

# A future for Computational Fluid Dynamic at CERN (?)

TS/CV/Detector Cooling - CFD Team  
TS workshop  
Archamps, France, May 24 – May 26, 2005

Michele Battistin





# From fluid dynamics to Computational Fluid Dynamics

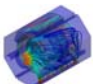
- What is CFD
- Industrial and CERN applications
- The CFD service team at CERN
- Opportunities
- What future for this team?



# Computational Fluid Dynamics

- ✓ Computational Fluid Dynamics (CFD) is an analysis of fluid flow, heat transfer and associated phenomena in physical systems using numerical methods.
- ✓ The basis of computational fluid dynamics is the reduction of the continuum differential equations describing the dynamics of the fluid (**Navier-Stokes + mass and energy conservation equations**) into a system of algebraic equations at a finite number of "grid" points, and the solving of the equations at these limited number of points only.

CFD is developing fast in many industry fields



# A wide range of application fields

Aerospace

Automotive

Biomedical

Buildings

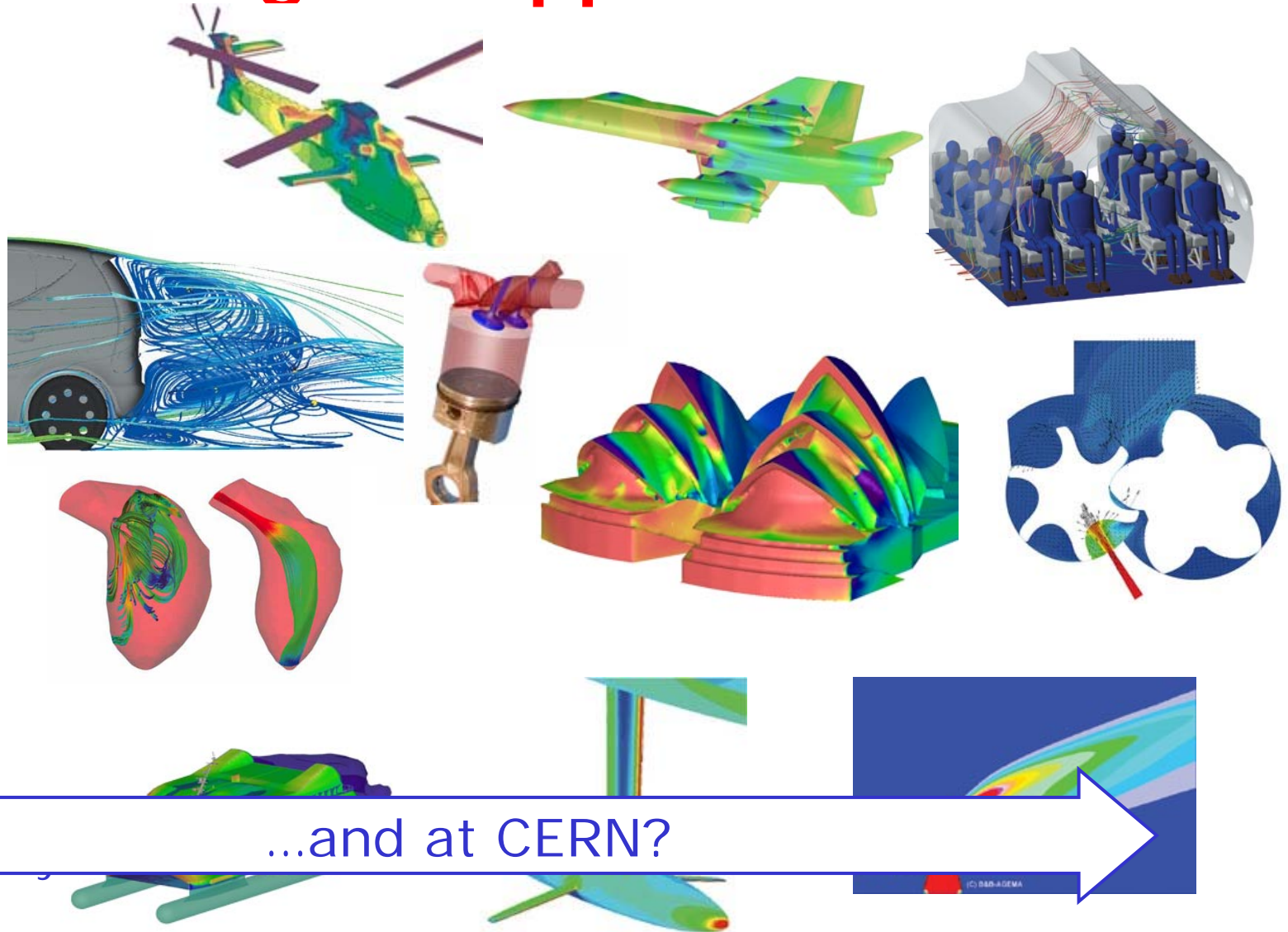
Chemical

Environment

Marine

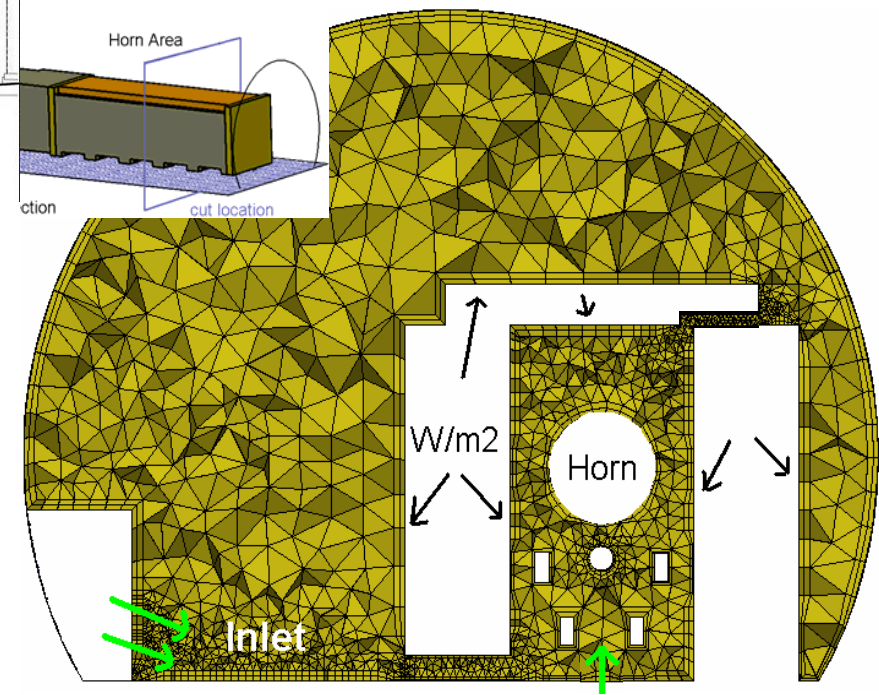
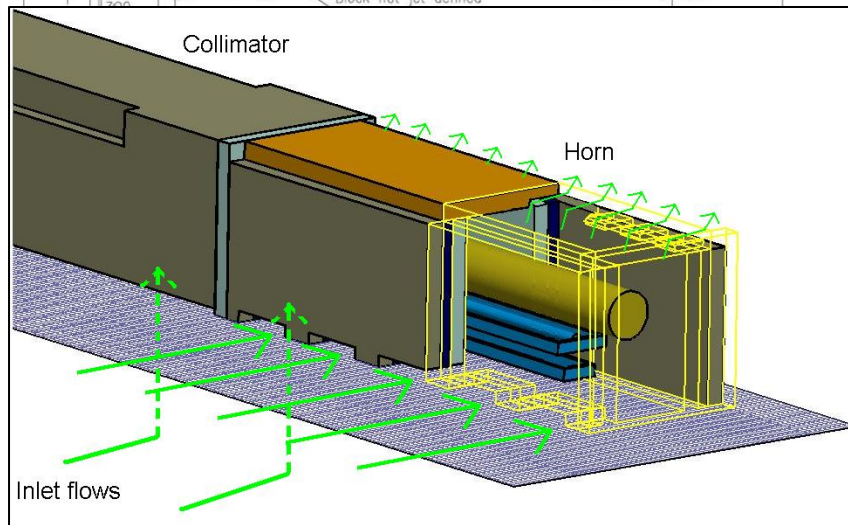
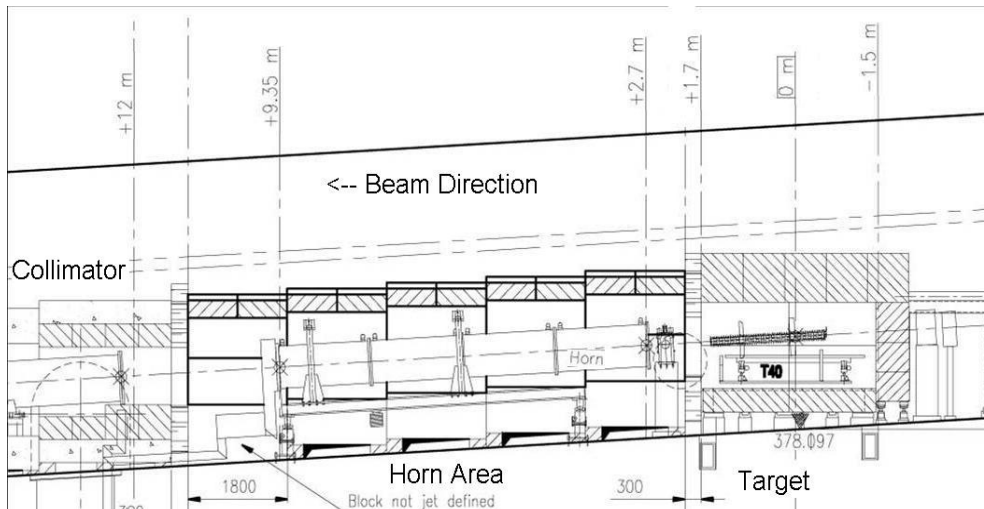
Power gen.

