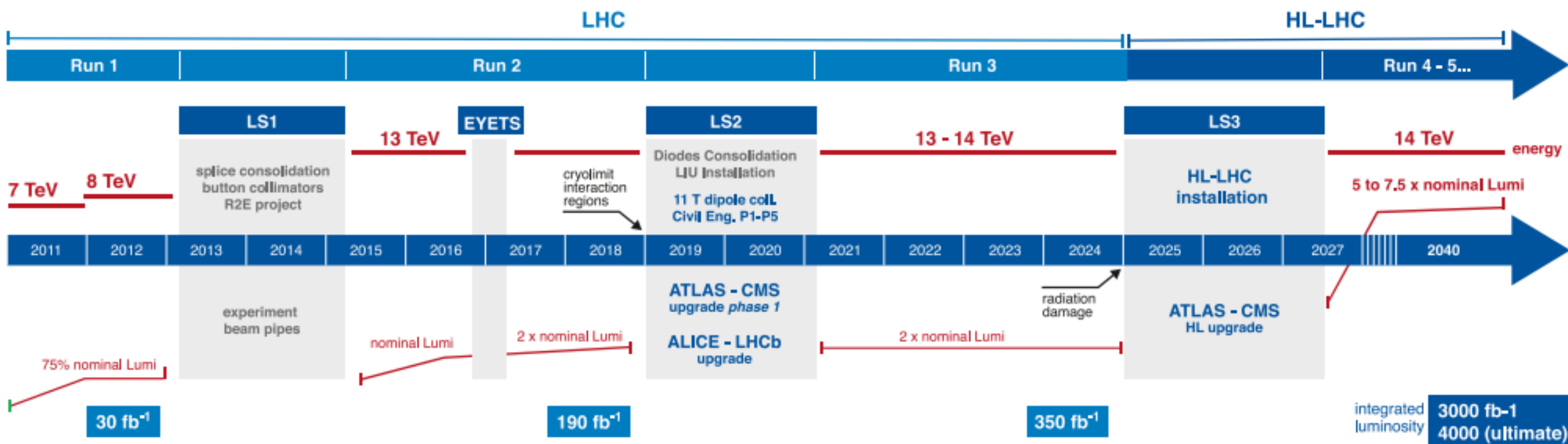


Initial Centre Strategy for ATLAS/LHC DM Program



LHC / HL-LHC Plan



HL-LHC TECHNICAL EQUIPMENT:

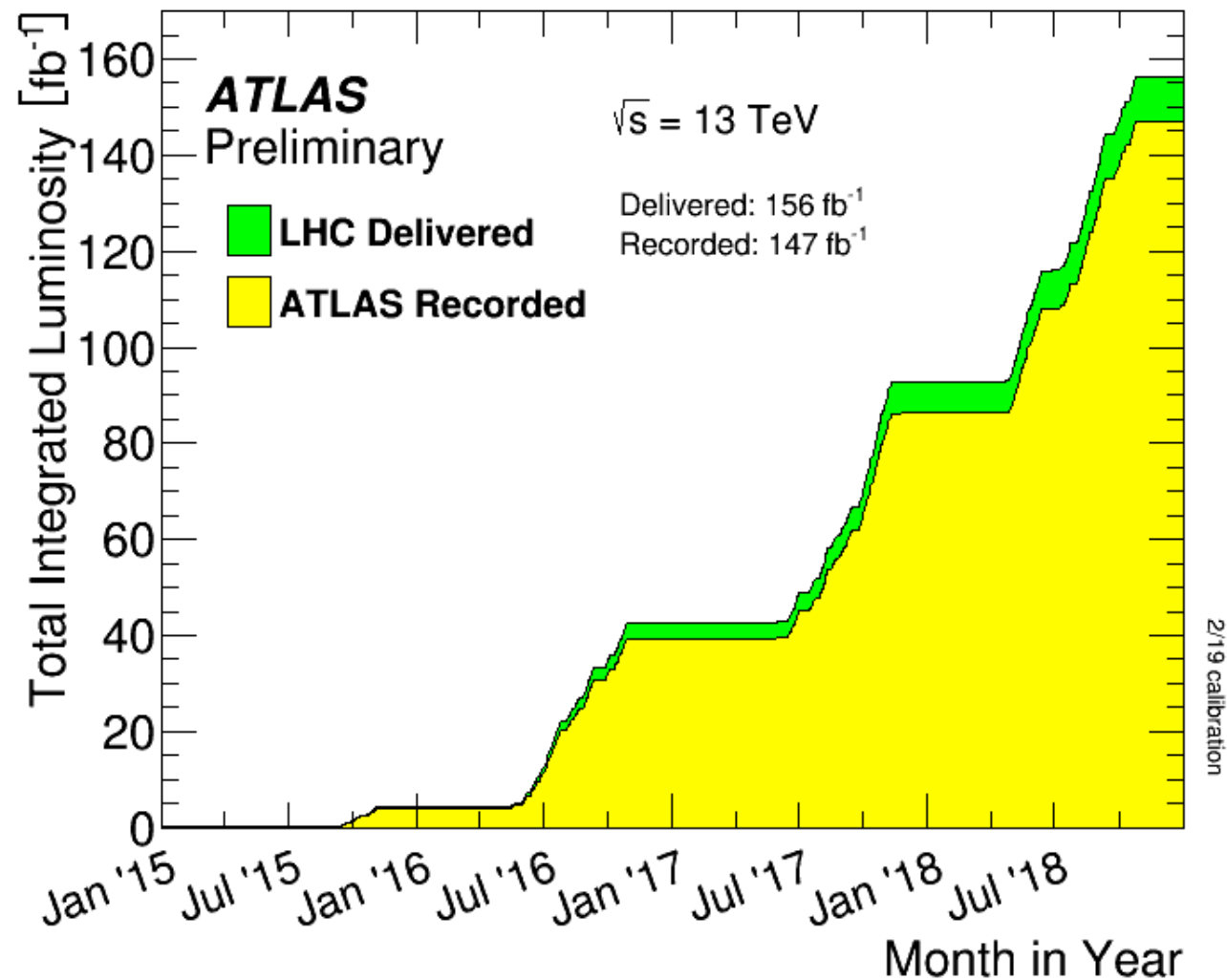


HL-LHC CIVIL ENGINEERING:



Initial Centre Strategy for ATLAS/LHC DM Program

Aiming for $\sim 300 \text{ fb}^{-1}$
by end of Run 3



Initial Centre Strategy for ATLAS/LHC DM Program

- Adelaide in process of hiring postdoc.
- Melbourne to follow with “tenure track” position.
 - Looking for analysis and hardware experience
 - ATLAS and SUPL work.
 - ATLAS participation will also expect national contribution to HL-LHC upgrade
 - (Not expressly part of CDMPP – we will continue to apply for ARC DP and LIEF)
- Supersymmetric DM (Jack- Adelaide), Generic kinematic searches, ...
- Previously Mono-X studies out of Melbourne
 - remains a key search strategy, need Melbourne post-doc effort
- Latest Schedule —> no HL-LHC running before end of Centre’s 7-Year operation.
 - Will have Run 3 data available during CDM (as well as existing Run 2 data)

