ATLAS as an example of a large scientific collaboration

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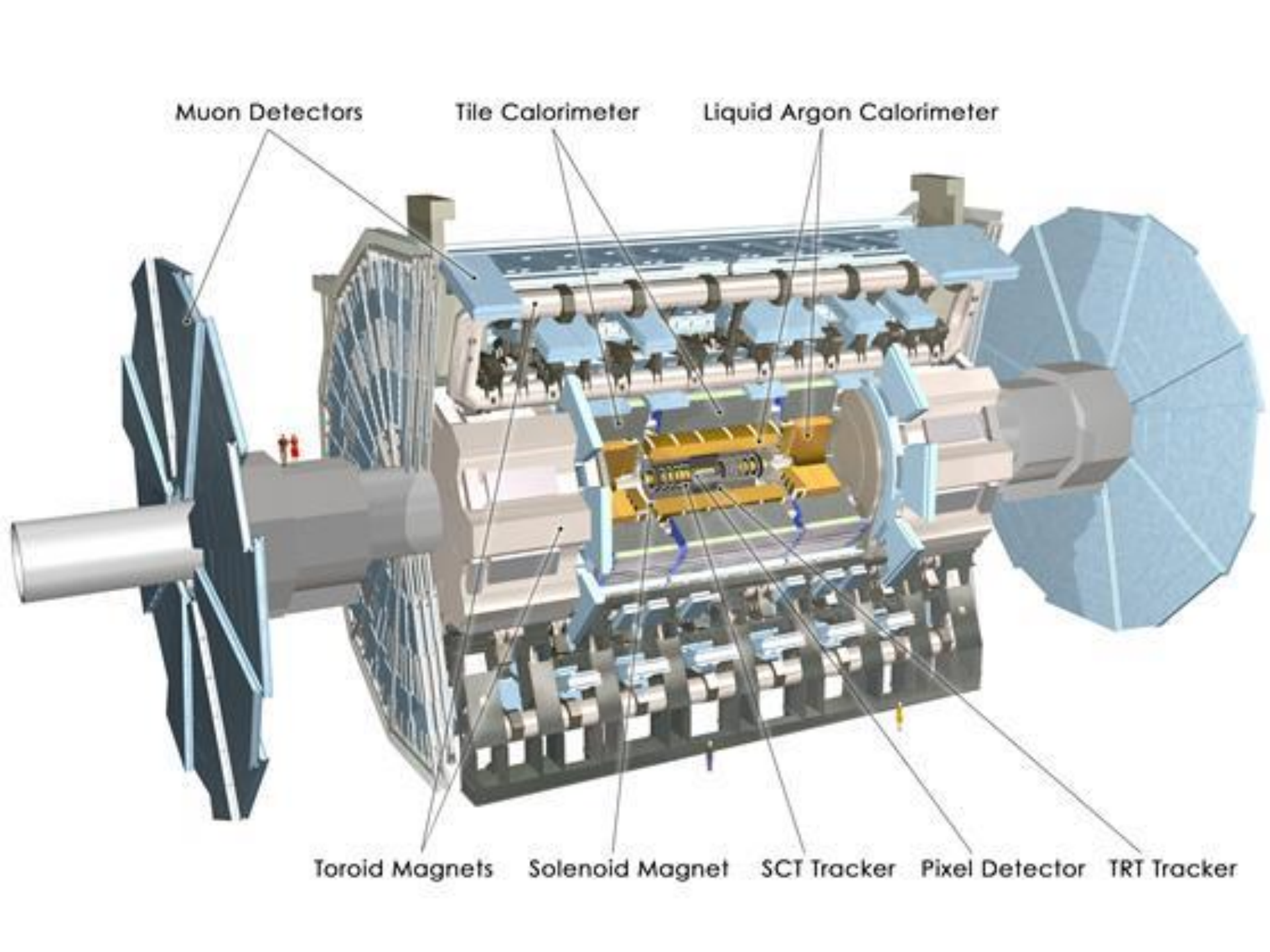
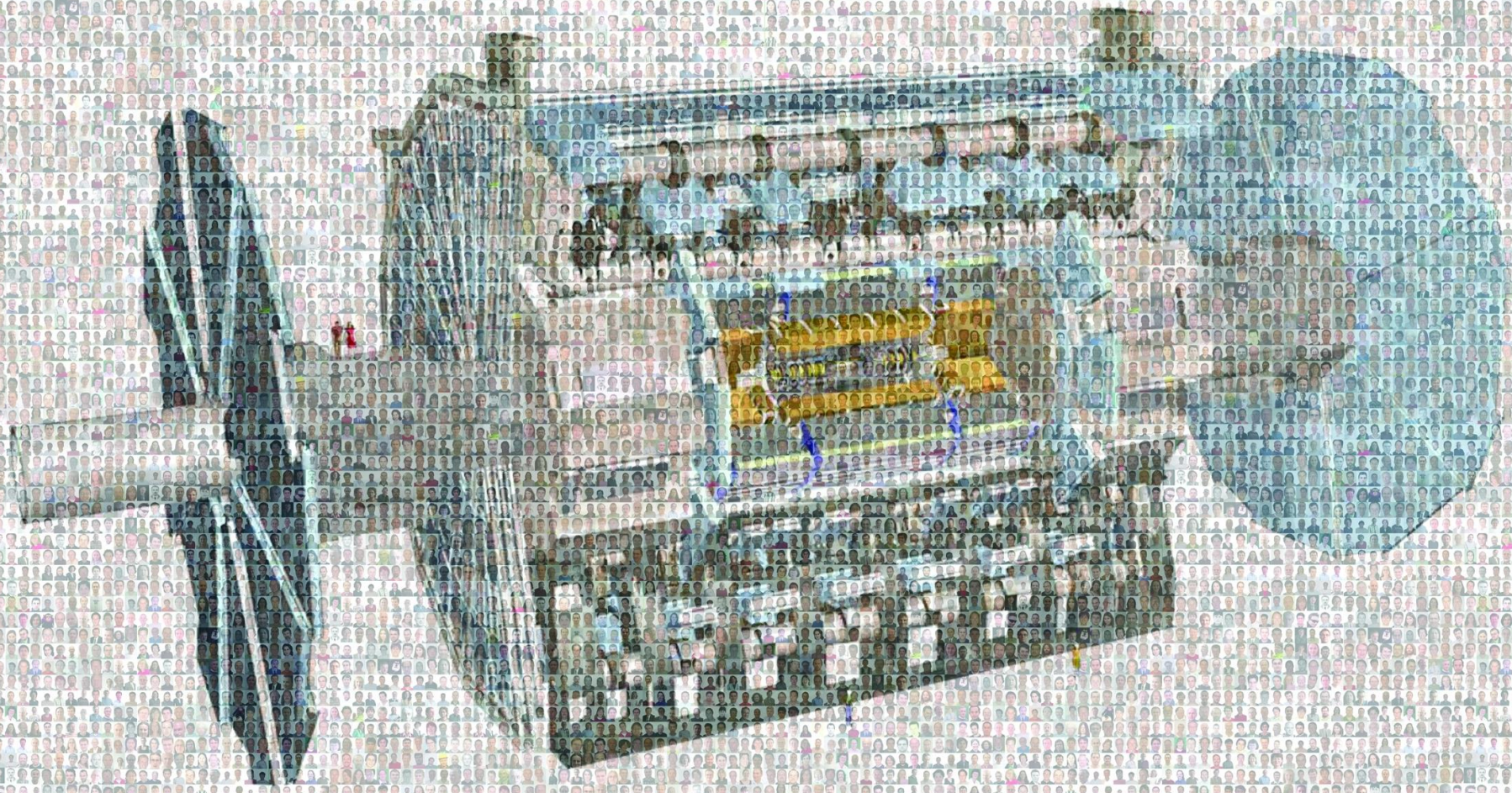
Disclaimer