Turbomachinery



# CNGS Horn Air Cooling

Particle energy deposition heats up the horn and its shielding structure



CFD simulations helped to decide modifications even during the construction phase

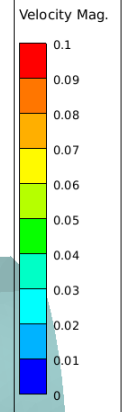
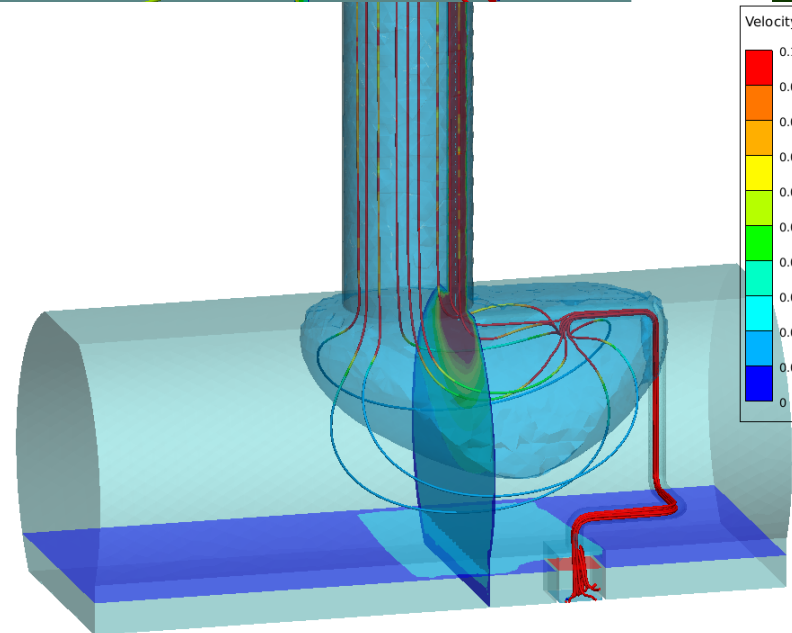
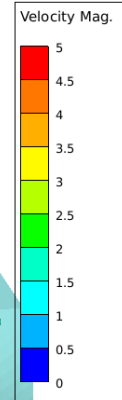
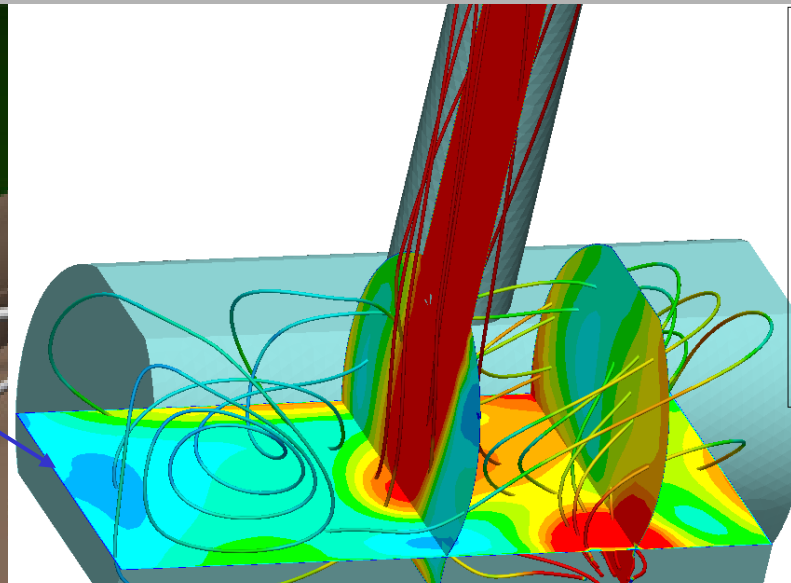
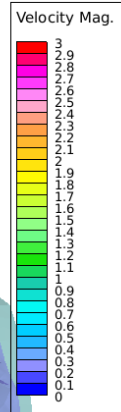
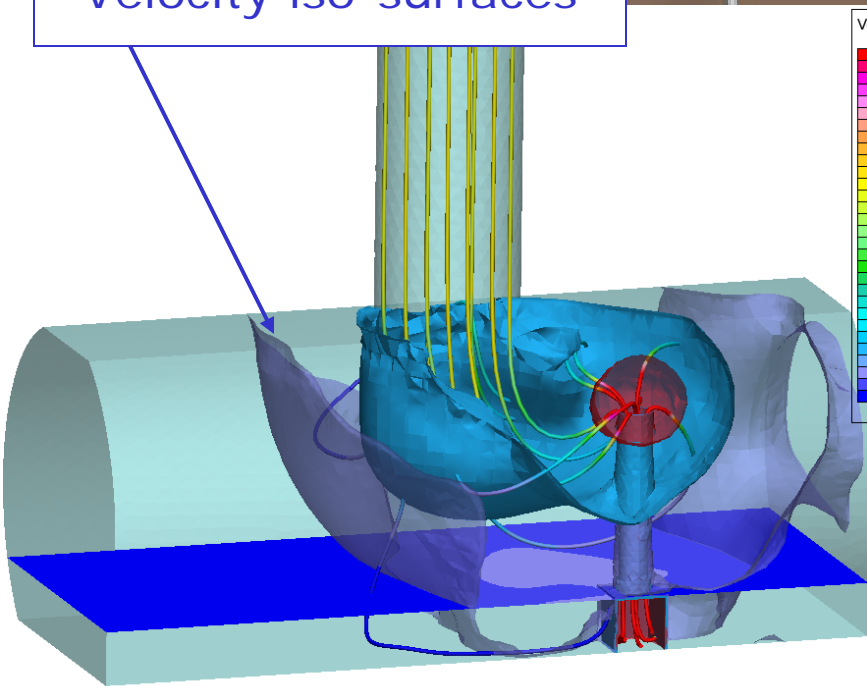


