Maintaining and improving the training program on the analysis software in CMS

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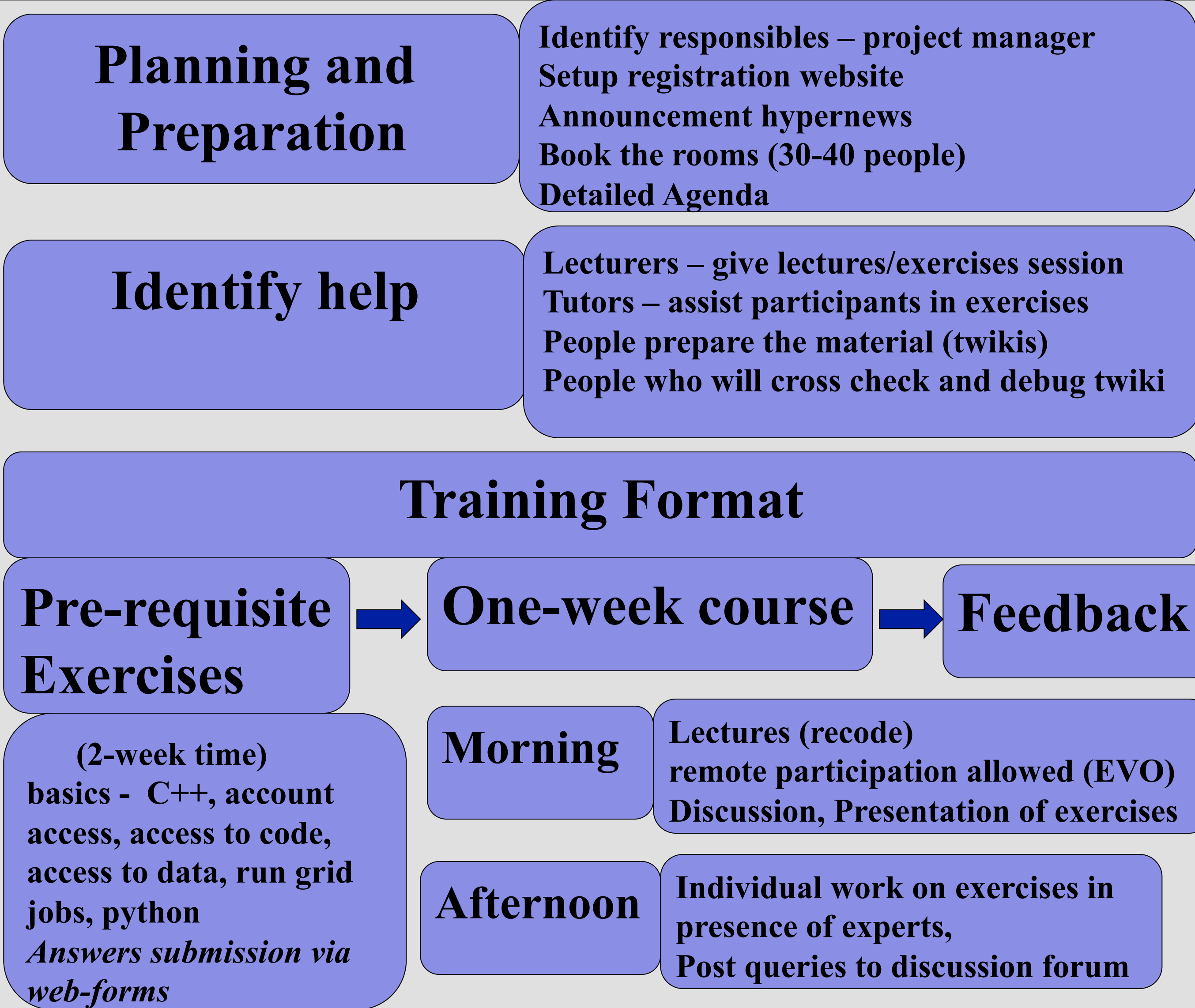3. Helsinki Institute of Physics, Finland

CMS and challenges

- Large size of the CMS community (3500 users)
- Geographical spread (5 continents)
- Distributed computing resources (200 institutes) countries)
- Multiple time zones
- Logistics and financial constraints
- Complex software and analysis tools
- Tap physics potential of every user

