Application of Diamond and Sapphire Sensors at FLASH: First Results

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Overview

- FLASH overview
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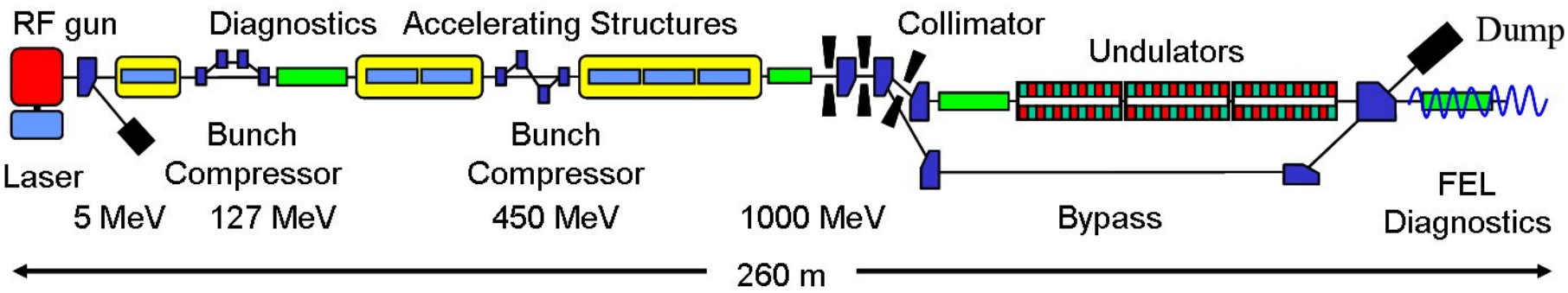
FLASH overview



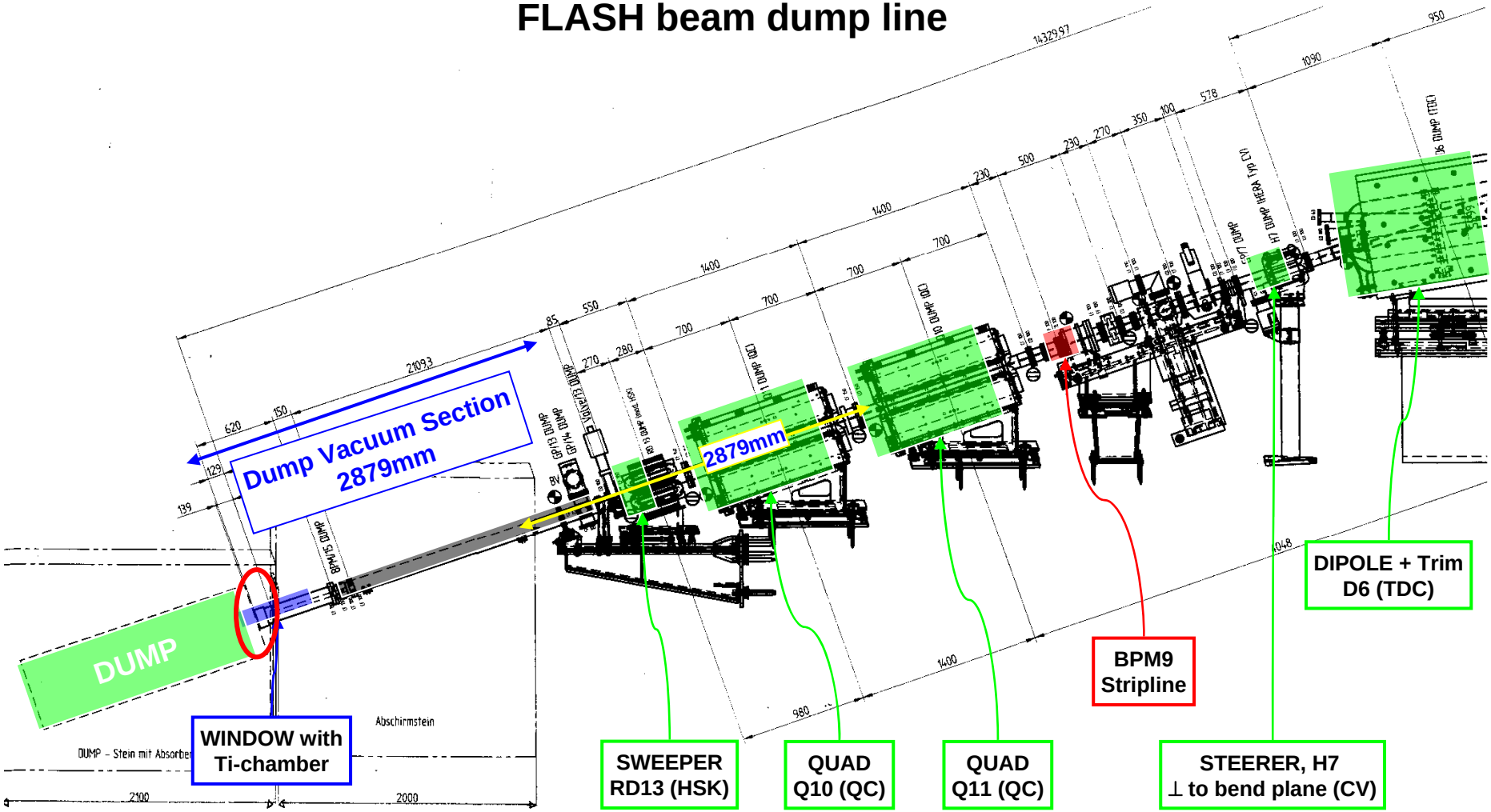
High-gain Free Electron Laser
VUV and soft X-ray regime
Self-Amplified Spontaneous Emission (SASE) mode

