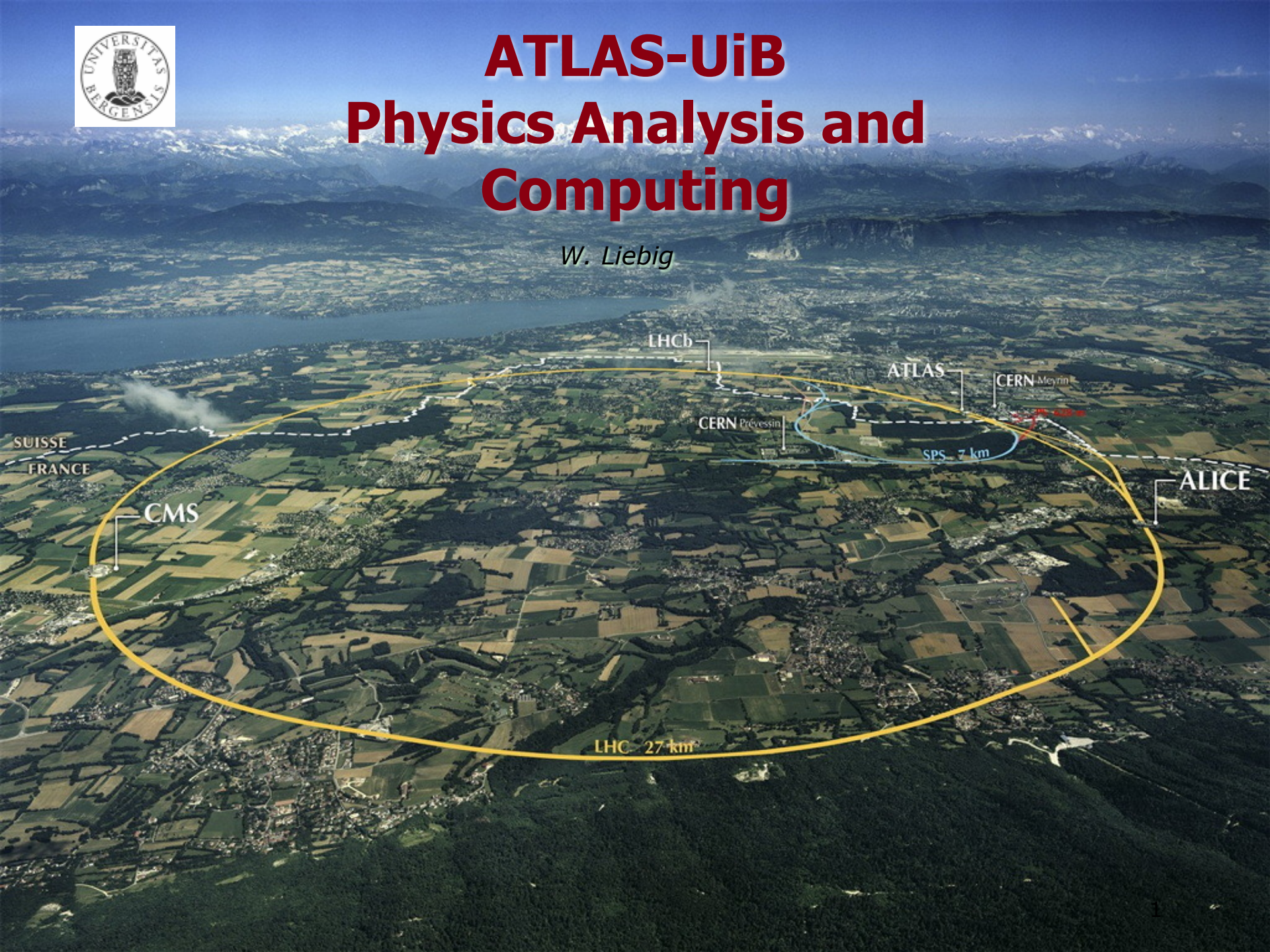
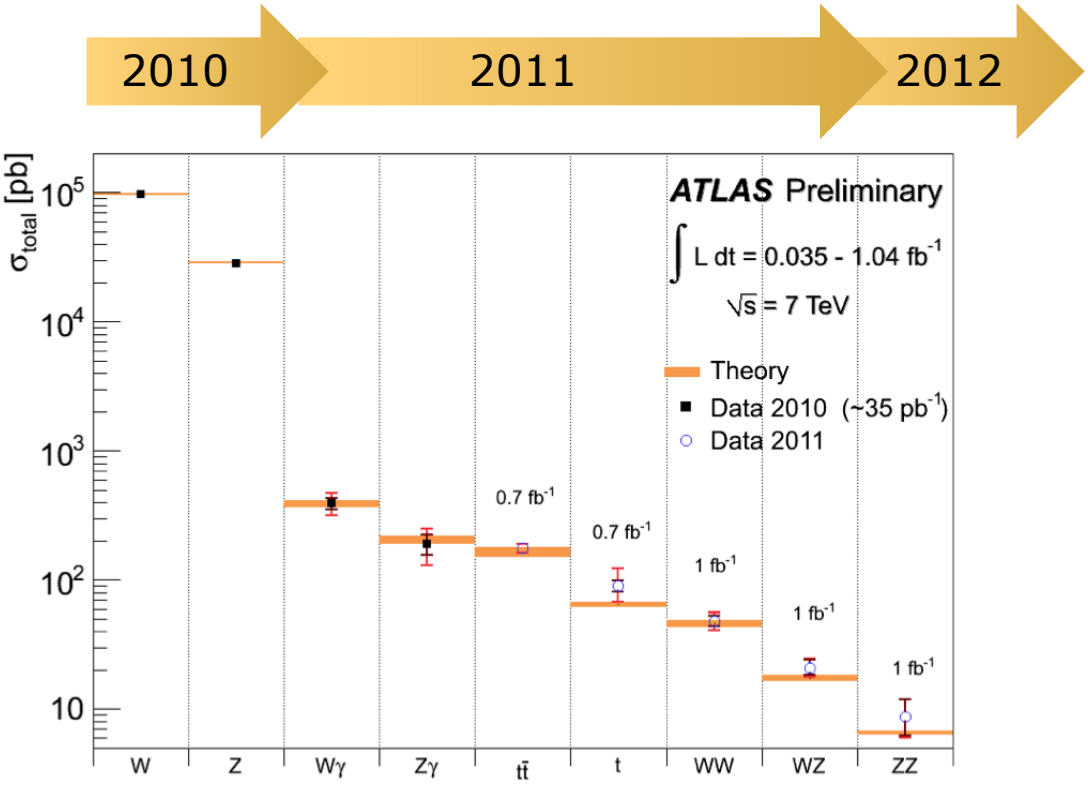
ATLAS-UiB Physics Analysis and Computing