# CERN NEUTRINOS TO GRAN SASSO Underground structures at CERN

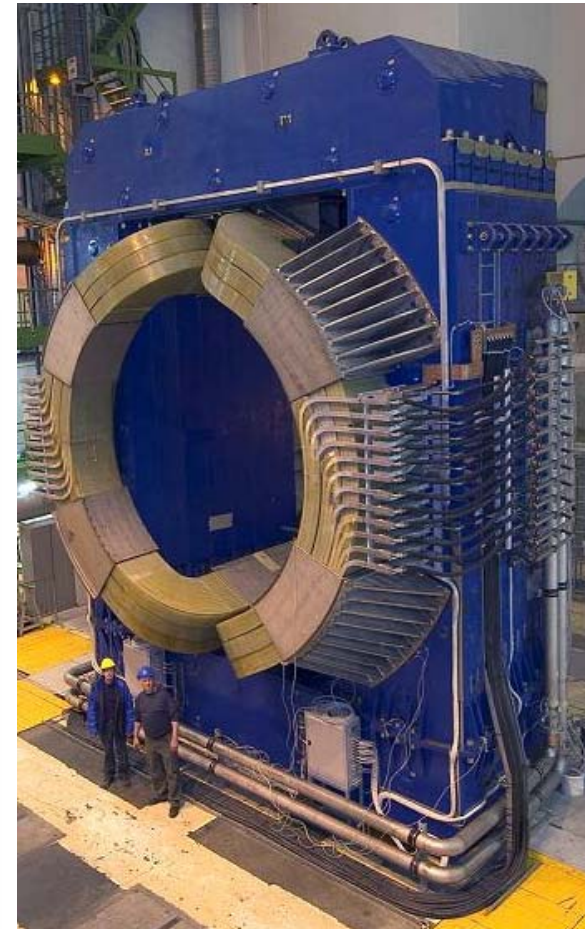
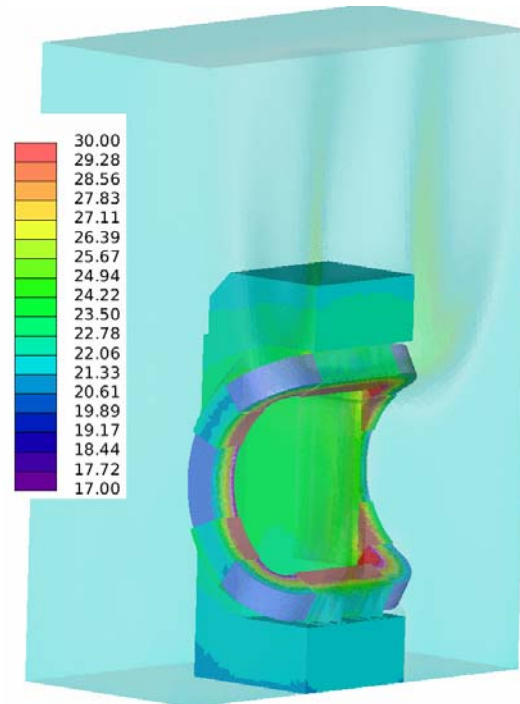
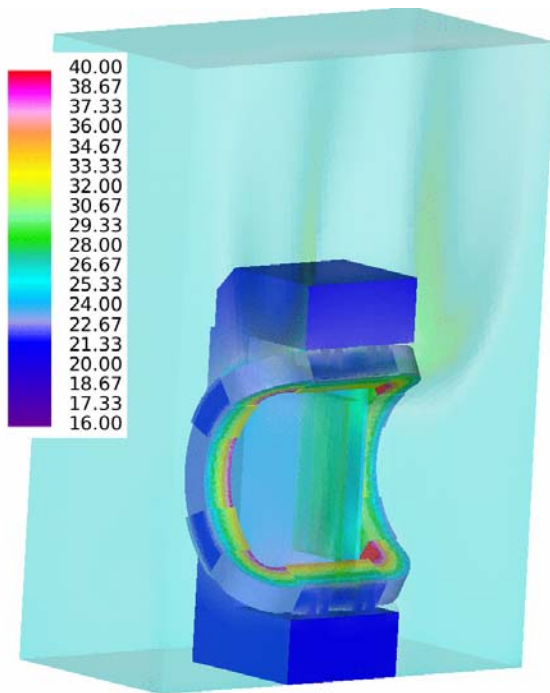
