



TUPDP099

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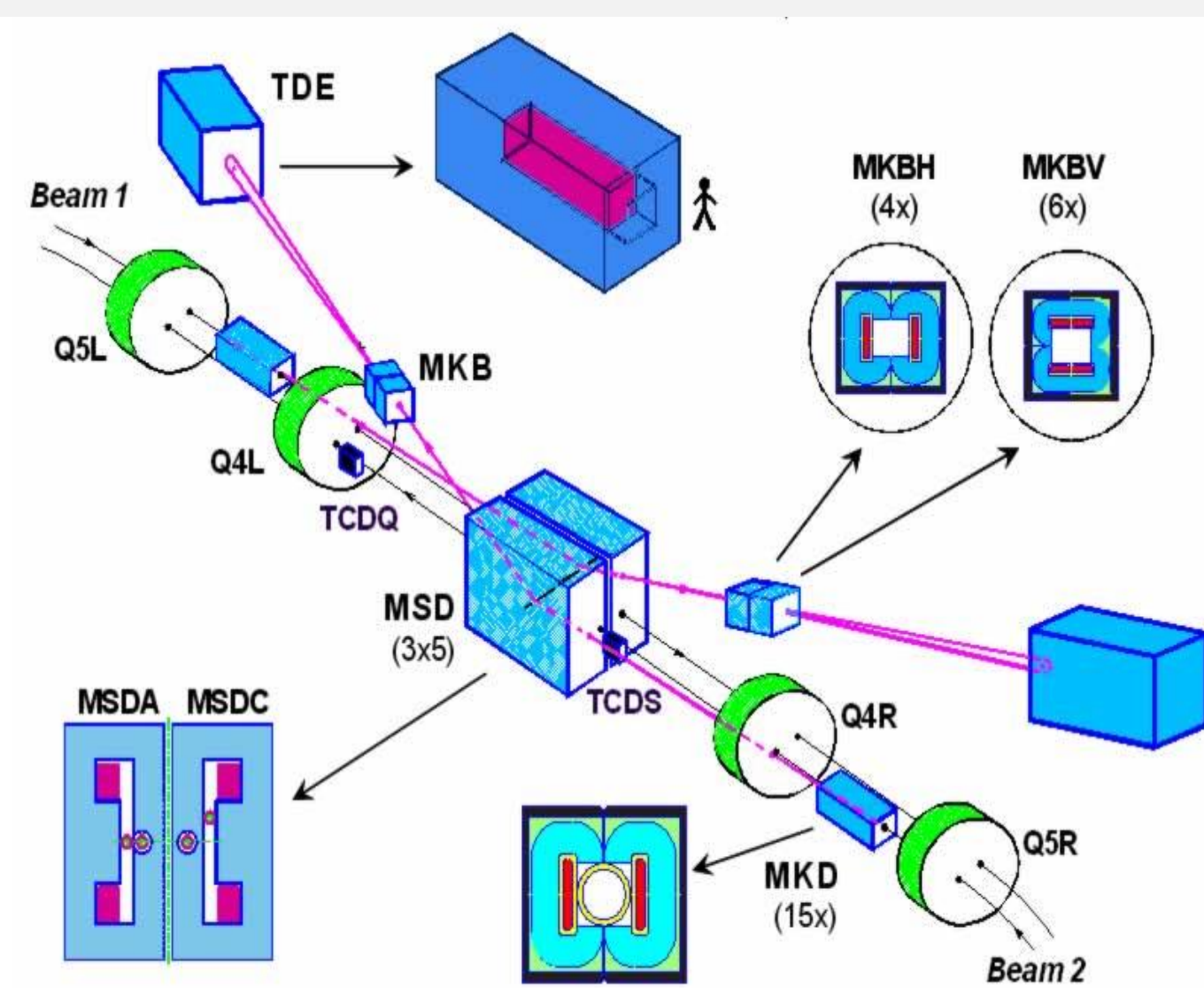


