

The Data Acquisition and Control System of EAST ME-SXR Diagnostic



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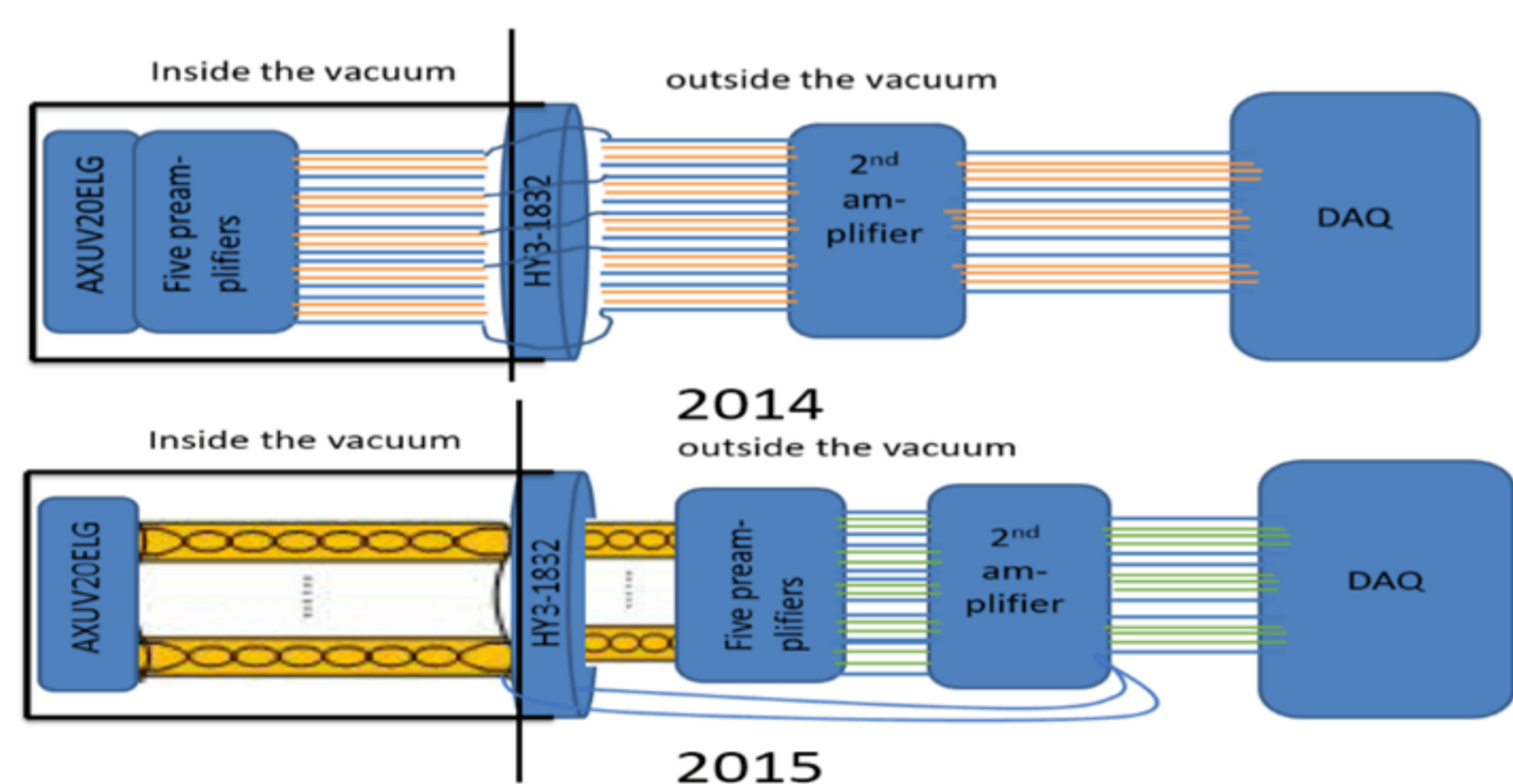
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ABSTRACT : A data acquisition and control system has been realized for a Multi-Energy Soft X-Ray (ME-SXR) diagnostic, which has been built for EAST (Experimental Advanced Superconducting Tokamak) electron temperature profile in the edge plasma region. The system has two functions: long-pulse data-acquisition and automatic gain-control. It provides 96 high-speed channels with optional sampling rates from 250 KSPS to 1 MSPS, which can long-pulse acquires signals of ME-SXR. In the meanwhile, it transfers the data to the MDSplus server in real-time and users can access to the data during the discharge. The signals from the diode array detectors are in the microampere range, which should be amplified by the electronics with the transimpedance in 8 stages. In the past, electronics' gain settings were totally man-control. In order to realize automatic gain-control, it makes data de-noising and calculates appropriate gains, according to the pulse situation and ME-SXR's reference signals in the last shot. The goal of the system is to ensure long-pulse data acquisition and electronics' automatic gain-control. The system has been demonstrated in the 2015 EAST campaign.

