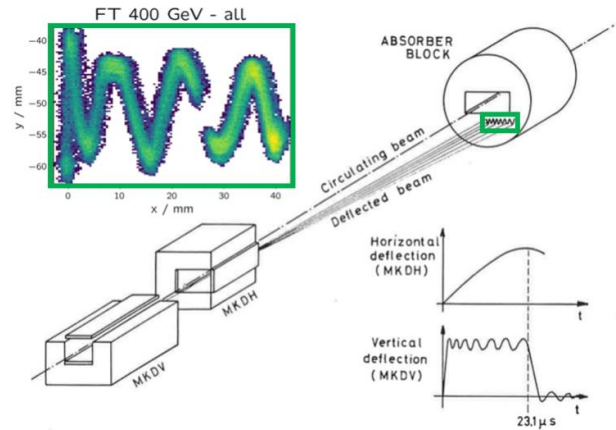# Beam Profile Measurements as Part of the Safe and Efficient Operation of the New SPS Beam Dump System
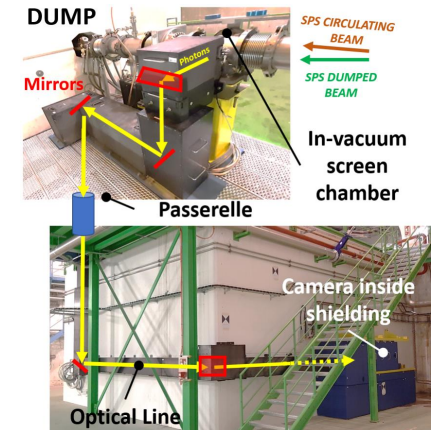
WEPV044

A. Topaloudis*, E. Bravin, S. Burger, S. Jackson, F. Maria Velotti, E. Veyrunes
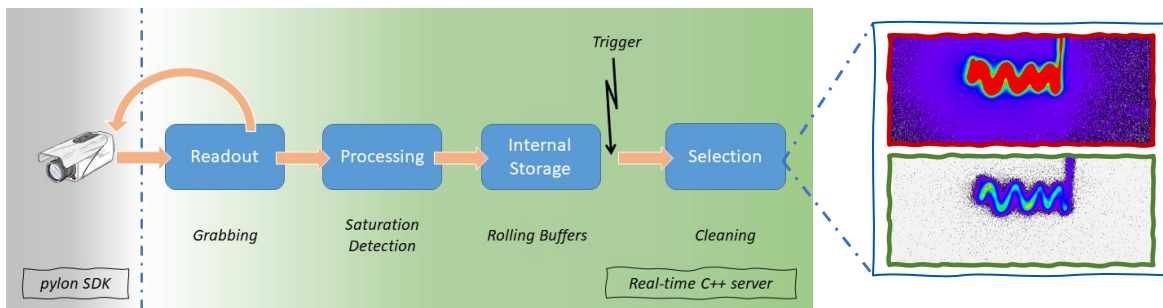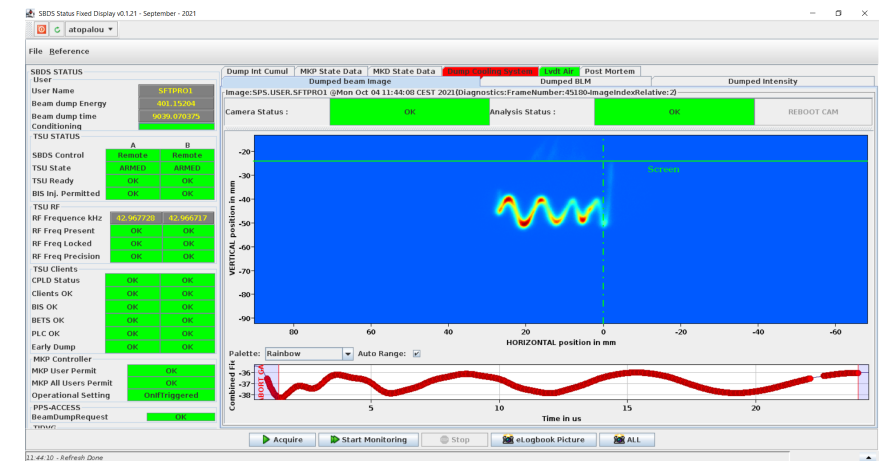CERN, Geneva, Switzerland

