

# NEW X-RAYS DIAGNOSTICS AT ESRF: THE X-BPMs AND THE HALO MONITOR

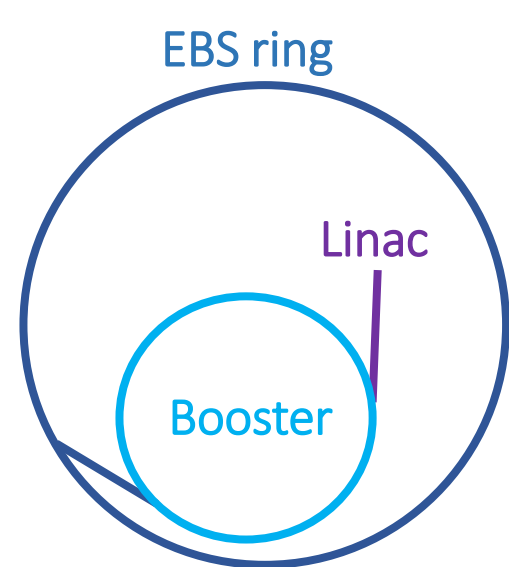
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## The ESRF complex

EBS parameters in **User-mode**:

- Circumference = 844 m
- Beam energy = 6 GeV
- Beam current = 200 mA
- Typical lifetime = 20h



**At injection:**

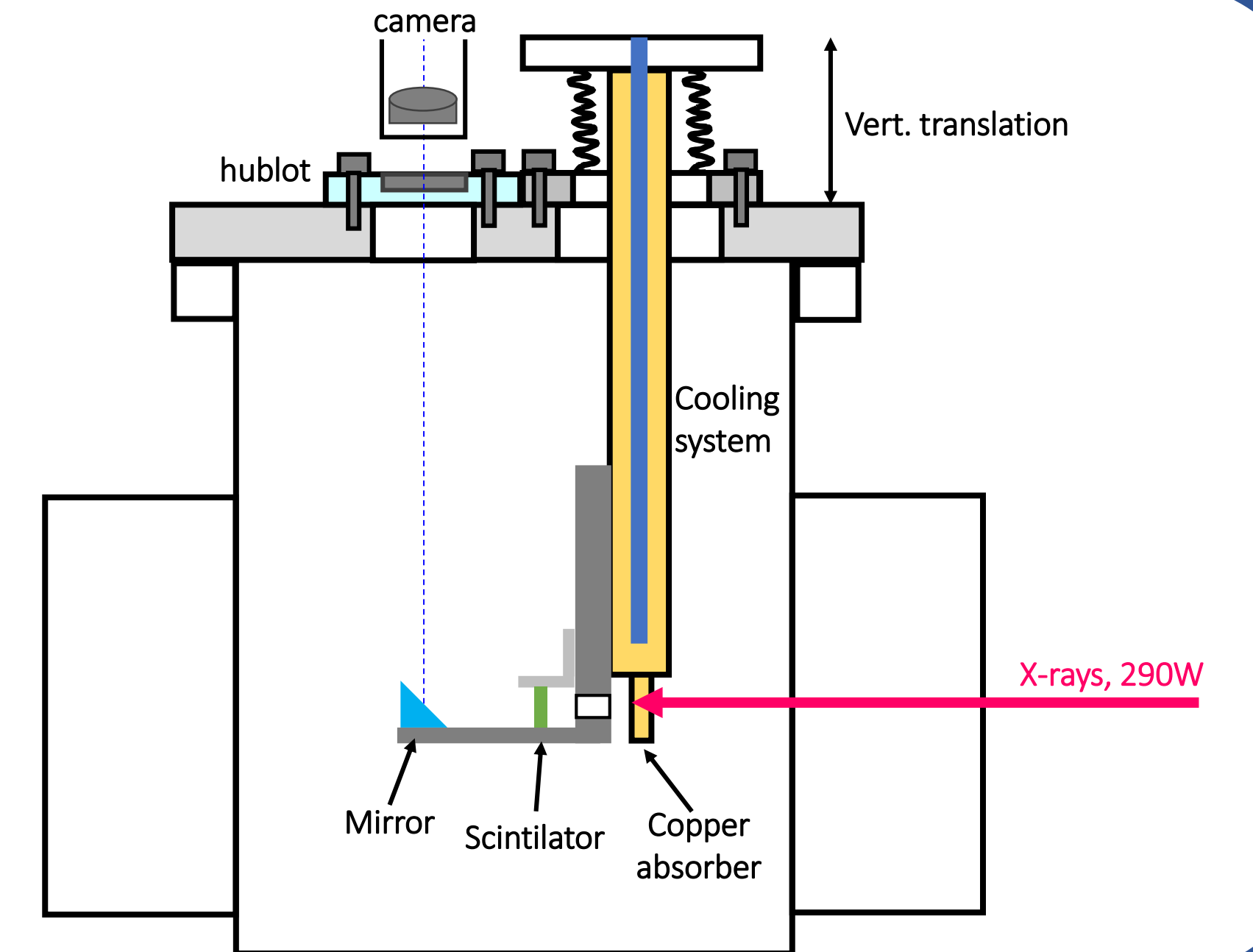
- 0.5 mA/shot
- 70% injection efficiency