Meeting the challenge

- Organised effort to support, engage users in analysis
- CMS Physics Support leads this effort
- CMS instituted extensive training program
- 1-day hands-on-sessions (grid, statistical tools, python, events visualisation), Physics Analysis Toolkit(PAT) Tutorials – 1-week, Data Analysis Schools – 1-week, By experts from CMS, Collaborative spirit
- LHC Physics Centres Worldwide
  ➢ Fermilab (LPC), DESY (Terascale), CERN (LPCC)

Organisation and Training Workflow of PAT training

Planning and Preparation
Identify responsibles – project manager
Setup registration website
Announcement hypernews
Book the rooms (30-40 people)
Detailed Agenda

Identify help
Lecturers – give lectures/exercises session
Tutors – assist participants in exercises
People prepare the material (twikis)
People who will cross check and debug twiki

Training Format

Pre-requisite Exercises → **One-week course** → **Feedback**

(2-week time)
basics - C++, account access, access to code, access to data, run grid jobs, python
Answers submission via web-forms

Morning
Lectures (recode)
remote participation allowed (EVO)
Discussion, Presentation of exercises

Afternoon
Individual work on exercises in presence of experts,
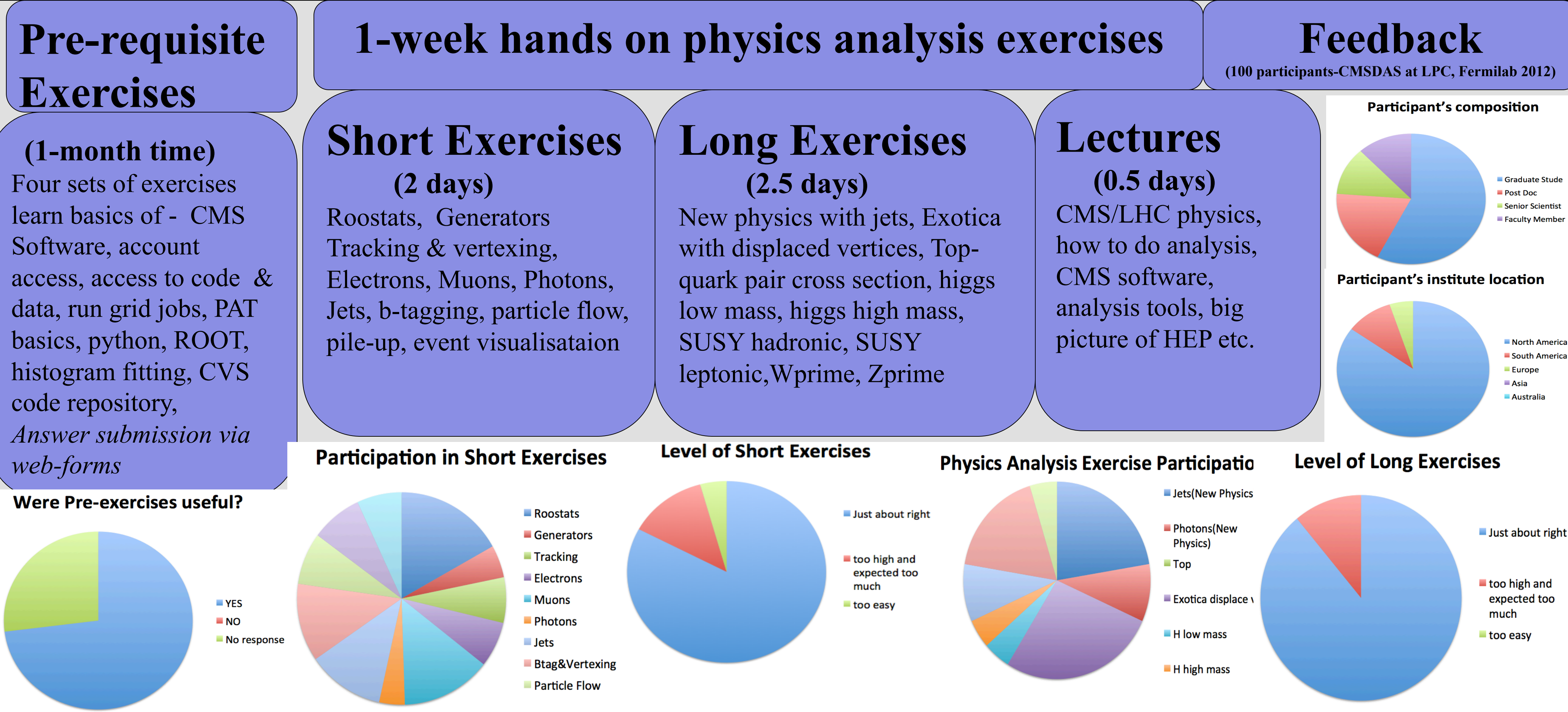Post queries to discussion forum

