

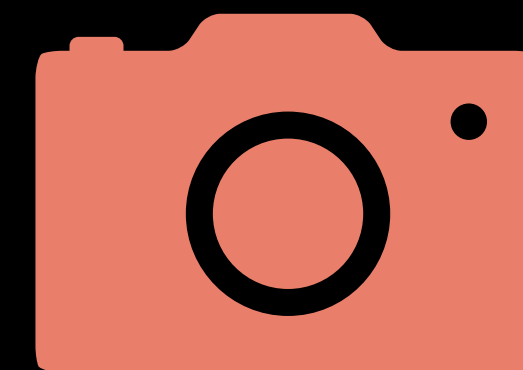
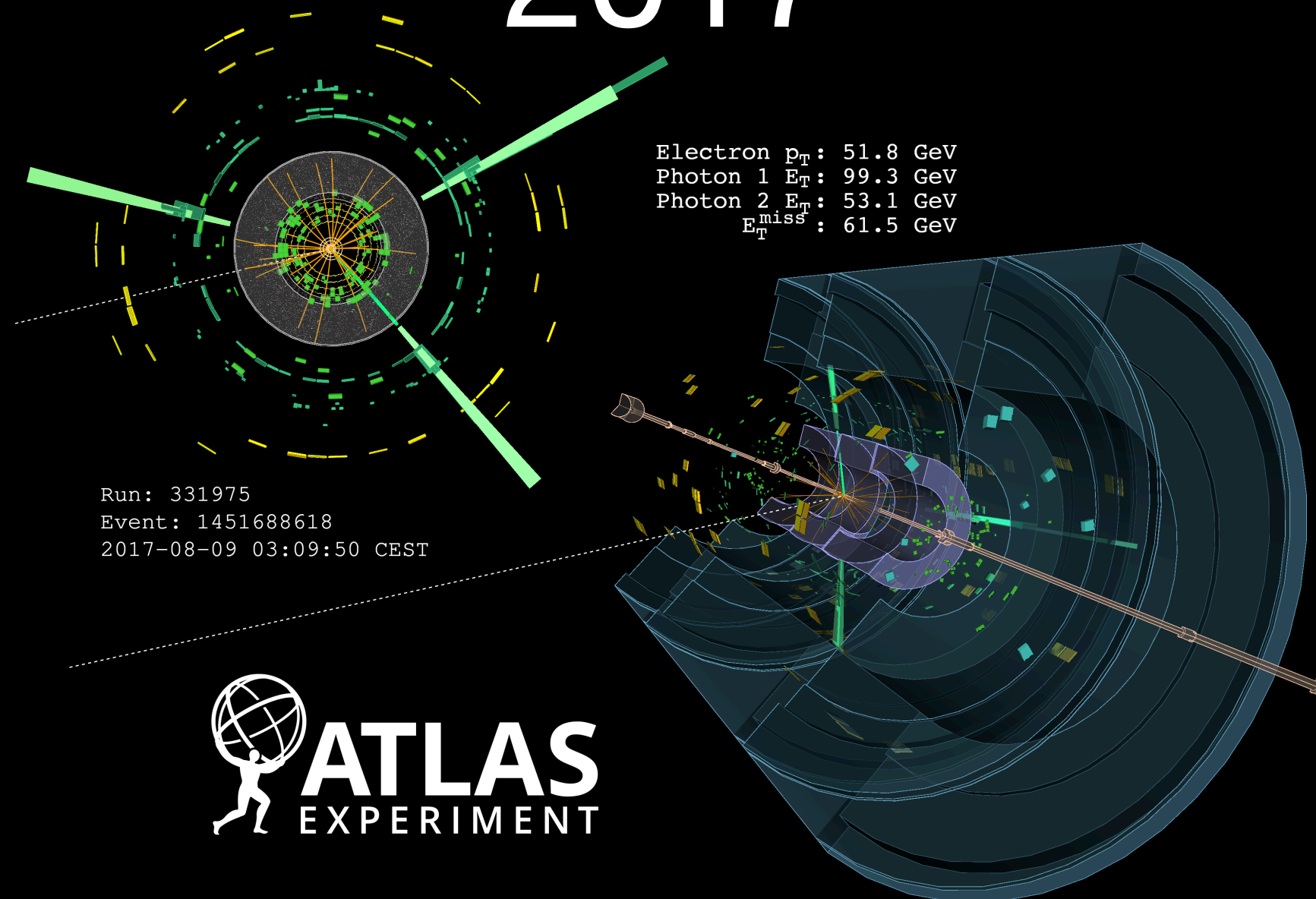
PHYS 7363 - Experimental Particle Detection and Detectors I