- Excavated
- Concreted

Cavern floor: where some person could be present

Velocity iso-surfaces

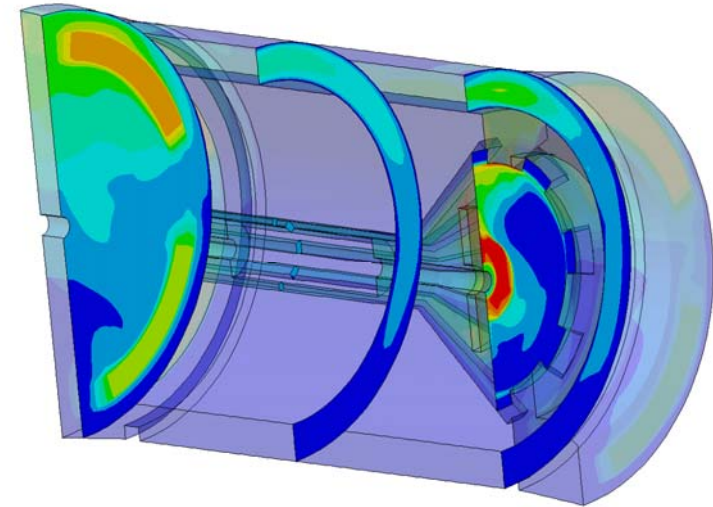
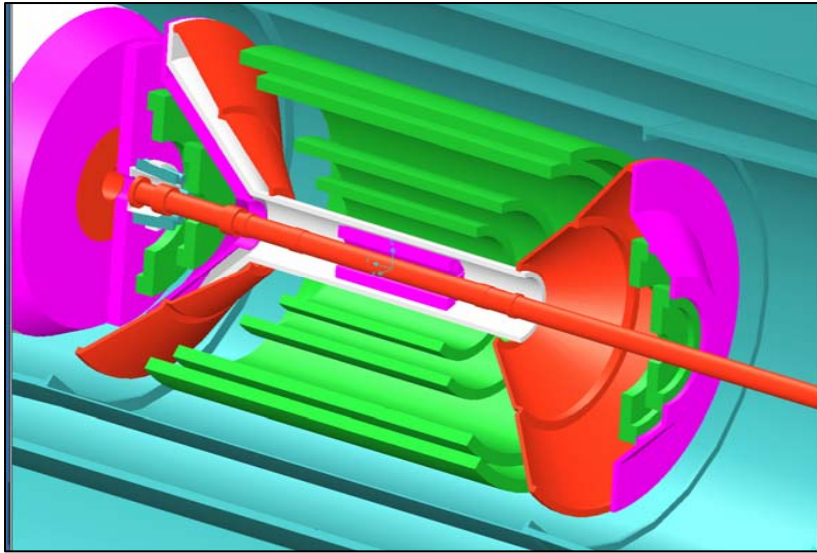