Improvement and evolution of training

- 12 PAT tutorials organised in last 3 years based on popular demand, frequency 2-3 times/year
- Pre-requisite exercises were added after feedback and experience (participants come well prepared)
- The PAT training format extended to apply new learned methods to a real physics/analysis case
- PAT format was applied to CMS Data Analysis School (CMSDAS), hands on physics analysis learning
- CMSDAS started in 2012 is an evolution of one-week workshop JTERM – an analysis and software tutorials held at Fermilab (U.S.A.) since 2006
- CMSDAS have been held in U.S.A(Fermilab), Italy (INFN,Pisa) and future ones in Taiwan (NTU) and Brazil (UNESP)
- Trained over 800-1000 CMS users in last 3 years

CMS Data Analysis School Format

Pre-requisite Exercises

(1-month time)
Four sets of exercises learn basics of - CMS Software, account access, access to code & data, run grid jobs, PAT basics, python, ROOT, histogram fitting, CVS code repository,
Answer submission via web-forms

1-week hands on physics analysis exercises

Short Exercises
(2 days)
Roostats, Generators
Tracking & vertexing, Electrons, Muons, Photons, Jets, b-tagging, particle flow, pile-up, event visualisataion

Long Exercises
(2.5 days)
New physics with jets, Exotica with displaced vertices, Top-quark pair cross section, higgs low mass, higgs high mass, SUSY hadronic, SUSY leptonic,Wprime, Zprime

Lectures
(0.5 days)
CMS/LHC physics, how to do analysis, CMS software, analysis tools, big picture of HEP etc.

Feedback
(100 participants-CMSDAS at LPC, Fermilab 2012)

Participant's composition

Participant's institute location

Were Pre-exercises useful?

Participation in Short Exercises

Level of Short Exercises

Physics Analysis Exercise Participation

Level of Long Exercises

LHC Physics Centers

CMS - new paradigm – many scientist in CMS not located at host lab (CERN), but face-to-face interaction still remain indispensible. In this scenario, the role and efficacy of a remote regional centre can hardly be overemphasized. Three LHC regional centres have come up in last few years, they are accessible to all CMS members

- **LHC Physics Centre (LPC) at Fermilab** - regional centre US CMS collaboration (700 members), vibrant community of physics object, algorithms, simulation experts, theory experts, Tier-1 computing centre, Remote Operation Centre for real time connection to CMS, hosts conferences, analysis schools and workshops
- **LPCC (LHC Centre) at CERN**, epitomizes initiatives to support LHC physics program. organisation of Workshops, development of event generators and other physics tools, corresponding web pages, serve as portal into LHC physics resources for the whole HEP community, EP/PP/LPCC seminar, LPCC students' lecture and LHC
- **Terascale Center at DESY** (Germany) bundles the German activities in high-energy collider physics - 18 universities, two Helmholtz Centres and one Max Planck Institute, alliance works new accelerator and detector technologies, methods of data analysis, theoretical models development of the relevant computing infrastructure

Conclusion

- CMS training program a success model
- Growing stronger and evolving
- PAT and CMSDAS epitomize these efforts
- Motivated team formed around training
- Makes CMS documentation robust
- 800-1000 people trained
- Made impact in engaging collaboration to contribute to physics
- Synergy between training and growth of LHC Physics Centres
- LHC centres act as training hubs, catalyst for physics learning and mutual exchange of new ideas