**Title** A software architecture for data acquisition, process and storage

**Abstract**

The control and data acquisition system is an important part of every modern physics experiment. As the boundaries of knowledge move forward, so do the requirements for these systems and this must be taken into account when designing them. Also, since experiments can span the course of several years or even decades, expansion and upgrade must also be considered. In fusion energy research it is common to view the sub-systems around the reactor as part of a whole and having the different tasks of configuration, control, data acquisition, data access and machine security as part of a unified system. Such a system is called a CODAC, standing for Control, Data Access and Communications. Typically they follow a hierarchical, tree-like structure and use proprietary technology.

This thesis is based on the work developed on the CODAC of COMPASS Tokamak, a medium-sized fusion research machine that was installed in Culham, UK, and was transferred to Prague, in the Czech Republic. The CODAC is based on the FireSignal system that is being used at the ISTTOK tokamak (Lisbon, Portugal) and was used in CASTOR, the predecessor of COMPASS in Prague. The operation of COMPASS is based on the ATCA control and acquisition boards developed on IPFN. When developing software and drivers for integrating diagnostics and actuators on the CODAC, it was necessary not only to take into account the physics behind them, but also the hardware capabilities. During this work, a real-time control system based on MARTe was successfully integrated, with parts of the operation being automated and data being transferred to the main database. Diagnostics such as reflectometry were also successfully integrated on the system, allowing operators to configure them on a common interface and automating the setup phase as much as possible. It was also necessary to develop database access tools that took into account the characteristics of COMPASS.

This thesis makes a broad analysis of CODAC design for physics experiments in general. Common challenges such as: increasing data volume, integration of faster electronics and new technologies; are taken into consideration to propose a structure that is more flexible and with expansion in mind.

**Keywords:** CODAC, real-time, data storage, signal query, scalability.