1GeV maximum electron beam energy

Wavelength down to 6.5 nm
10 fs pulses
Peak current 1-2 kA

BHM system

FLASH beam dump line



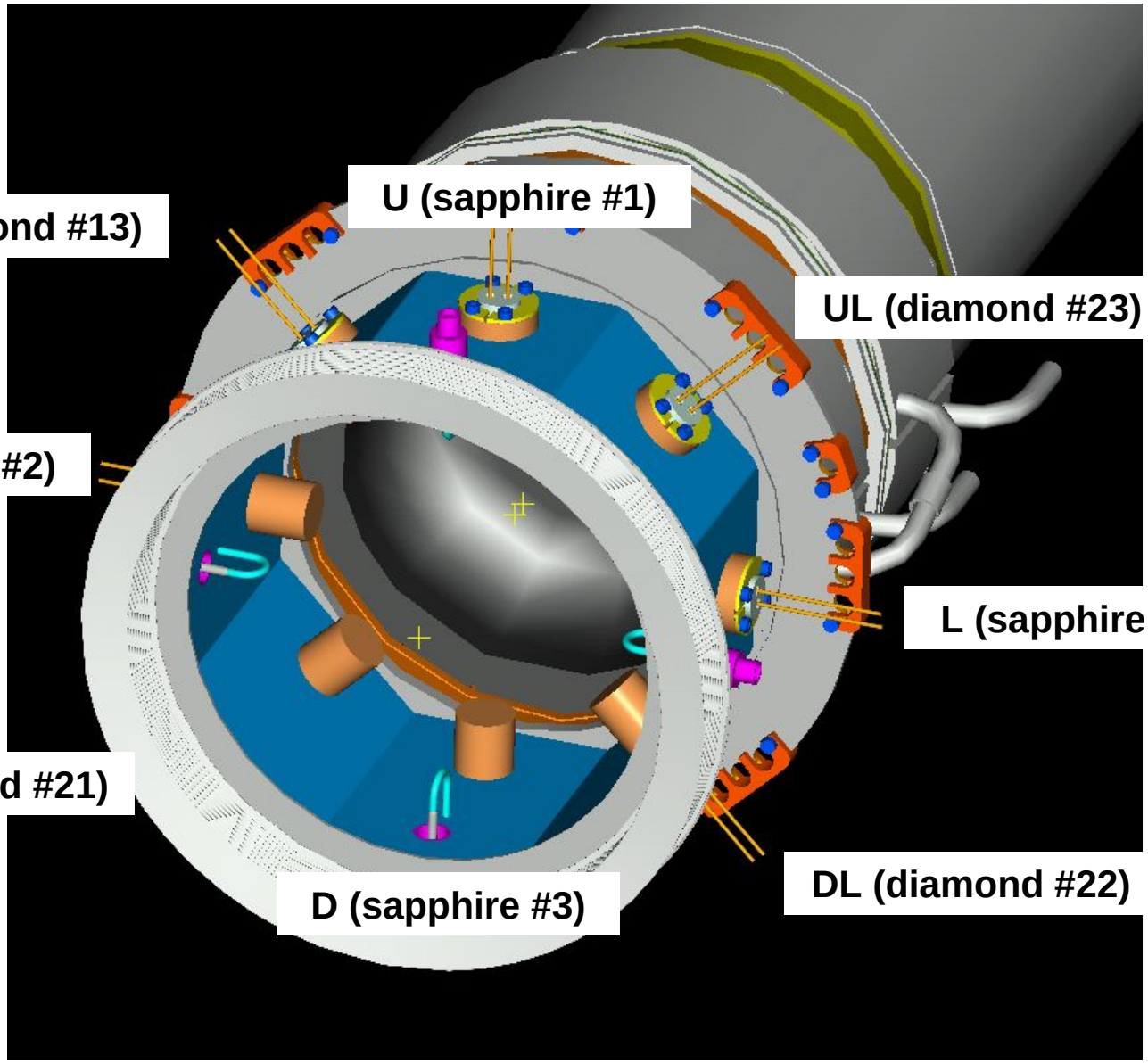
Sensors

1. pCVD diamond produced by Diamond Detectors Ltd.
   Dimensions 10×10×0.3 mm^3
   Metallization: 50/50/200 nm Ti/Pt/Au

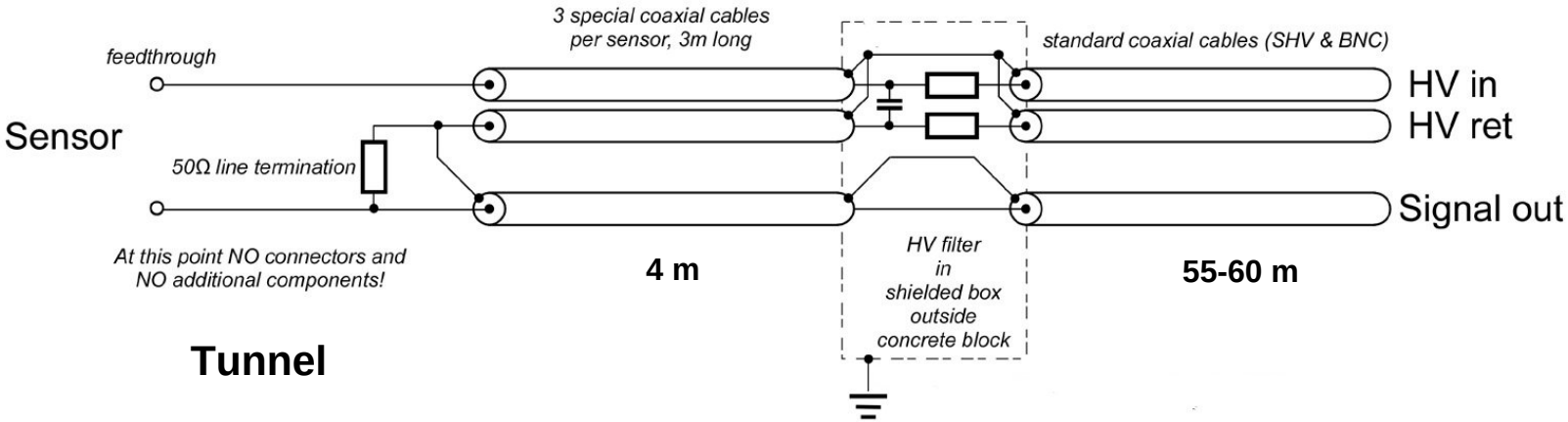
2. Single crystal sapphire (Al_2O_3) produced by CRYSTAL GmbH
   Dimensions 10×10×0.5 mm^3
   Metallization: 50/50/200 nm Al/Ti/Au

