Timescale impact on ECRs – or ‘my story’

Richard Hawkings (CERN, EP dept)

Future colliders for early-career researchers event , 27/9/22

- Working on or transitioning to future experiments that are decades away
  - My experience working on ATLAS (LHC), OPAL (LEP) and ATLAS again
  - Personal story / experiences, biased towards ATLAS
  - Try to draw out some reflections at the end

My timeline wrt LEP/LHC

- The last 30+ years:

Year	Position	Main activities
1991-94	Oxford PhD	RD2/ATLAS, SCT/L2 trigger/ H→4l
1995-96	CERN fellow	OPAL, tracking/b-tagging, b-physics
1997-99	DESY fellow	OPAL b-physics, LC Z-factory
2000-3	CERN LD staff	OPAL W mass, ATLAS ID calib/align
2004	CERN IC staff	ATLAS ID, databases, s/w, data-prep
2009	“	ATLAS Top/Standard Model physics TopWG, physics coord^{n}, flavour tagging, luminosity measurement
2022	“	CERN EP management, part-time ATLAS

LEP1 1989-95

LEP2 1996-2000

LHC construction, delays, ‘incident’

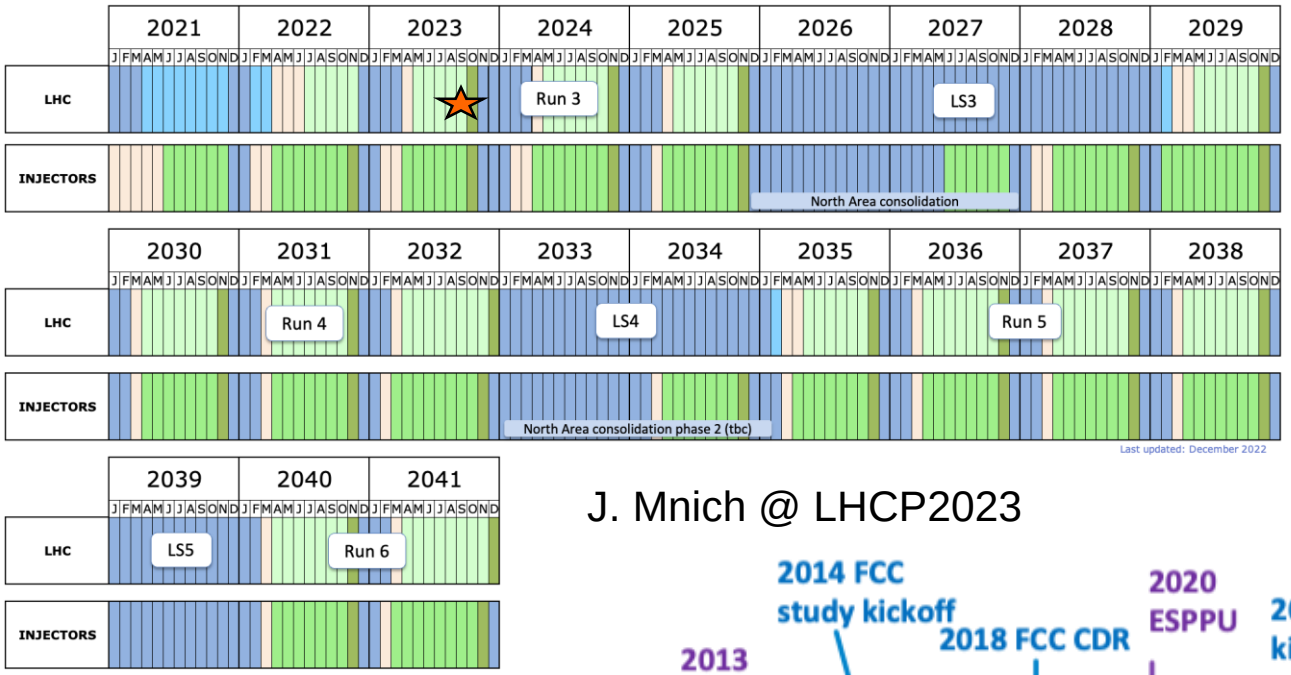
LHC 2010-2025

HL-LHC 2029+

- 9 years between end of LEP and start of LHC physics
  - 19 years between starting my PhD and seeing LHC data