SY
Accelerator Systems

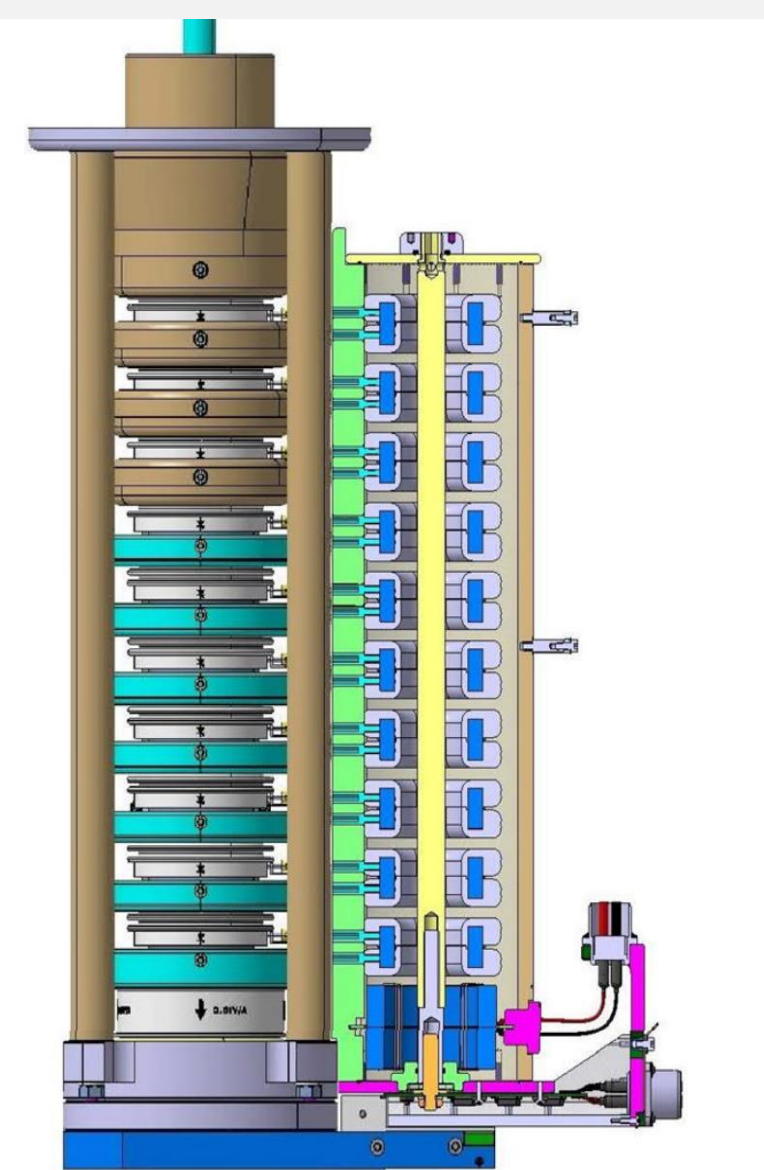
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LBDS HV Generators

- LBDS contains 15 extraction and 10 dilution kicker magnets per beam.
- Each kicker is powered by a high-voltage pulse generator (HVPG), using HV switches to discharge the energy stored in capacitors into the kicker magnets.
- HV sparking in HV switches in HVPG can cause a self-trigger and asynchronous beam dump.
- There are pick-ups placed in HVPG for detection of spark current signals.
- SAM monitors the fluctuations on the pick-up outputs to capture when a spark occurs.
- SAM system is developed to monitor spark signals and detect critical spark activity before a self-trigger occurs.