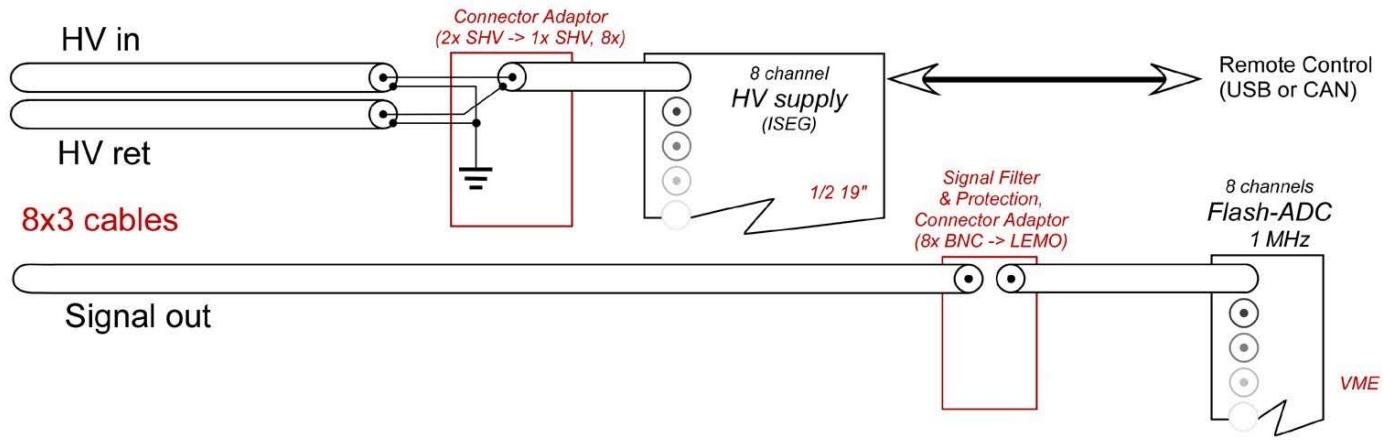
The sensors will be operated like solid-state ionization chambers