## The X-rays Beam Position Monitors (X-BPMs)

Two optical X-BPMs installed in Front End of BM8 and BM16:

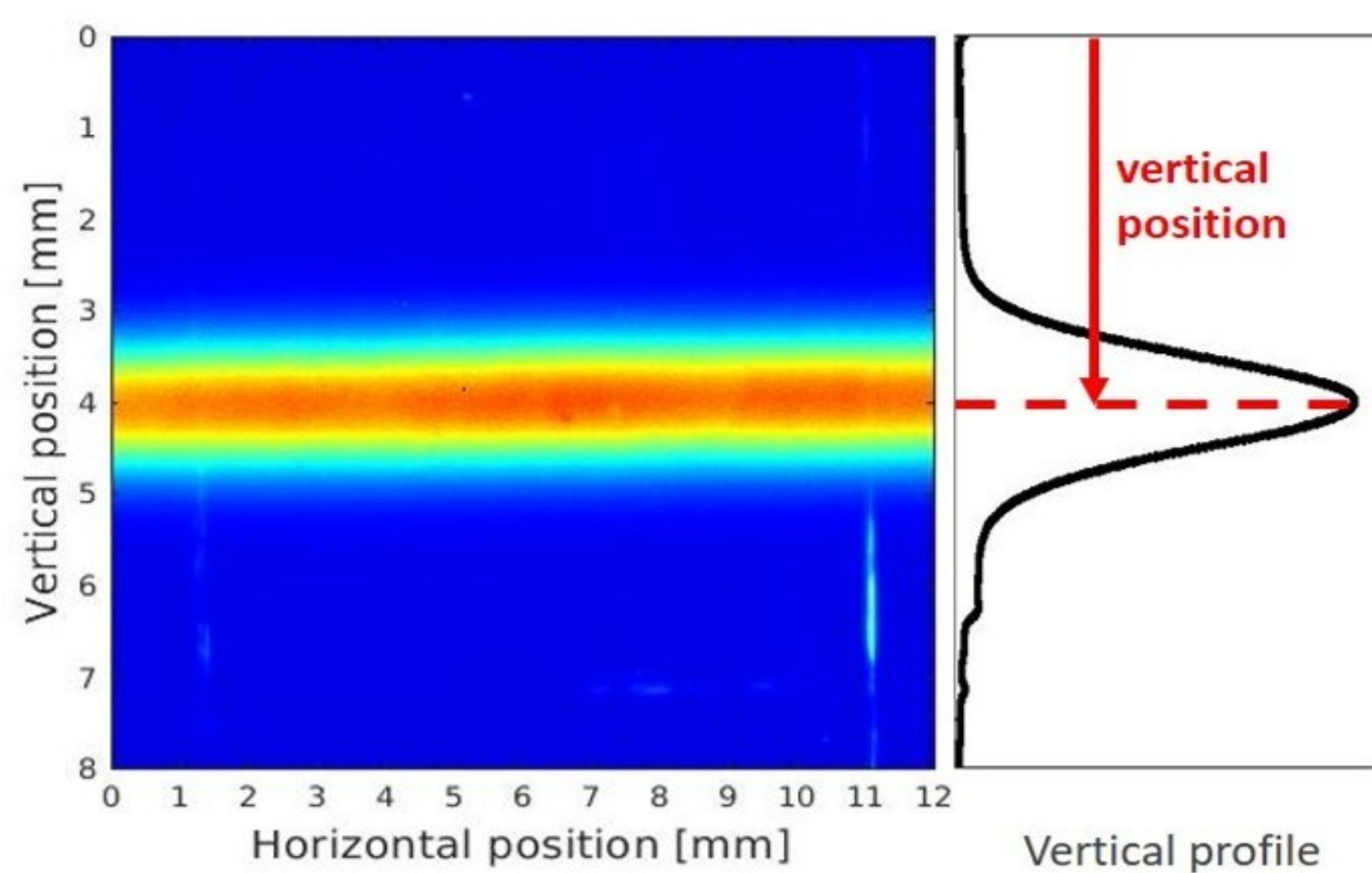
- A **source** (SBM) of 0.875 T;
- A in-vacuum **copper absorber**, in order to stop the majority of the X-ray power;
- The **optical X-BPM** installed 23 m from the source:
  - A **LYSO scintillator** (15\*15\*1.5 mm),
  - a 45-degrees **mirror**,
  - a **camera & optics**.

