

The U.S. CMS Software and Computing Project: View From the CMS PRS Groups

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What Are the PRS Groups?

The PRS groups are responsible for:

- Simulation tools (GEANT3, GEANT4, and fast mc)
- C++-based code for detector and physics object reconstruction (ORCA)
- Calibrating detectors and physics objects
- Designing higher-level trigger (HLT) and
- Designing offline algorithms for physics objects
- Developing trigger tables
- Developing offline physics
- Simulating staging scenarios and other emergency

Organization of PRS Groups

Subgroups of both the CPT (computing, physics, and trigger) group and the detector groups.

4 PRS groups

- **HCAL/jet/MET**
S. Eno (U. Maryland), S. Kunori (U. Maryland)
- **ECAL/e/gamma**
C. Seez (Imperial)
- **Tracker/b/tau**
M. Mannelli (CERN), L. Silvestris (U. Bari)
- **Muon/muon**
U. Gasparini (U. Padova), D. Acosta (U. Florida)

Organization of PRS Groups

U.S. Participation

- **HCAL/jet/MET**: MD, Wisconsin, Iowa, Texas Tech, Iowa State, 19 active physicists world-wide, _ In US.
- **ECAL/e/gamma**: CalTech, Minnesota.
- **Tracker/b/tau**:
- **Muon/muon**: Florida, UCLA, UCR, UC Davis.

Our Milestones

- **Complete online selection for low-luminosity: Dec 2001**
- Determine calibration methods and samples: Mar 2002
- Data rates, data formats, online clustering: Mar 2002
- Complete online selection for high-luminosity: Jun 2002
- CPU analysis of online selection: Jun 2002
- **DAQ TDR ready (PRS part): Sep 2002**
- DAQ TDR submission (DAQ milestone) Nov 2002
- **have GEANT4 fully developed: end 2002**
- **produce physics TDR: mid 2004**

What We Currently Use From US S&C

- 1) User Support (advice, help, etc)
- 2) User Computing
- 3) Very Large Scale Monte Carlo Productions
- 4) CORE Software
- 5) Nucleus for US efforts



User Support



Best support group I've ever worked with!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Can not say enough good things!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

They listen!

They don't tell you what they have, and ask if you are interested, they listen to what you need, and see how they can provide it.

User Support

- Provide training to new users via workshops
- Provide one-on-one training to new users and answer naïve questions of new users via email
- Help set up computing facilities at home institutions
- Help debug code when nobody else is available
- Provide C++ expertise
- Timing studies for Production jobs
- Web page support (jet/met page is served from FNAL)
- Book keeping support, documentation support
- **Whatever you want!!!**

User Support

Especially the Jet/Met group has benefited greatly from support from FNAL and also Caltech.

User Computing

The Jet/Met group has scientists at MD, CERN, Hungary, Turkey, Finland, and Russia that have used computers at FNAL for “analysis” computing. (The other PRS groups mostly compute at CERN). Most of these groups are too small to support their own computing at their home institutions. This is not likely to change in the near-term future. I suspect it will remain important throughout the life of the experiment.

This resource has been essential to our work

Complaints –

Purchasing needed hardware takes a long time! We have been told that there will be a linux “user” cluster soon for a long time now.

Production: Needs

Need: Frequent (!!) large scale Monte Carlo productions for trigger rate studies, staging studies, algorithm development

Production: History

Fall 99 – large scale production of high luminosity MC. 1×10^6 events, GEANT stage done at CERN, Caltech, Wisconsin, ORCA-ization done at CERN.

- no pthat information (for branson weights)
- sequential pileup
- small pileup sample (only 10000 events)
- only intime pileup (wrong GEANT time step size, caused problem HF for out-of-time pileup)
- HF towers were summed in E, then converted to ET, instead of summed in ET
- etc etc...

In spring 2000, we remade the min bias and signal samples using ORCA 4.2.0. This fixed problems 2-4, but left problem 1,5

Production: History

Fall 2000

Tried to redo production. Started at CERN, but they could not finish it. FNAL took over most production for the HCAL/Jet/Met group. The HCAL/Jet/Met group also uses facilities elsewhere (Russia, Britain, Finland). The other groups mostly do their production elsewhere. FNAL did not finish the production (neither did any place else). In August, we switched to doing low luminosity production. FNAL finished the low luminosity production by the end of September.

Next large production starts Jan, 2002

Production: Conclusions

The US production team is as good as CERN's. However, production is difficult because

- 1) Large number and size of events
- 2) Large pileup makes processing difficult
- 3) My impression is a wide variety of “unexpected” problems cause big delays (running out of tapes, bandwidth between machines, etc etc etc)

We will miss our milestone for the DAQ TDR if the production in January fails or is delayed. We need more manpower working in this area. Especially, people to deal with “unexpected” hardware problems/limitations.

Production

It is absolutely clear that the flexibility that comes with having the production distributed over the globe, and a large number of production centers will be essential to the success of the LHC. When one center fails, the others pick up the slack. However, this is a difficult task, and needs more manpower to be successful.

CORE Software

We still have need for good CORE software engineers:

Data is still difficult to access. Impossible, for example, to access full generator-level pileup information in next production (and very difficult in past productions).

Still, we lack people with C++ experience, and will need much experienced people to help train

Also, to take calorimetry as an example:

- absence of Calo-responsible person and proper maintenance;
- Calo software in ORCA should be rewritten at some point;
- persistency issues requires some care, especially in the light of possible future move in the direction other than

Nucleus for US Efforts

Times are different than they were... Timescales for experiments are very very long. But, the organization of U.S. experimental physics not only hasn't changed, its actually moved in the wrong direction...

- 1) Its impossible for young faculty to work on CMS, because their tenure depends on the votes from other non-hep faculty, who don't understand long time-scale experiments.
- 2) DOE is decreasing, not increasing the number of Research Scientists based at Universities.
- 3) For some completely incomprehensible reason, FNAL also will not hire physicists to work on algorithm development, "physics" for CMS, etc.

Nucleus for U.S. Efforts

If the U.S. wants to play a major role in CMS physics, they should build a team of physicists in the U.S. **now**. The algorithms are being developed now. The analysis strategies are being developed now.

FNAL now:

- 1) Dan Green
- 2) Pal Hidas (on 1.5 year loan from Hungary)
- 3) A 1 year Bulgarian visitor will replace Pal when he leaves).
- 4) A small group at FNAL does do some physics but for some reason they do not interact with the PRS groups. I think it essential to hire a group of maybe 4 full time physicists at FNAL to pave the way for future US analysis effort (or, give them to me at MD ;)).

Other S&C Involvement in PRS

Software Engineer at UCDavis working on detector description (part of our simulation charge)

Things From S&C We Don't Use

We don't use the analysis tools that are being developed directly (maybe use "tags" in the objectivity data base?)

I don't foresee using them for the DAQ TDR. Hopefully for the physics TDR.

Conclusions

- 1) U.S. S&C has a strong team
- 2) It has the right focus, understands the problems, and is definitely “customer” centered.
- 3) But, they need more manpower
- 4) I wish somehow the problem of physicists for algorithm development, etc, could be addressed.