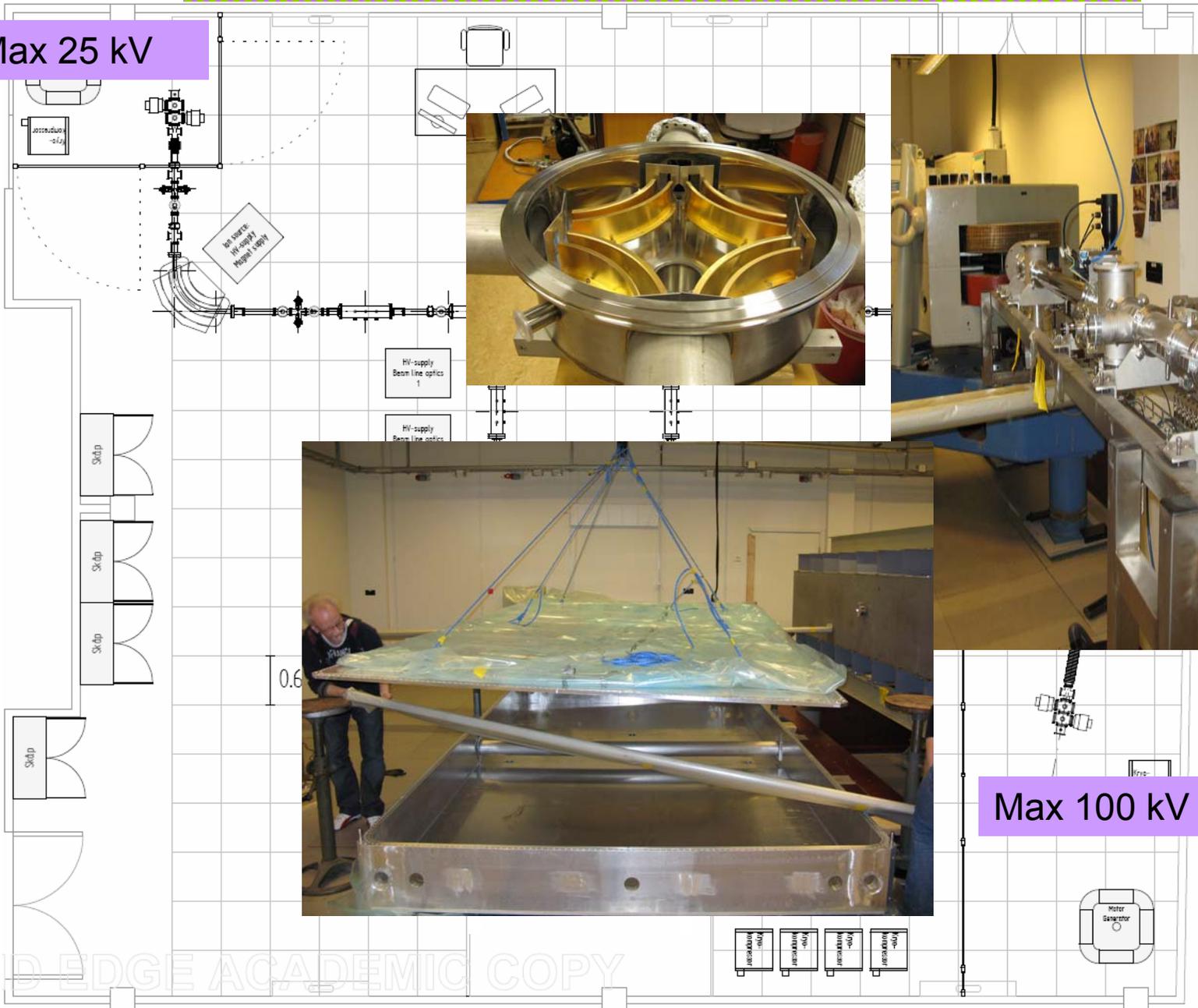
# Overview of Double ElectroStatic Ion Ring ExpEriment (DESIREE)

- Operated at both □ room temperature → is bakable at 150°C  
□ cryogenic temperature (~ 10-20 K)
- Vacuum chambers § inner vacuum chamber » aluminium  
§ outer vacuum chamber » iron
- Vacuum ~ 10<sup>-14</sup> mbar → very long storage times.
- Two injectors  
→ 25 kV for lighter ions and 100 kV for heavier ions  
→ analyzing magnet and different kinds of ion source.
- Dimensions: # outer ~ 5×3×1 m<sup>3</sup>  
# inner ~ 4.4×2.4×0.3 m<sup>3</sup>