for **beam stability measurements in mid-long term (hours, days, weeks)**



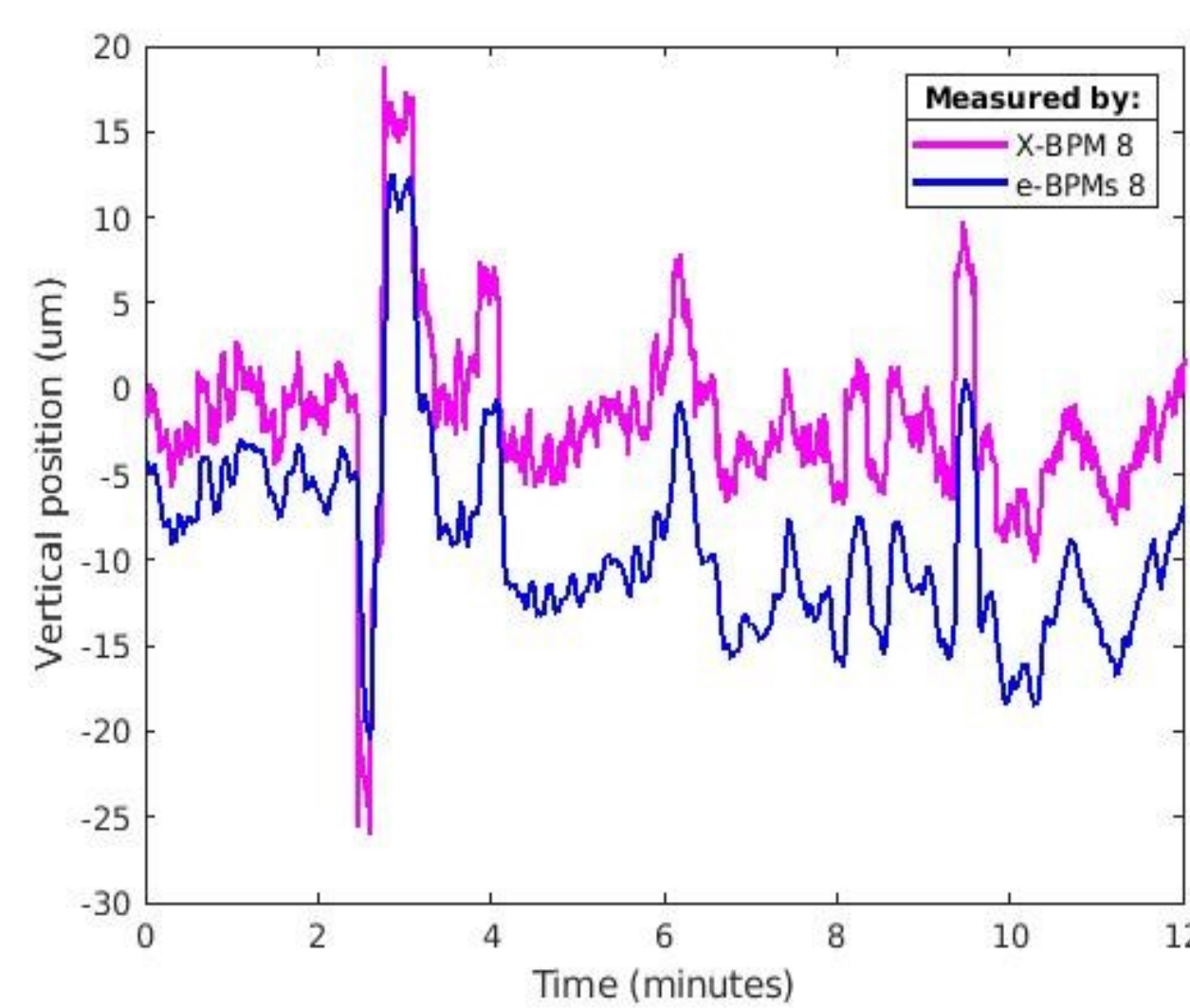
## X-rays detected (BM8)