System description

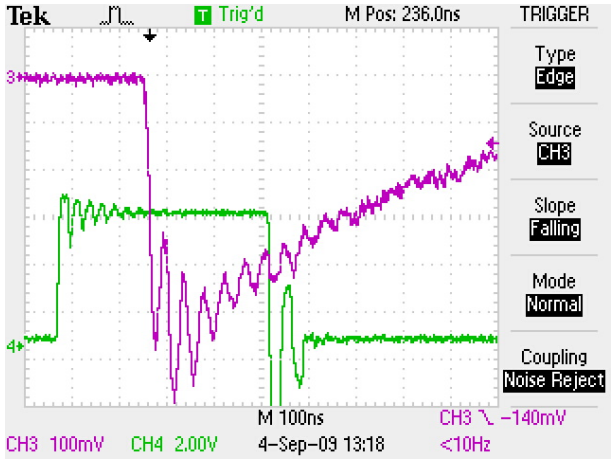


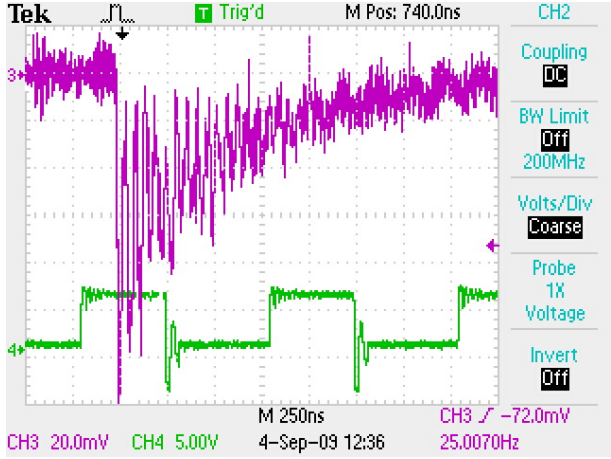
Bias voltage feed and signal readout