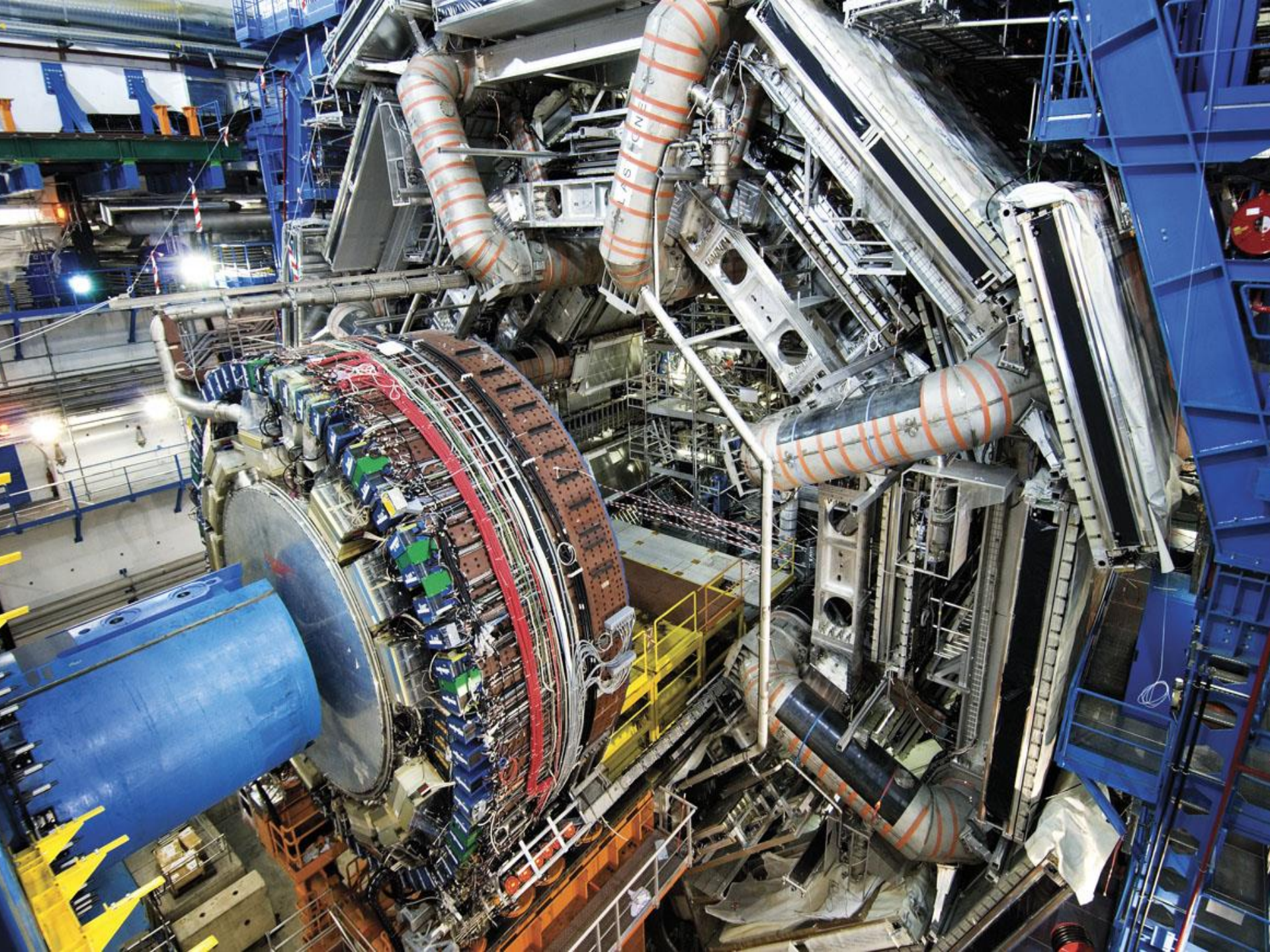
- ATLAS is used here as an example simply because I know it the best
- Other major LHC experiments are very similar in terms of governance structure so you can replace “ATLAS” with any favorite other LHC experiment you may have in mind ☺
- I am not representing ATLAS but its management kindly encouraged me to give this talk (provided I did not screw it up)
- The purpose of this talk to is share with you how large collaborations work from an admin perspective