200 mA beam

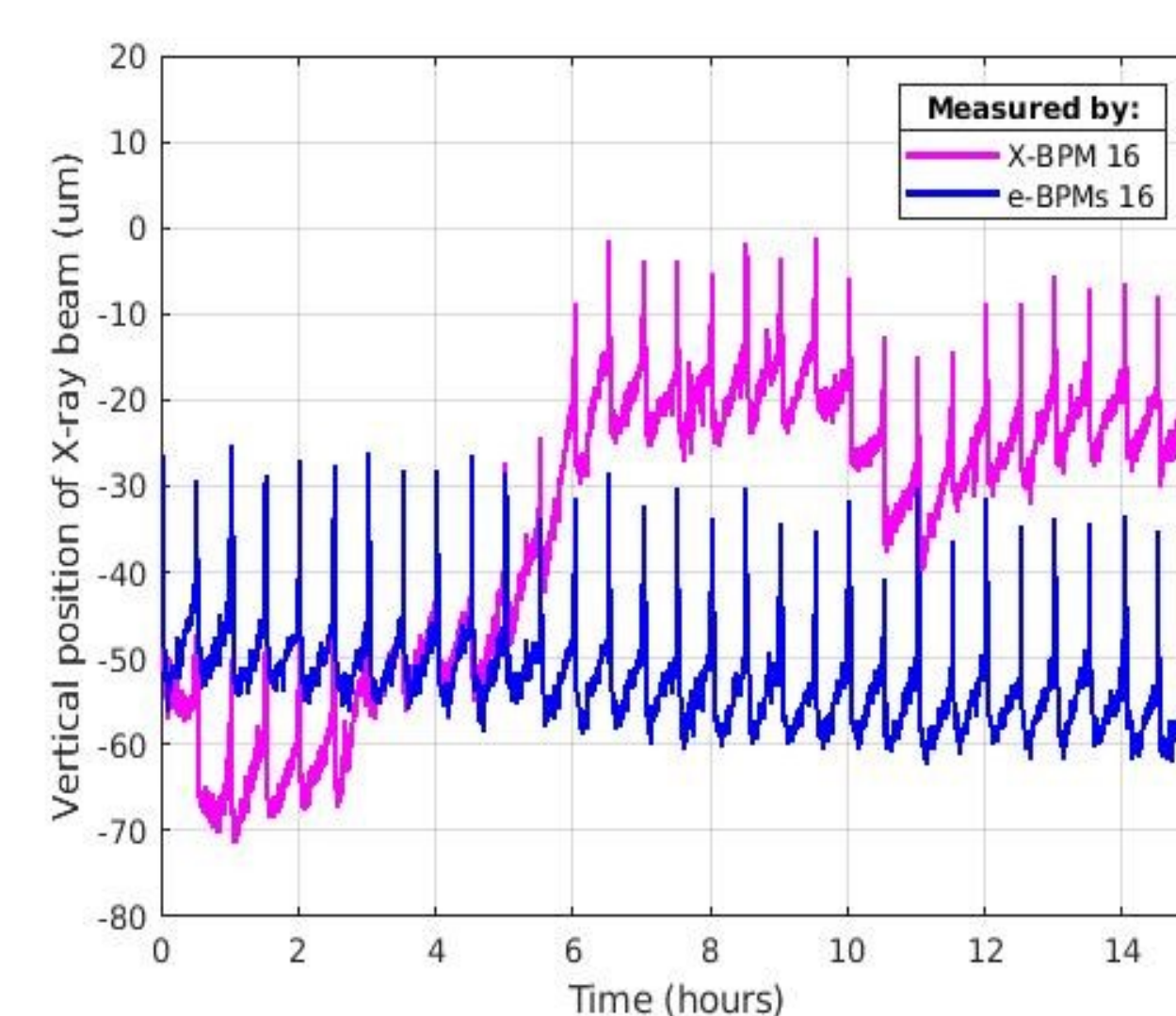


## X-BPMs vs electron-BPMs

**Short term:**  
excellent agreement!



**Longer term:**  
discrepancy (drift)

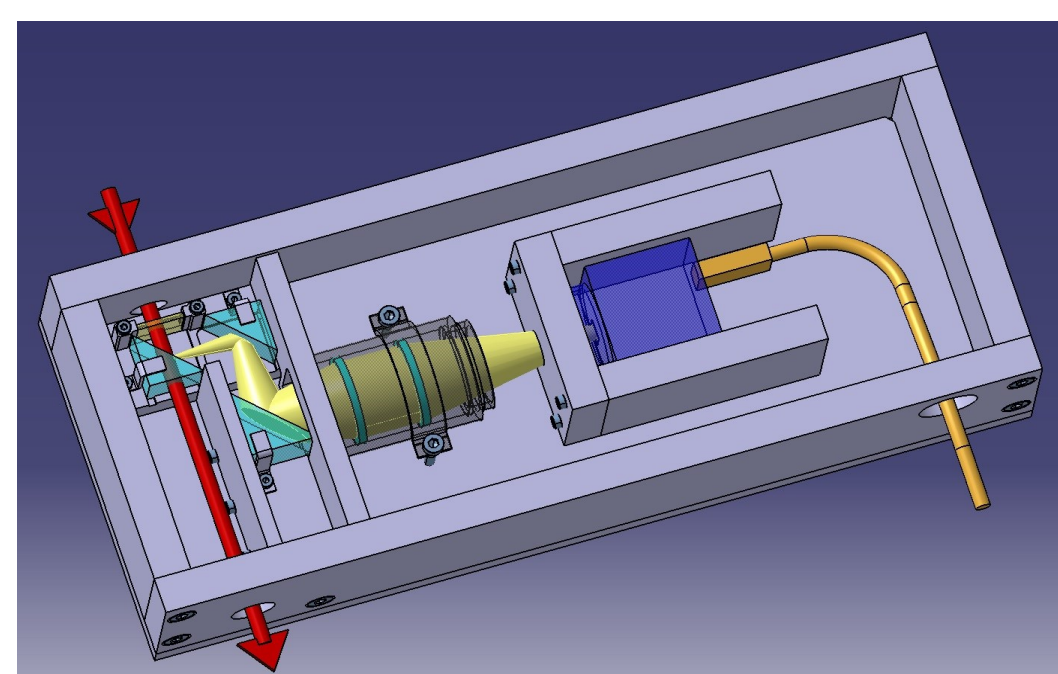


- The X-BPM variations are strongly correlated with the **temperature variation of the e-BPM Libera Spark controller**, that falsify the e-BPM readings.
- The Spark temperature change is seen as **beam movement** and, therefore, **corrected by the orbit control and feedback**, resulting in a constant X-ray position shown by the e-BPMs.
- We implemented a **temperature-controlled electric rack** in one cell. Soon all e-BPMs BMs will be equipped with ventilators.