Introduction

The ME-SXR (Multi-Energy Soft X-Ray) diagnostic is used to measure electron temperature profile in the edge plasma region. It was installed in 2014, and upgraded in 2015. [1]

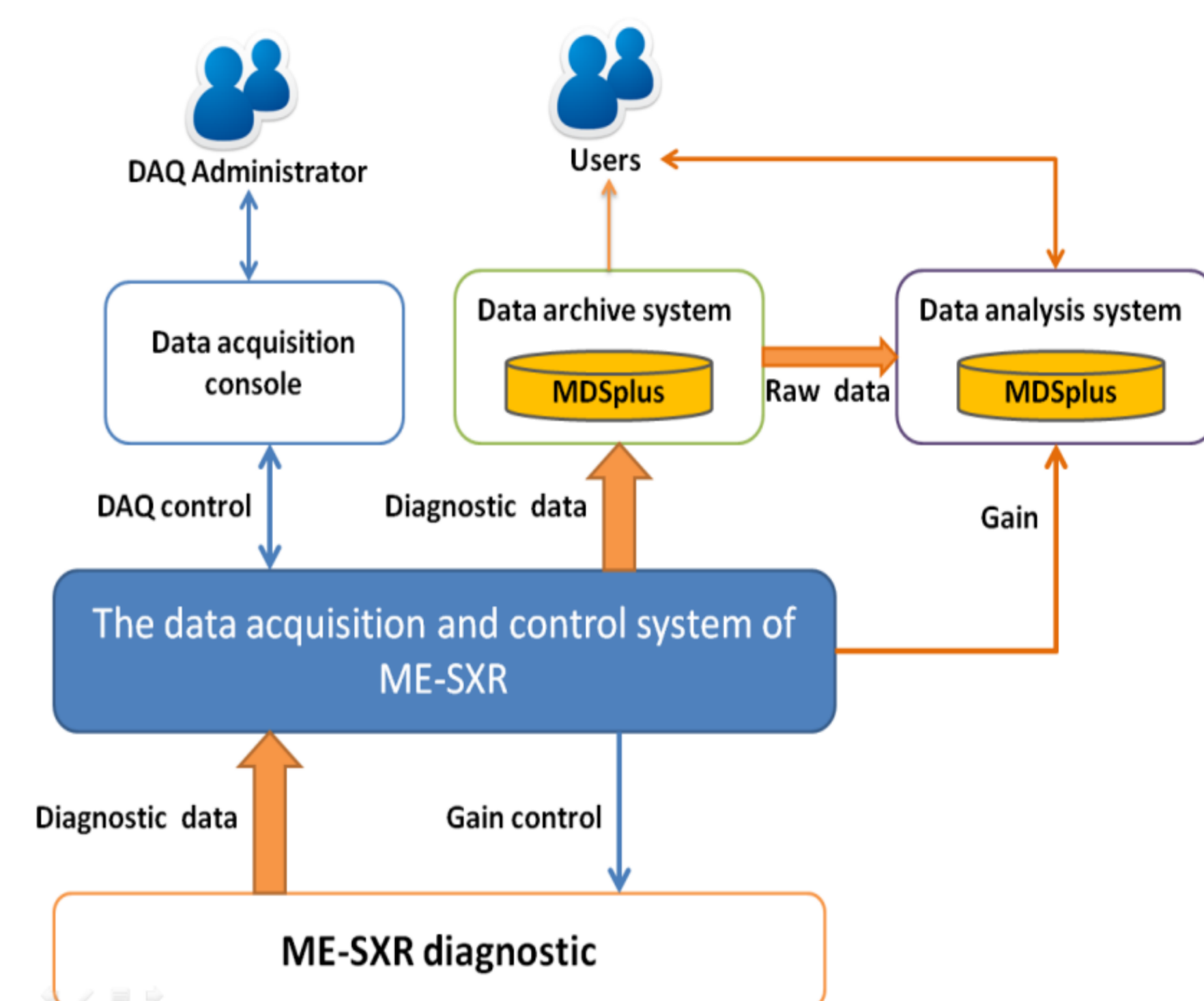


The key requirements of the data acquisition and control system:

- Real-time data access is essential. EAST has achieved 411s long-pulse discharge with 0.28MA plasma current in 2012 campaign.[3] With the increased pulse time, researchers need to know the plasma status in real time.
- The gain's auto-control is necessary. An EAST campaign usually lasts few months with discharge incoming rising at more than 100 shots a day. In the past, electronics' gain settings were totally manual in every shot. It's too hard and tired for experimenters.
- The system should be in favor of auto data analysis. In the future more and more EAST diagnostic system will realize auto data analysis.