New SPS Beam Dump

Beam Observation System in the SPS Beam Dump

## Acquisition System

Operational Integration

New SPS Dump System (SBDS)

This paper describes the new Beam Observation system that uses its images to contribute to the safe and efficient operation of the SPS Beam Dump System (SBDS) and hence the accelerator.

The new Target Internal Dump Vertical Graphite (TIDVG#5) is designed to withstand an average dumped beam power as high as 235 kW to cope with the increased intensity and brightness of the Upgraded LHC Injector beams whose energies in the SPS range from 14 to 450 GeV.

Monitoring of the the characteristics of the dumped beams, i.e. the exact position of the dumped beam with respect to the dump as well as its shape is crucial to certify the safe and efficient operation of the SBDS.
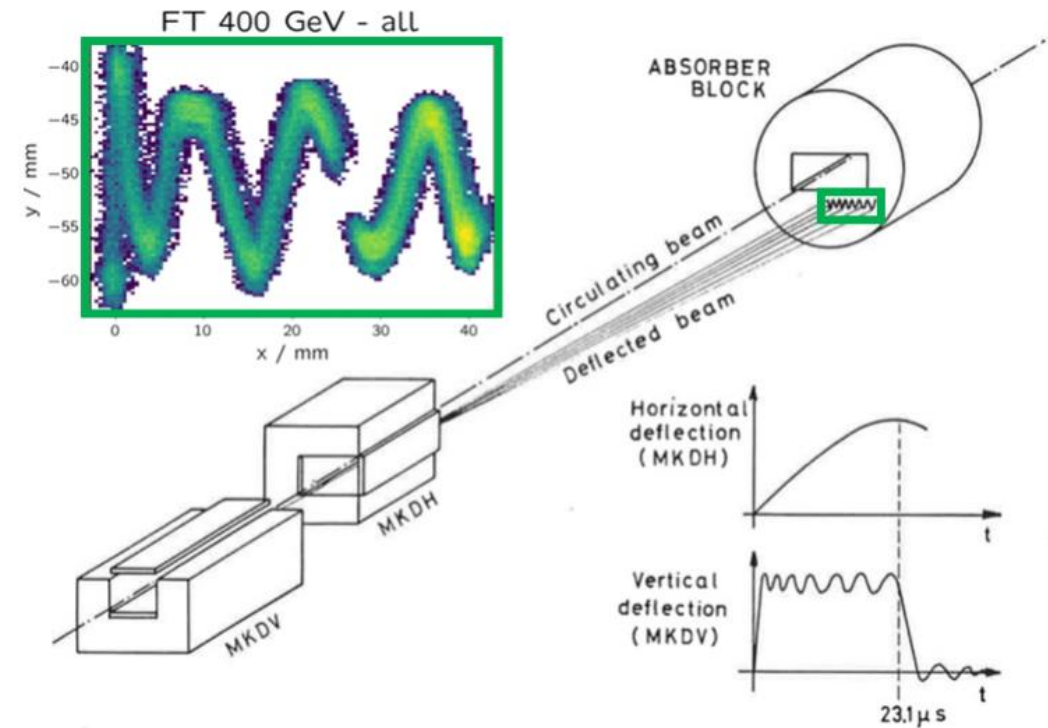
Principle of beam dumping in the SPS and simulation of a Fixed Target diluted beam

Beam Observation System in the SBDS

A scintillation screen made of Alumina doped with Chromium (CHROMOX) is installed about 1.6m upstream of the dump shielding blocks

The light produced on the screen is guided to the detector over a 17 m optical line consisting of 5 high quality mirrors.

The light is eventually picked-up by a GigE digital camera from Basler with a Complementary Metal–Oxide–Semiconductor (CMOS) sensor.

