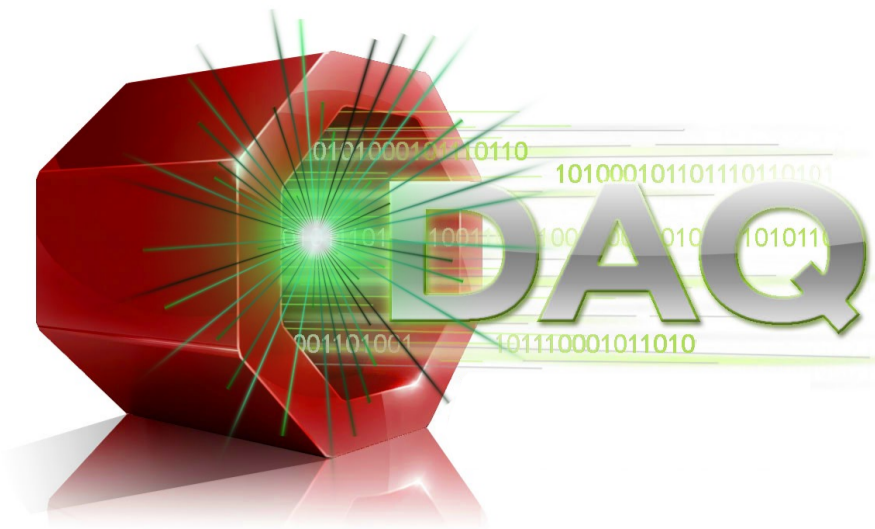# Orthos - an alarm system for the ALICE DAQ operations