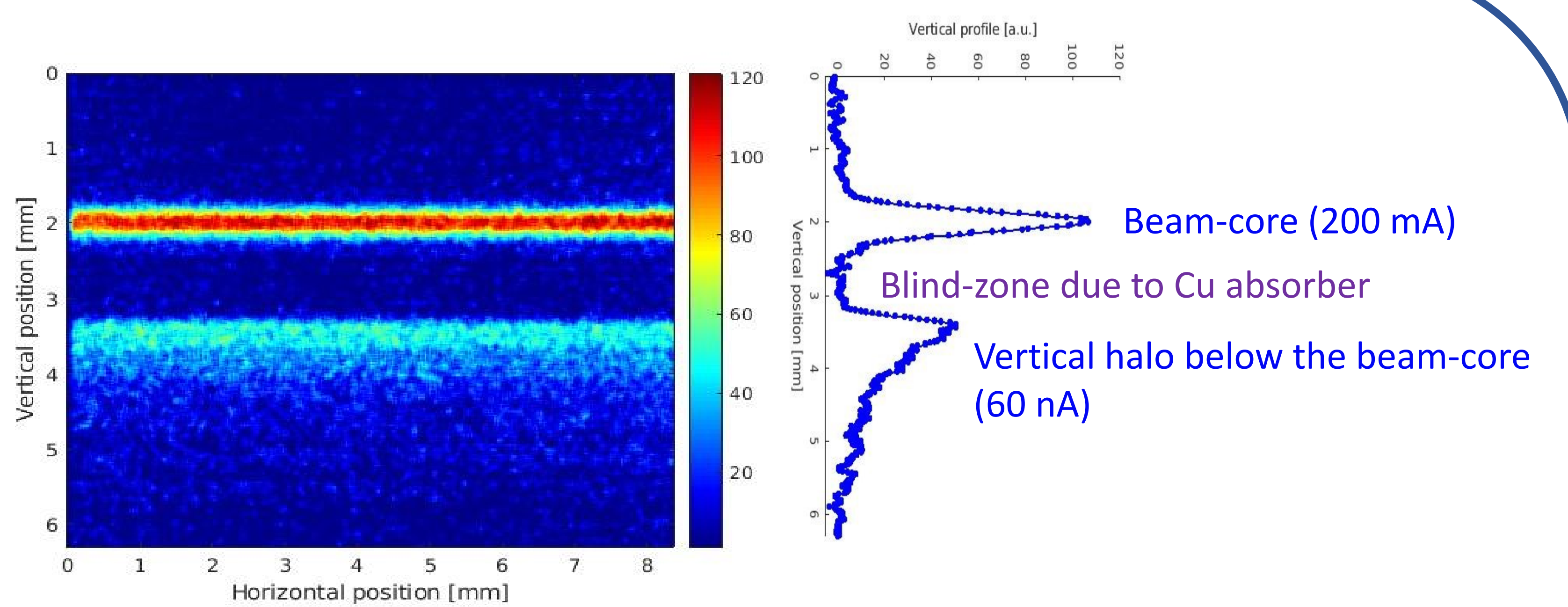
## The Halo Monitor

A **non-destructive vertical halo-monitor** in cell 10:

- A **dipole source** (DQ1D) of 0.57 T;
- A 30-mm in-vacuum **copper absorber**, to stop the beam core and its divergence (178  $\mu$ rad);
- A 1-mm in-air **tungsten attenuator** to optimize the relative intensity of the beam-core peak with respect to the halo-peak;
- The **optical halo-monitor**:
  - a 2-mm LYSO scintillator,
  - three **mirrors**,
  - **double achromat lenses**,
  - a **CMOS camera**.