The road ahead

- Timeline of HL-LHC, FCCee and other big projects



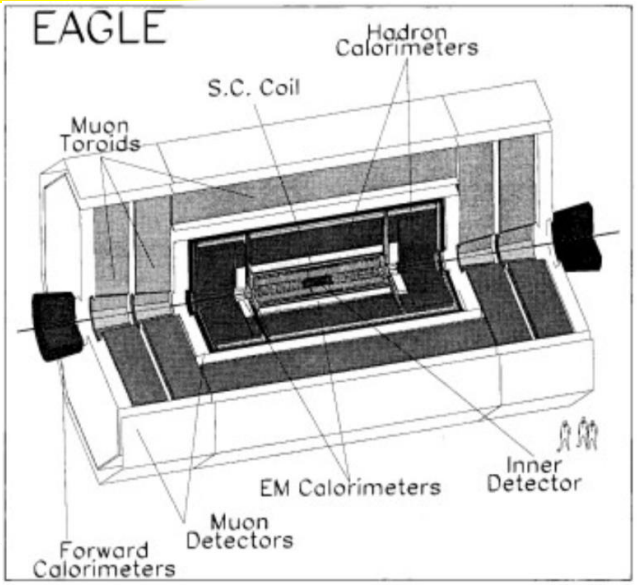
J. Mnich @ LHCP2023

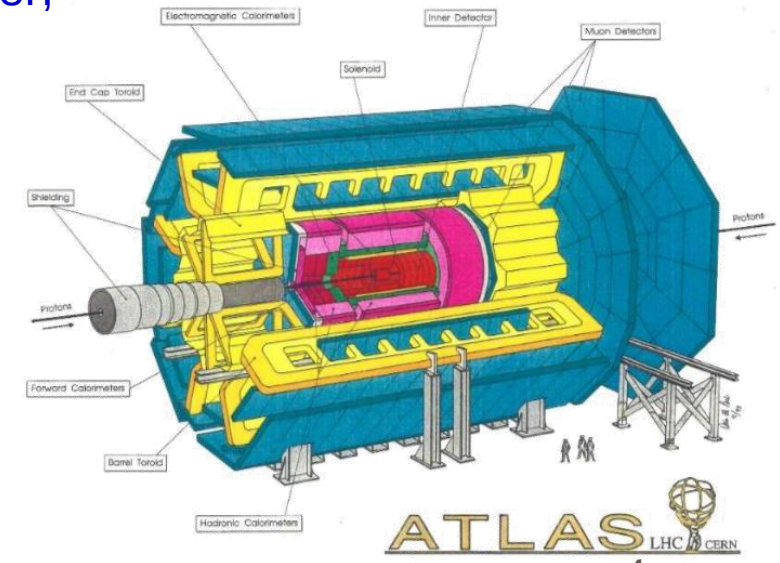
- Data-taking start dates for some other projects:
  - DUNE: 2029
  - Future ECN3:2030

- ~5 (??) years between end of LHC data-taking and FCC-ee data-taking
  - 22+ years from now to FCC-ee data-taking