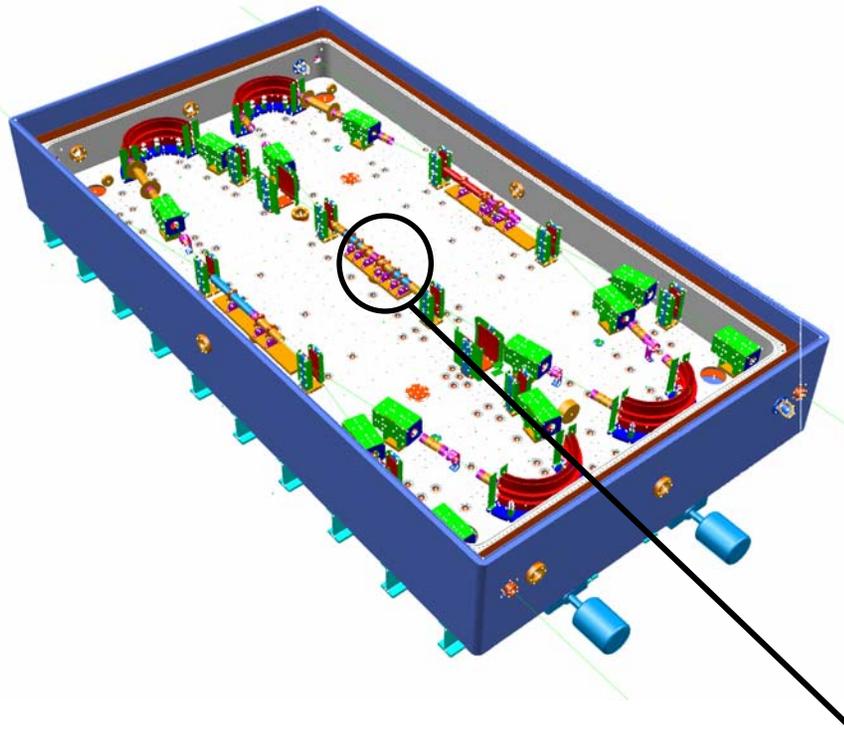
# Overview of DESIREE → DESIREE in its laboratory

Max 25 kV



Max 100 kV

# Overview of Double ElectroStatic Ion Ring ExpEriment (DESIREE)



## Diagnostics, basic

- Electrostatic pickups
- Zero degree detectors
- Faraday cups
- Scrapers in the overlap section
- Detectors for neutral particles and charged reaction products

Optimizing and measuring the overlap between the two beams is particularly challenging

# Overview of Double ElectroStatic Ion Ring ExpEriment (DESIREE)

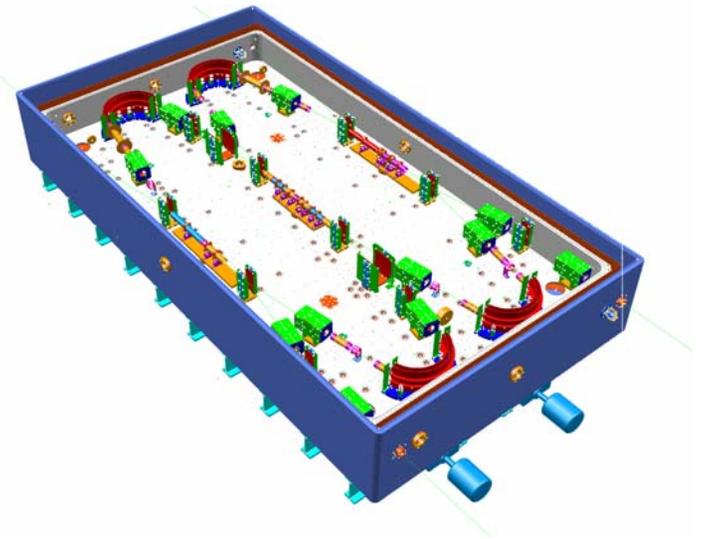
Experiments can be performed at DESIREE:

## Single-Ring Experiments

- Lifetime measurements of metastable ions
- Laser spectroscopy of atomic and molecular ions
- Biomolecules.

## Merged-Beams Experiments

- ◆ Mutual neutralization in fundamental systems
- ◆ Mutual neutralization in astrophysical plasmas
- ◆ Fullerenes
- ◆ Biomolecules



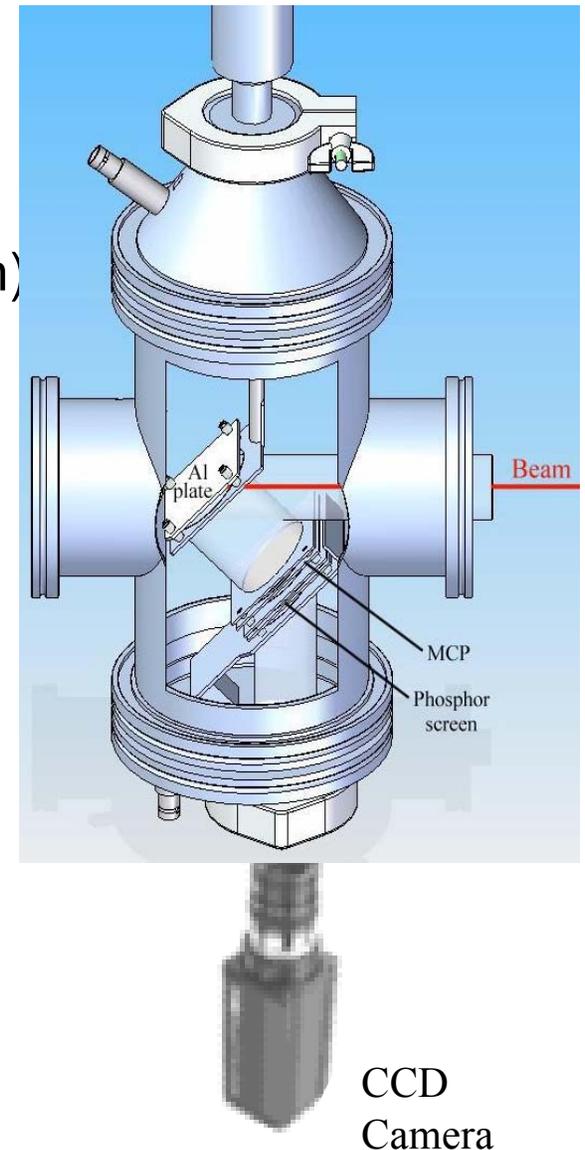
# Beam diagnostic system for REX using BPMS at CRYRING