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Particle detectors are the workhorses of experimental physics. In this course, we'll dive deep into their physics, exploring the incredible evolution of our experimental techniques over the past nine decades. You'll gain a solid understanding of *particle detection and identification*, examine the intricate designs of modern detectors, and learn how machine learning is being harnessed to push the boundaries of detector design. If you're intrigued by how we “see” subatomic particles, this course is for you!

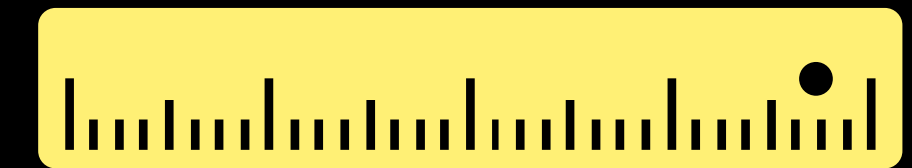
2017



Detect



Identify



Measure

To discuss prerequisites (and any questions on the content of the course), please contact me: saptaparnab@smu.edu



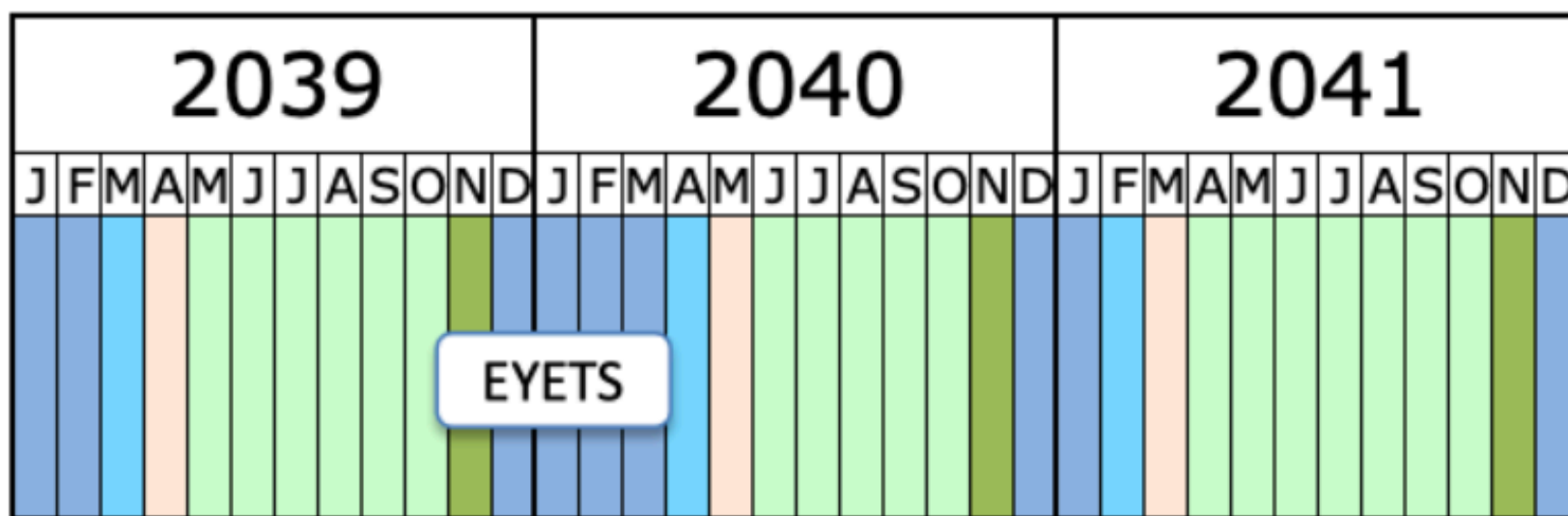
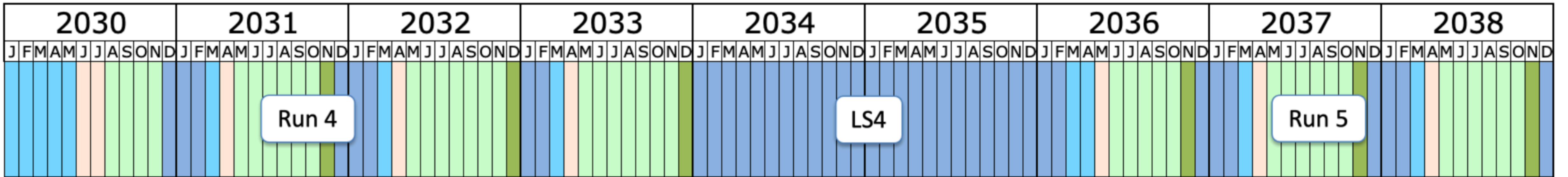
Schedule