Early years

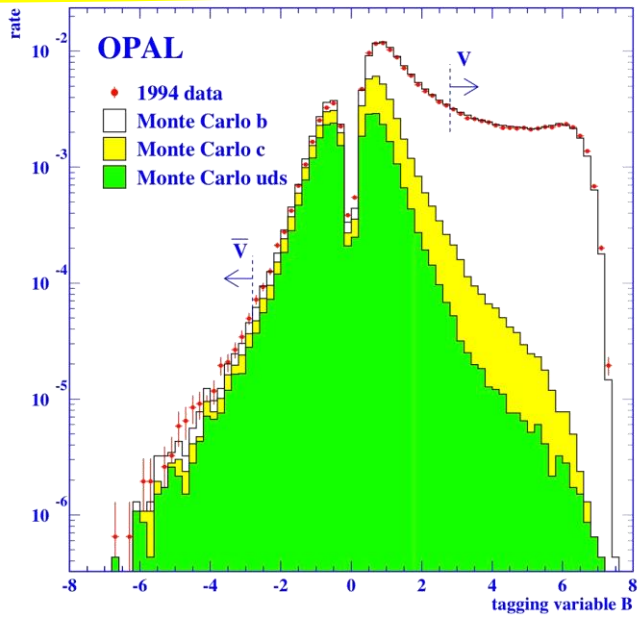
- Offered PhD position working on future LHC detector
  - Others in Oxford working on DELPHI, ZEUS
    - Experiments that were running or commissioning
  - Small group on LHC and SSC experiments
    - Timelines: SSC first data 1999, LHC 1997 !!
- Contributions to RD2 SiTV, forerunner of SCT
  - Detector testing, testbeams at RAL and CERN
    - Photon identification using a preshower detector
  - Simulation studies - algorithms for L2 electron trigger, top-quark background in H→ZZ*→4l search
- EAGLE EoI became ATLAS Technical Proposal
  - A Terribly Large Apparatus for ... Something
  - Contributed to various studies for the TP
    - And to 2 NIM detector papers
  - Interesting and varied PhD, but
    - 'Does your PhD contain a single falsifiable fact'?
- In the meantime, LHC construction was approved





Interlude on OPAL experiment at LEP

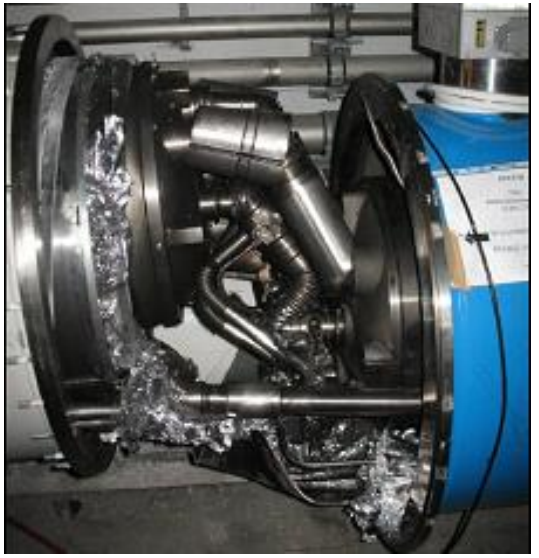
- CERN fellowship – ‘Join a running experiment’
  - Joined OPAL for last year of LEP1 ($e^+e^-\rightarrow Z\rightarrow qq/ll/\nu\nu$) and took part in LEP2 with $\sqrt{s}$=161-210 GeV
    - New experiences, data-taking, shifts, ‘service tasks’, physics working groups, finding analysis topic, …
  - Worked on tracking/b-tagging (early NNs), b-physics, finally W mass
  - Convener responsibilities in b and W groups, physics coordinator in 2022
  - Contributed to many analyses and papers
- Shutdown of LEP in 2000 was ‘controversial’
  - Some hints of ZH-like events with m_H~115 GeV
    - At the limit/beyond LEP sensitivity, not seen in all experiments
  - Try to run LEP in 2001 and raise beam energy?
  - Causing a delay to LHC programme?
    - Was expected to start in 2005; realistic schedule?
  - But CERN had to focus on LHC construction