W. Liebig



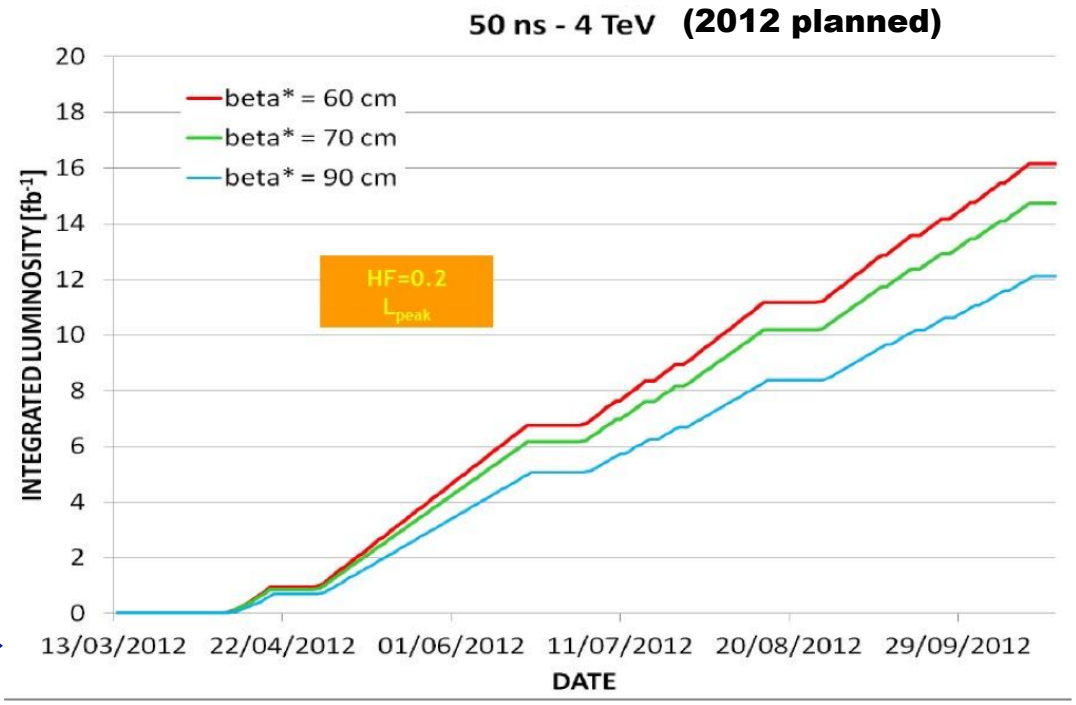
Physics Analyses in ATLAS

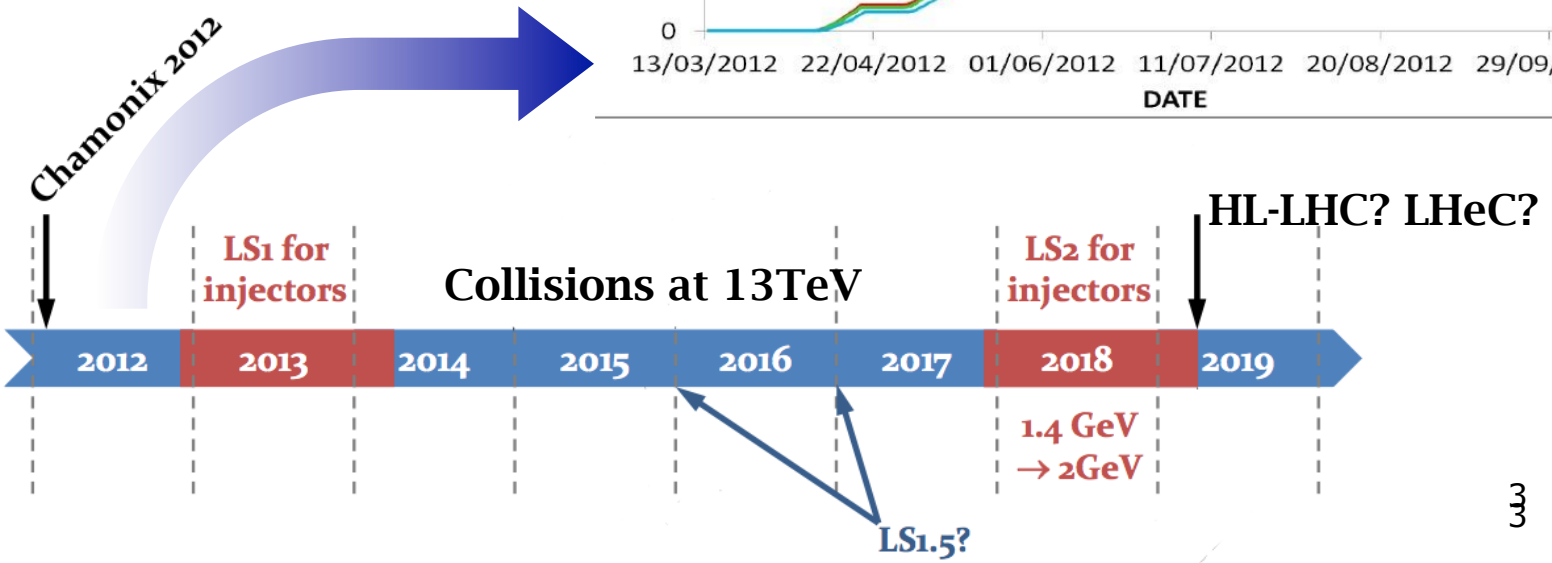
- Now all about data analysis @ 7 TeV collision energy
- 2010: 0.040 fb^{-1}
  - commissioned detector and physics performance
  - consolidated physics analyses by confirming measurements from past decades of proton collider physics
- 2011: 5.0 fb^{-1}
  - now analysis of rare processes and search for new physics play key role
  - detector and trigger working well, further improve performance



