

# Operation Experience with Klystron Lifetime Management system at European-XFEL



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**Abstract**

The special fast protection system for the klystron, called **Klystron Lifetime Management (KLM)** system has been successfully installed in the European XFEL accelerator. This system has been developed to minimize the influence of service conditions on the lifetime of klystrons. The main task of this system is to detect all events which can destroy the tube as quickly as possible, and switch off the driving RF signal. The KLM system implementation is based on the standard Low Level RF (LLRF) Micro Tele-communications Computing Architecture (MTCA.4). After more than a year of operation of the accelerator with the system enabled, we can assess the impact of this system on the accelerator's downtime. This poster shares the experience gained with the KLM system.

### System Overview

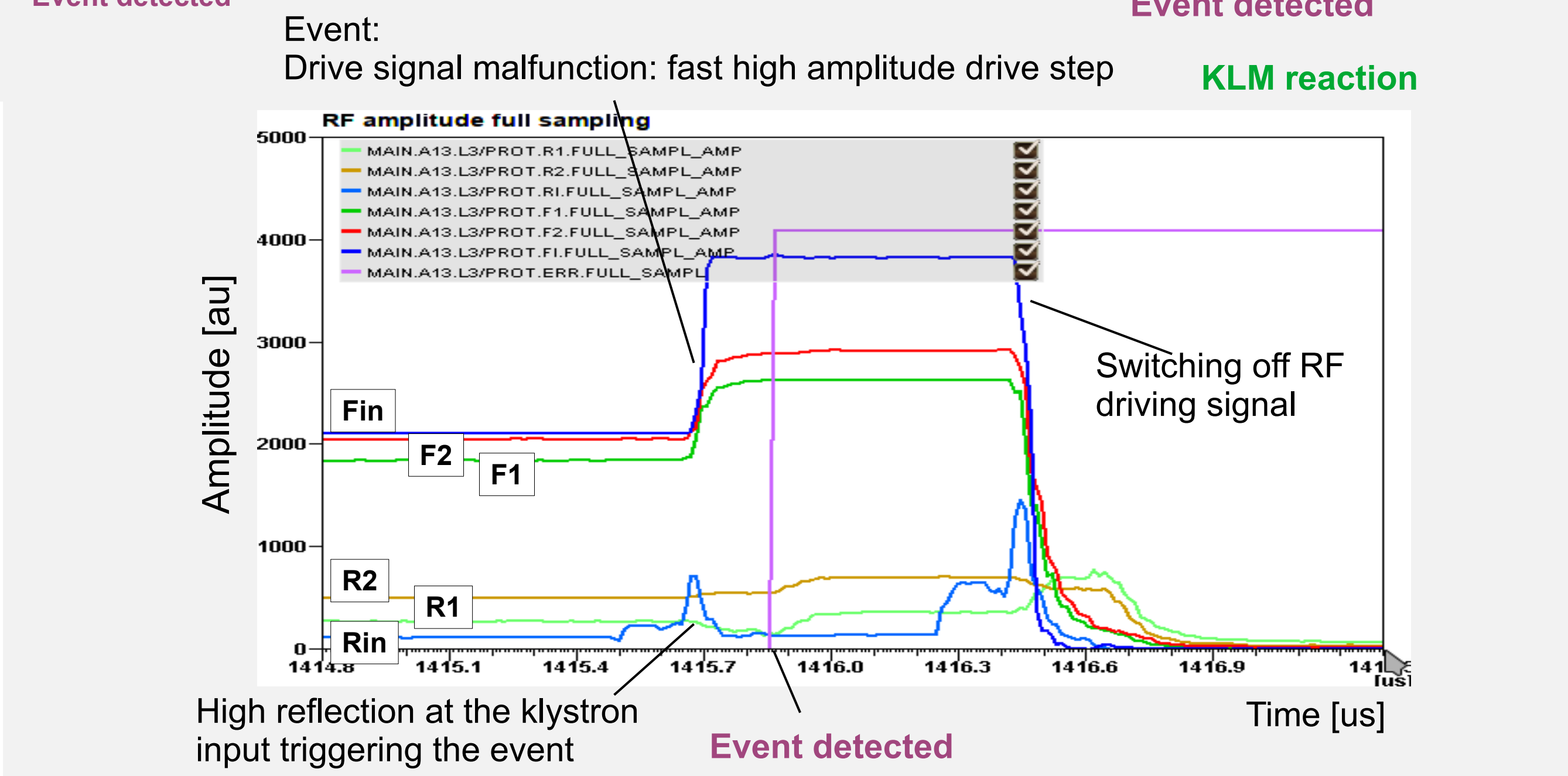
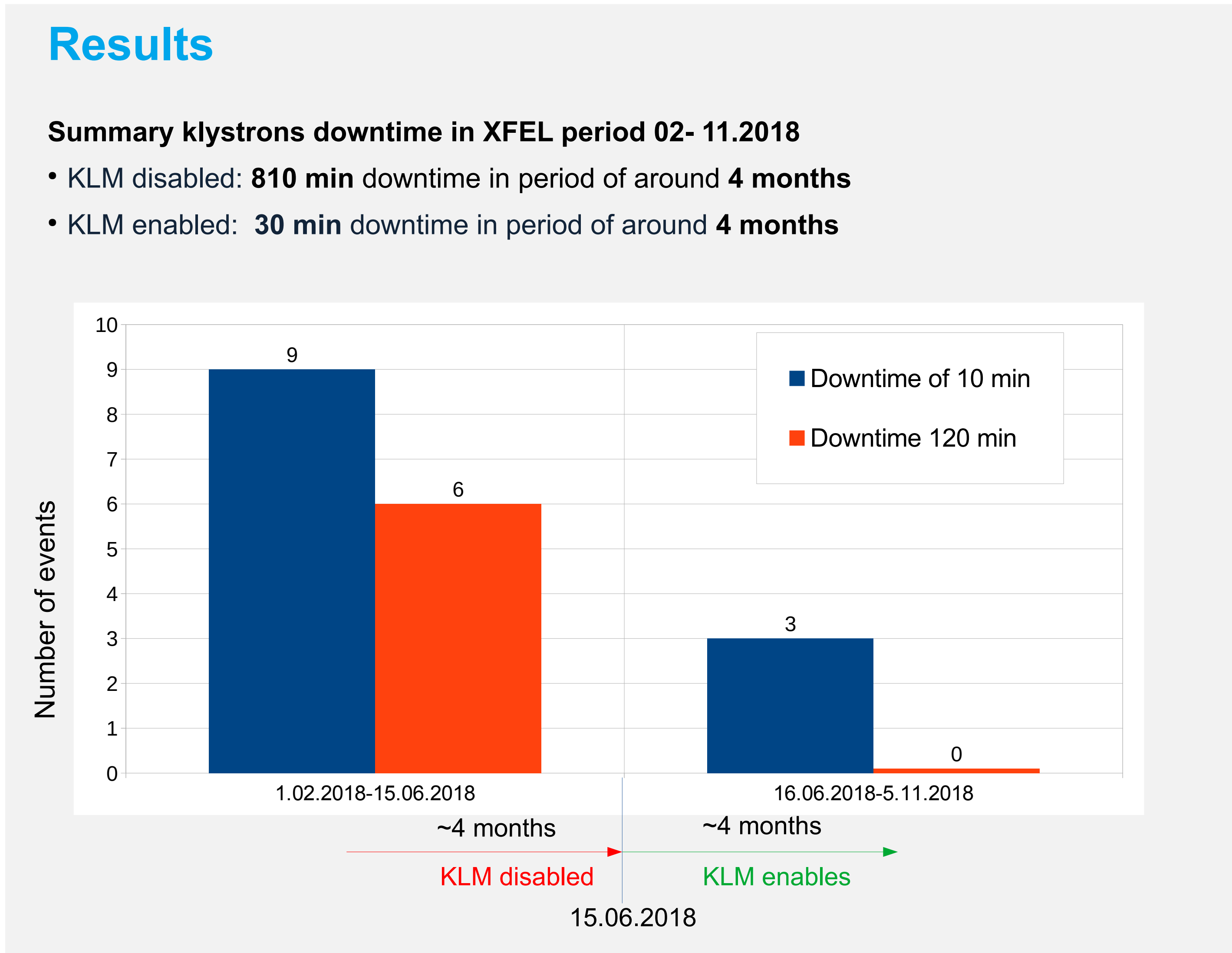
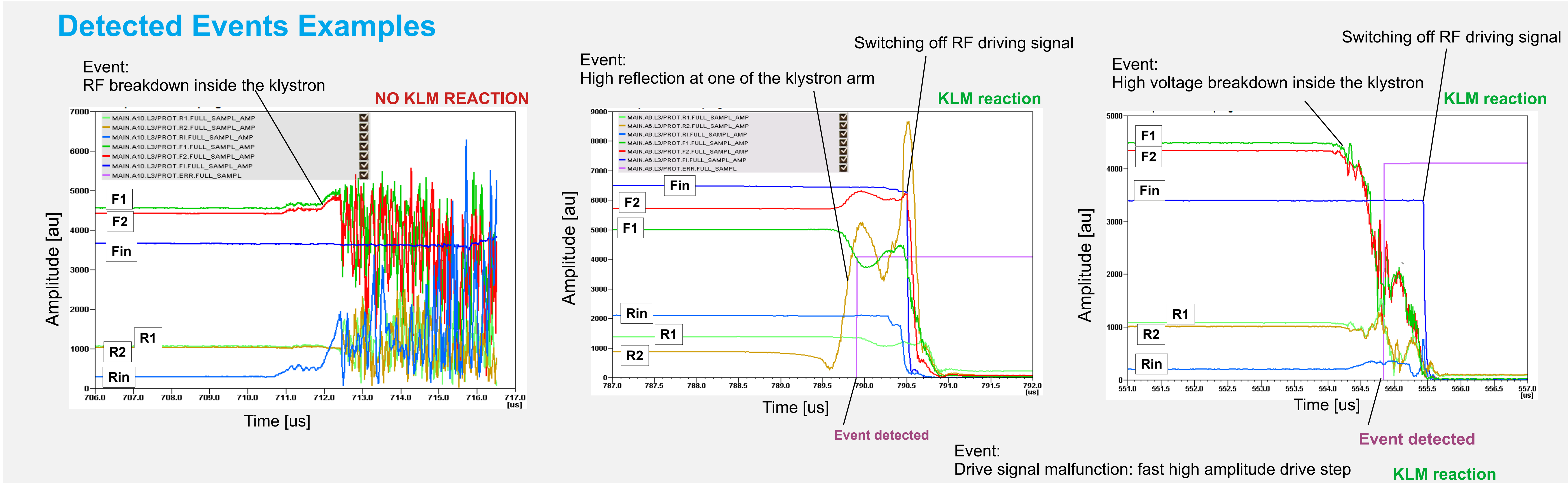
**The main idea:**

- System monitors signals from the klystron:
  - RF forward and reflected at both klystron outputs and input
  - cathode high current and voltage
- It compares measured amplitude values of the RF signals with the values calculates based on the model
- When difference crosses set threshold the event is detected

**Reaction on detected events:**  
Switch off the RF driving signal.  
Reaction time is in a range: **600-700ns**

In case of event detected system keeps event waves in the full ADC resolution for a further analysis.

**The fast response prevents vacuum events that lead to a long recovery time**



### Conclusion

System has been successfully installed on 26 RF stations of the European-XFEL accelerator

- System can properly detect events in such as:
- High reflection at klystron input and outputs
  - High voltage breakdown
  - RF breakdown inside the klystron
  - Malfunction of the LLRF system of RF drive signal

There is a visible influence to the summary downtime of the klystrons in the European-XFEL.

KLM system is a great tool in analysis of the RF station failures.

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