System Architecture

The data acquisition and control system has two main functions: long-pulse data acquisition and electronics' gain auto-control.



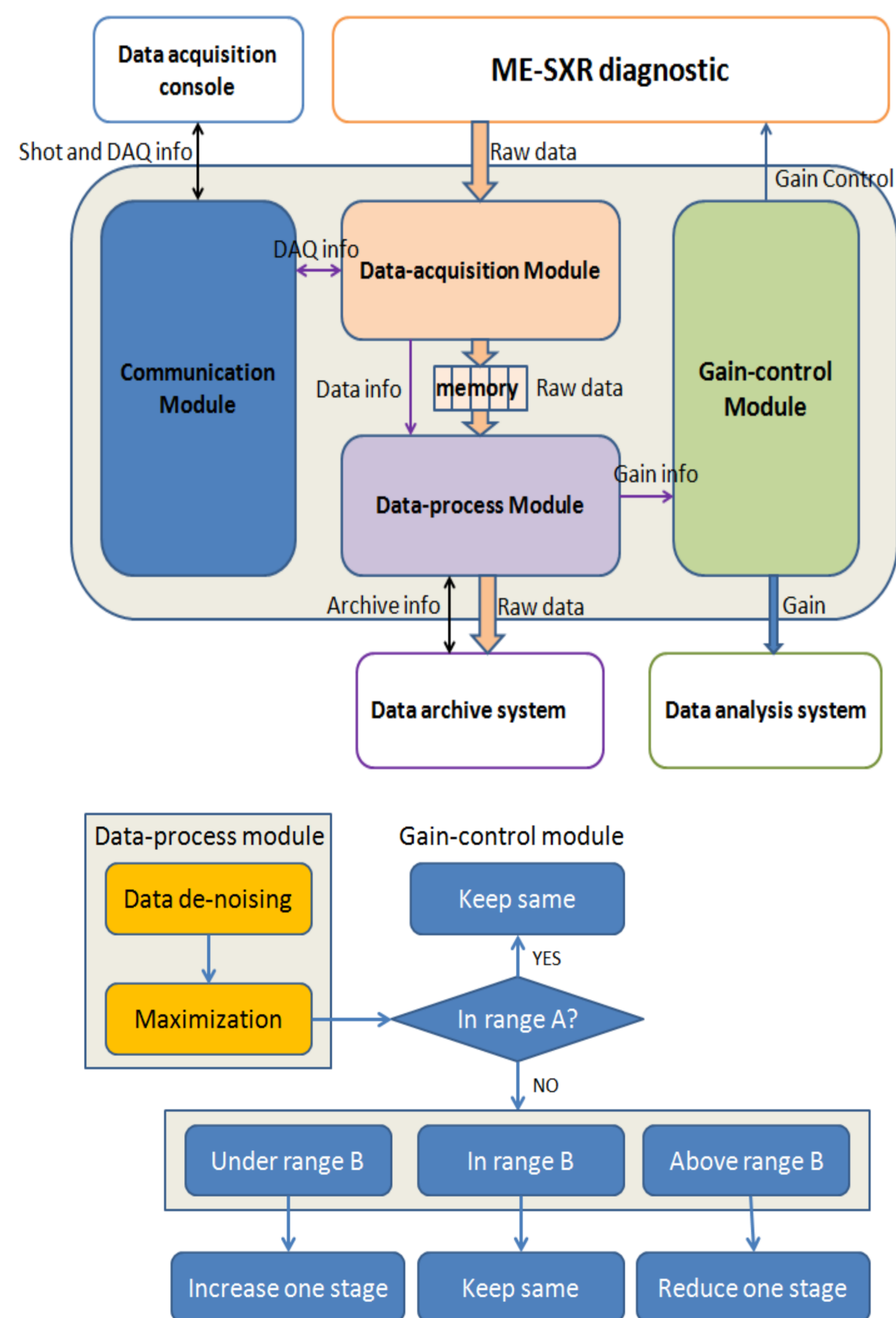
Long-pulse Data Acquisition:

- 96 high-speed channels with optional sampling rates from 250 KSPS to 1 MSPS.
- Continuous long-pulse data acquisition.
- The diagnostic data will be transferred to the data archive system in real time. The data will be stored into MDSplus format.
- Users can access to the data during the current discharge.