Perspectives for Physics at LHC

- 2012 should deliver the bulk data for first run
  - around 15fb^{-1} at 8 TeV to be added to the 5fb^{-1} at 7 TeV
  - aimed at Higgs boson discovery or exclusion by ATLAS and CMS
- 2013: long shut-down for machine repair and upgrade
  - raise collision energy to 13 TeV
- 2012-13 ideal for rich data analysis on mature detector
  - esp. for master and PhD theses

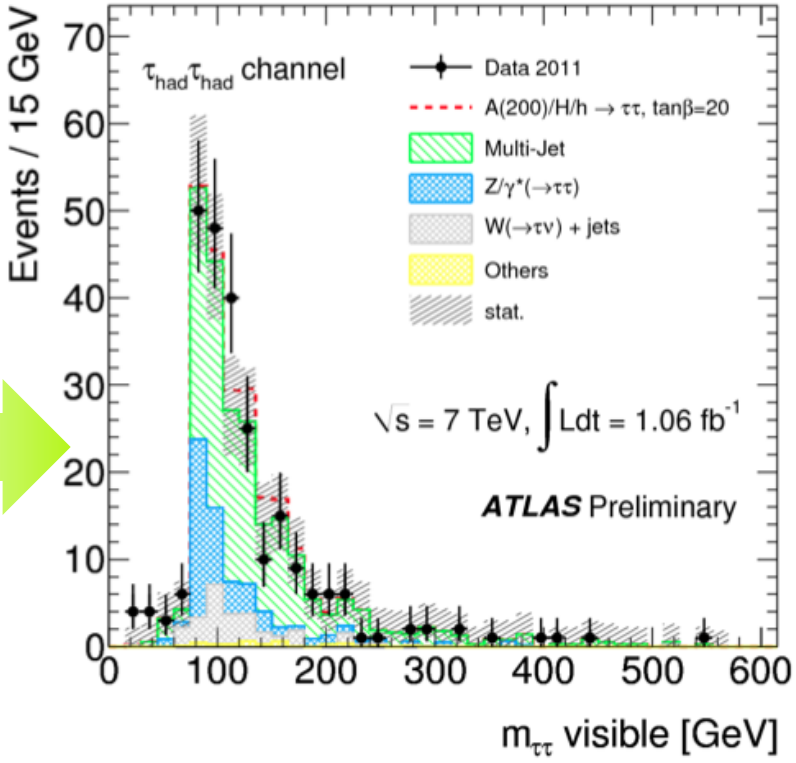




Physics Analyses in Bergen

Bergen involved in

- Std. Model and top physics:
  charge measurement of the top quark
- rare B-decays:
  sensitive to new physics
- Higgs boson search in τ lepton channel:
  Strength of Higgs search
  comes from combination of all channels
- SUSY search in τ lepton channel:
  physics beyond Std.Model and TeV scale,
  dark matter candidate



Physics Analyses – Perspectives

Bergen involved in

Master students

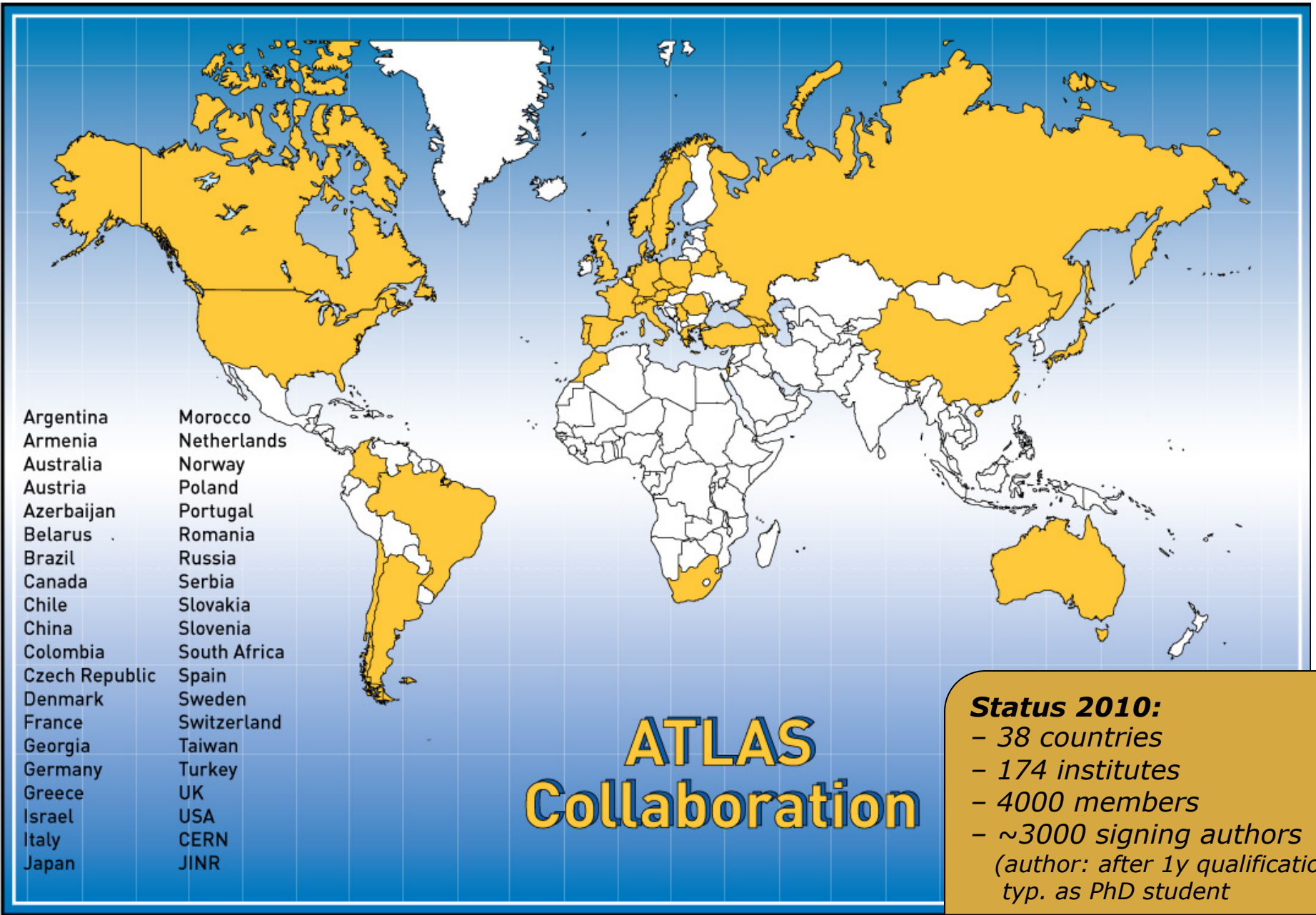
- SM and top physics (charge measureme
  Approved as ATLAS CONF note but no manpower to continue
  1
- rare B-decays: (sensitive to new physics)
  Bs–>μμ in the process of becoming ATLAS CONF note
  2
- Higgs search in τ channel: (one channel in combination)
  Discovery or exclusion expected by ATLAS with 2011+2012 20fb^{-1}
- SUSY search in τ lepton channel: (physics beyond SM/TeV scale, dark matter candidate)
  short-term: CONF note with 5fb^{-1}
  long-term: SUSY search will stay interesting over full LHC lifetime (until discovered and measured)
  0.5