Muon Detectors
Tile Calorimeter
Liquid Argon Calorimeter
Toroid Magnets
Solenoid Magnet
SCT Tracker
Pixel Detector
TRT Tracker

THE ATLAS DETECTOR

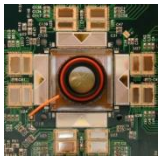


BEHIND EVERY GREAT DETECTOR, THERE ARE LOTS OF GREAT PEOPLE!




ANA
JAPAN AIRLINES
JAL

Evolution of ATLAS



- Initial (conceptual) project planning started by informal, ad-hoc group(s) of interested scientists in mid 1980's
- Timeline
  - Late 1980's: Further R&D was needed to prove feasibility of proposed technical concepts. CERN initiated formal, generic detector R&D projects
  - Early 1990's: Bottom-up detector proposals (EAGLE, ASCOT); merging into ATLAS Letter of Intent (LoI, 1992)
  - Mid 1990's: ATLAS Technical Proposal (TP,1995); sub-detector prototyping; sub-system Technical Design Reviews (TDRs)
  - Late 1990/Early 2000's: Approval of Cost Book; signing of MoU; start of detector modules manufacturing (always following a Production Readiness Review PRR and respective TDRs); start of installation at CERN (cavern handed over in 2003)
  - Mid 2000's: Installation, commissioning of ATLAS in the cavern. ATLAS completed in 2008 for initial runs
- Initial project coordination was implicit and handled by the contact persons for the early proposals. After ATLAS LoI in 1992, the project coordination was carried out by the ATLAS mgmt team
  - Later on, reporting interactions got defined and set up in the MoU (signed in 1998)