The wilderness decade

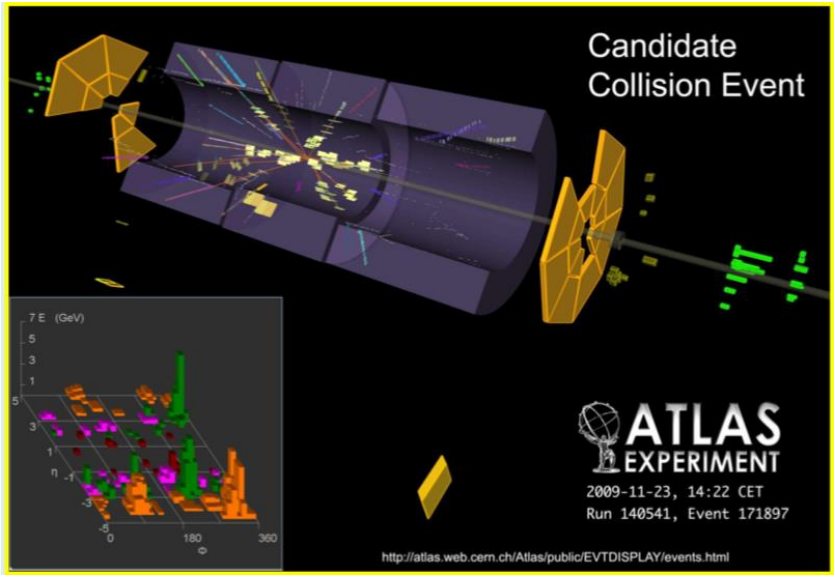
- From 2001, split time between OPAL analysis and ATLAS preparation activities
  - Alignment, ID integration, software, databases
    - Lots of very technical work, good to keep analysis activities alive in OPAL (until ~2004)
- LHC start-date kept receding (e.g. cryoline)
  - Some colleagues ‘moonlighted’ on other expts.
- Very busy period in ATLAS
  - Large-scale production, technical setbacks
  - Software integration, combined testbeams
    - Few physics studies in this period – we had decided what to build, now had to build it
- From ~2007, renewed focus on physics
  - PhD students could hope to see data !
  - ‘Computing system commissioning’ provided a focus for analysis – e.g. MC with hidden signals
- Then ‘LHC incident’ on 19/9/2008 ☹ ☹ ☹
  - 1 year delay; appreciation of complexity of LHC

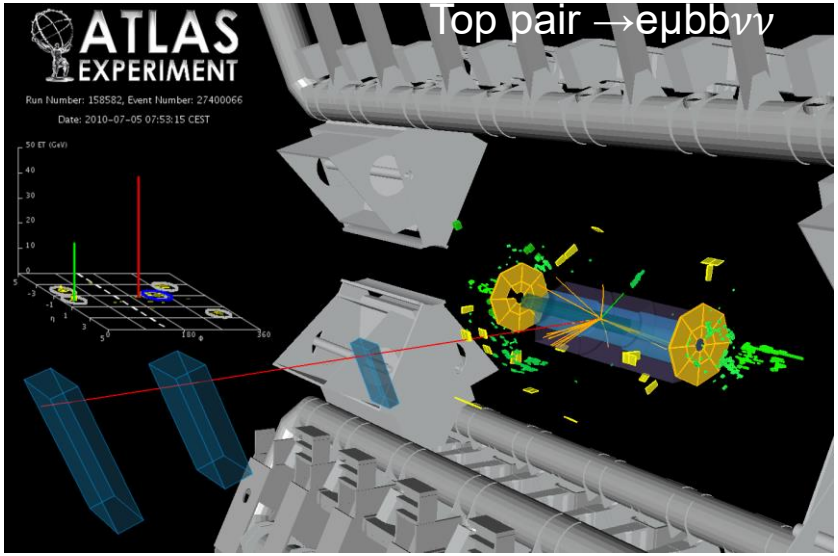

Barrel toroid and barrel calorimeter (plus solenoid) installations 2004-2005



LHC physics, finally ...