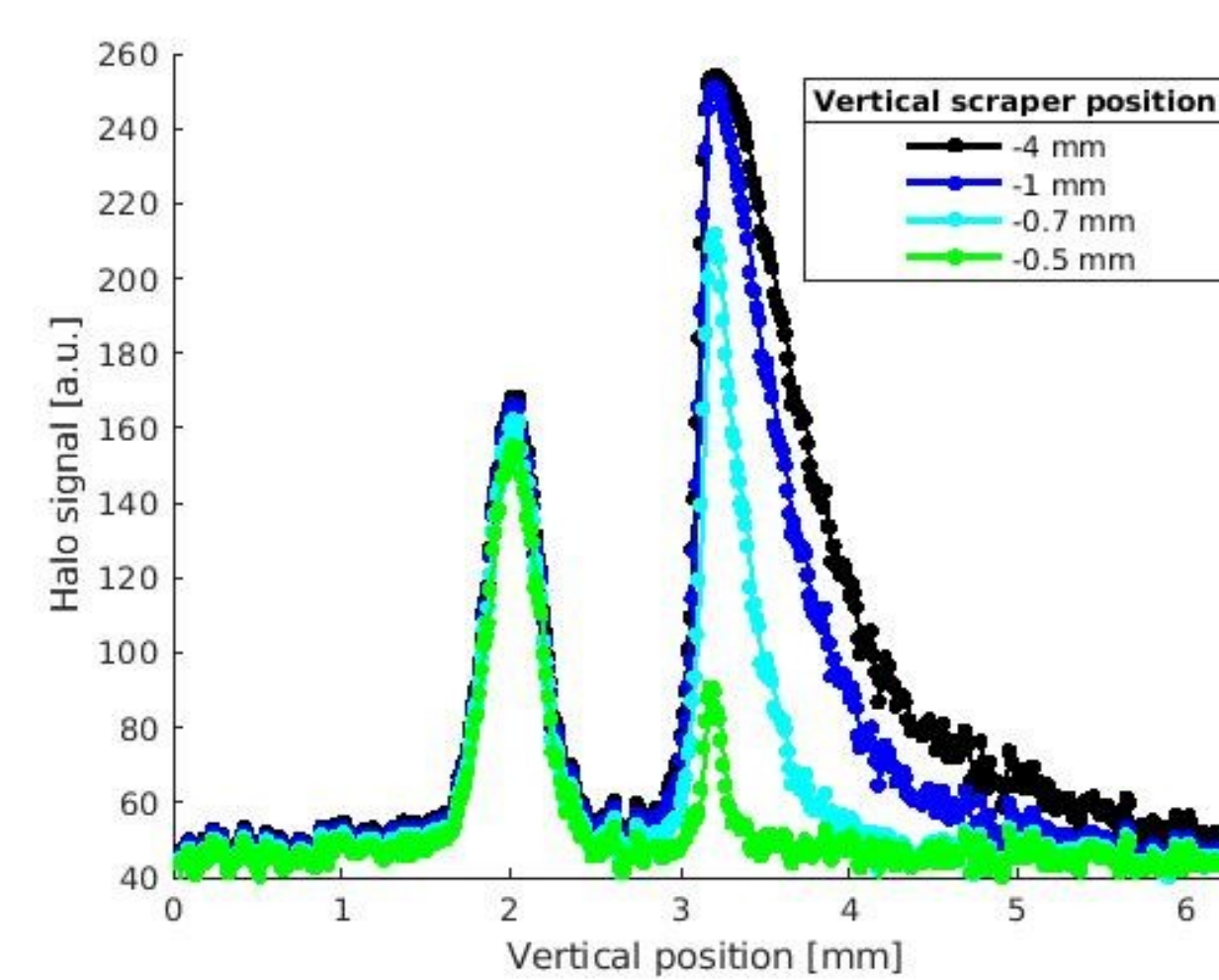


to **measure the electron density at large distance (1-3 mm) from the beam core, in a non-destructive manner.**



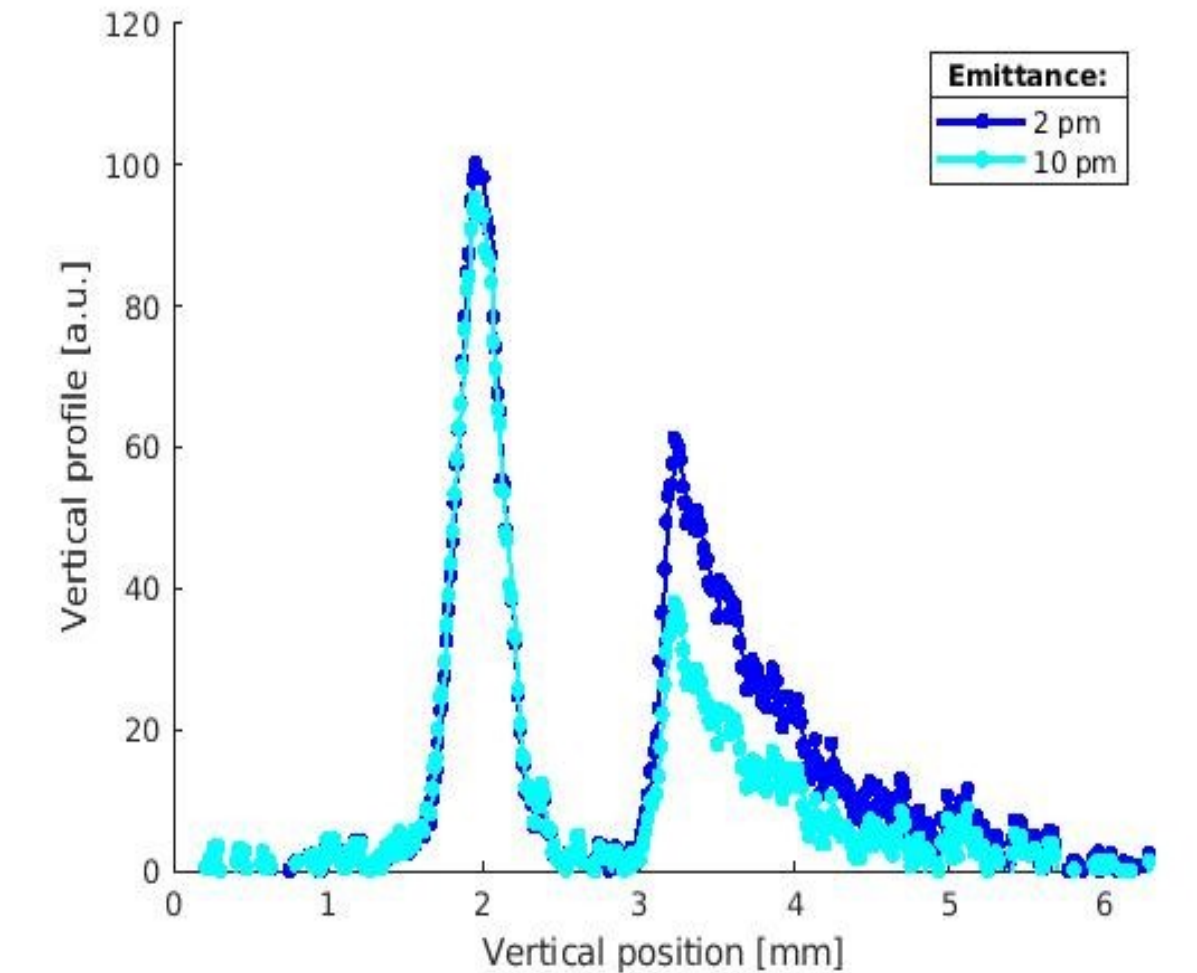
## Halo as a function of vertical scraper position

