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Context: LHC & CMS

Investing in the future

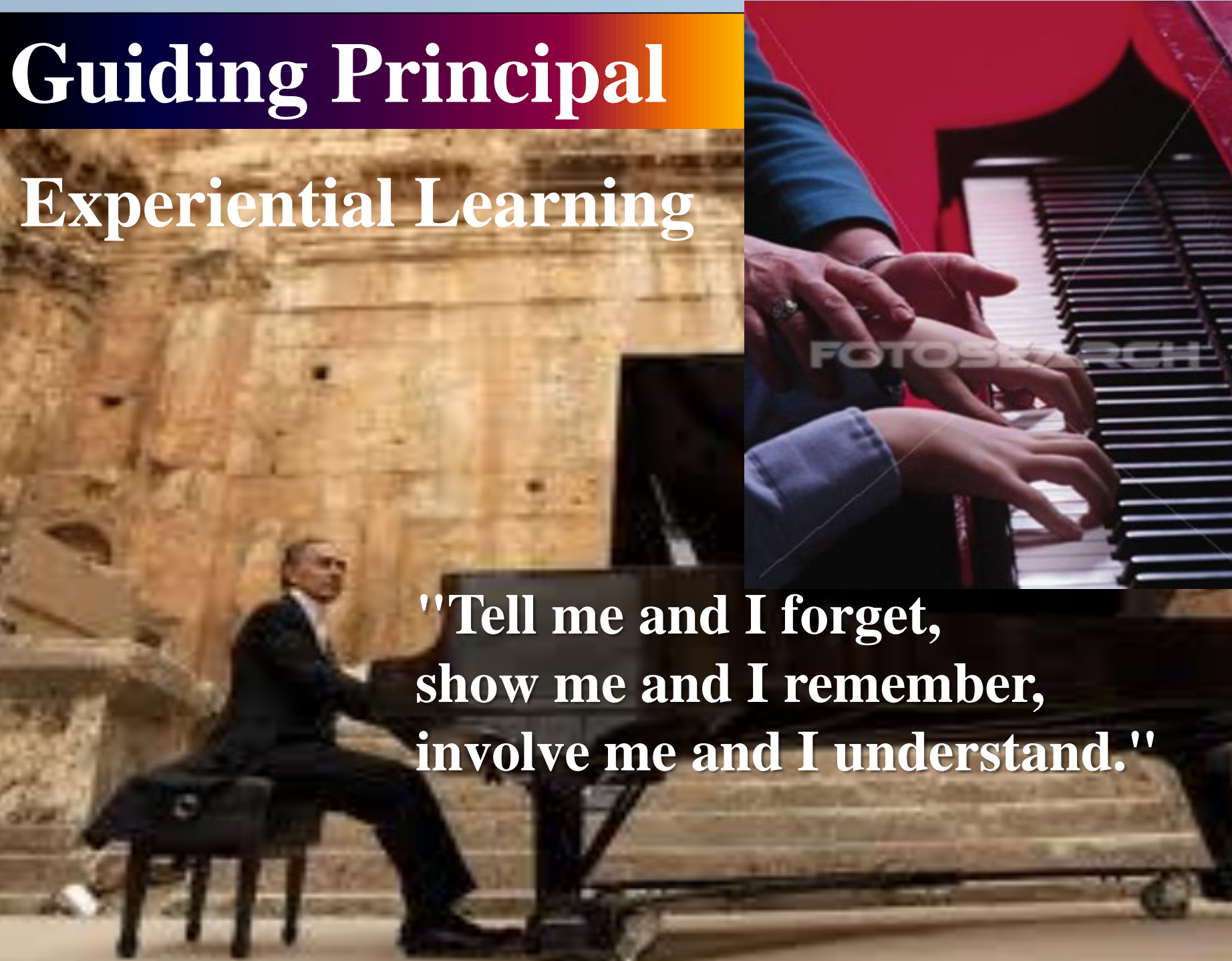
- Large Hadron Collider (LHC) at CERN is a global phenomena and CMS experiment at LHC has a large community (3500 users)
- Geographical spread (5 continents), Distributed computing resources, (200 institutes, 50 countries)
- Multiple time zones, Logistics and financial constraints
- Complex software and analysis tools
- Engage users in the development of physics, upgrade, education of new comers and career development of young people