## Spatial resolution test

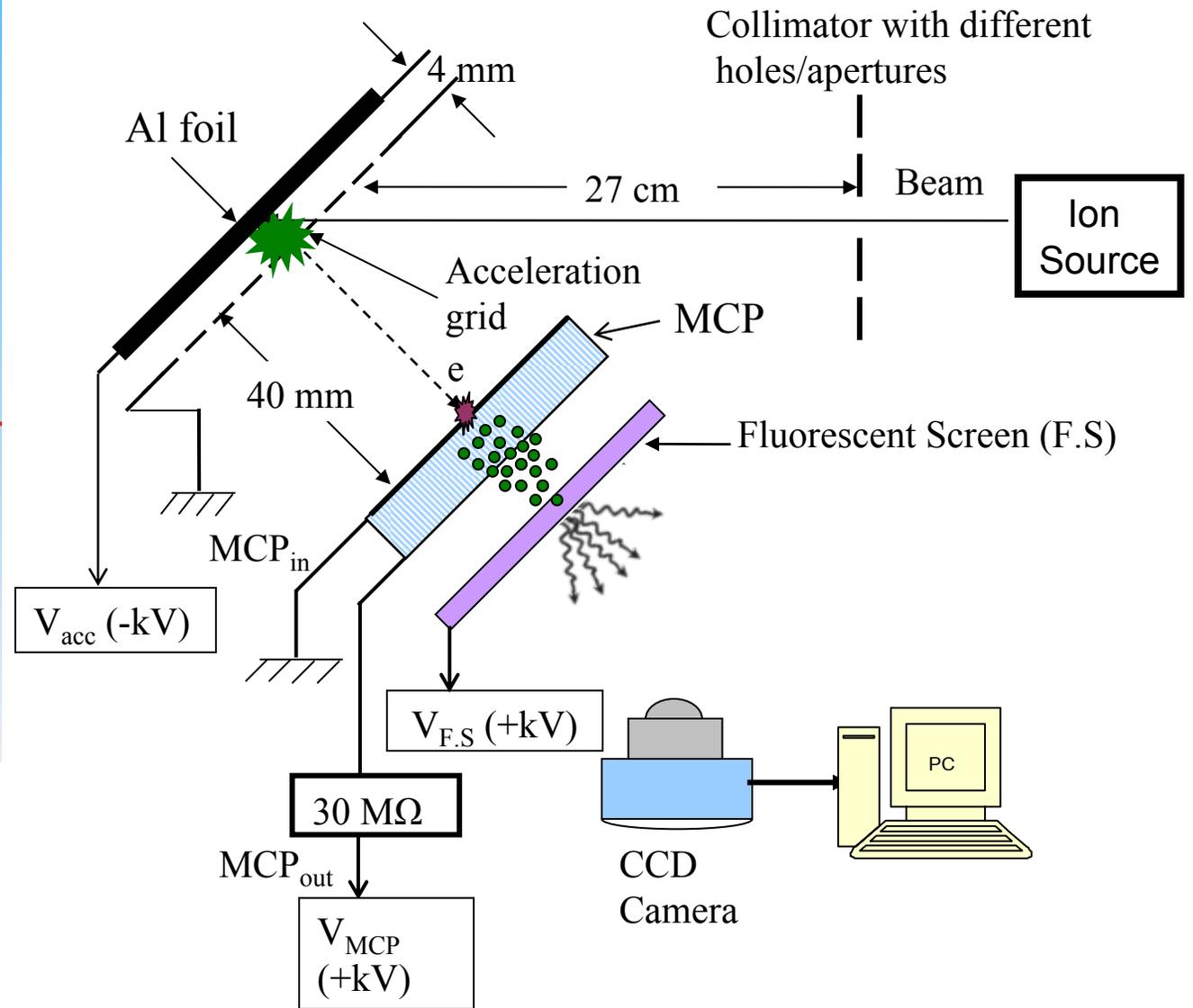
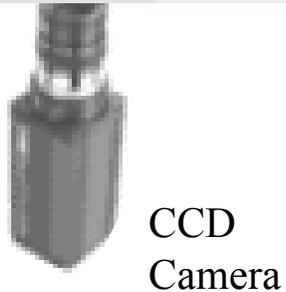
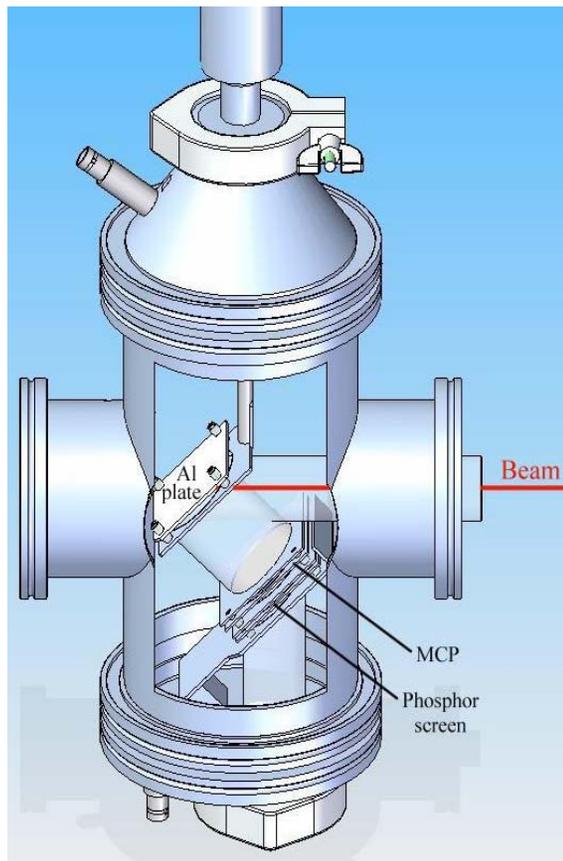
- Faraday Cup (FC) to measure the beam,
- Collimator with circular apertures of different sizes (for spatial resolution measurements of the system)
- Beam Profile Monitoring System (BPMS)