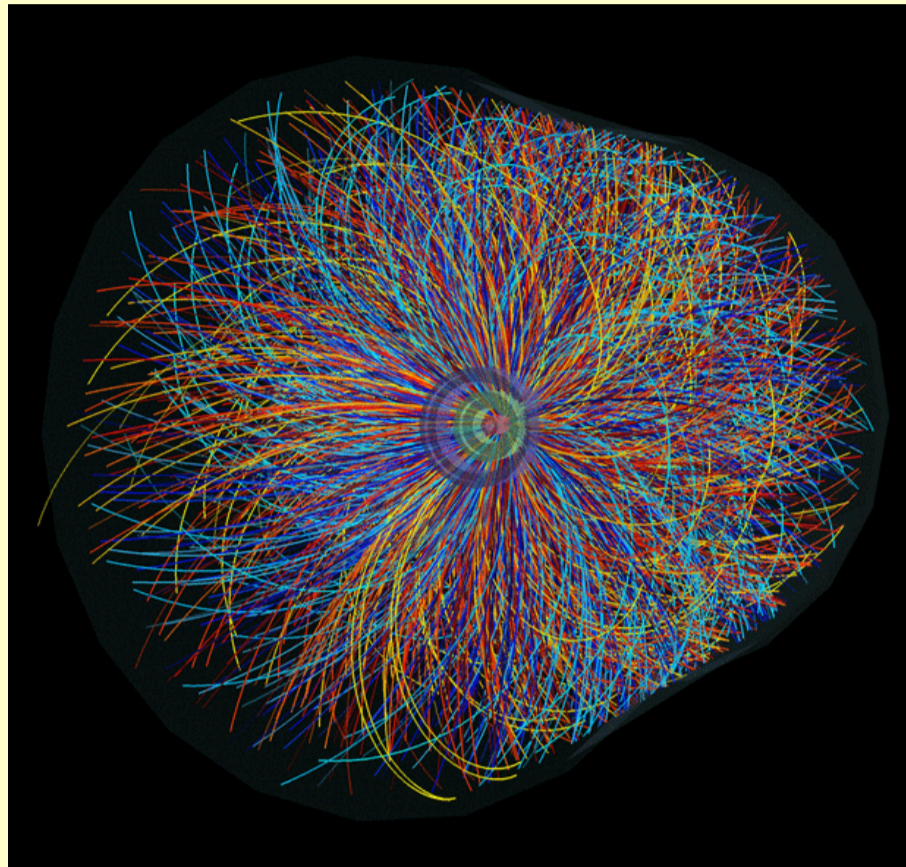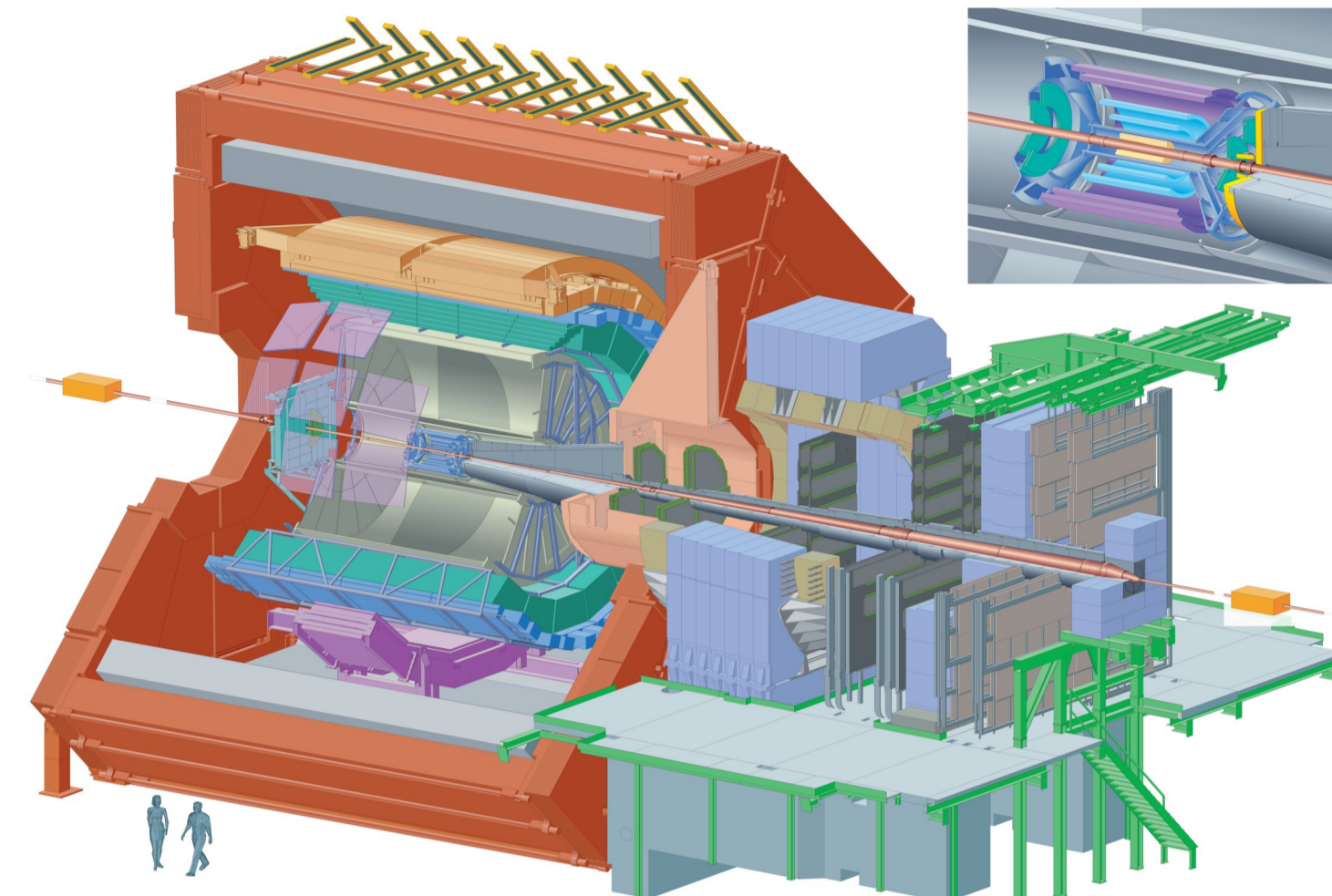## ALICE detector