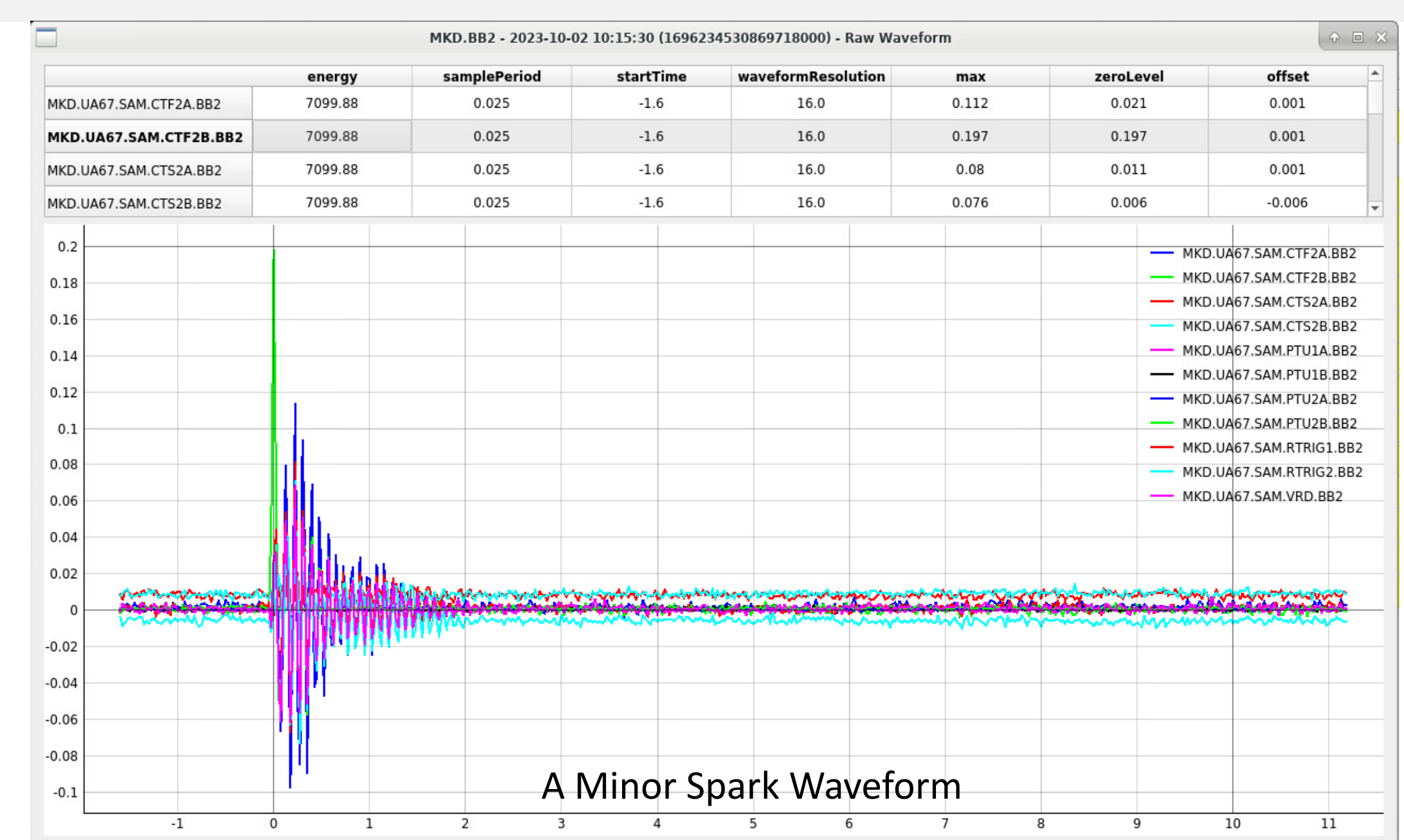
LHC Beam Dump System (LBDS)