- Aluminium plate
- Grid
- Micro Channel Plate (MCP)
- Fluorescent screen
- CCD Camera
- Control unit (PC)

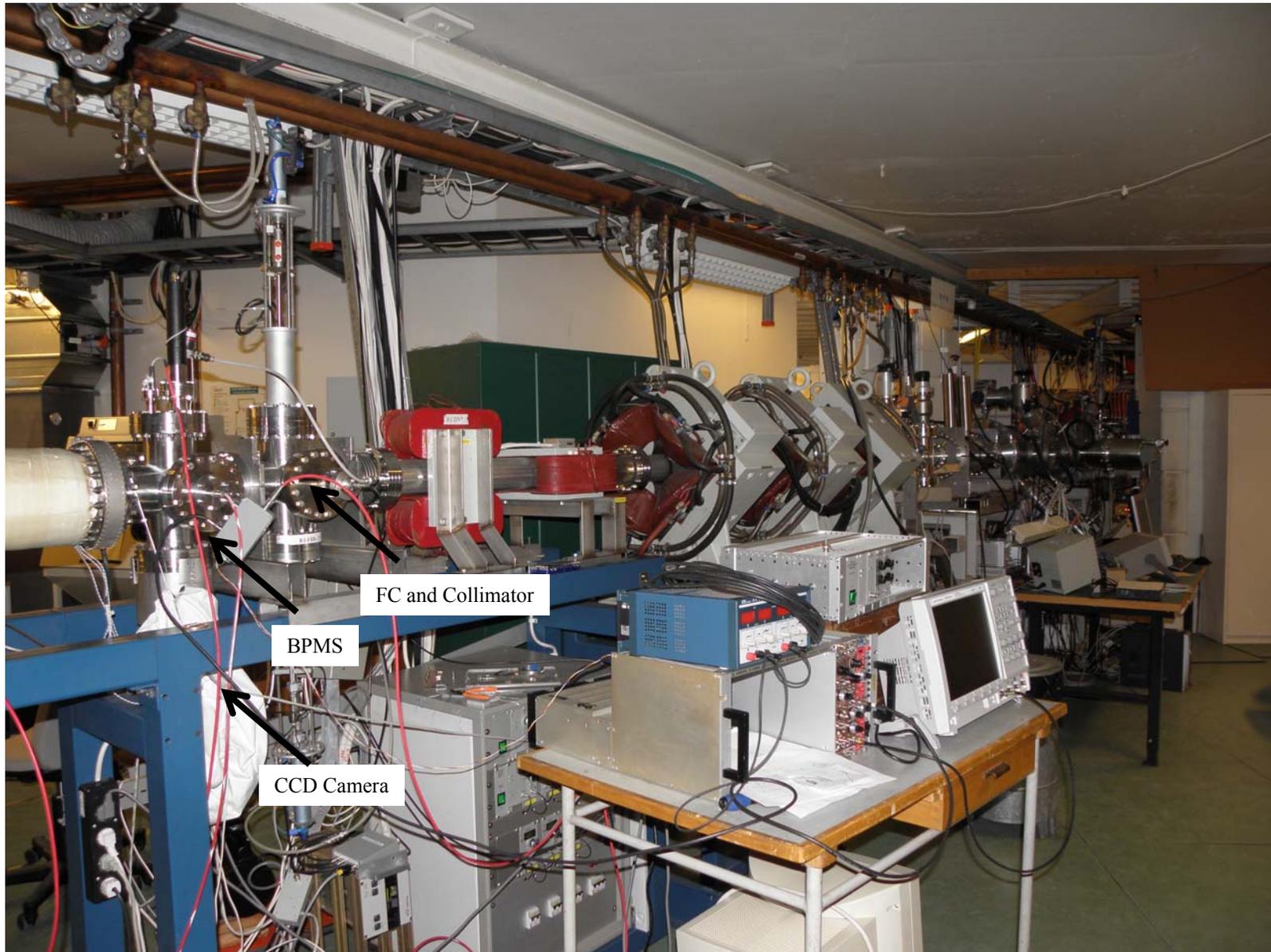
10 keV Proton beam used



# Schematic diagram of the beam diagnostic set-up



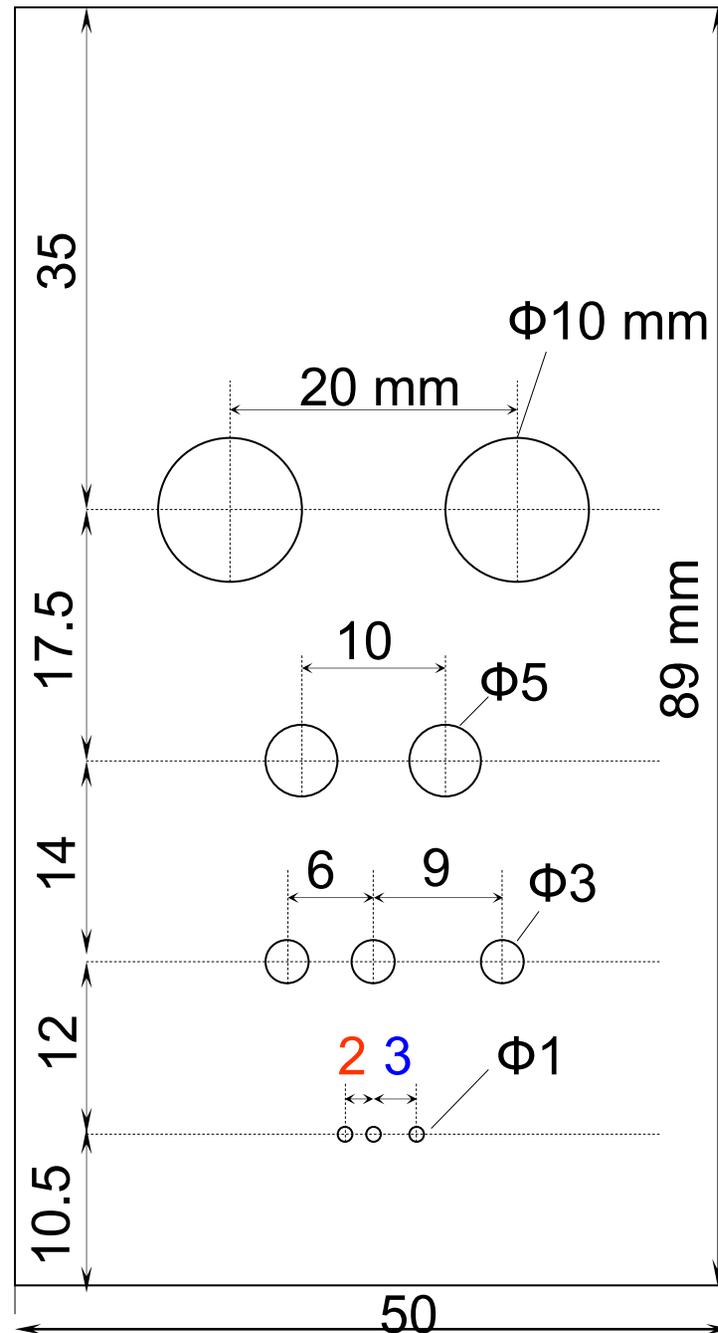
# Beam diagnostic set-up



Collimator with circular apertures of different sizes for spatial resolution measurement of the system

