Cooling Consideration from CMS Experience

A. Hervé / ETHZ

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Introduction

- I have prepared this list at the request of Ron Settles.
- The general concept of ILD seems close enough from the CMS one, that some of the experience can be used directly.
- This is particularly true for fire protection and cooling (for example).

This has been prepared for discussion only.

I - CMS principles
that seems useful to be retained

- Active cooling of front-end electronics is *a must* especially in confined areas like Vacuum Tank.
- Temperature stabilization is needed as temperature dependence of sub-detectors is often neglected or known quite late, light detectors, RPCs, ….
- It is good practice that each sub-detector can be considered as an adiabatic, or isothermal enclosure wrt. its neighbors, that is each one is responsible for removing its own thermal flux.
- Air (or gas) cooling is very inefficient, it can be used *at best* to remove residual heat.

II - CMS principles that seems useful to be retained

- The inside of the vacuum tank is inaccessible, although its contains the heart of the experiment in terms of investment in time and cost. It *must* be protected against fire by maintaining an inert atmosphere (enriched in nitrogen) to quench any source of fire ignition.
- Thus, inside VT, gas cooling can only be natural convection. Cold sources must be provided by stabilizing in tempearture the Vacuum Tank itself or the HCAL absorber (for example).
- Liquid cooling is thus mandatory to extract the heat as near as possible from where it is created.
- Water as cooling fluid still seems to be the best choice.

ILD Considerations

- The cycling of power is a tremendous help for keeping the heat inventory as low as possible.
- This has also the advantage of limiting the section of cables and pipes reaching the inner detectors.
- However, I am worried by the consequence of cycling the accompanying Lorentz force at the same 5Hz frequency.
- This could be completely destructive for light detectors like Vertex, Tracker.
- This could also render the alignment and stability of sub-detectors very difficult to achieve.