Dark Matter Searches at the LHC

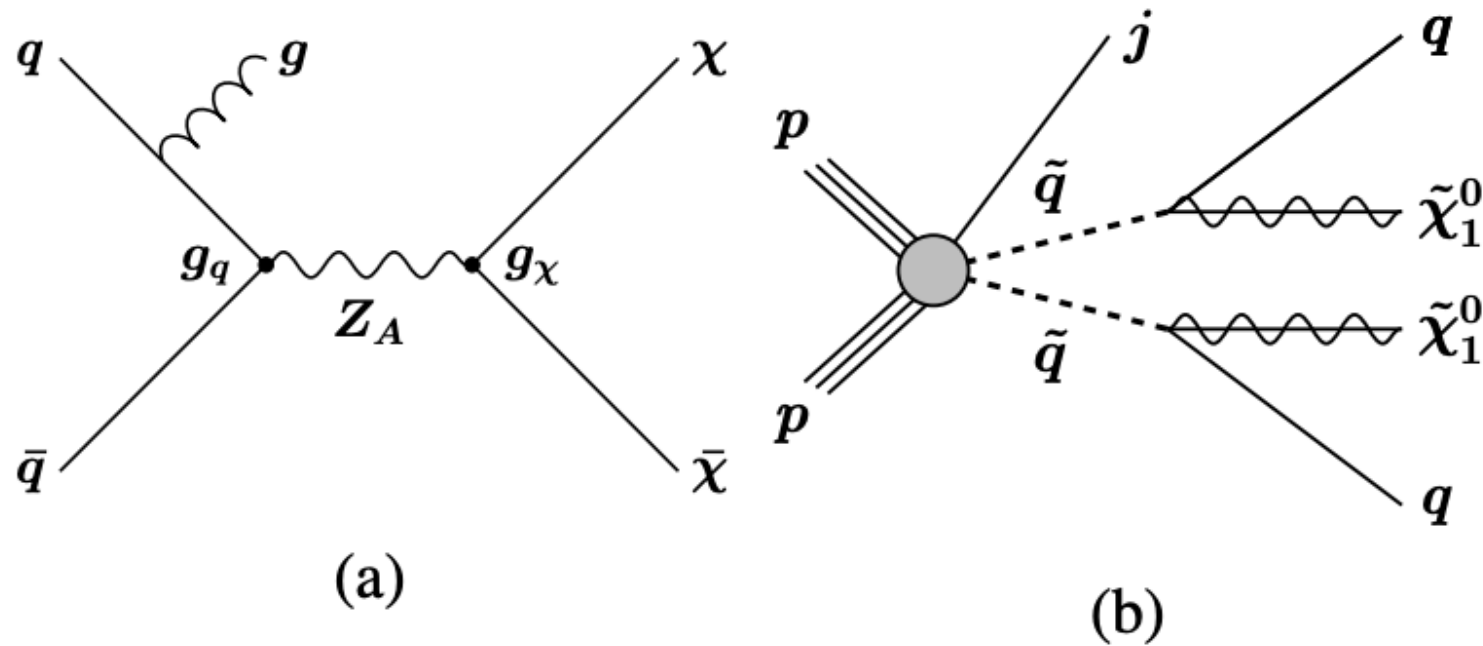
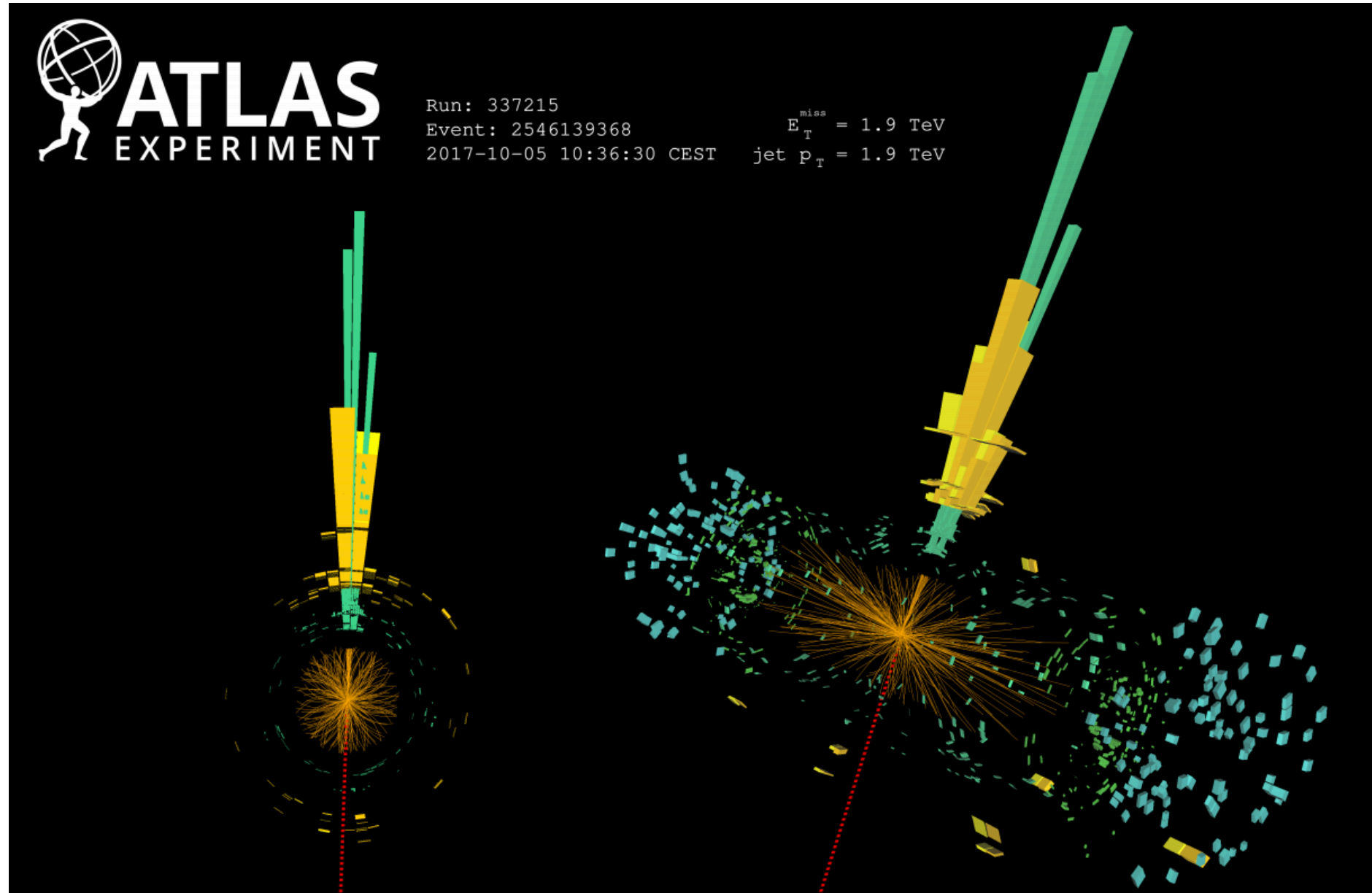