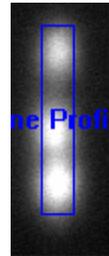
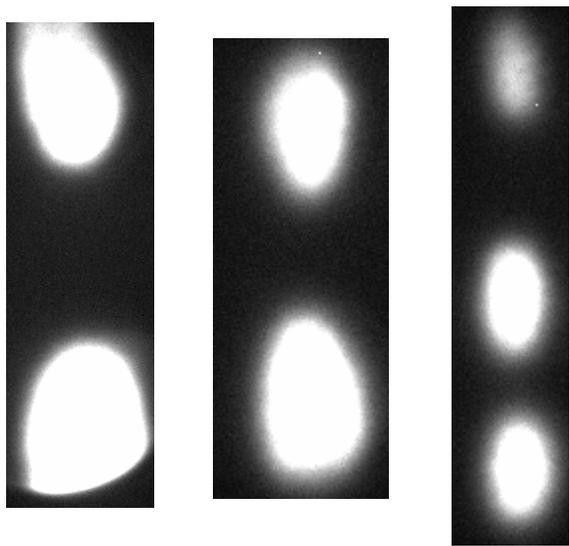
cuts out area equal to the circular holes from the beam  
→ well separated narrow beams of approximately same intensity

$\Phi$  = diameter of the hole/circular aperture

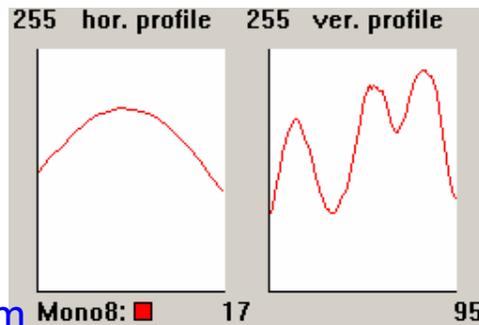


# Spatial resolution test / Results and discussion

Aluminium (Al) foil voltage,  $V_{acc}$  (-kV)  
MCP ( $V_{MCP}$ ),  $V_{F.S}$  → kept fixed