For smaller gap, we kill the electrons populating the halo



## Halo as a function of vertical emittance

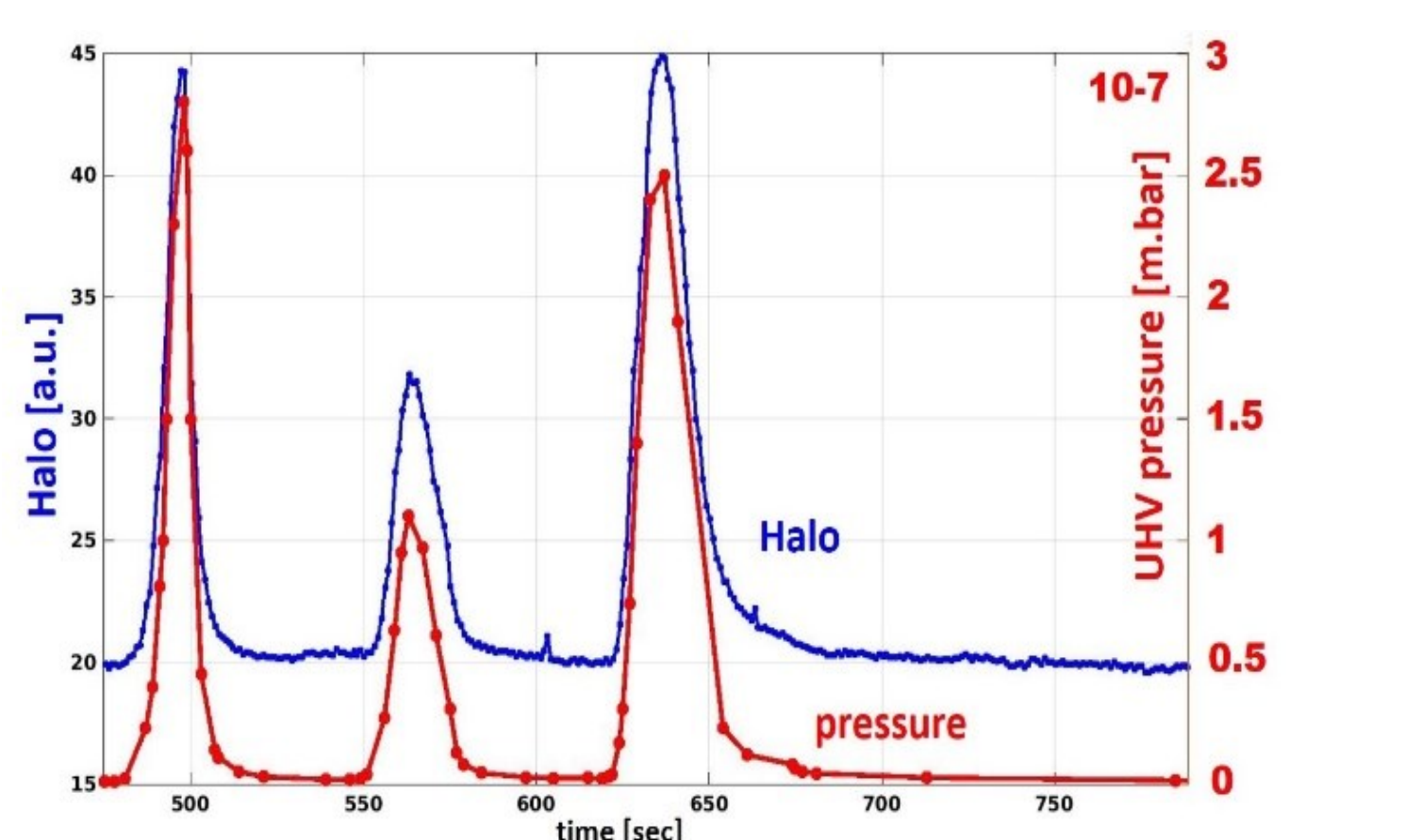
Smaller  $\epsilon$ , higher Touschek effect