ALICE is the heavy-ion detector designed to study physics of strongly interacting matter and the quark-gluon plasma at the at the CERN Large Hadron Collider.

The detector includes high resolution tracking (silicon detectors, large time-projection chamber), particle identification, and triggering elements. It features two large magnets, a main solenoid and a dipole on the Muon arm.

It primarily targets heavy-ion lead-lead collisions, but it also has a substantial physics program with proton-proton and proton-ion collisions.

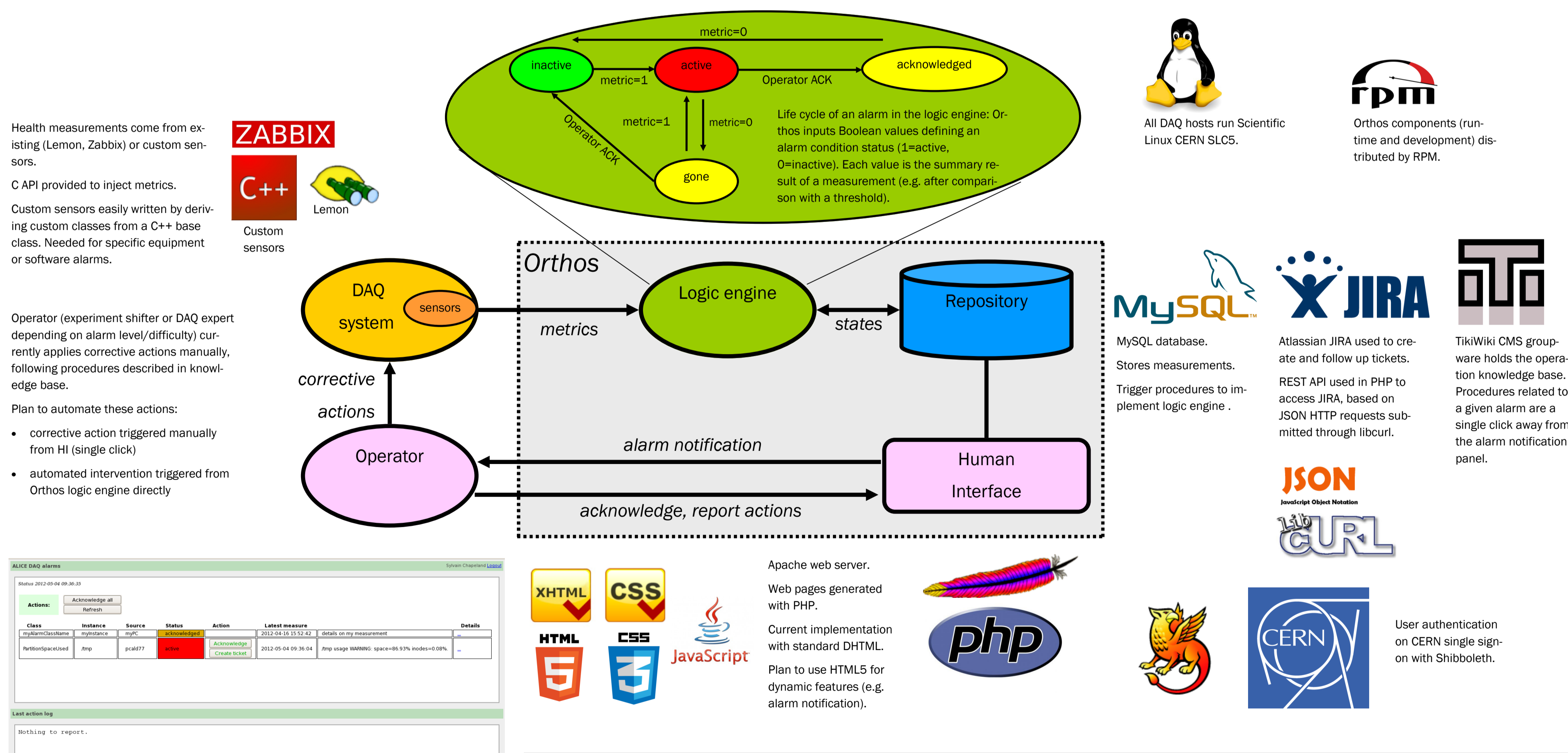*An example of lead ion collision as seen by ALICE*

The ALICE detector

ALICE data-acquisition system (DAQ)

The DAQ handles the data flow from the sub-detector electronics to the archiving on tape. It is capable of sustained recording rates of more than 3GB/s. In 2011, ALICE DAQ recorded 2.5PB of data to permanent storage.

The DAQ facilities currently consist of 480 PCs (servers and desktops), 423 RORCs (the PCI readout cards receiving data from detectors), 79 disk arrays, and 43 other devices (switches and power distribution units). This implies hundreds of hardware and software components susceptible to fail. Abnormal situations have to be detected, advertised, and fixed rapidly to maximize the data-taking time of the experiment.

Orthos, a toolkit to detect, log, report, and follow up abnormal situations

Orthos aims at providing a unified interface to raise alarms from the various DAQ components, and means for the operators to handle them. It brings together information and action flows. It interconnects monitoring, notification mechanisms, issue tracking system, and operations knowledge base.

Health measurements come from existing (Lemon, Zabbix) or custom sensors.

C API provided to inject metrics.

Custom sensors easily written by deriving custom classes from a C++ base class. Needed for specific equipment or software alarms.

Operator (experiment shifter or DAQ expert depending on alarm level/difficulty) currently applies corrective actions manually, following procedures described in knowledge base.

Plan to automate these actions:
- corrective action triggered manually from HI (single click)
- automated intervention triggered from Orthos logic engine directly

All DAQ hosts run Scientific Linux CERN SLC5.

Orthos components (runtime and development) distributed by RPM.

Life cycle of an alarm in the logic engine: Orthos inputs Boolean values defining an alarm condition status (1=active, 0=inactive). Each value is the summary result of a measurement (e.g. after comparison with a threshold).

MySQL database.

Stores measurements.

Trigger procedures to implement logic engine .

Atlassian JIRA used to create and follow up tickets.

REST API used in PHP to access JIRA, based on JSON HTTP requests submitted through libcurl.

TikiWiki CMS groupware holds the operation knowledge base. Procedures related to a given alarm are a single click away from the alarm notification panel.

Apache web server.

Web pages generated with PHP.

Current implementation with standard DHTML.

Plan to use HTML5 for dynamic features (e.g. alarm notification).

User authentication on CERN single sign-on with Shibboleth.

Example view of Orthos alarm display interface in a Web browser.

Plan to add email & SMS notification, and application for mobile devices.

List of alarm classes

The following groups of alarms have been defined, and cover most abnormal situations encountered in production:

low disk space, dead process, high temperature, detector event size out of limits, device hardware error, device conditions out of range, host down, wrong software installed, wrong software configuration, wrong user account settings, wrong hardware configuration, wrong process running, resource not available, low resource.