38 Countries
177 Institutions
~ 3000 Scientific Authors
(~1800 with a PhD)
ATLAS
Collaboration

CERN/LHCC/94-43
LHCC/P2
15 December 1994

ATLAS

TECHNICAL PROPOSAL

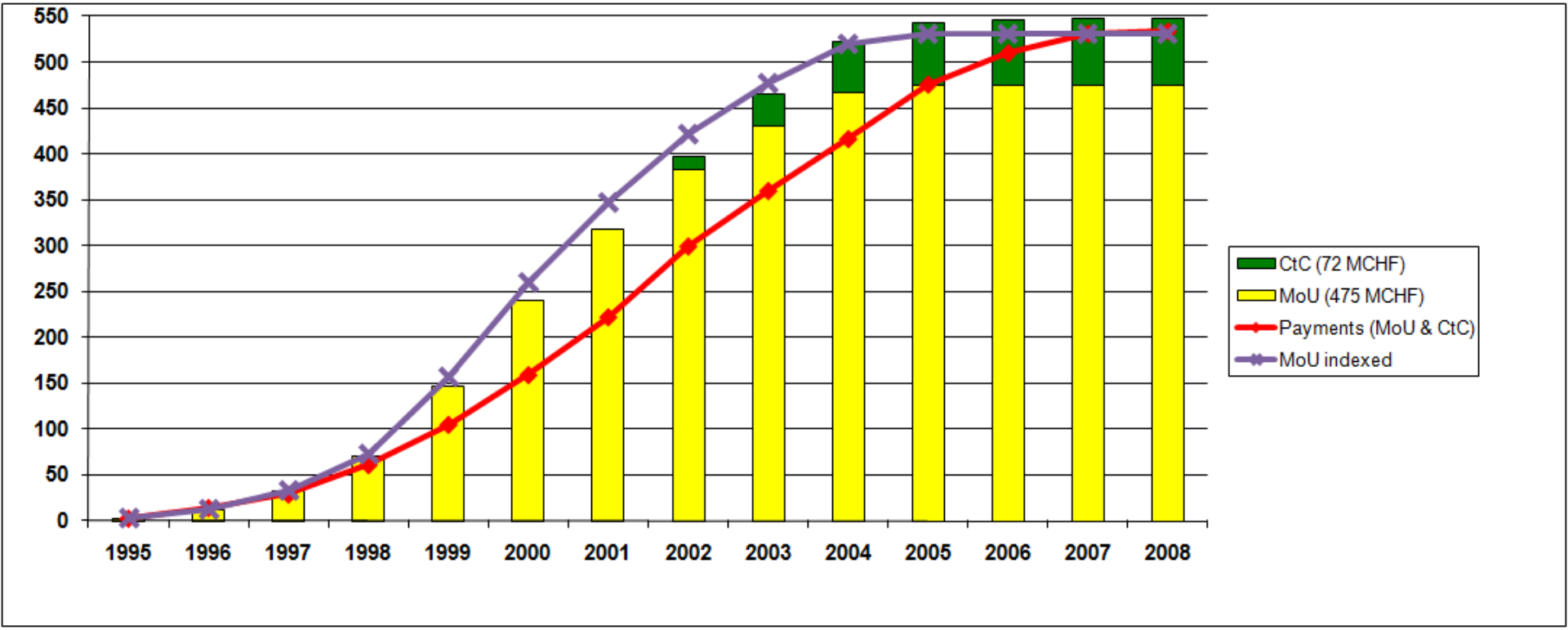
for a
General-Purpose
pp Experiment
at the
Large Hadron Collider
at CERN