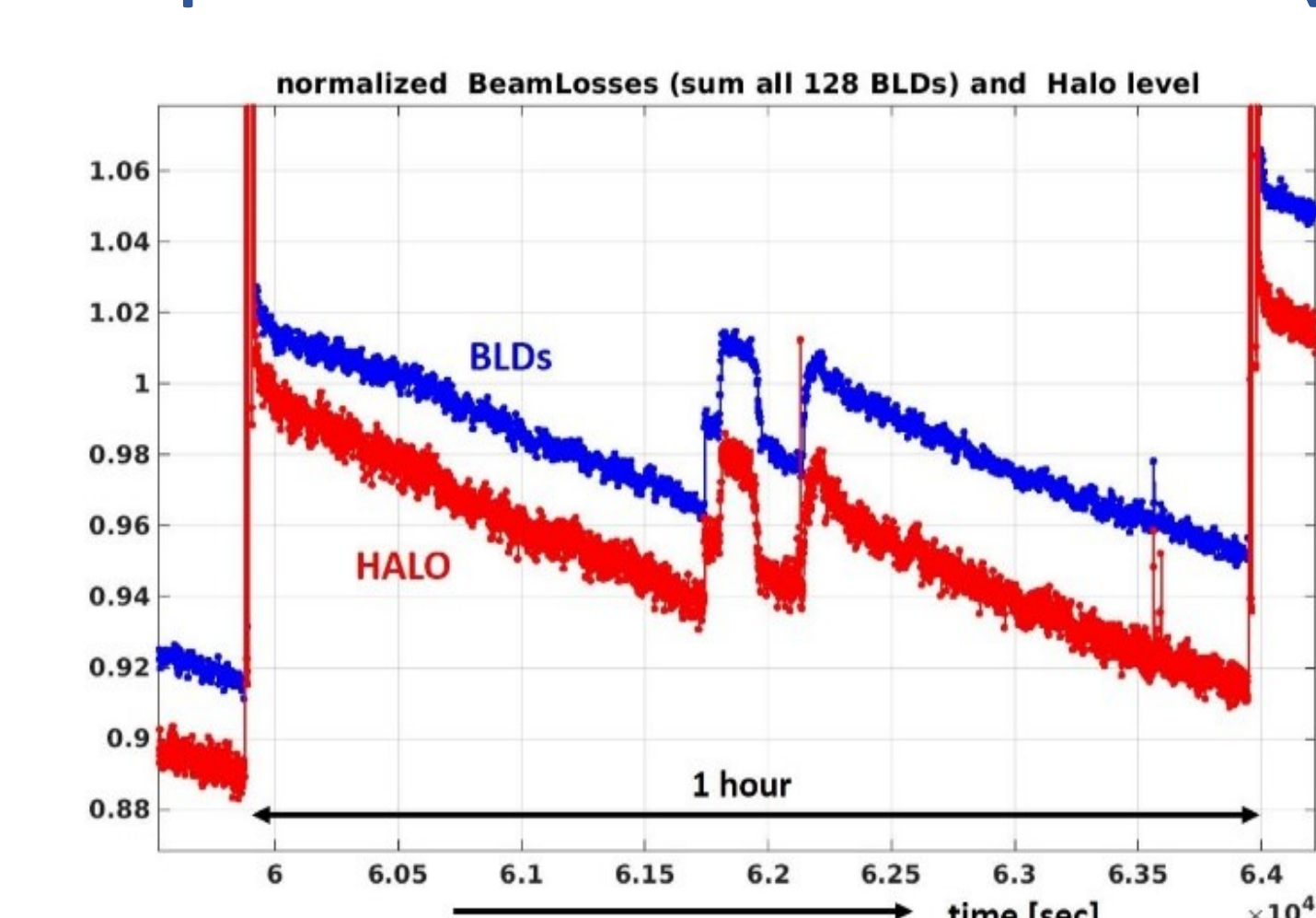
## Comparison with other diagnostics

### Comparison with pressure gauges

( $10^{-6}$  mbar simulated with Ti sublimators)



### Comparison with Beam Loss Detectors (BLDs)



## Conclusions

The **X-BPMs** gave useful information to detect the temperature influence on the e-BPMs electronic, that disturbs the beam stability.

The non-destructive vertical beam **Halo-monitor** is a very sensitive diagnostics that allows to detect vacuum events and to estimate the electron density at large distance (1-3 mm) from the beam core.