# Instrumentation and Applied Acoustic Research Group

The UPM-I2A2 research group has more than 15 years of experience researching and developing data acquisition and high throughput processing applications using PXI/PXIe and interlock solutions with cRIO form factor. In particular, the research group started its work in this field in 2001-year developing advanced DAQ solutions for the fusion community in collaboration with CIEMAT and Joint European Torus for different projects related to machine learning applications. Since 2010 I2A2 is a strong collaborator of ITER CODAC in the field interlock solutions and advanced data acquisition and processing applications for ITER fast controller using FPGA-based DAQ devices. I2A2 has an extensive experience integrating hardware and software for CODAC applications.

## Facilities and infrastructures
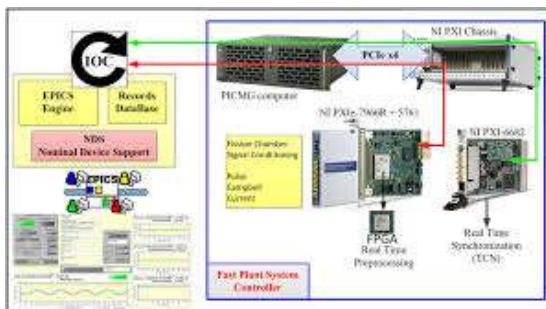




The UPM-I2A2 research group has dedicated facilities for the development of advanced instrumentation systems using most common industrial form factors such as MTCA, PXIe and cRIO. There is a specific area with Instrumentation and Control cubicles with industrial computers running ITER CODAC Core System, connected to MTCA , PXIe, and cRIO systems. These systems have high-speed data acquisition devices using XILINX and IntelFPGA devices with different I/O modules for signal and image processing.

I2A2 has all the software tools to develop applications for Artificial Intelligent and Machine learning in the Edge solutions applied to big science applications.

I2A2 is also an expert in the integration of hardware in EPICS. The infrastructure for software development is completed with all agile solutions using JIRA, and STASH.
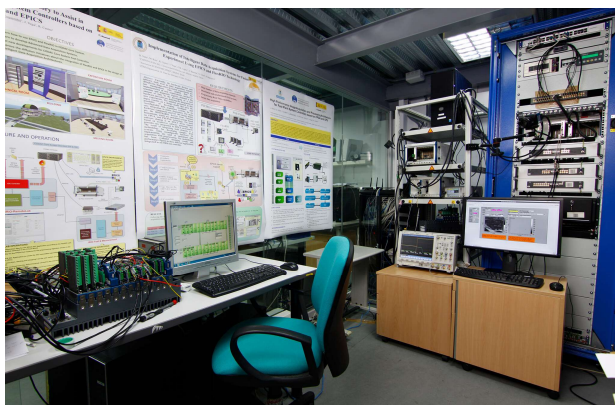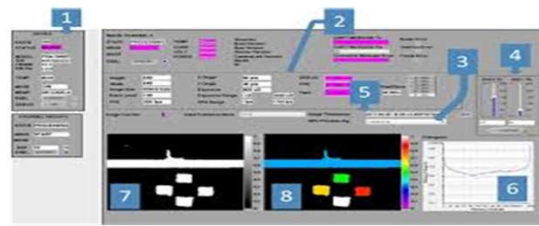
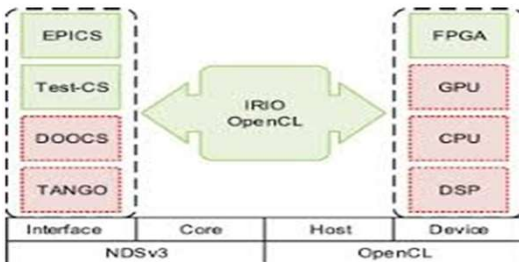# Research areas associated with Big Science

### ADVANCED DATA ACQUISITION AND PROCESSING SYSTEMS
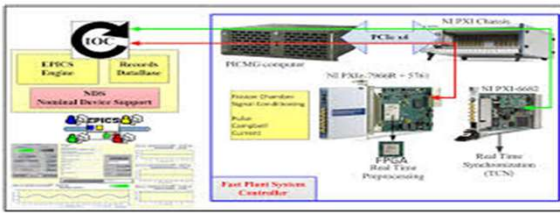


### INTEGRATION IN EPICS



### ADVANCED HETEROGENEOUS PLATFORM



### FPGA-BASED DAQ APPLICATIONS



## Main projects in Big Science

- *NDS CORE SOFTWARE SUPPORT FOR CODAC CORE SYSTEM (in collaboration with GMV Aerospace and Defense). Development and integration of standard device driver for ITER fast controllers in PXIe and MTCA.*
- *NDS DRIVERS FOR PXIE DEVICES DEVELOPMENT AND SUPPORT FOR CODAC CORE SYSTEM. Development and integration in CODAC Core System of PXIe timing and DAQ devices.*
- *ITER UPPER WAVS SENSORS, DATA ACQUISITION ELECTRONIS AND DATA ANALYSIS SOFTWARE PROJECT (in collaboration with Bertin Technologies and Princeton Plasma Physics Laboratory). Development of advanced image acquisition and processing for ITER upper WAVS.*
- *VALIDATION OF FAST INTERLOCK ARCHITECTURE. Development of the validation and verification solution for ITER fast interlock platform.*

## Collaboration with Large European Scientific Facilities

- *ITER: development of advanced data acquisition platforms for ITER fast controllers (CODAC and Interlock). Development and Integration of software with real-time applications and EPICS.*
- *JET: development and integration of Machine Learning applications for JET fusion device (in collaboration with CIEMAT and UNED).*
- *IFMIF: development of fast interlock solutions for IFMIF-EVEDA in collaboration with GMV Aerospace and Defense.*

## Software, tools or licenses to be applied to Big Science

- *Integration of advanced data acquisition systems in EPICS using open source tools.*
- *Nominal Device Support for ITER CODAC.*
- *Development of on the edge Artificial Intelligent solutions for big science applications using IntelFPGA-OpenCL SDK and XILINX-Vitis.*
- *Development and integration of embedded platforms using ACAPs, SoCs, and FPGA.*
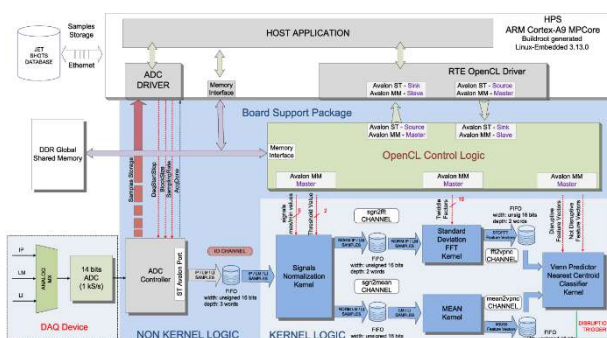


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