Electronics' Automatic Gain-control :

- Controlling five electronics with transimpedance in 8 stages.
- Data de-noising based on Savitzky-Golay filter
- Calculating appropriate gains according to the plasma current and ME-SXR's reference signals of the last discharge.
- Gains are transferred to the data analysis system in real time for automatic data analysis.

System Implementation



Gain controller: five electronics with 15 switches



Chassis:	PXIe-1075						PXIe-6259
Controller	DAQ	DAQ	DAQ	DAQ	DAQ	DAQ	Gain Out
	PXIe-8135	PXIe-6358	PXIe-6358	PXIe-6358	PXIe-6358	PXIe-6358	PXIe-6259

Conclusions

During the 2015 EAST campaign, the data acquisition and control system has realized continuous data acquisition with optional sampling rate and automatic gain-control in the long-pulse quasi-steady state. It meets the four requirements: input channels with optional sampling rates, real-time data access, automatic gain's setting and extension for automatic data analysis. It provides 96 input channels with optional sampling rates for long-pulse acquiring the diagnostic data. Users can access to the data in real time during the discharge. The automatic gain-control has freed experimenters from the tired manual operation. And the gains are ready for data analysis.

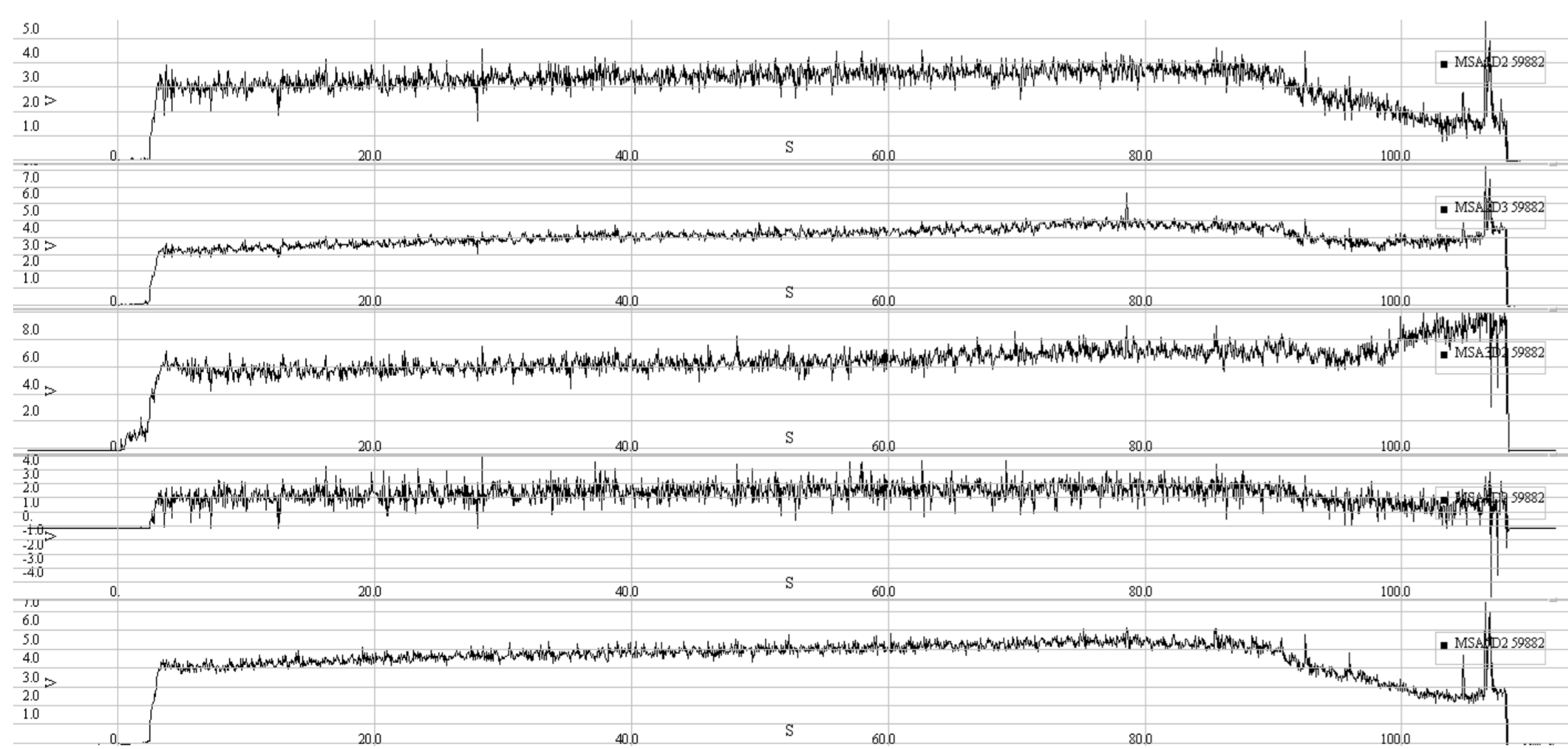
Soon, the ME-SXR diagnostic system will realize automatic data analysis. Finally, it will realize automation including acquisition, control and analysis. Other similar diagnostic systems may refer to this system.