Month	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
October	6 <input checked="" type="checkbox"/> 1.5 hours	7	8 <input checked="" type="checkbox"/> 1.5 hours	9	10	11	12
	13 <input checked="" type="checkbox"/> 1.5 hours	14	15 <input checked="" type="checkbox"/> 1.5 hours	16	17 <input checked="" type="checkbox"/>	18	19
	20	21	22	23 <input checked="" type="checkbox"/> 1.5 hours	24 <input checked="" type="checkbox"/> 1.5 hours	25	26
	27: Midterm	28	29 <input checked="" type="checkbox"/> 1.5 hours	30	31 <input checked="" type="checkbox"/> 1.5 hours	1	2
November	3 <input checked="" type="checkbox"/> 1.5 hours	4	5 <input checked="" type="checkbox"/> 1.5 hours	6	7 <input checked="" type="checkbox"/> 1.5 hours	8	9
	10 <input checked="" type="checkbox"/> 1.5 hours	11	12 <input checked="" type="checkbox"/> 1.5 hours	13	14 <input checked="" type="checkbox"/> 1.5 hours	15	16
	17 <input checked="" type="checkbox"/> 1.5 hours	18	19 <input checked="" type="checkbox"/> 1.5 hours	20	21 <input checked="" type="checkbox"/> 1.5 hours	22	23
	24 <input checked="" type="checkbox"/> 1.5 hours	25	26	27	28	29	30
December	1 <input checked="" type="checkbox"/> 1.5 hours	2	3	4	5	6	7
	8	9	10	11	12	13	14

Key milestones

- 10 September 2008: LHC **first** beam
- **23 November 2009**: LHC **first** collisions
- **30 November 2009**: **world record** with beam energy of 1.18 TeV
- **16 December 2009**: **world record** with collisions at 2.36 TeV and significant amount of data recorded
- **March 2010**: **first** beams at 3.5 TeV (19 March) and **first high energy collisions** at 7 TeV (30 March)
- **8 November 2010**: LHC first lead-ion beams
- **22 April 2011**: LHC sets **new world record** beam intensity
- **5 April 2012**: **First** collisions at 8 TeV
- **4 July 2012**: **Announcement of the discovery of a Higgs-like particle at CERN**
- **28 September 2012**: [Tweet](#) from CERN: “The LHC has reached its target for 2012 by delivering 15 fb⁻¹ (around a million billion collisions) to ATLAS and CMS”
- **14 February 2013**: At 7.24 a.m, the last beams for physics were absorbed into the LHC, marking the end of Run 1 and the beginning of the Long Shutdown 1
- **8 October 2013**: Physics Nobel prize to François Englert and Peter Higgs “for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN’s Large Hadron Collider”

LHC Upgrade Schedule



- Shutdown/Technical stop
- Protons physics
- Ions
- Commissioning with beam
- Hardware commissioning

Longer term LHC schedule

Update September 2024:

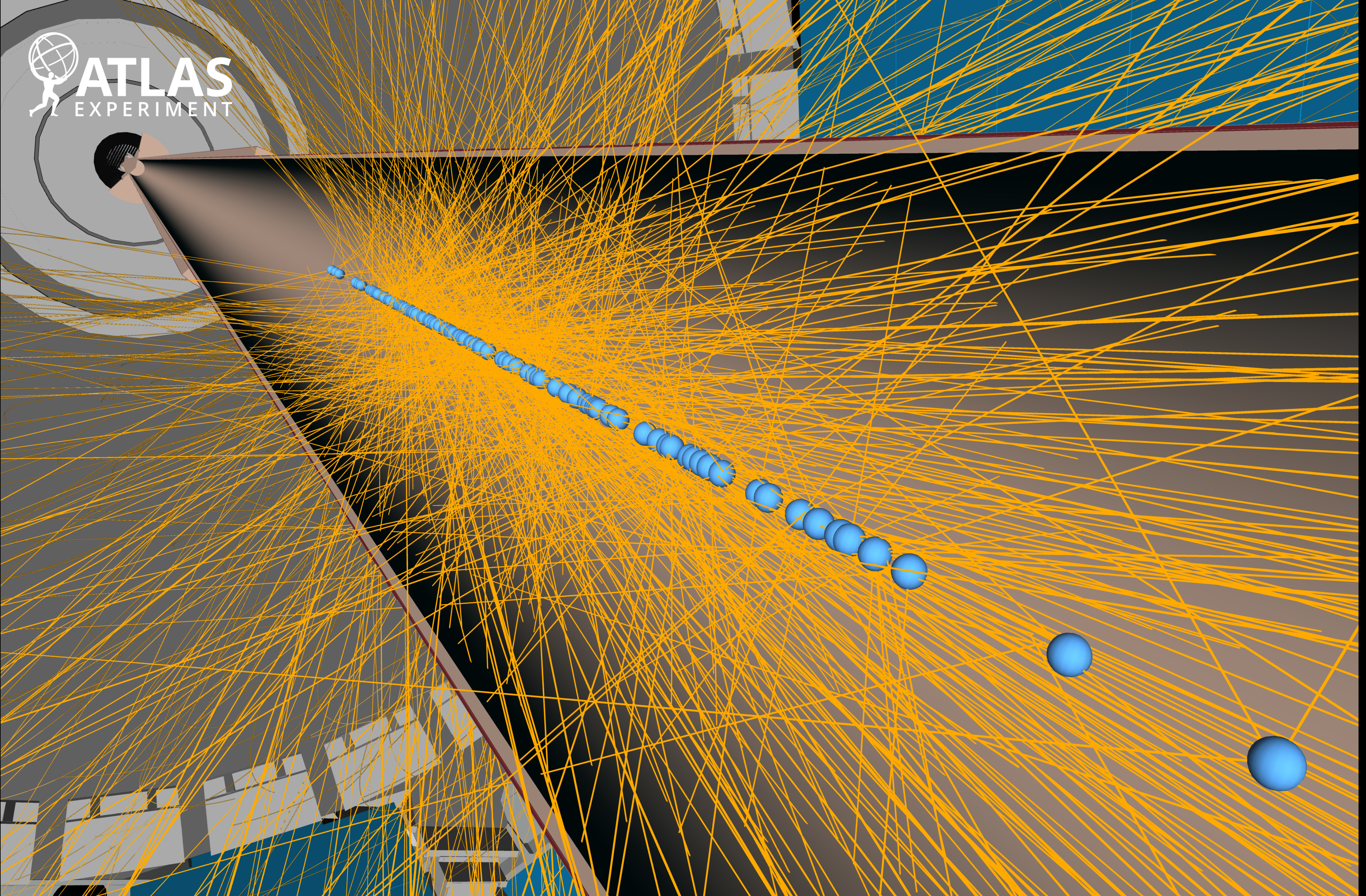
- Short YETS 25/26
- Extend Run 3 to end June 2026
- Start LHC LS3 July 2026
- Start final Hardware Commissioning January 2030
- First beam June 2030
- LS3 - beam to beam: 3 years 11 months, 47 months