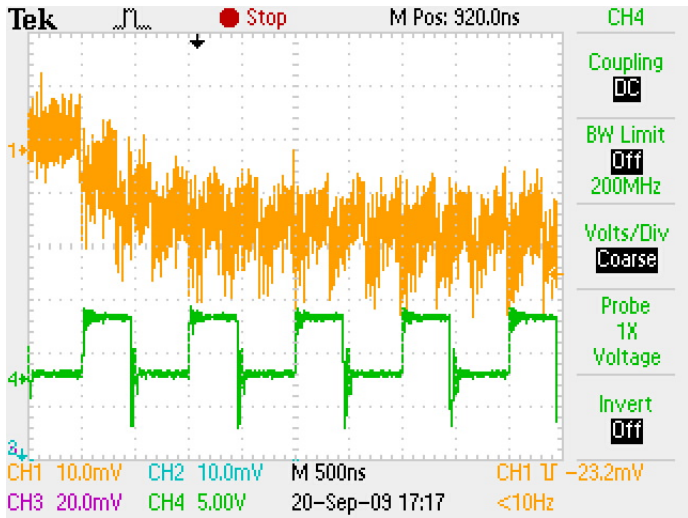


9 mA run

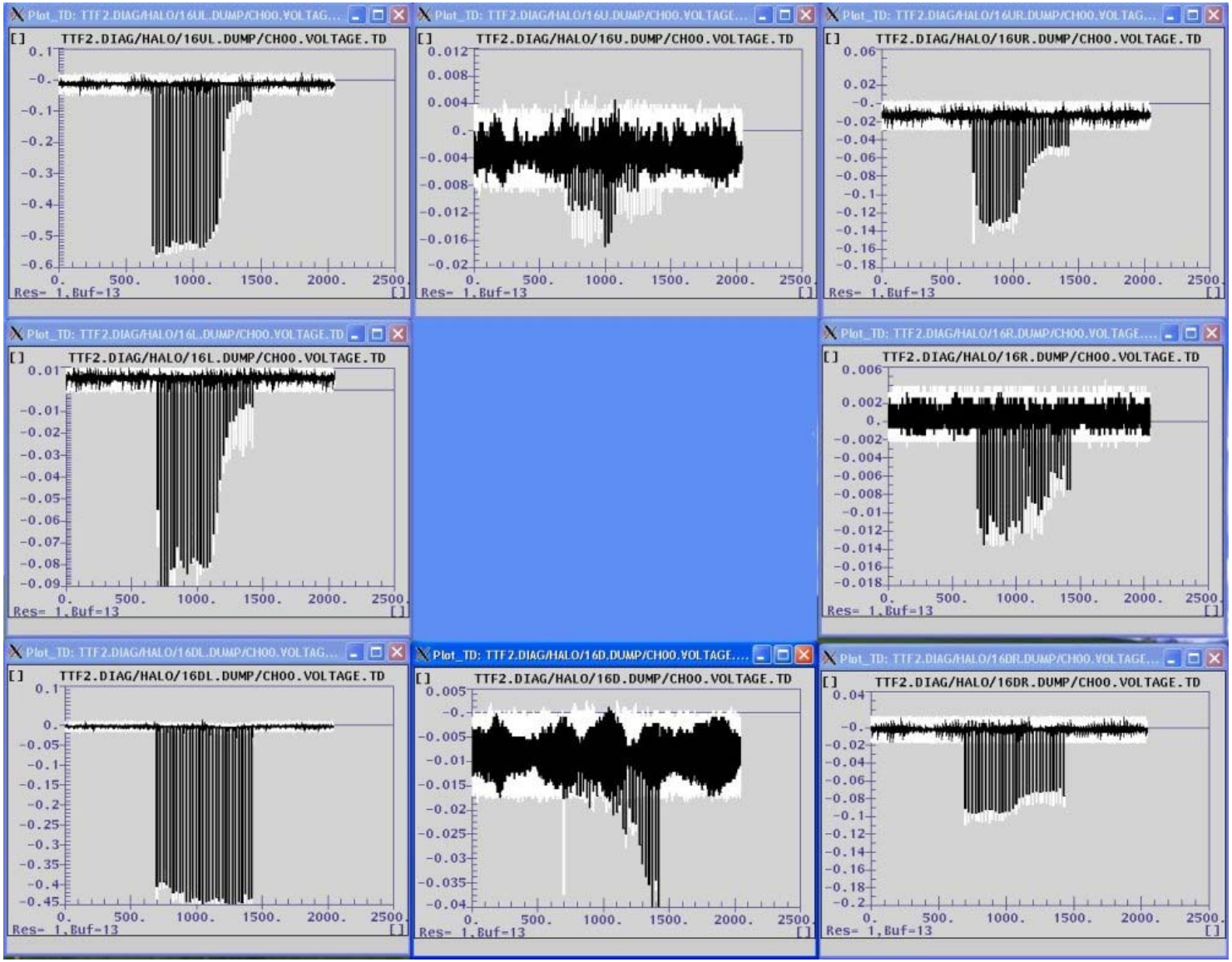