# Alice Muons Detector heat transfer





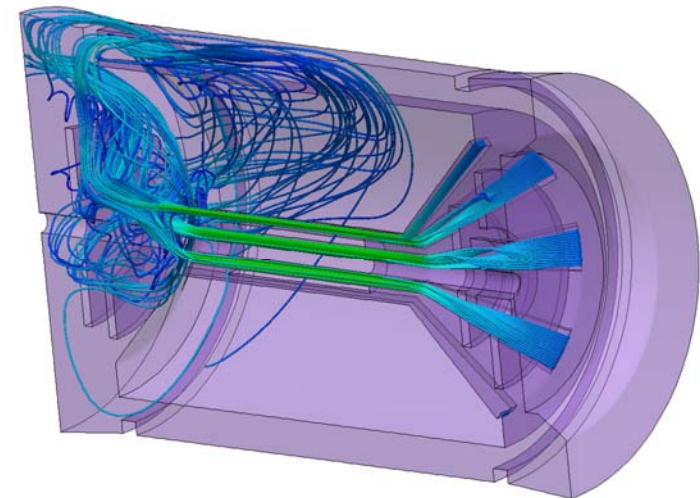
# Alice ITS: no time for prototypes

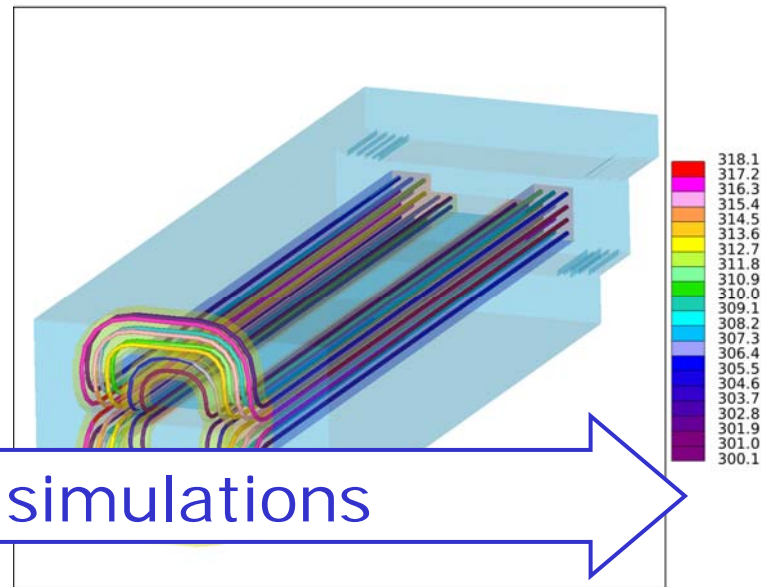
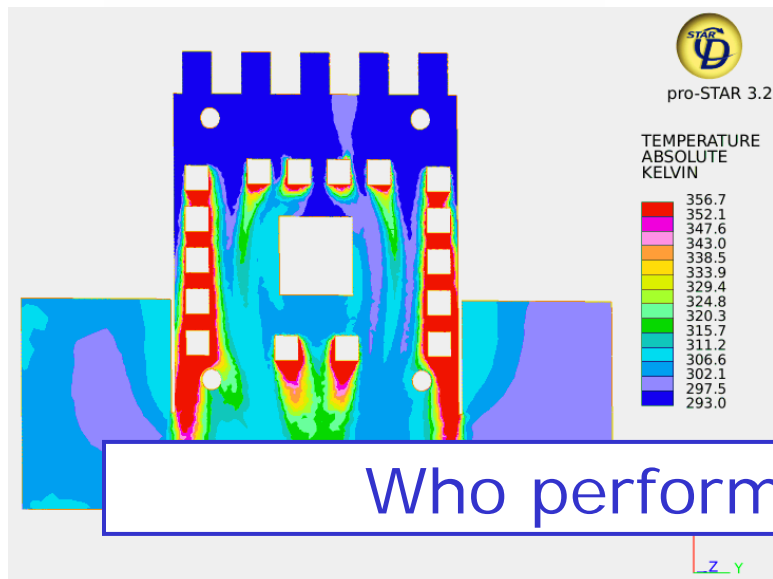
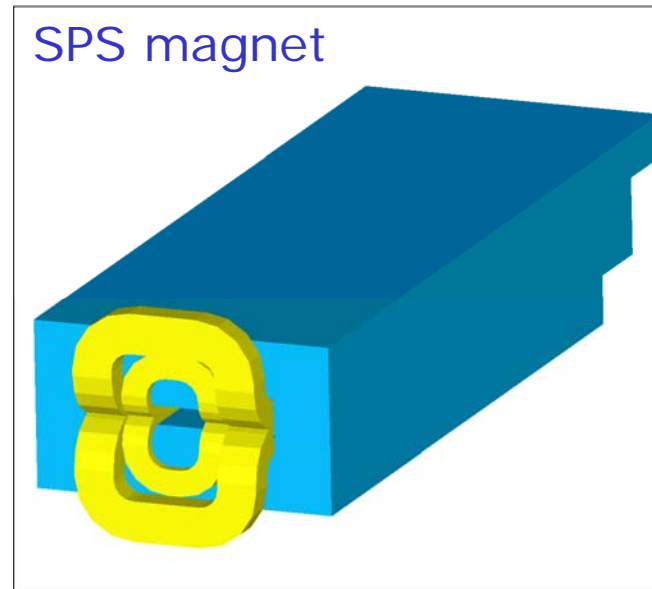
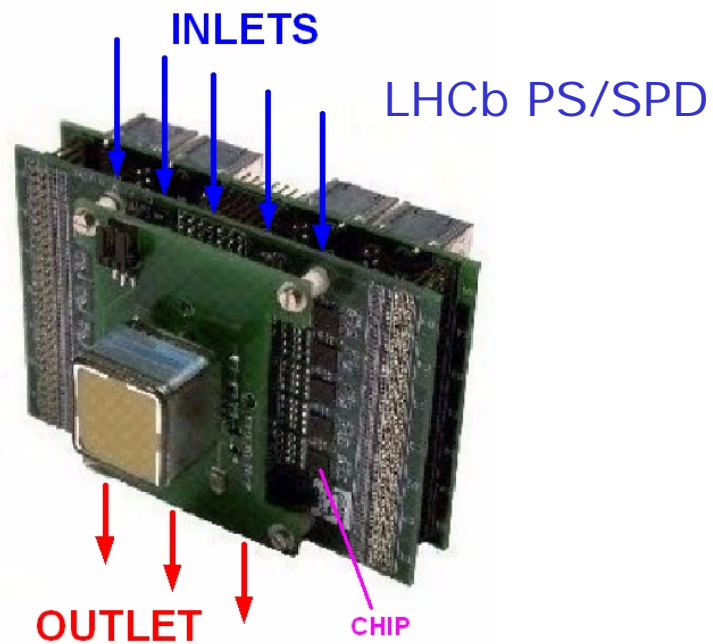


At CERN, most of the times, the final system is the prototype.

CFD can provide insight into fluid flow problems when experimental techniques are too expensive or physically impossible.

The Alice, ATLAS and CMS Inner Trackers are good examples.