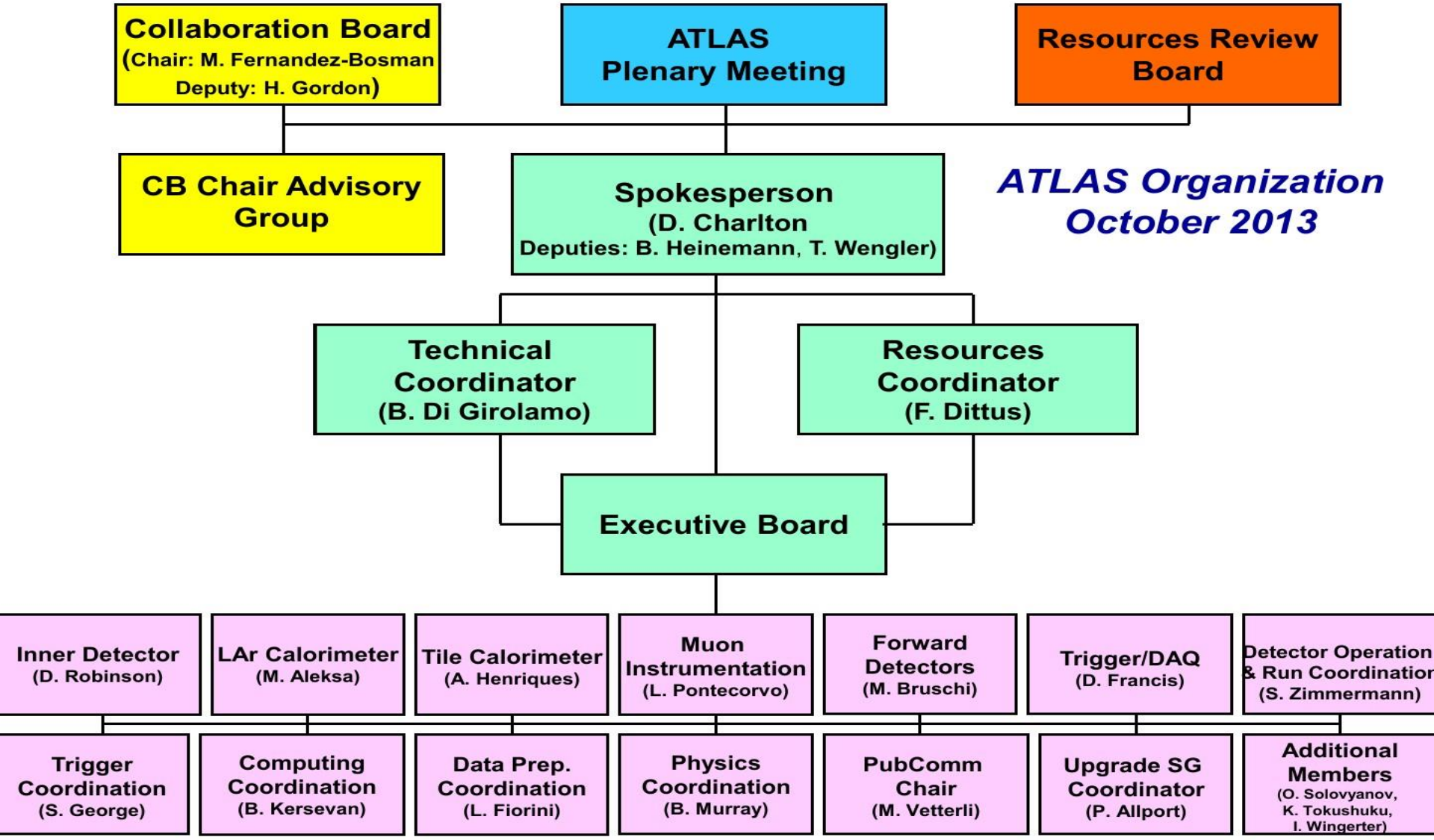

ATLAS
TECHNICAL PROPOSAL
For a General-Purpose pp Experiment at the Large Hadron Collider at CERN
ATLAS
END-CAP TOROIDS
ATLAS
DETECTOR AND PHYSICS PERFORMANCE VOLUME II
ATLAS
DETECTOR AND PHYSICS PERFORMANCE VOLUME I
ATLAS
FIRST-LEVEL TRIGGER
ATLAS
High-Level Trigger Data Acquisition and Controls
ATLAS
TECHNICAL CO-ORDINATION
ATLAS
COMPUTING TECHNICAL DESIGN REPORT
ATLAS
MUON SPECTROMETER
ATLAS
CALORIMETER PERFORMANCE
ATLAS
TILE CALORIMETER
ATLAS
INNER DETECTOR VOLUME 1
ATLAS
INNER DETECTOR VOLUME 2
ATLAS
PIXEL DETECTOR