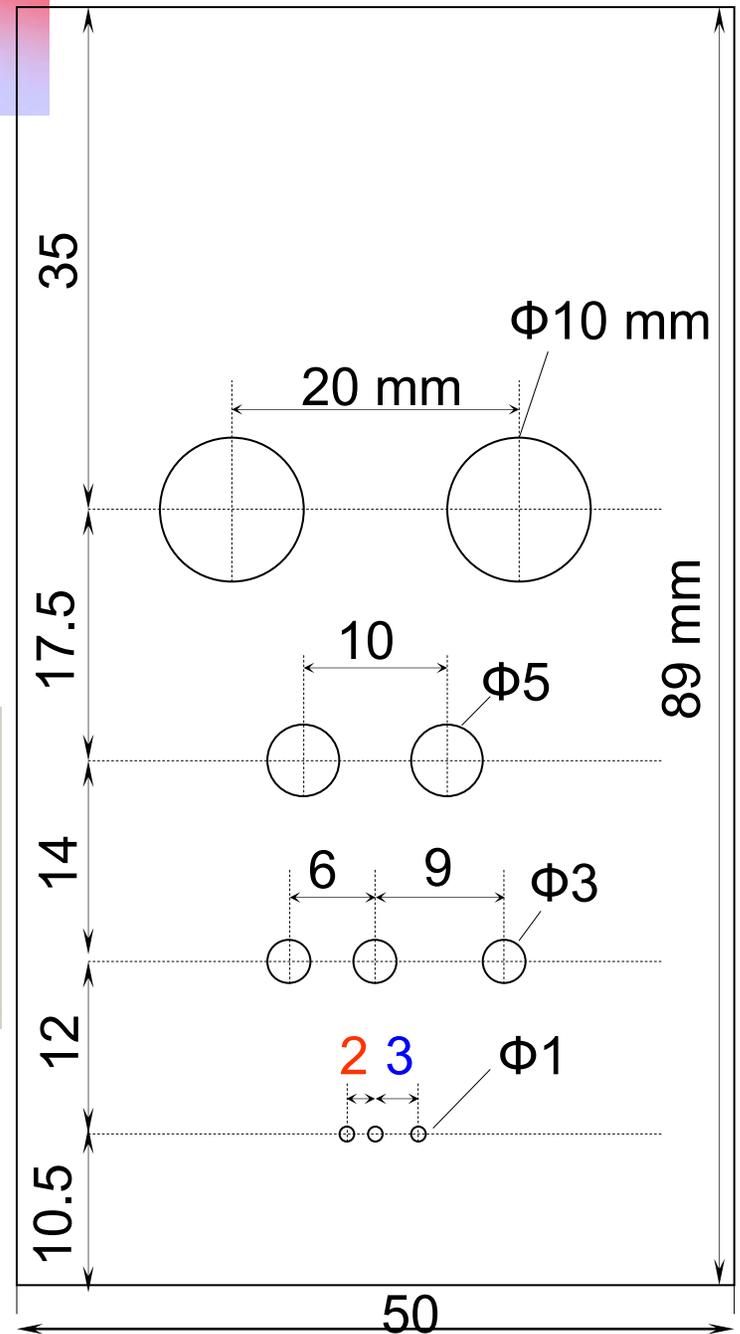


$\Phi = 1$  mm;  
 $d = 2$  and  $3$  mm



$\Phi = 10$  mm,  $\Phi = 5$  mm,  $\Phi = 3$  mm  
 $d = 20$  mm  $d = 10$  mm  $d = 6$  and  
 $9$  mm