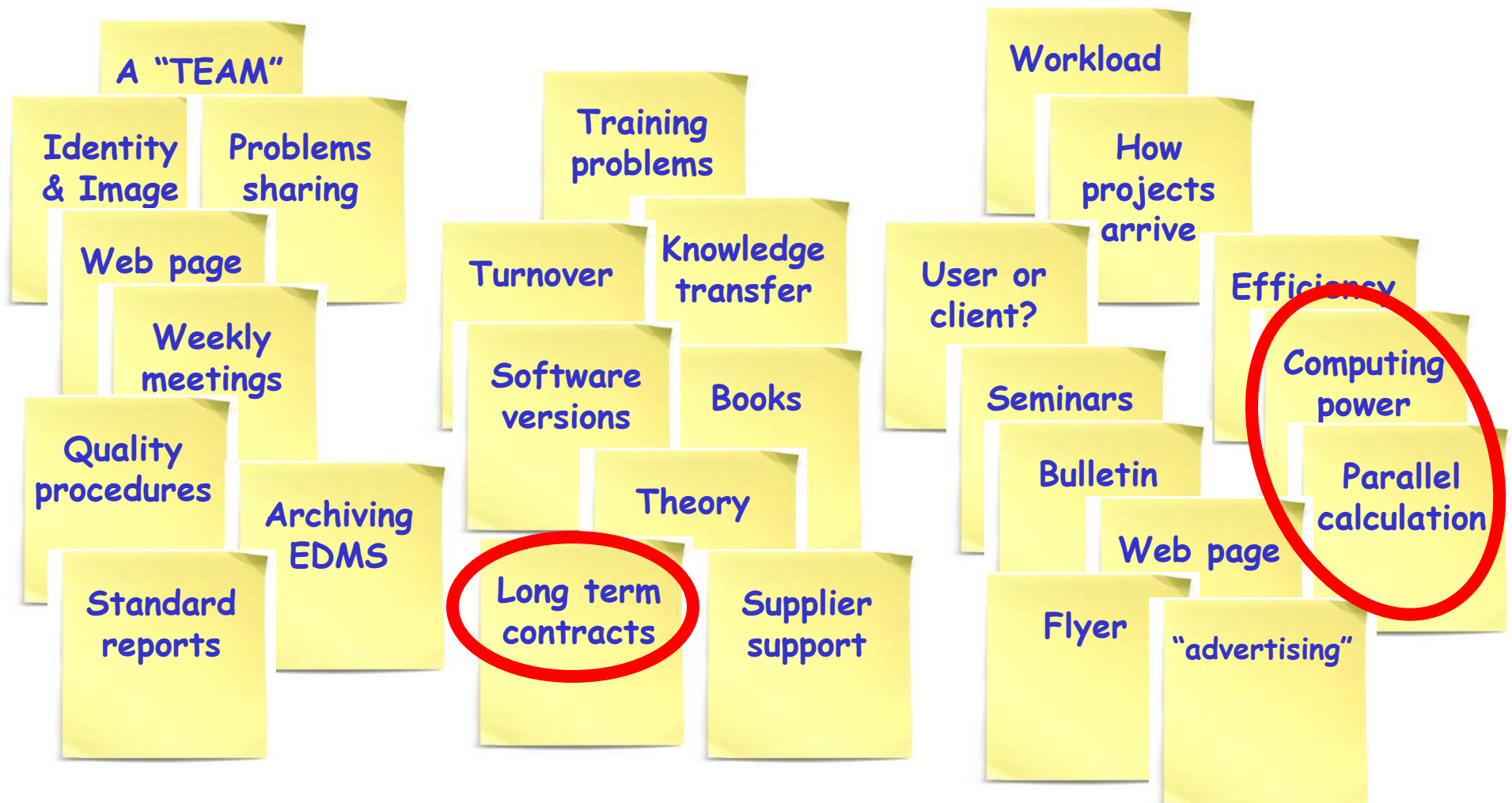




Who performs these simulations



# ...a new team... and its opportunities



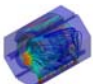
# Computing power IS the limiting resource of CFD

- LxParc (6 DP machines)
- OpenLab tests
- 20 Itanium 64 bit DP machines cluster
- 20 kCHF to improve ~8 times the calculation speed
- **IT could support the implementation of CFD on GRID**



The Grid will become soon THE natural calculation environment for CFD applications.

CERN CFD team could have the opportunity to run simulations in this environment with an important advance and advantage over the industry!



# Experience and continuous training

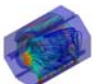
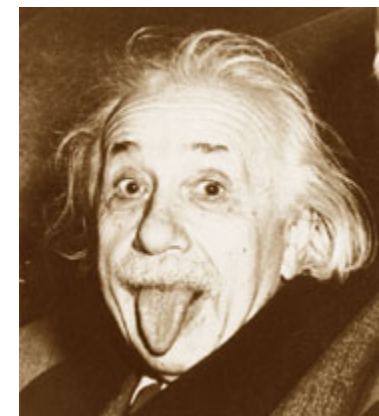


High turnover doesn't allow knowledge consolidation

Induction training:  
Technical students  
Spanish & Portuguese programs  
Project Associates  
Doctoral Students  
Fellows

An important competence on this field can be achieved only with a **long term training strategy** which unfortunately is not compatible with the present nature of contracts of the team members!

**In order to maintain at least the CFD framework a dedicated staff position with the mandate of technical coordination of the team is required!**





pro-STAR 3.2

TIME = 320.000  
LOCAL MX= 97.95  
LOCAL MN= 16.99