Figure 1: (a) Diagram for the pair-production of weakly interacting massive particles χ , with a mediator Z_A with axial-vector couplings exchanged in the s-channel. (b) A generic diagram for the pair-production of squarks with the decay mode $\tilde{q} \rightarrow q + \tilde{\chi}_1^0$. The presence of a jet from initial-state radiation is indicated for illustration purposes.

ATLAS Monojet Searches

A monojet event with jet $p_T = 1924$ GeV and recoil $p_T = 1913$ GeV collected in the 2017 ATLAS dataset.

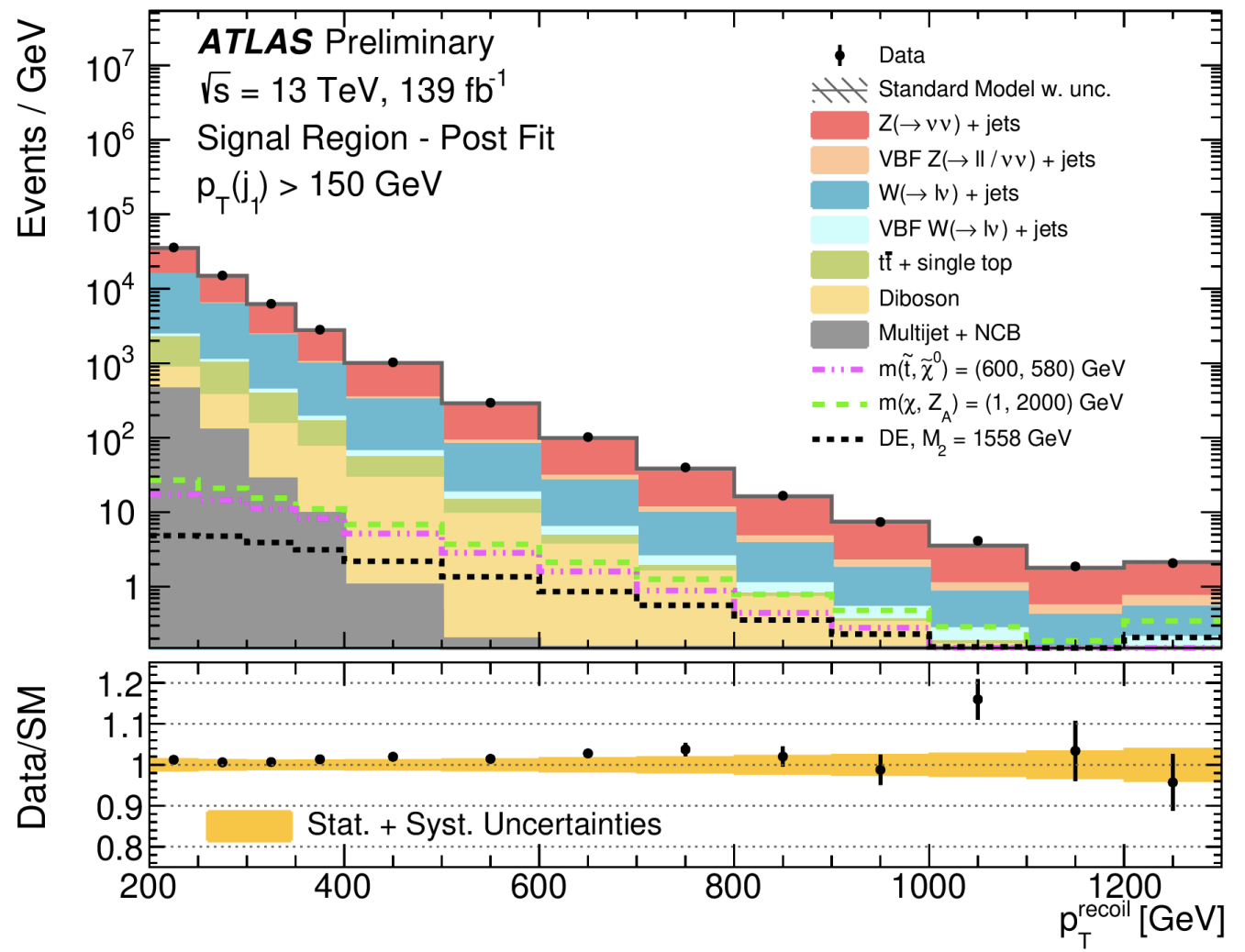
(Event = 2546139368, Run = 337215). No additional jets with p_T above 30 GeV are found.