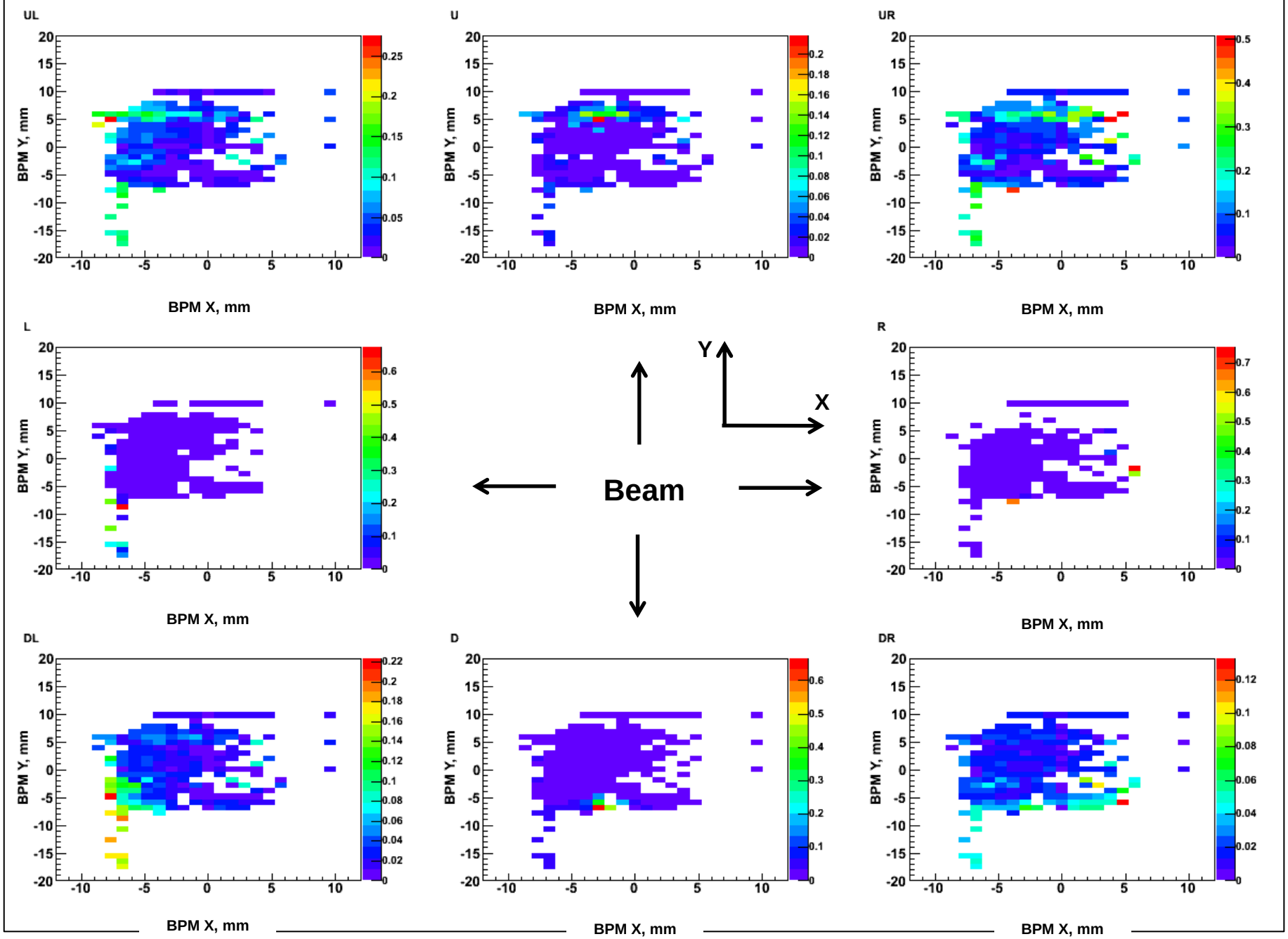
Analog signals from a diamond (left) and a sapphire (right) as a response to 1 bunch
No amplification