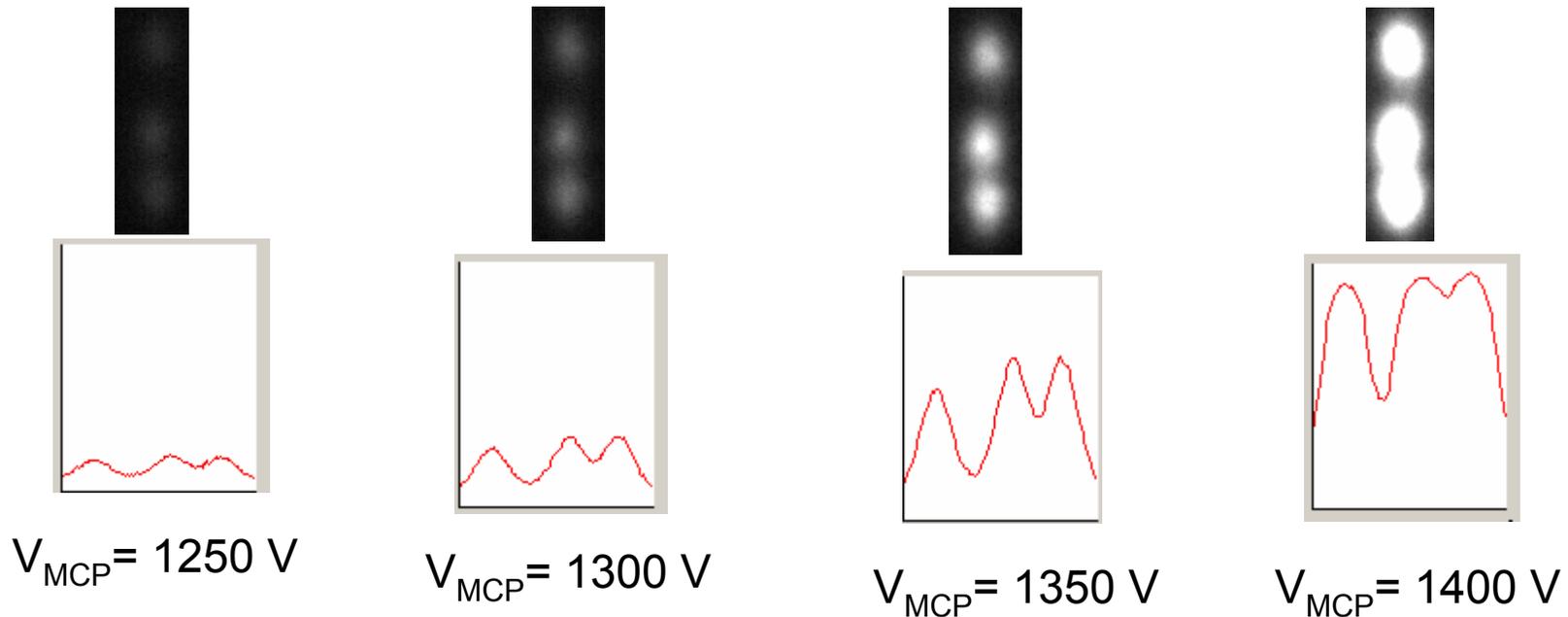
$d$  = center-center separation



## Spatial resolution test / Results and discussion

Aluminium (Al) foil voltage,  $V_{acc} \sim -5\text{kV} \rightarrow$  kept fixed  
MCP ( $V_{MCP}$ ),  $V_{F.S} \rightarrow$  Varied

$\Phi = 1\text{ mm};$   
 $d = 2\text{ and }3\text{ mm}$



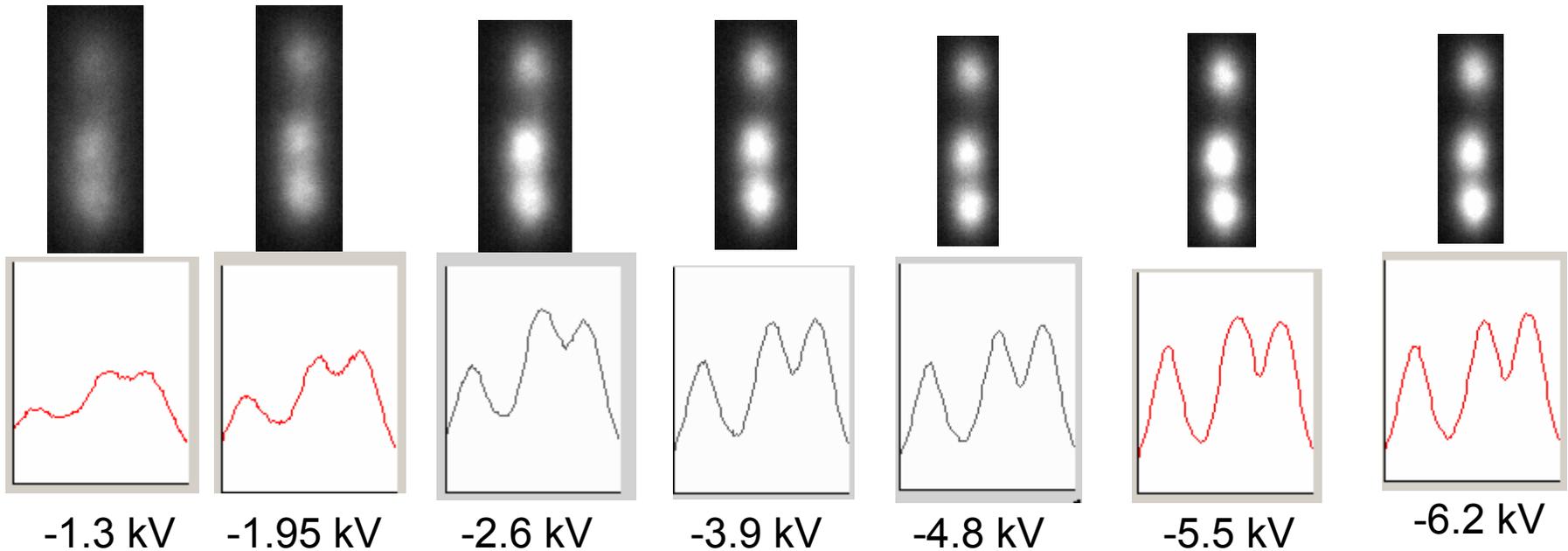
Images of the proton beam passed through the 1 mm collimator as function of  $V_{MCP}$ . The beam profiles are also shown.

✿ System distinguishes two beams at distance of 2 mm  $\rightarrow$  Resolution is better than 2 mm

## Spatial resolution test / Results and discussion

Aluminium (Al) foil voltage,  $V_{\text{acc}} \rightarrow$  Varied  
 $V_{\text{MCP}}/V_{\text{F.S}} \sim 1370/4000 \text{ V} \rightarrow$  Kept Fixed

$\Phi = 1 \text{ mm};$   
 $d = 2 \text{ and } 3 \text{ mm}$

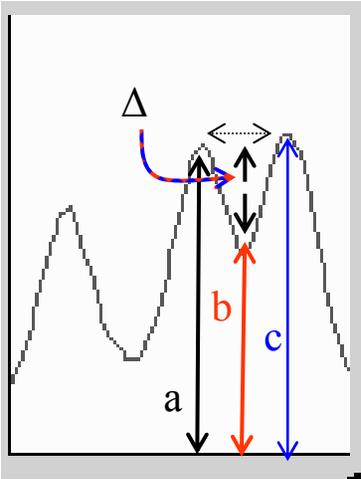


Images of the proton beam passed through the 1 mm collimator as function of  $V_{\text{acc}}$ . The beam profiles are also shown.