Memorandum of Understanding (MoU)

- The Project Charter is the Memorandum of Understanding (MoU)
- Legally non-binding agreement based on best effort
- Drafted between **CERN** (Host Lab) and **Funding Agencies**, the MoU describes the sharing of detector hardware construction responsibilities and costs
- Relationship between the Host Lab and ATLAS broadly defined
- Fundamental principle of *deliverables* (in-kind contributions)
  - Potluck party
  - Deliverables grouped around **sub-projects**
  - Items not pledged for are pooled centrally, funds collected as “tax”
- The construction cost envelope in 1995 Swiss Francs was 475 MCHF
  - Direct costs, excluding manpower, R&D, institute infrastructure, prototyping, VAT
  - Major exchange rates fixed (e.g. $/CHF=1.1; GBP/CHF =1.8)
  - No centralized budget contingency
  - CERN provides technical infrastructure support, but is also a participating scientific institute
- Project personnel (management, project leaders, coordinators) are elected by the **community**
- Participating institutes have equal voting rights

Project Funding Profile at Completion EoY 2008




Collaboration Board
(Chair: M. Fernandez-Bosman
Deputy: H. Gordon)
ATLAS
Plenary Meeting
Resources Review
Board
CB Chair Advisory
Group
Spokesperson
(D. Charlton
Deputies: B. Heinemann, T. Wengler)
ATLAS Organization
October 2013
Technical
Coordinator
(B. Di Girolamo)
Resources
Coordinator
(F. Dittus)
Executive Board
Inner Detector
(D. Robinson)
LAr Calorimeter
(M. Aleksa)
Tile Calorimeter
(A. Henriques)
Muon
Instrumentation
(L. Pontecorvo)
Forward
Detectors
(M. Bruschi)
Trigger/DAQ
(D. Francis)
Detector Operation
& Run Coordination
(S. Zimmermann)
Trigger
Coordination
(S. George)
Computing
Coordination
(B. Kersevan)
Data Prep.
Coordination
(L. Fiorini)
Physics
Coordination
(B. Murray)
PubComm
Chair
(M. Vetterli)
Upgrade SG
Coordinator
(P. Allport)
Additional
Members
(O. Solovyanov,
K. Tokushuku,
I. Wingerter)

Albany, Alberta, NIKHEF Amsterdam, Ankara, LAPP Annecy, Argonne NL, Arizona, UT Arlington, Athens, NTU Athens, Baku, IFAE Barcelona, Belgrade, Bergen, Berkeley LBL and UC, HU Berlin, Bern, Birmingham, UAN Bogota, Bologna, Bonn, Boston, Brandeis, Bratislava/SAS Kosice, Brookhaven NL, Buenos Aires, Bucharest, Cambridge, Carleton, CERN, Chinese Cluster, Chicago, Chile, Clermont-Ferrand, Columbia, NBI Copenhagen, Cosenza, AGH UST Cracow, IFJ PAN Cracow, UT Dallas, DESY, Dortmund, TU Dresden, JINR Dubna, Duke, Frascati, Freiburg, Geneva, Genoa, Giessen, Glasgow, Göttingen, LPSC Grenoble, Technion Haifa, Hampton, Harvard, Heidelberg, Hiroshima, Hiroshima IT, Indiana, Innsbruck, Iowa SU, Irvine UC, Istanbul Bogazici, KEK, Kobe, Kyoto, Kyoto UE, Lancaster, UN La Plata, Lecce, Lisbon LIP, Liverpool, Ljubljana, QMW London, RHBNC London, UC London, Lund, UA Madrid, Mainz, Manchester, CPPM Marseille, Massachusetts, MIT, Melbourne, Michigan, Michigan SU, Milano, Minsk NAS, Minsk NCPHEP, Montreal, McGill Montreal, RUPHE Morocco, FIAN Moscow, ITEP Moscow, MEPhI Moscow, MSU Moscow, Munich LMU, MPI Munich, Nagasaki IAS, Nagoya, Naples, New Mexico, New York, Nijmegen, BINP Novosibirsk, Ohio SU, Okayama, Oklahoma, Oklahoma SU, Olomouc, Oregon, LAL Orsay, Osaka, Oslo, Oxford, Paris VI and VII, Pavia, Pennsylvania, Pisa, Pittsburgh, CAS Prague, CU Prague, TU Prague, IHEP Protvino, Regina, Ritsumeikan, UFRJ Rio de Janeiro, Rome I, Rome II, Rome III, Rutherford Appleton Laboratory, DAPNIA Saclay, Santa Cruz UC, Sheffield, Shinshu, Siegen, Simon Fraser Burnaby, SLAC, Southern Methodist Dallas, NPI Petersburg, Stockholm, KTH Stockholm, Stony Brook, Sydney, AS Taipei, Tbilisi, Tel Aviv, Thessaloniki, Tokyo ICEPP, Tokyo MU, Toronto, TRIUMF, Tsukuba, Tufts, Udine/ICTP, Uppsala, Urbana UI, Valencia,
UBC Vancouver, Victoria, Washington, Weizmann Rehovot, FH Wiener Neustadt, Wisconsin, Wuppertal, Würzburg, Yale, Yerevan