We rely on master and PhD students (and post-docs) as active members

Introducing Master Student

- scientific introduction
  - courses in Bergen on Statistics, PP and ATLAS
  - possibly attend summer school or academic lectures at CERN
- technical training for analysis
  - create access and authorizations to information and infrastructure
  - make familiar with physics analysis tools (e.g. *root*)
  - follow ATLAS tutorial at CERN or remotely (repeated ~4 times per year)
- working with data
  - learn what is in the data, e.g. tables of event/particle properties *(ntuples)*
  - and produce plots from it
  - typically start from existing Bergen or ATLAS group data
- contribute to technical duties
  (UiB responsibilities, share based also on #master students)
  - usually involves coming at CERN
- approach topic of thesis
  - modify and gather data needed for analysis, validate analysis code
  - apply selections to enrich process of interest
  - discussions with colleagues (UiB and ATLAS), present at meetings

ATLAS Collaboration

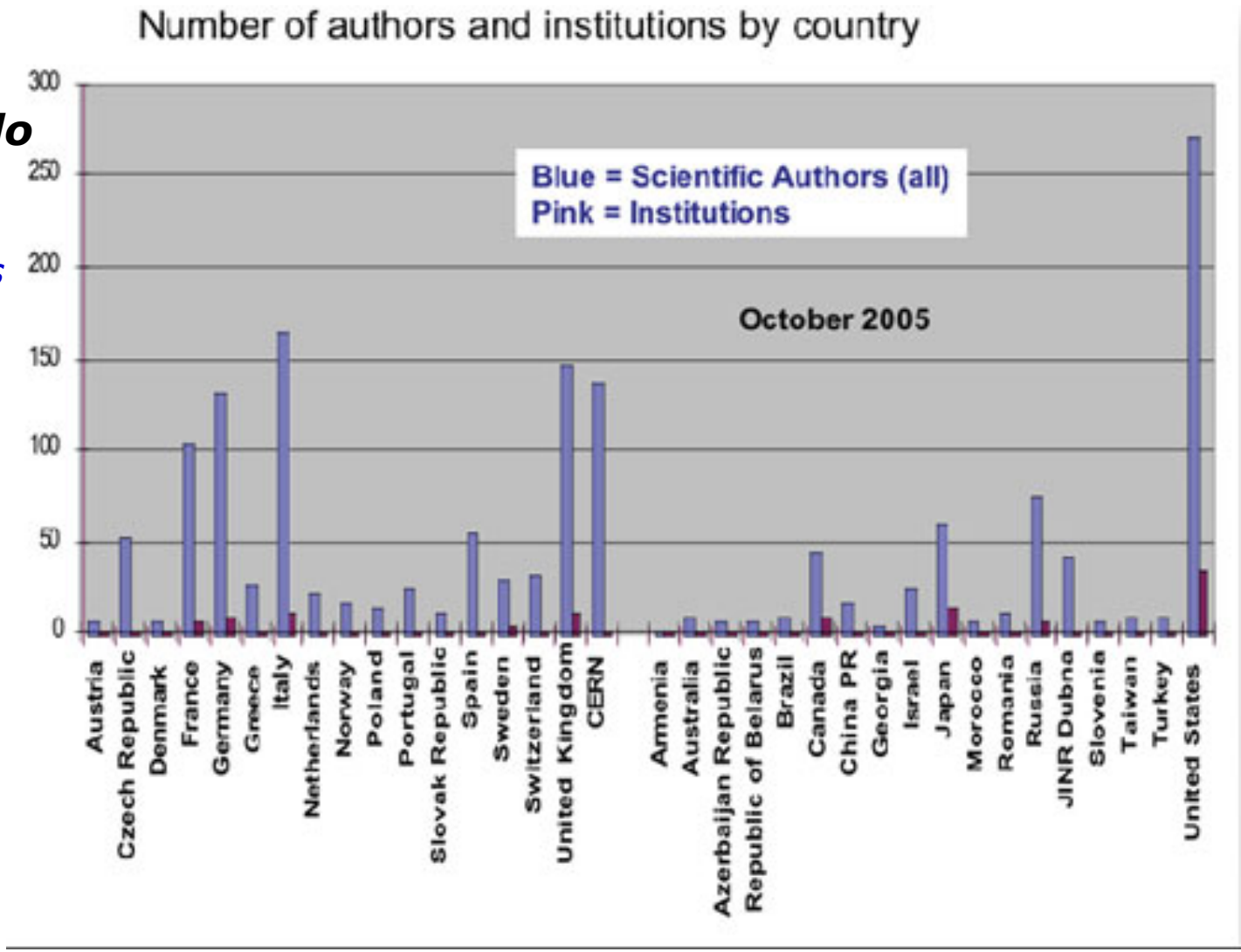


Status 2010:

- *38 countries*
- *174 institutes*
- *4000 members*
- *~3000 signing authors*
  (author: after 1y qualification, typ. as PhD student

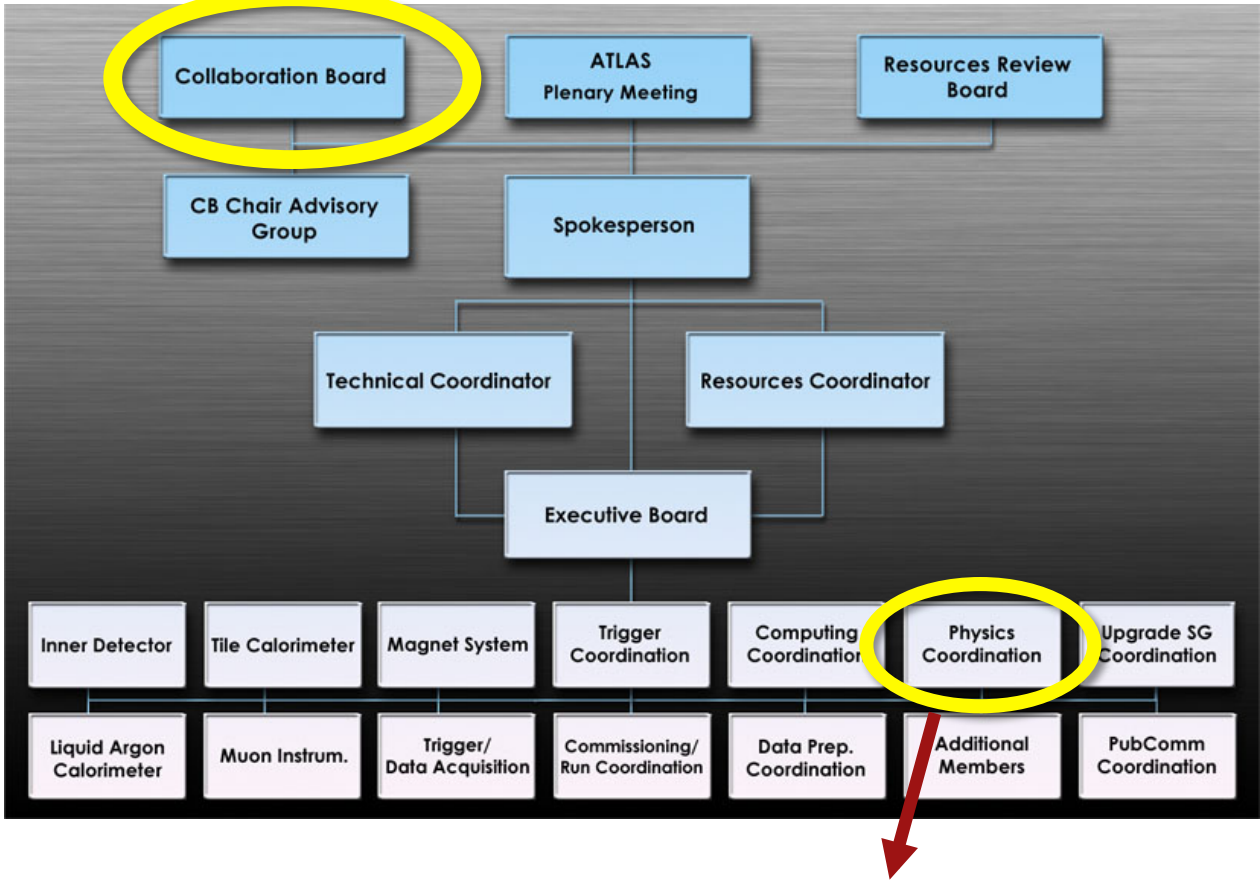
ATLAS Collaboration

- *Two groups:*
  Bergen and Oslo
  – *number of authors comparable with larger EEC countries*



Organising ~4000 Members

- Internal rules and management structure defined
- Influence by members and institutes
  - through **collaboration board**: 174 seats, 1 institute = 1 vote
  - other means, like candidate proposals
- Collaboration board
  - elects most management positions
  - votes on changes to rules
- Further democratic structures
  - limitation of management mandates to 2 (+2) years



Look at structure of physics groups on slide 14

Publishing with 3000 Co-Authors

Internal Publications

- documents in physics or technical matters
- draft for CONF notes and papers
- detailed back-up documentation for collaboration signing a paper
- e.g. ATL-COM-PHYS-2012-001

Under ATLAS information protection

Authors are documented (title page, database)

External Publications

- CONF notes presenting results as "ATLAS preliminary"
- Papers
- Conference proceedings

Signed by "The ATLAS Collaboration"

Author visible on conference proceedings ("Author o.b.o ATLAS")

➔ Important that UiB members obtain talks as ATLAS conference speakers

Publication Procedure

Interaction with Physics Working Group (WG)
- physicists present their work/progress to relevant Ph. WG
- address open questions, readiness of analysis
- choice/agreement between competing analyses
- WG Conveners initiate publication process in ATLAS

Editorial Board (EB)
- WG conveners ask management for EB
- EB=Editorial Board of indep. experts for reviewing and signing off paper/note

Circulation in ATLAS
- EB discusses with authors and agrees to circulate
- announced to all active physicists inviting to comment
- deadline 2 weeks (1 week for 2nd circulation)