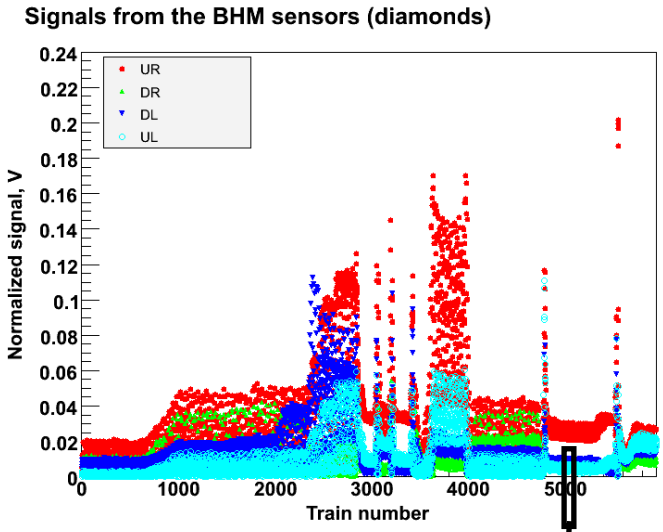
Analog signal, bunch repetition rate 3 MHz

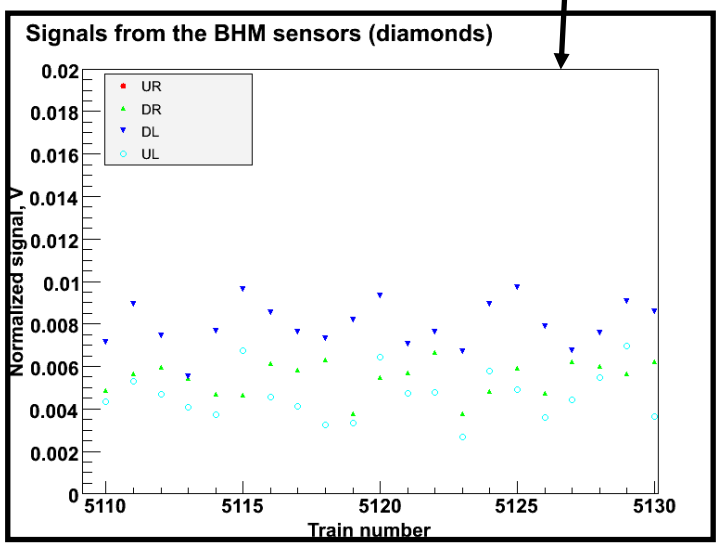


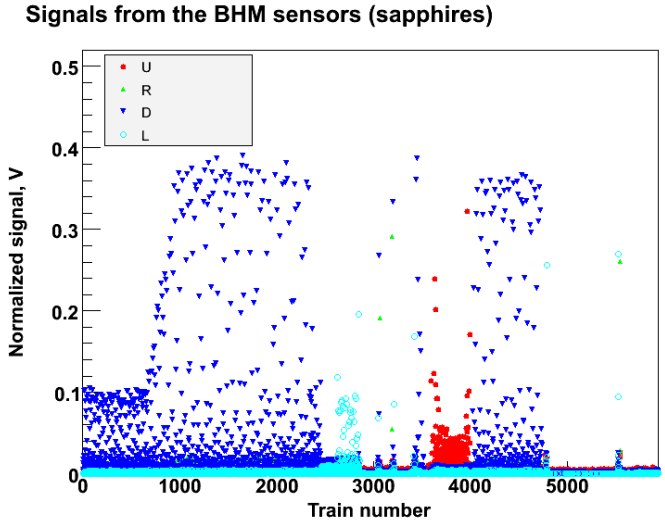
Signals from the BHM sensors (digital, 1 train of 30 bunches)



Signal size (V) as a function of beam position (by air BPM). Beam steering period of ~ 20 min, sweeping







Train repetition rate 5 Hz

Sweeping period 1.1 s

Summary

1. 4 pCVD sensors and 4 artificial sapphire sensors were used for Beam Halo Monitor system at FLASH

2. All the sensors were operational during the test run

3. The dependence of the signal size on the beam position was observed

4. Diamond sensors were sensitive to the beam position change due to sweeping

5. The analysis is ongoing

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All the shifters