Key Parameters

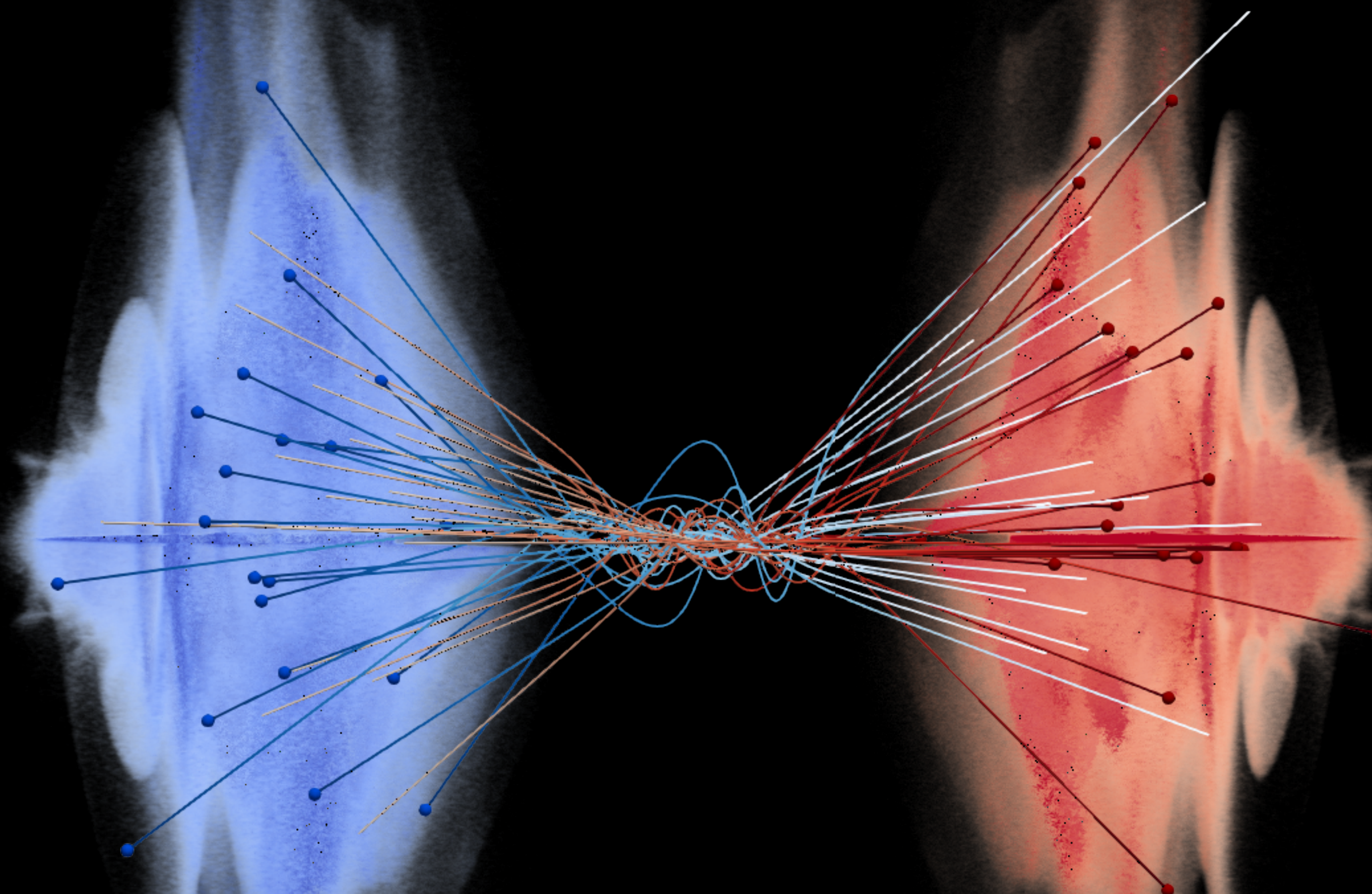
Parameters	Tevatron	LHC (nominal)
Circumference	6.28 km (2*PI)	27 km
Beam energy	980 GeV	7 TeV
Number of bunches	36	2808
Protons per bunch	275 X 10 ⁹	115 X 10 ⁹
Stored proton beam energy	2.1 MJ	732 MJ
Main dipoles	780	1232
Bend field	4.2 T	8.3 T
Main quadrupoles	~200	~600
Operating temperature	4.2 K (liquid He)	1.9 K (superfluid He)
Number of collisions per second	10 million	1 billion

1 stick of dynamite releases 2.1 MJ of energy 

Pileup



Beam Dynamics



<https://blast-warpX.github.io/warpX-tutorials/install.html>