A GLOBAL PROJECT

The project comprises ~4000 people in the collaboration
+ thousand of industrial relations


C
D

Come Together Now… Why?

- Shared Purpose
  - One common aim of “Out of this world” discoveries; such as the Higgs
  - Better understanding of the fundamental forces and particle (Big Bang)
- Shared Commitment
  - Passion to “Can-do”
  - Members of ATLAS prepared to solve the encountered technological (and human) challenges
  - Willingness to accept also less glorious tasks for the common good
  - Some have been working for ATLAS since mid 1980s…
  - Trust in colleagues fulfilling their commitments (MoU)
- Shared Tolerance
  - Willingness to work together, irrespective of geographical location or language barriers
  - Willingness to share information
  - Principle of “Raw Diamond”

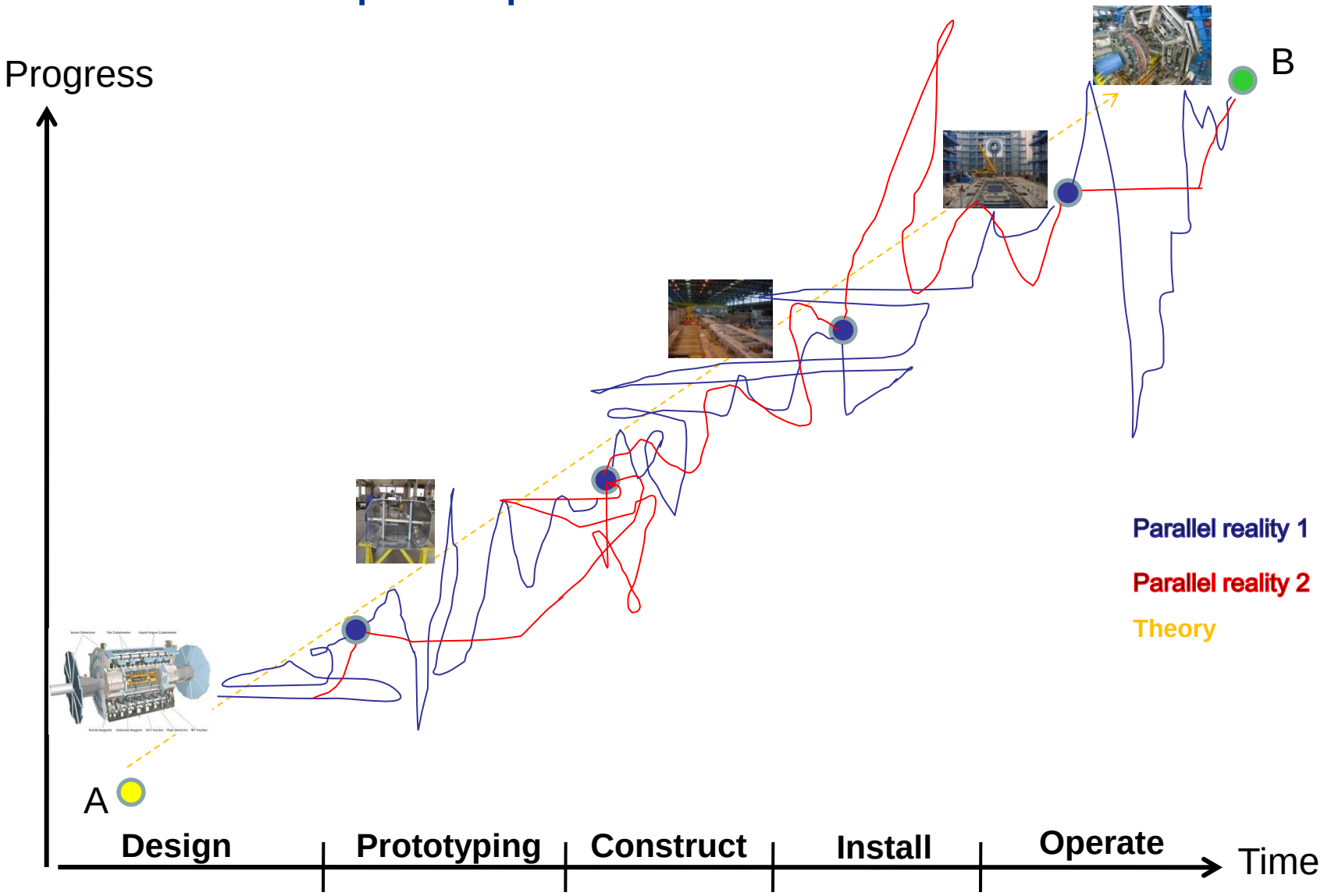
Cultures of ATLAS

- There are several underlying “sub-cultures” in ATLAS
  - Physics culture versus Engineering culture
  - Hardware oriented culture versus software/computing etc.
  - Sub-system cultures (e.g. ”LAr culture versus Muons culture”)
  - Geographical cultures (“North versus South; West versus East”; languages)
- Such cultural diversity originates itself from
  - Global nature of modern high energy physics (38 countries, 70 nationalities in ATLAS)
  - Decentralized nature of resources, diverse funding sources
  - Different ways to account and organize resources
- Project cycles and dominating cultures
  - Sub-system/engineering culture more dominant during construction
  - Physics culture very strong during project definition (design); then resurfaces when physics analysis starts

How are (tough) decisions made?

- Consensus-driven approach
- Bottom-up approach, in consultation with ATLAS management
  - ATLAS management can't dictate, instead coordinates and steers the process
- Keep everyone on board!
- "Factorize" the encountered problems as much as possible
- Working groups come up with alternative solutions, they select and propose the most suitable one
- Leave tough decisions to the last possible moment (without compromising the schedule)
- Collaboration Board approves collaboration actions (one institute, one vote)
- Financial matters approved in the Resources Review Board
  - But I do not recall for the past 12 years <u>any</u> formal voting

Rainbow perhaps but no Waterfall?