The camera is installed in a low radiation area below the SPS dump in a dedicated shielded enclosure to protect it from the high levels of radiation and minimise the number of electronics Single-Event-Upsets.
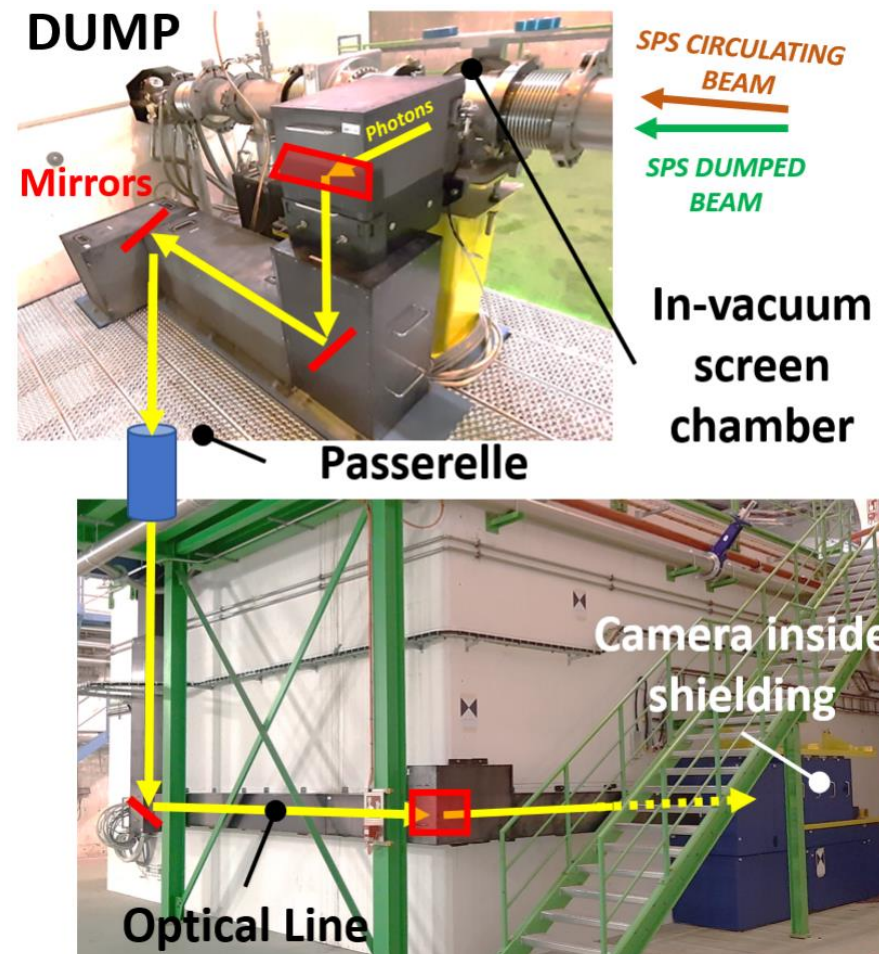
Optical line of the imaging system around the new SBDS