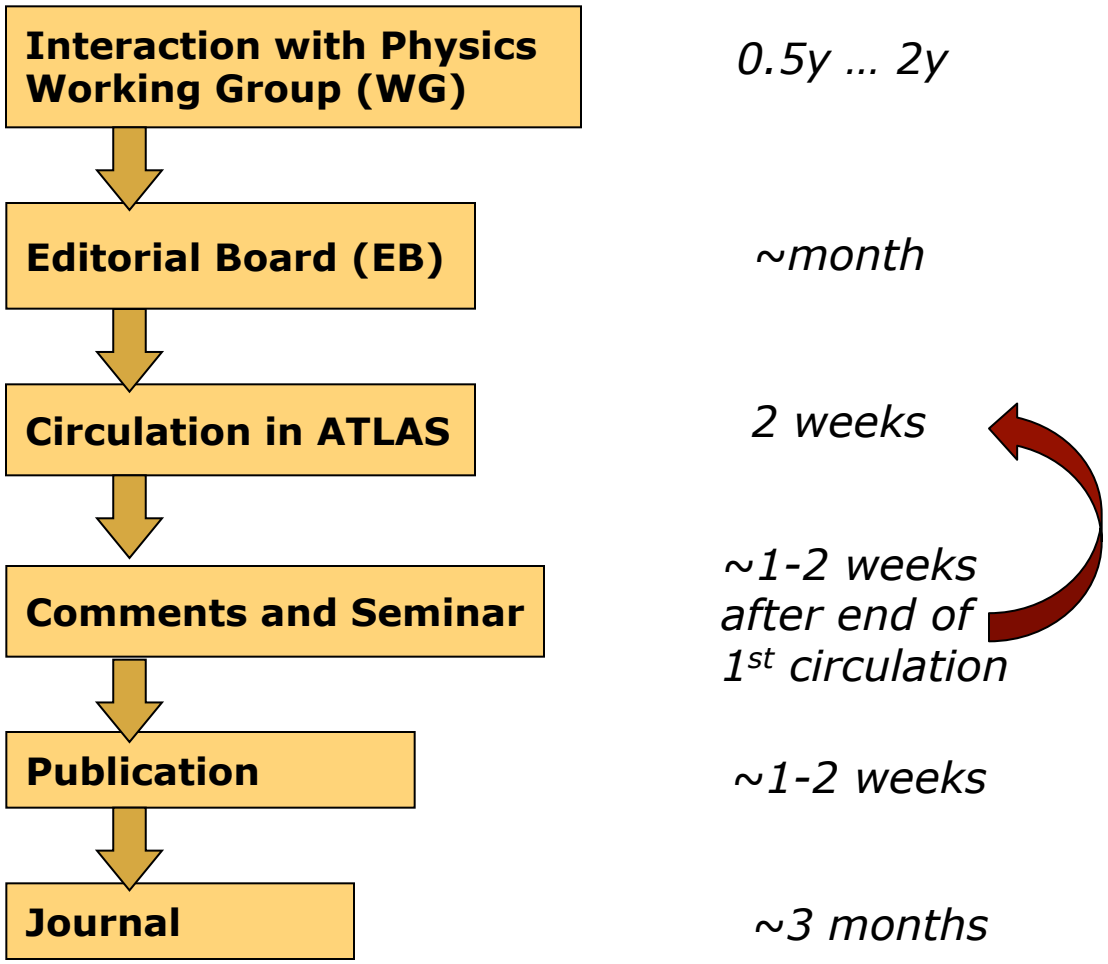
Second iteration for papers

Comments and Seminar
- depending on interest: ~5…100 comments
- comments need to be answered
- answers followed also by EB
- seminar given on plenary meeting to present result and address major comments in person

Publication
- final round and signed off by EB
- comments and sign-off by physics coord. and publication committee
- published on ATLAS page, arXiv

Journal
- another round of editing/review

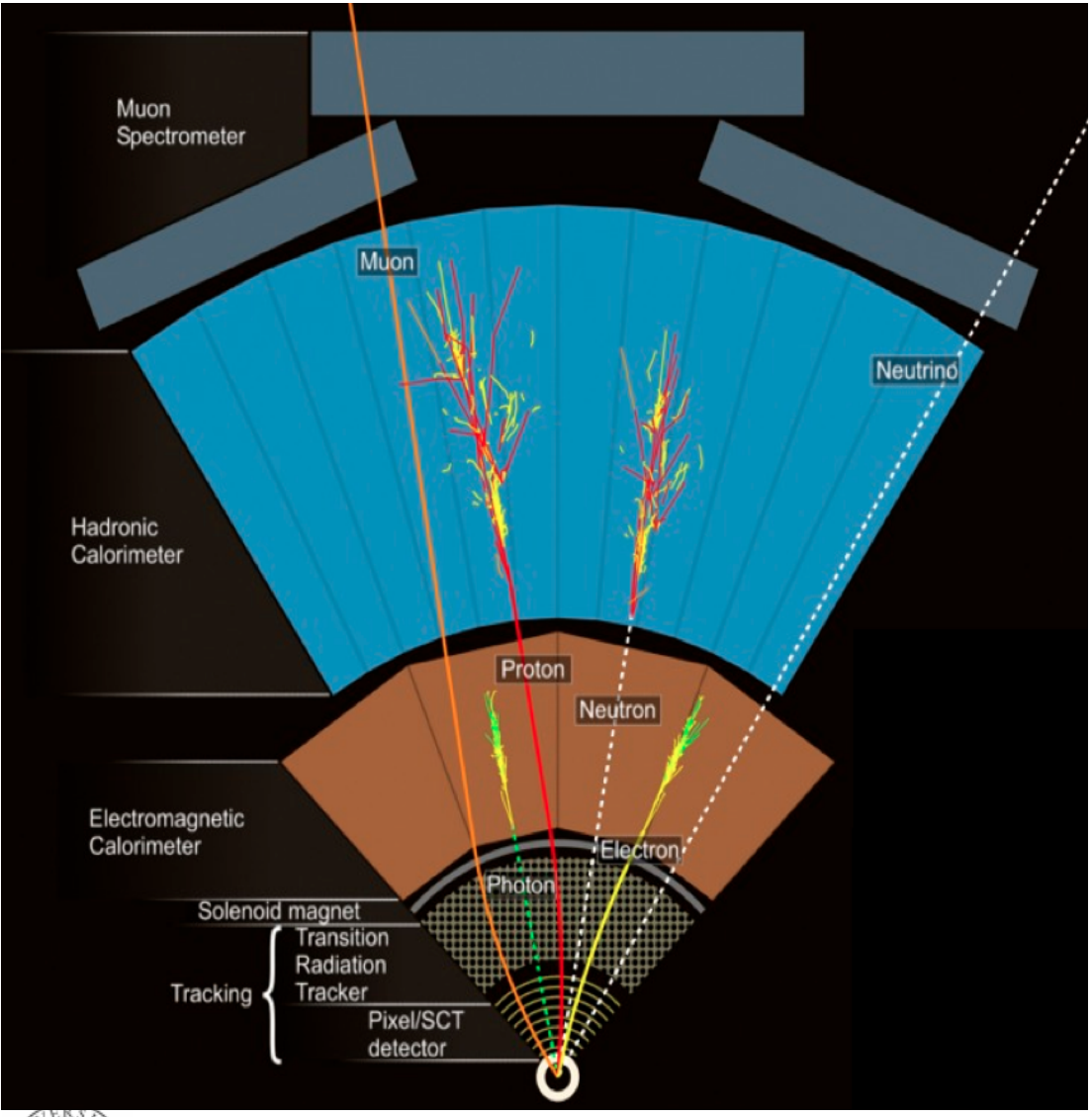
Publication Procedure (2)