High-Voltage Switch in HVPG

Waveform Acquisition and Analysis

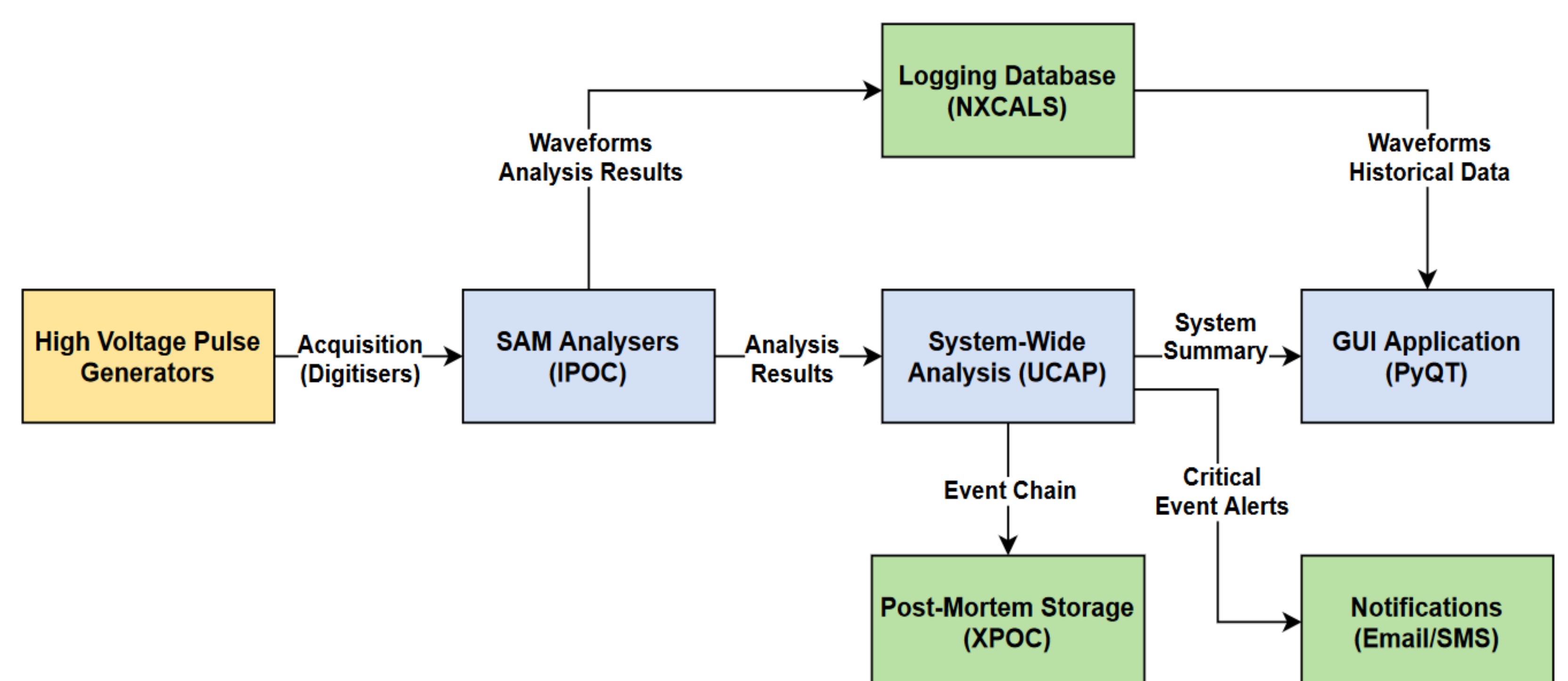
- Digitisers deployed on HVPGs to detect and capture the spark waveforms.
- When there is activity on one channel of a generator, all channels capture waveforms and starts the analysis.
- The waveform acquisition and analysis is done by Internal Post-Operation Check (IPOC) software.
- The waveform analysis on the analysers determine the key characteristics of a waveform. All waveforms and analyser results are logged on NXCALS.
- There are 450 digitiser channels deployed across LBDS.
- Since it is not possible to analyse such large data manually, a monitoring system is needed.