Acquisition System

- <u>Readout:</u> max internal frame rate (35 Hz)
- <u>Processing:</u> pixel scanning for saturation detection
- <u>Image Storage:</u> 8 rolling buffers (1 active, 7 available), 100 images each, split into pre-trigger and post-trigger ones
- <u>Image Selection:</u> automatic selection of the first non-saturated post-trigger image
- <u>Image Cleaning:</u> empty background image subtraction to improve the signal-to-noise ratio
- <u>Internal Watchdog:</u> part of the SPS Software Interlocks System
    - *Acquisition status* based on image reception and publication
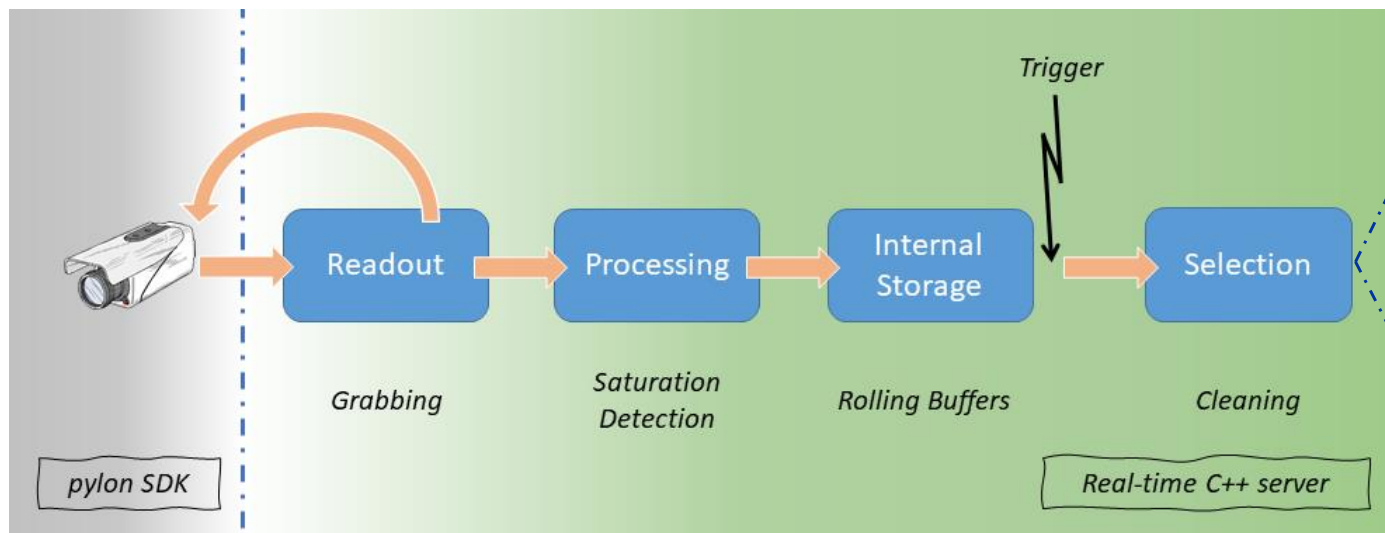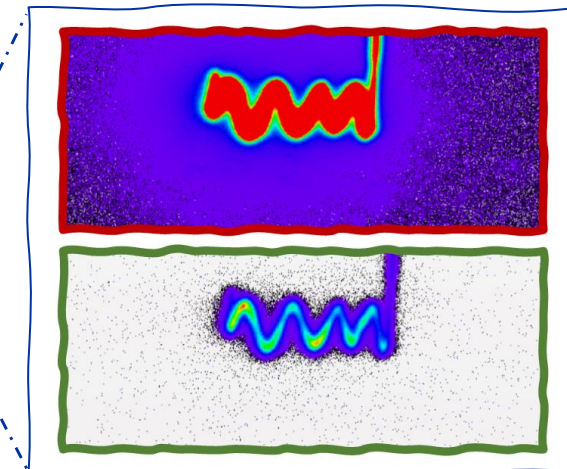   - *Camera status* including remote power reset mechanism

The acquisition system at the SBDS installation is based on the relatively low decay time (> few 100 ms) of the light yield of the CHROMOX screen used.

Taking advantage of the beam footprint staying on the screen for several milliseconds, the system continuously monitors the screen and selects the first image that is not saturated.

Image acquisition software model

*the first (**saturated**) image in the rolling buffer*

*the sixth (the first **non saturated**) image in the same buffer*

Example of the automatic image selection with a Fixed Target dumped beam.

Operational Integration

The system was extensively used to commission the whole SBDS system measuring the transfer function of the kicker magnets, verifying their polarity, and assessing the effects of their potential failure.