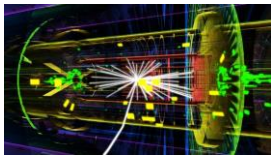
Monitoring and Information Systems

- Collection, recording and reporting of Project performance and progress information
  - Information is regularly collected from the sub-system project leaders for Project stakeholders: ATLAS Collaboration Board, Executive Board, CERN Mgmt, Research Review Board
- Collected information is submitted to different informatics tools (e.g. EDMS, PPT, CDS, EUCLID/CATIA, OTP, other web-based reporting tools)
- ATLAS Mgmt reviews the collected data and summarizes it for reporting
  - Schedule issues, technical performance issues,
  - Organization issues, financial issues
  - Science policies, Project personnel nominations, budgets
  - Project progress, milestones met, encountered technical issues (excluding resources)
  - All resources related matters; project status reports

How to keep members informed and involved?

- Roughly 1 000 members of the ATLAS Collaboration are physically at CERN at any given moment
- How then do we keep the other 2000 – 3000 members informed and involved?
  - Broadcasting of regular weekly common meetings
  - Working groups use Collaborative tools (videoconferencing)
  - Collaboration Weeks ~ 4 times a year
  - Collaboration Board meetings ~ 4 times a year
  - Many email-groups

Anything to Learn From?



- Lessons learned?
  - It can be done ☺
  - But not necessarily best solution for more conventional projects
- What should be changed or improved (for the future)?
  - Handling of contingency
  - Sharing of responsibilities (better mechanisms to ensure deliverables)
- Can it be replicated?
  - Sure; for next generation physics experiments (and not only HEP)…
  - Projects around eScience have similar characteristics (see next slide)
  - Open science/innovation models
  - Industrial R&D management models (laissez-faire)?

Conclusions

- ATLAS is a large scientific project that can be described as
  - Complex
  - Global
  - Culturally diverse
  - Shared vision, commitment and tolerance
  - Efforts made to hear the individual
- ATLAS is not managed like a corporation
- Instead, ATLAS is
  - Run by self-managed individuals and teams
  - Has a Spokesperson, not a CEO
  - Guided by engagement, discussions, trial & trust, and justification rather than hierarchical powers or ex-ante directives
  - A challenge for coordination …