System distinguishes two beams at distance of 2 mm  $\rightarrow$  Resolution is better than 2 mm

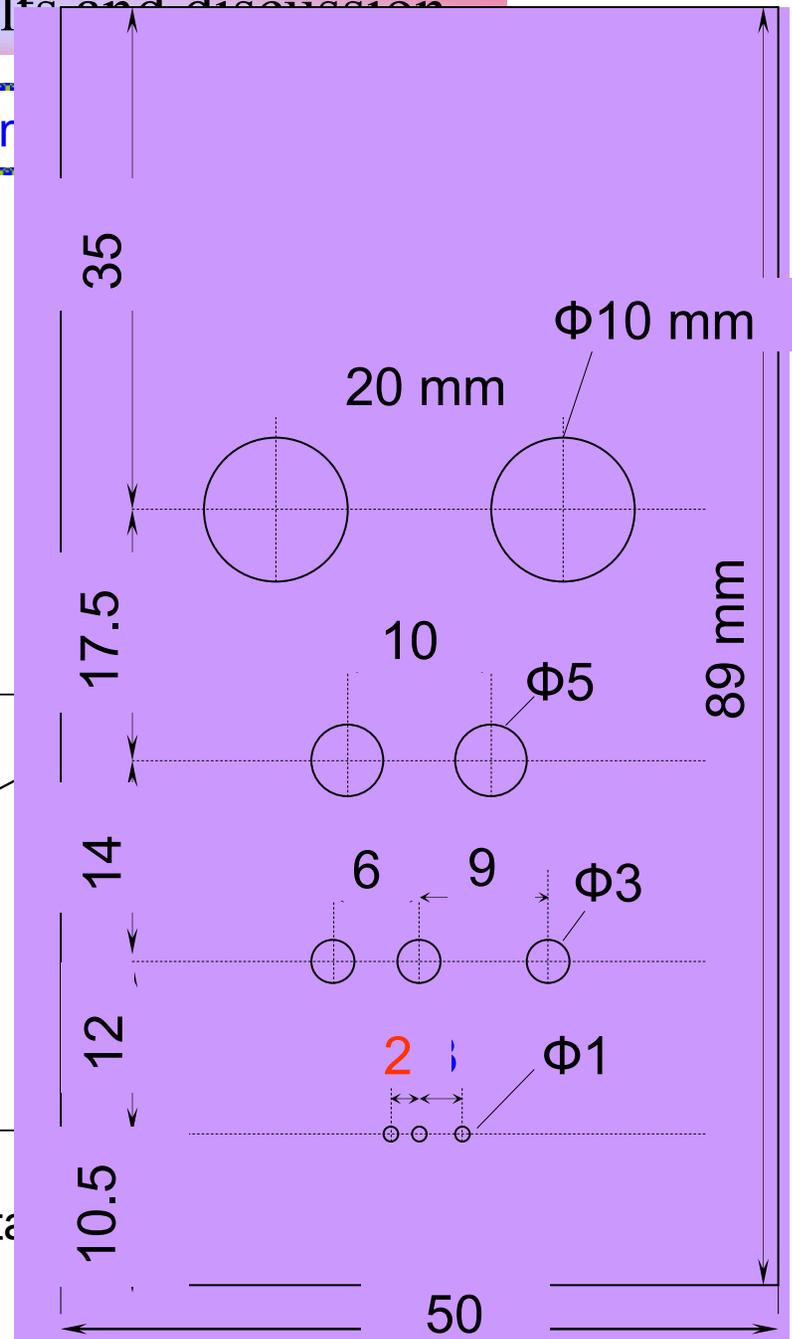
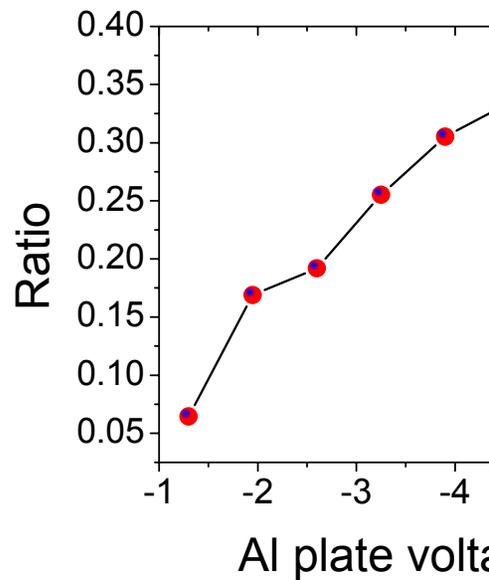
# Spatial resolution test / Results and discussion

## Change of resolution as a function



$$\Delta = (a+c)/2 - b.$$

$$\text{Ratio} = \Delta / [(a+c)/2]$$



## Conclusions

- ➡ Outline of the DESIREE project described.
- ➡ Beam diagnostic set-up using BPMS studied » resolution up to 2 mm achieved.

## References

DESIREE: 1. Proceeding of the EPAC 2004/2006, Lucerne, Switzerland/ Edinburgh, Scotland, 2. The DESIREE project at MSL ([www.msl.se](http://www.msl.se)), 3. NIM A **394** (1997), 281  
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## Acknowledgement

- ◀ Conference committee.
- ◀ DITANET/Marie Curie Fellowship



# Thank You

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