	Typical time scales	Preparations
Interaction with Physics Working Group (WG)	*0.5y … 2y*	*Quality of plots and results for WG approval*
Editorial Board (EB)	*~month*	*Prepare draft and additional note with detailed internal info*
Circulation in ATLAS	*2 weeks*	*Polished draft after fast iterations with EB*
Comments and Seminar	*~1-2 weeks after end of 1st circulation*	*Answer comments, give presentation*
Publication	*~1-2 weeks*	*Address final comments by management*
Journal	*~3 months*	*Address final comments by journal editors*

➔ 2-3 months for ATLAS-internal part of publishing a paper draft (if all goes smoothly)

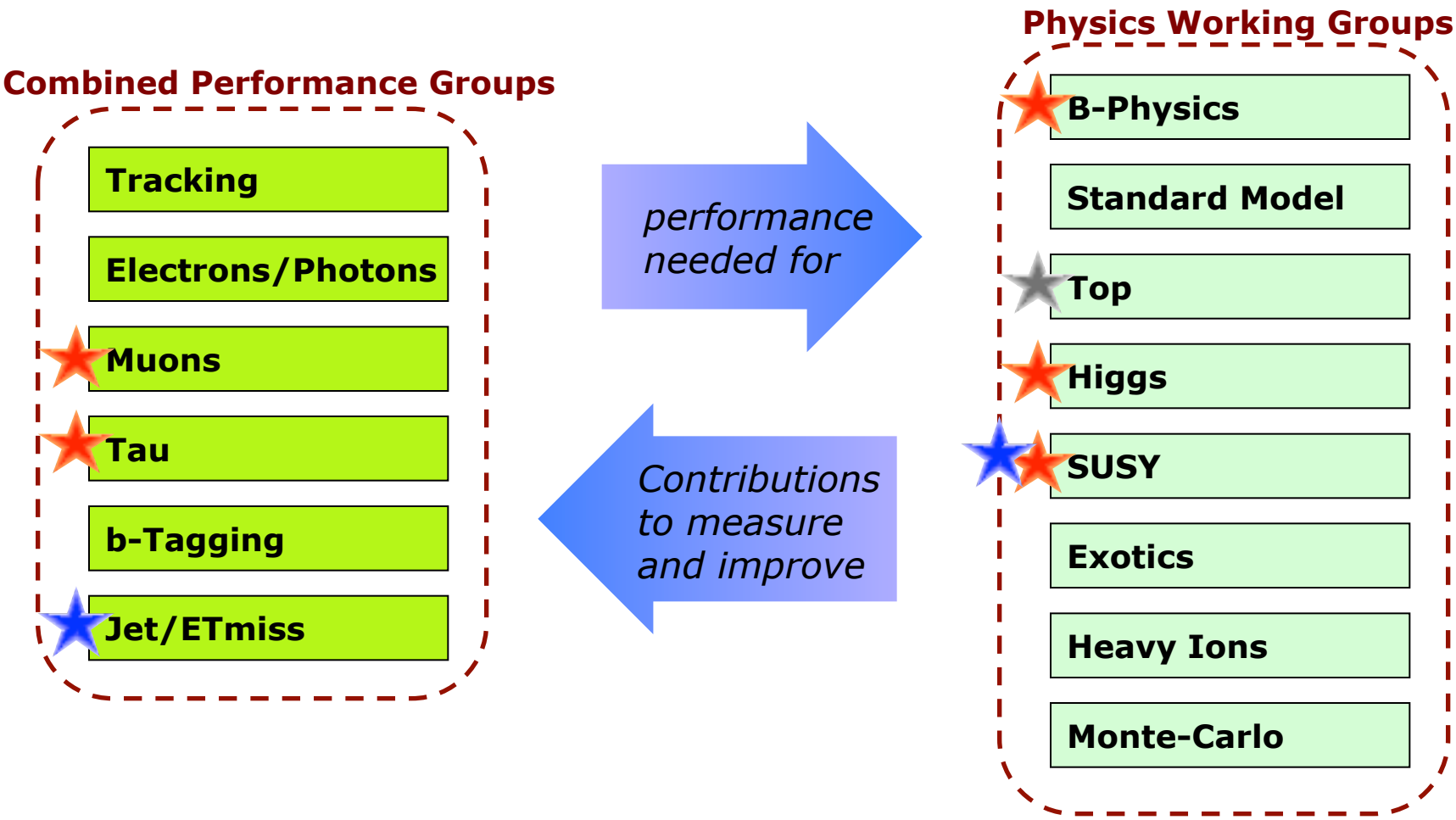
Physics Objects and Analyses



- Data from detector
  - hits from e.g. SCT or calorimeter clusters
- Event characterised by particles and their kinematic properties
  - reconstruction algorithms needed
  - information from detector systems is combined
  - e.g. muon from hits in all systems
- ATLAS "Combined performance"
  - performance associated to particle identification
  - typically efficiency, purity, resolution