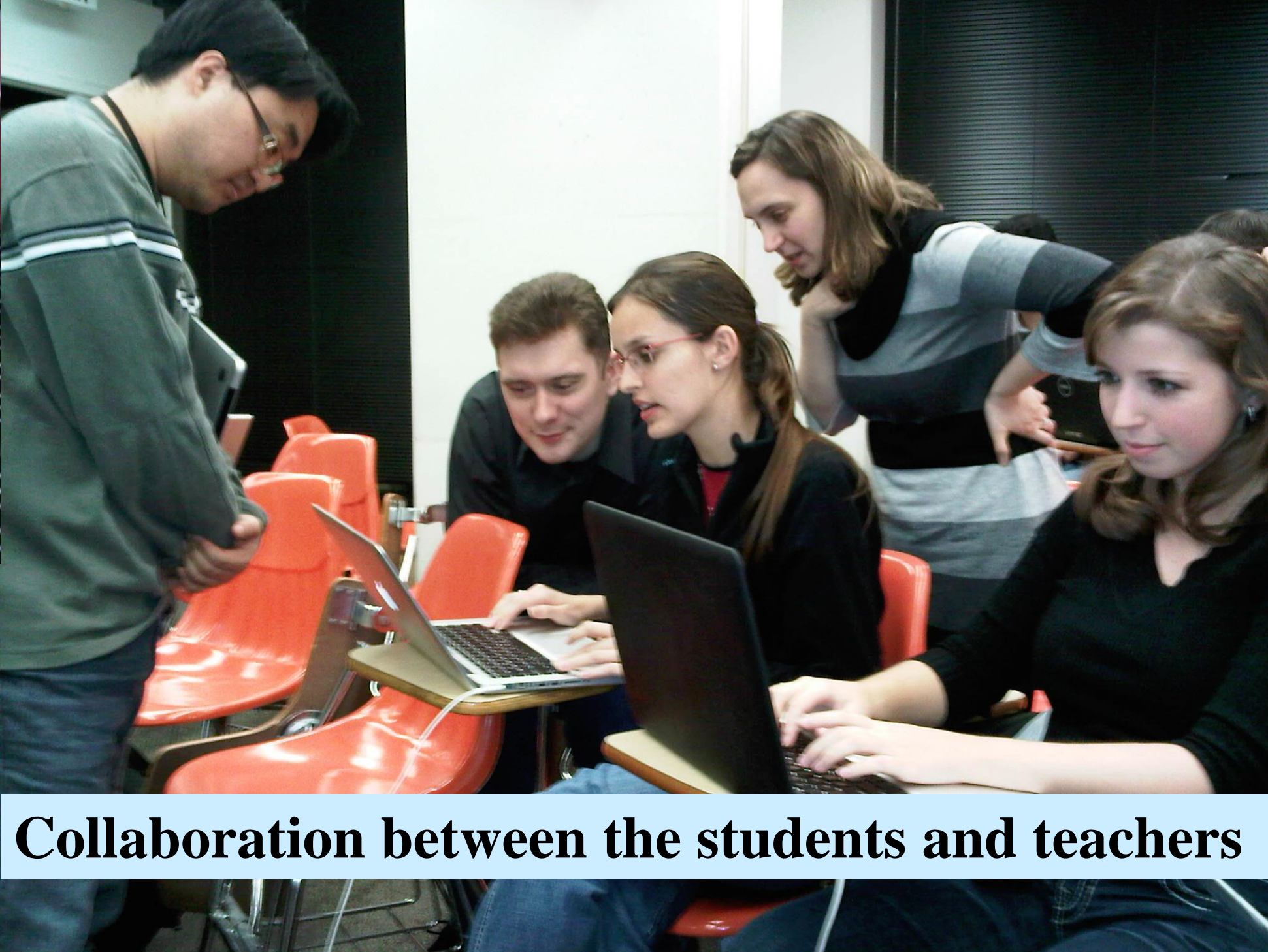
- CMS will likely remain a major productive scientific collaboration for at least two decades and given this longevity, it is especially important to continue to develop a nurturing and sustainable collaboration where all can reach their full potential. CMS aspires to be a harmonious family.
- The future of the collaboration depends on its youngest members, critical that CMS provide effective collaboration-scale opportunities to aid the development of young physicists in all aspects of experimental physics: training in data analysis, software and hardware, and to provide career development paths.
- A PRIME EXAMPLE OF COLLABORATION SCALE EDUCATION IS THE CMS DATA ANALYSIS SCHOOL (CMSDAS)


Guiding Principal

Experiential Learning



"Tell me and I forget,
show me and I remember,
involve me and I understand."





- 5 day school, 10% lectures 90% hands on analysis of collision data
- >500 students have participated

Analysis School Format

Pre-school exercises month prior to school

1-week hands on physics analysis exercises

Lectures (0.5 days)

Short Exercises (2 days) Objects & techniques

Long Exercises (2.5 days) Physics

(All exercsies use CMS collision data)

Symposium (students physics analysis results)

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

Pre-requisite Exercises 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

Long Exercises 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

Short Exercises Roostats, Generators Tracking & vertexing, Electrons, Muons, Photons, Jets, b-tagging, particle flow, pile-up, event visualisation

Examples of Short and Long Exercises

Rootstats (Short Exercise)

Electrons (Short Exercise)

Higgs Long Exercise: Low-to-High Mass Higgs decaying to 4-leptons

Higgs Long Exercise: Low Mass Higgs decaying to b-jets

Feedback on the school (provided couple of months after the school))

80-90% Participants provide Feedback

Usefulness of Pre-exercises

Short (Physics Object/Tools) Exercises

Long (Physics Analysis) Exercises

Conclusion

Highly successful training program, engaging users to quickly contribute to physics, 6 schools in last 3 years, trained about 500 students