A Minor Spark Waveform

System-Wide Analysis

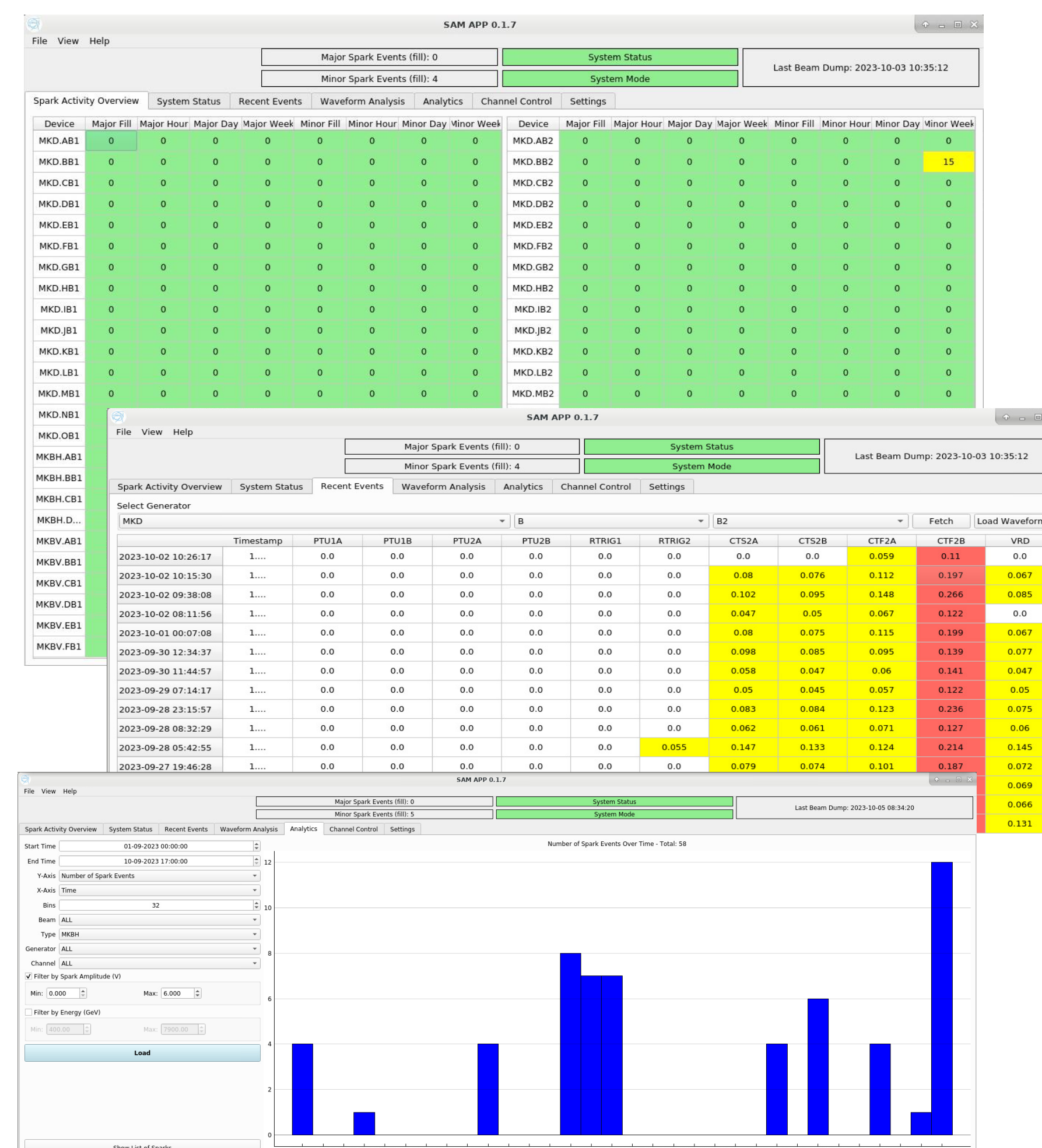
- The system-wide analysis software developed with CERN UCAP framework
- It collects all waveform analysis results as well as other relevant system data such as the accelerator mode, LBDS state etc.
- It combines all SAM events published by all SAM analysers into one dataset and determines the related events by checking the occurrence timestamp and source channel of SAM events.
- The SAM events are categorized and classified by event criticality.
- The system sends notifications to experts by SMS and email when a critical activity such as a major sparking is detected.



Main components of SAM system and data flow between them.

GUI Expert Application

- A GUI Expert Application is implemented to provide system summary and statistics.
- It shows the number of SAM events on each generator for different time windows.
- It lists the recent SAM events with the detected source channel and maximum spark amplitudes on each channel.
- It can extract the waveforms for specific events to analyse the spark event.
- It can extract long-term historical data from NXCALS and create charts to present statistics with numerous filtering options on different distribution domains (time, beam energy, spark amplitude etc.) for experts to further analyse the sparking events.



Screenshots from SAM Expert Application

First Experience with the System

- The spark detection and waveform acquisition system is very sensitive. A lot of noise signals are captured which are not caused by real sparks but due to external system activities.
- Filtering and categorization of the data is very important to extract useful information from the large amount of data collected.
- Recently self-triggers of an HVPG occurred without any prior spark activity detected. Also, minor spark activity is detected on some other HVPGs without any self-trigger.
- The relation between minor spark activity and self-trigger of HVPG is not clear yet.