References

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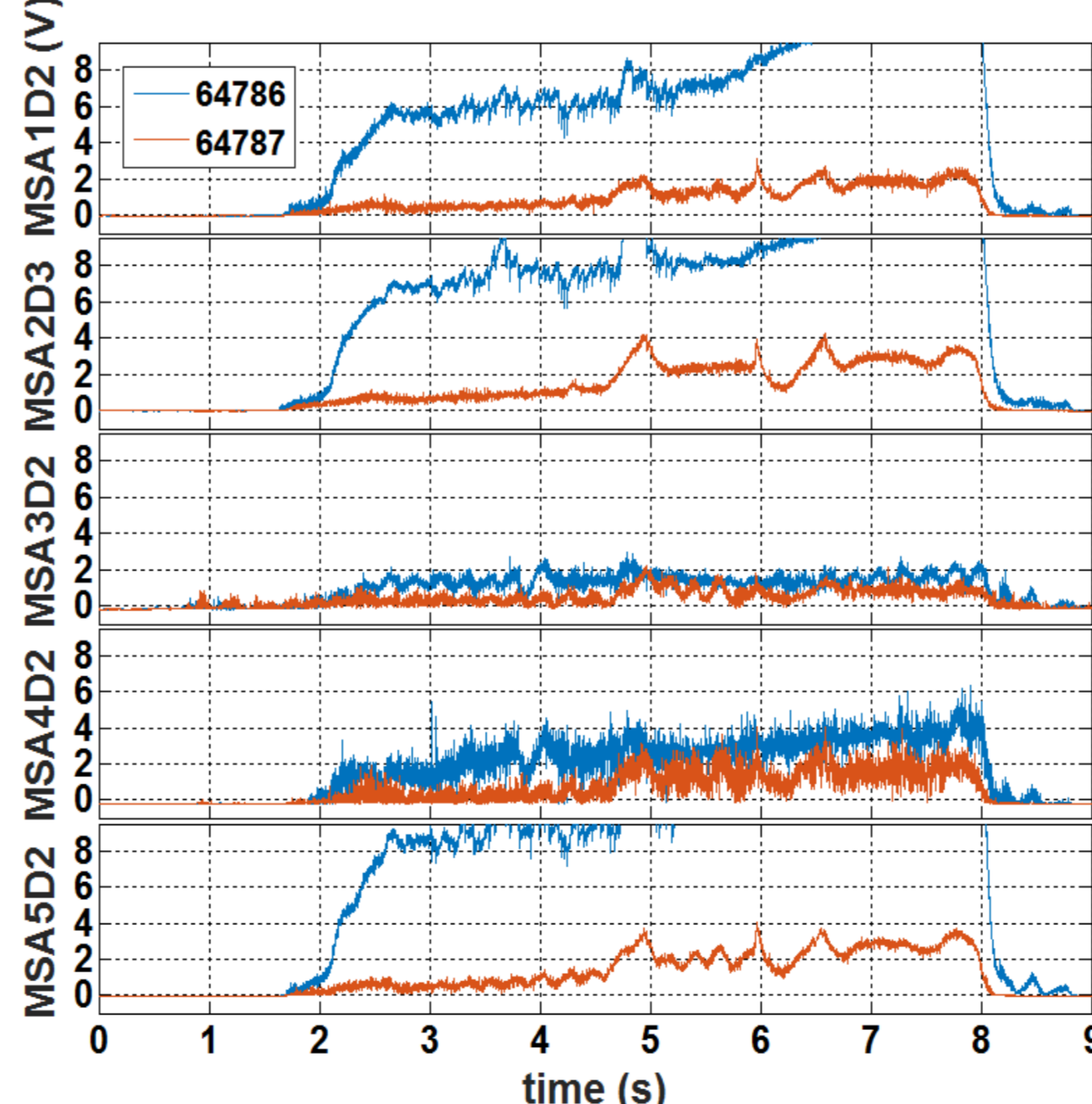
Result

• Long-pulse data acquisition



Five signals of ME-SXR (shot@59882, pulse time=104.18s)

• Electronics' gain auto-control



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