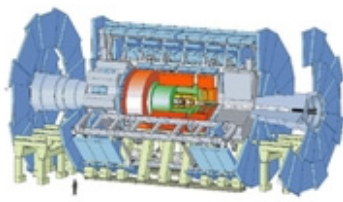




the ATLAS Experiment



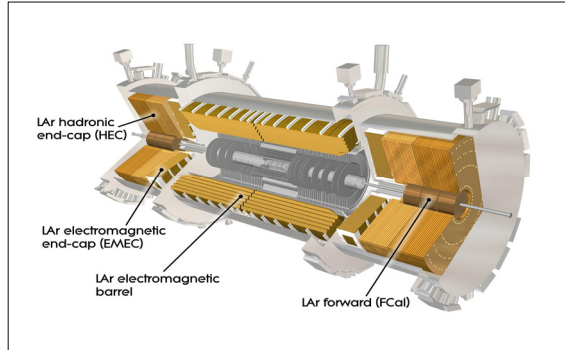
ATLAS Liquid Argon Calorimeter High Voltage System LHC Relative Luminosity Measurement

How to extract one of the most important parameters in a collider experiment using a system that wasn't primarily designed for it.

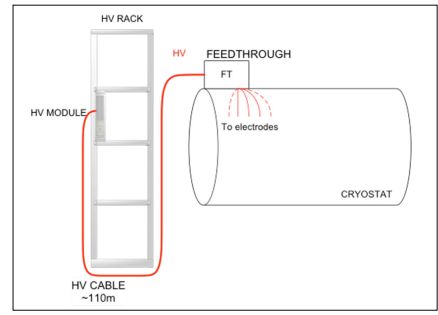
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1. The ATLAS Liquid Argon Calorimeter (LAr)

Its purpose is to measure the energy deposited by particles produced in LHC proton-proton interactions. Being the electromagnetic part of the ATLAS calorimetry system, its focus will be on high resolution energy measurement for electrons and photons, but it will participate in hadronic calorimetry as well (in the forward region).
The detection of charged particles, produced in electromagnetic showers, is similar to one of an ionization chamber. Particles pass through a liquid argon gap where an **electric field** is applied (typically 1kV/mm). The ionization of the liquid argon produces electron-ion pairs which drift in the field, inducing a signal that when measured is found to be proportional to the energy deposited by the incoming particle.



Artist view of the ATLAS liquid argon calorimeter



High Voltage feeding a calorimeter electrode

2. The High Voltage (HV) System

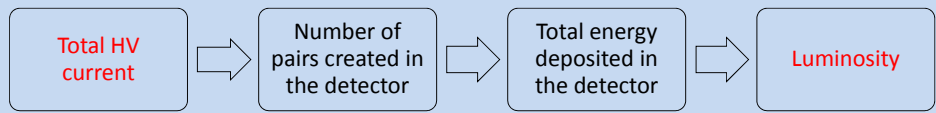
Provides a constant electric field in the liquid argon gaps of the calorimeter by compensating the charges created during the ionization process. Over 4700 HV lines feed the detector electrodes through ~100m cables into the three liquid argon cryostats (Barrel and two Endcaps).

The monitoring of each of these channels is part of the ATLAS Detector Control System (DCS) slow control infrastructure.

Published in 1996, the Liquid Argon Calorimeter Technical Design Report states: *"Monitoring the DC current not only provides a useful check of the correct operation of the detector but also should give a relative measure of the luminosity in the machine [...]"*.

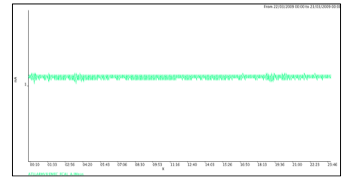
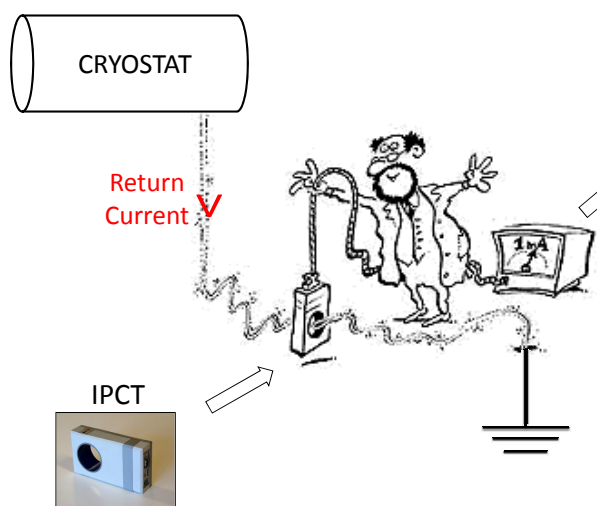
3. Principle of the measurement

Originally presented in a paper by W. Bonivento published in 2001 (*"Online luminosity monitoring with liquid argon calorimeters in ATLAS and D0"*, ATL-LARG-2001-001), the idea of the measurement is the following : the current induced in the detector's liquid argon gaps is proportional to the number of electron-ion pairs produced, therefore to the total energy deposited in the calorimeter, which is found to be proportional to the luminosity.



4. HV Currents measurements

-Incoming current : directly from the HV power supplies internal current meters. Allows high granularity.
-Outgoing current or **return current** : coming back from the cryostats ground. The current injected by the HV system to the detector returns to the ground. Measuring it using a pick-up coil (IPCT = **Integrated Parametric Current Transformer**) will provide alternative results at high sampling rate. Resolution is typically 10µA RMS per LAr partition (~1000 HV lines).



5. Luminosity

The variation of this current will give a relative measurement of the luminosity due to LHC collisions.
Comparisons will be done with the absolute luminosity measurement of the ALFA (Absolute Luminosity For ATLAS) experiment, as well as other luminosity measurements.