During operations, it is an essential feature of the SBDS status Fixed Display which displays the selected image sent for post-mortem analysis and statuses which are part of the SPS Software Interlocks System

Various statuses

Beam Observation statuses

Selected image for post-mortem analysis

Beam filling pattern
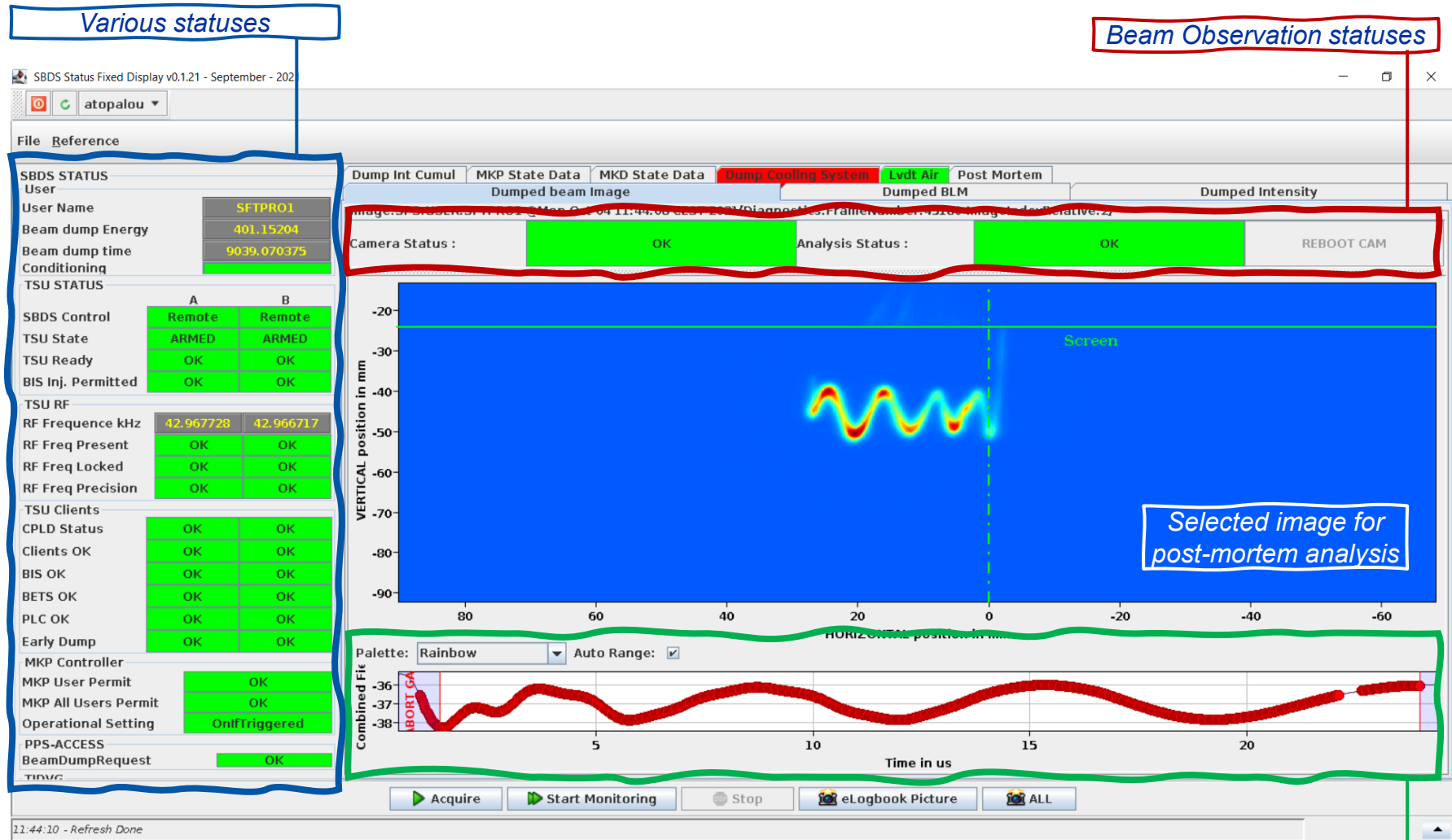
SBDS status Fixed Display depicting a Fix Target dump event.