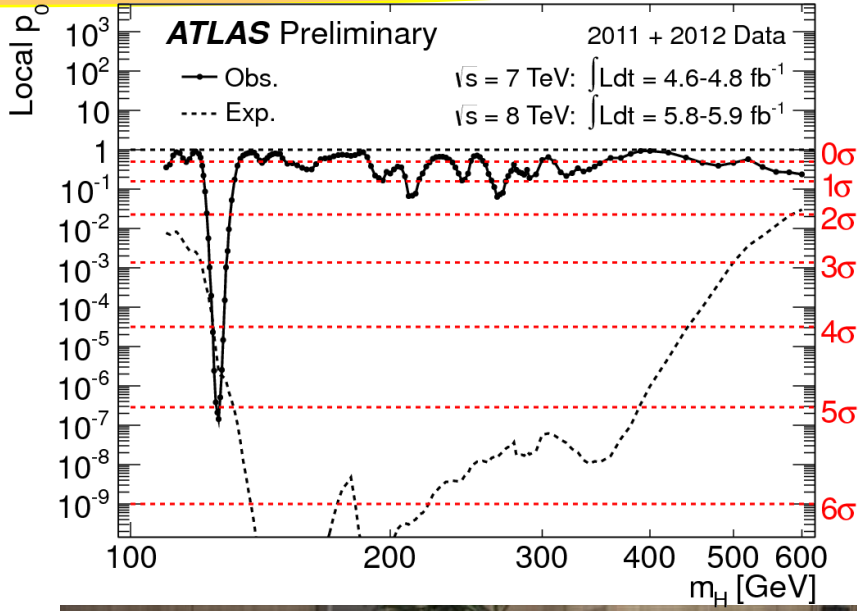
- After 9 years without collisions at CERN
  - First LHC pp collisions on 23/9/2009 (450 GeV)
  - 7 TeV collisions the following spring – it works!
- Very exiting and intense period
  - Understanding the detector, trigger, calib^{n}
  - Extracting first physics results
    - Commissioning the analysis/paper procedures
- Waiting for first 'European' top quark events
  - Arrived just in time for ICHEP2010 in July
  - Started writing ATLAS 'top rediscovery' paper
- Became deputy phys-coord in Oct 2010
  - LHC already surpassing Tevatron limits on some processes with 2010 data
    - First Pb+Pb run – jet quenching
  - Avalanche of results for 2011 winter confs.
    - 35 approval meetings in 1 week





Higgs discovery

- ATLAS+CMS built to explore the whole Higgs mass range over 100 GeV – 1 TeV
  - Rapidly extended Tevatron limits
  - 2011 datasets showed hints at $m_H \approx 125$ GeV
- Early 2012 data could be decisive ...
  - Focus on efficient and unbiased analysis
    - Prepare, fix analyses, prepare, scrutinise …
  - Hectic period in run-up to ICHEP 2012
- ATLAS and CMS both had 5σ observation
- Higgs Independence Day – 4/7/2012
  - Seminar at CERN, transmitted to Melbourne
- Culmination of ~20 year journey (for me)
  - Lucky to be in the right place at the right time
    - Benefitted from jobs allowing a 'coherent' research / work programme
- Who knows when/where/what the next discovery will be?



Reflections

- ECRs need to be involved in future projects – it is **your** future
  - In the early stages, these projects are driven by experienced senior colleagues
    - They have the luxury/duty of preparing the future, but todays ECRs will benefit from this and actually carry out the science – get involved, you can make a difference ...
- Participating in running experiments gives invaluable experience
  - Real data is not simulation, but ATLAS SCT works a lot better than the testbeam
  - Experience the full chain from detector operations to paper acceptance
  - A different experience of collaboration, analysis WGs/hierarchies, getting results
    - Some colleagues worked only on LHC expts. from 1990 until now – I'm glad I did not
- Expertise is transferrable between experiments / projects
  - Figure out what you are interested in and good at – look for synergies
    - I have worked on tracking/b-tagging & precision measurements at OPAL and ATLAS
- Say yes to leadership opportunities even if it upsets your plans
  - Explore different areas, learn new skills, broaden your horizons
    - Less-attractive tasks are still vital, people appreciate that you take them on
- Be prepared for setbacks, surprises and successes – good luck !