➔ ATLAS members are responsible also for combined performance

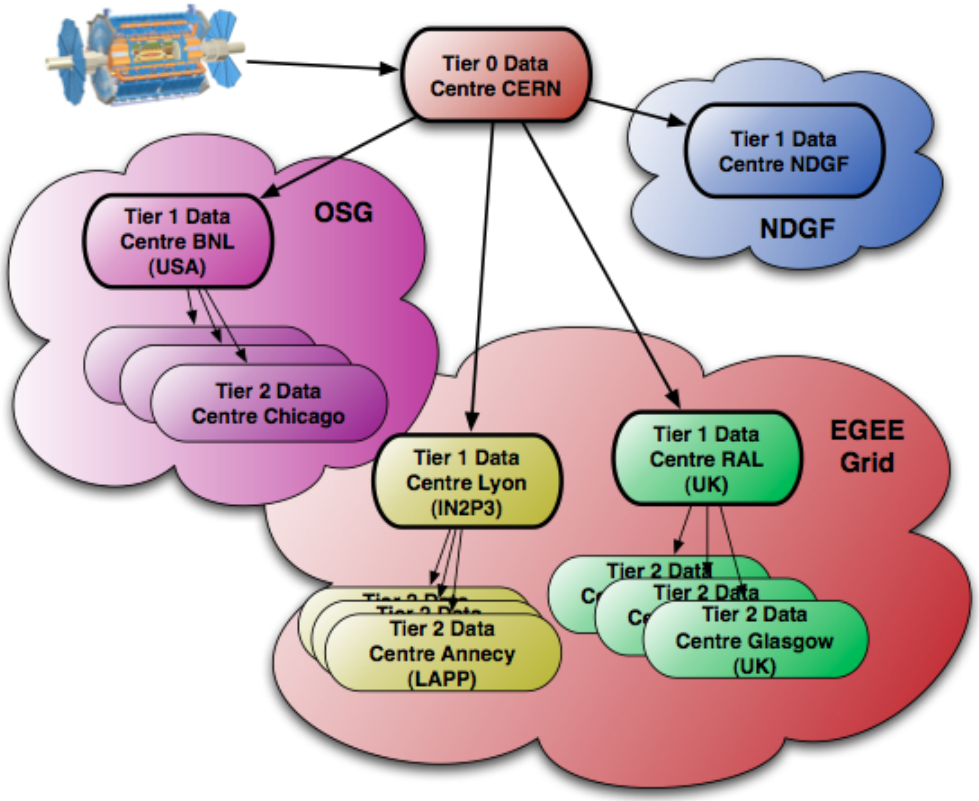
Physics Objects and Analyses



ATLAS-UiB activities (HEPP project)

ATLAS-UiB activities (DAMARA project)

ATLAS Computing



- ATLAS distributes software
  - simulation, reconstruction physics analysis software
  - available as release kits
  - run jobs at CERN, on GRID or a local linux system
- … and data
  - hierarchy system of tiers common to HEP, 1x tier0, 10x tier1, ~40x tier2
  - jobs go to where data is
  - data volume is huge [...]
- ATLAS software has specific requirements
  - various well-defined versions of underlying libraries: *gcc*, *root*, *python*…
  - collaborative tools: *grid tools*, *afs* distibuted file system, *subversion*

➔ Local system needed to look at results of jobs

Computing for Physics Analysis

For the example of SUSY in tau channel analysis at ATLAS-UiB

- Data Sizes are flexible
  - Large Analysis Object files with information for all ATLAS analyses
  - Smaller data vector files for specific physics analyses
- AOD & SUSY WG samples created centrally by ATLAS
- UiB samples created by PhD student on GRID
  - takes about one week
  - including queue, bookkeeping, restart failed jobs, etc…
- Analysis performed on small UiB specific samples
  - data vectors (ntuples) with filtered events and information
  - takes few minutes to produce a plot
  - on local machines or even laptops

Samples	Data 2011	Simulation
ATLAS Analysis Objects (AOD)	~60 TB	5.6 TB
ATLAS SUSY Working group	18.0 TB	2.4 TB
UiB SUSY/tau analysis	4.3 GB	5.6 GB

Local Computing in Bergen

- ATLASDISK
  - 16TB fully raided disk server
  - accessible on both ATLASØ and ATLASPRIME and remotely (ssh)
- ATLASØ
  - 12 GB RAM, 4x Intel Xeon, 2TB local scratch space
  - User accounts also for students, guests, grid production
  - Collaborative tools (wiki, svn) servers compliant with ATLAS Information Protection
- ATLASPRIME
  - 12 GB RAM, 24x Intel Xeon, 14TB local scratch space

➔ Standard enterprise linux system, funded by HEPP project (ATLAS), administered by scientific group members

Remote Collaboration

- Dedicated room @UiB for connecting to activity at CERN
  - remote shifts
  - working group meeting
  - join meeting as a group of UiB participants
- Videoconferencing equipment
- Ability to fully focus on meeting/shift contribution is important
  - instead of wasting attention on not disturbing / not being disturbed by office mates

Control Room in Bergen

➔ Financed by DAMARA project

Presence at CERN

in the era of email, distributed computing and video conferencing

Kick-start analysis
- gather technical knowledge from people outside Bergen
- learn about software and data; hands-on

Visibility inside the collaboration
- plenary talks
- discussions and connections
- personal presence can increase impact of contribution

Efficient collaboration
- boost progress in analysis by interacting directly with colleagues at CERN (eg. where fast publication is important)
- attend a "physics week" (block of meetings)

In-situ duties
- technical and safety training
- shifts or expert work at detector
- convener responsibilities with presence at CERN
- management (e.g. Collab. board)

Inspiration
- coffee discussion at CERN is often where ideas are born or decisions made

Conclusions

- Now is key period to contribute to data analysis
- Publication of analyses as conference note or in a journal requires close interaction with ATLAS working groups and the bodies involved in the draft editing process
- To achieve integration in ATLAS analyses, competitiveness and a fast publication time scale the institute needs to be strong also in computing aspects and ensure a frequent presence at CERN