from: ATLAS CONF Note CONF-EXOT-2020-048

Monojet Search - New result at ICHEP2020

Figure 4: Measured distributions of the $p_T(\text{recoil}) > 200$ GeV selection compared to the SM predictions in the signal region. The latter are normalized with normalization factors as determined by the global fit that considers exclusive $p_T(\text{recoil})$ control regions.



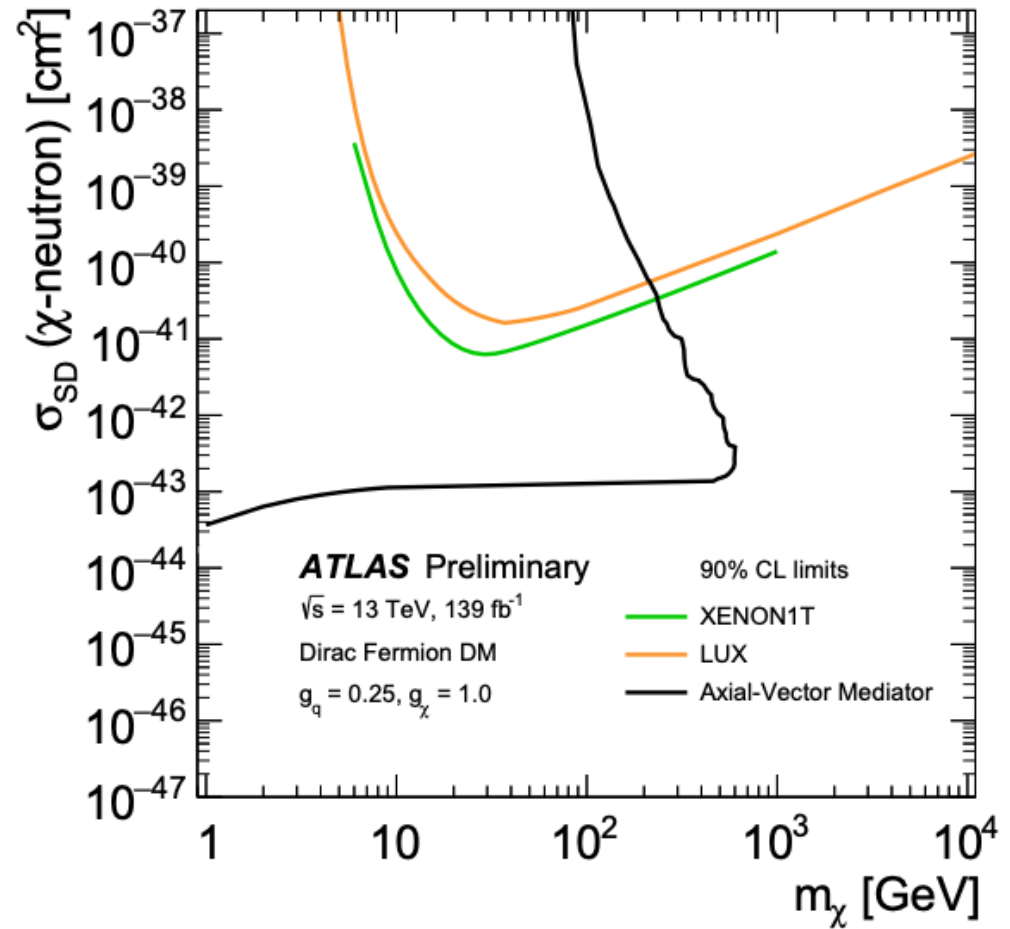
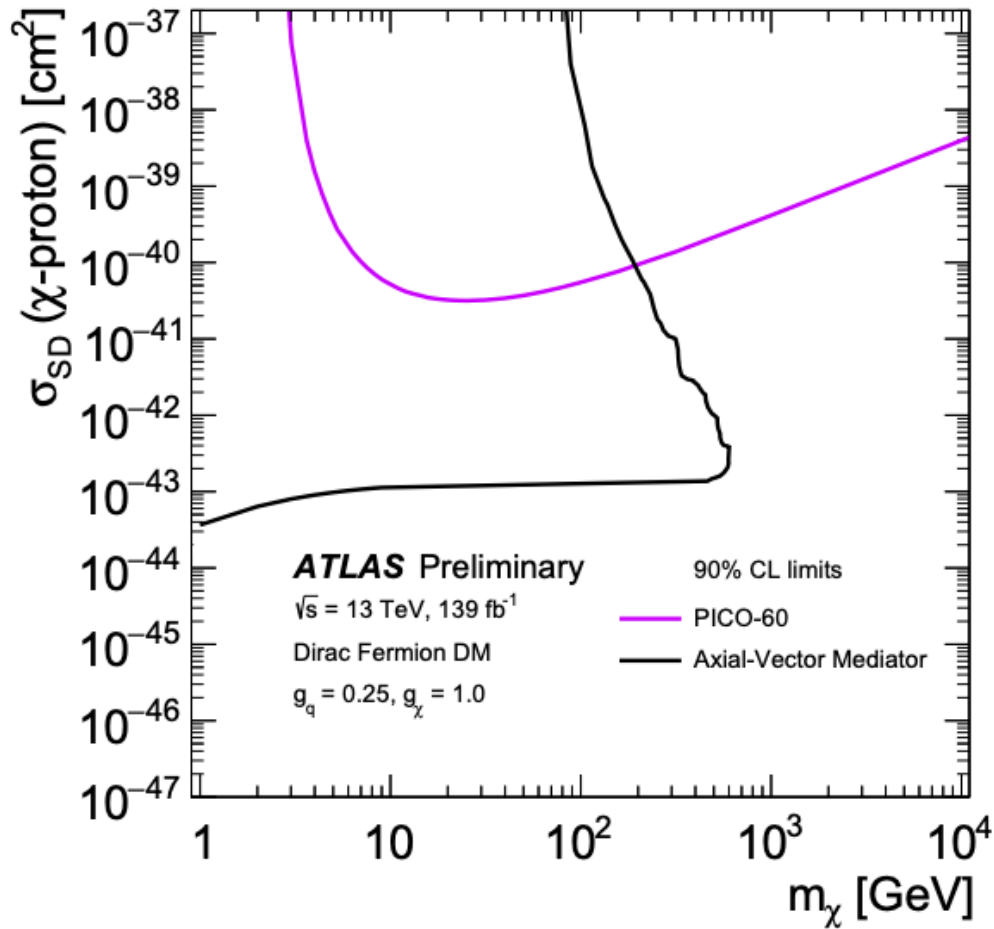


Figure 6: A comparison of the inferred limits (black line) to the constraints from direct detection experiments on the spin-dependent (a) WIMP–proton scattering cross section and (b) WIMP–neutron scattering cross section as a function of the WIMP mass, in the context of the simplified model with axial-vector couplings. Unlike in the $m_{ZA} - m_\chi$ parameter plane, the limits are shown at 90% CL. The results from this analysis, excluding the region to the left of the contour, are compared with limits from the PICO [119] (purple line), LUX [120] (orange line), and XENON1T [121] (green line) experiments. The comparison is model-dependent and solely valid in the context of this model, assuming minimal mediator width and the coupling values $g_q = 1/4$ and $g_\chi = 1$.

SUSY Still Elegant Provider of WIMP Candidate

SUSY provides elegant prediction for the existence of a stable weakly interacting particle

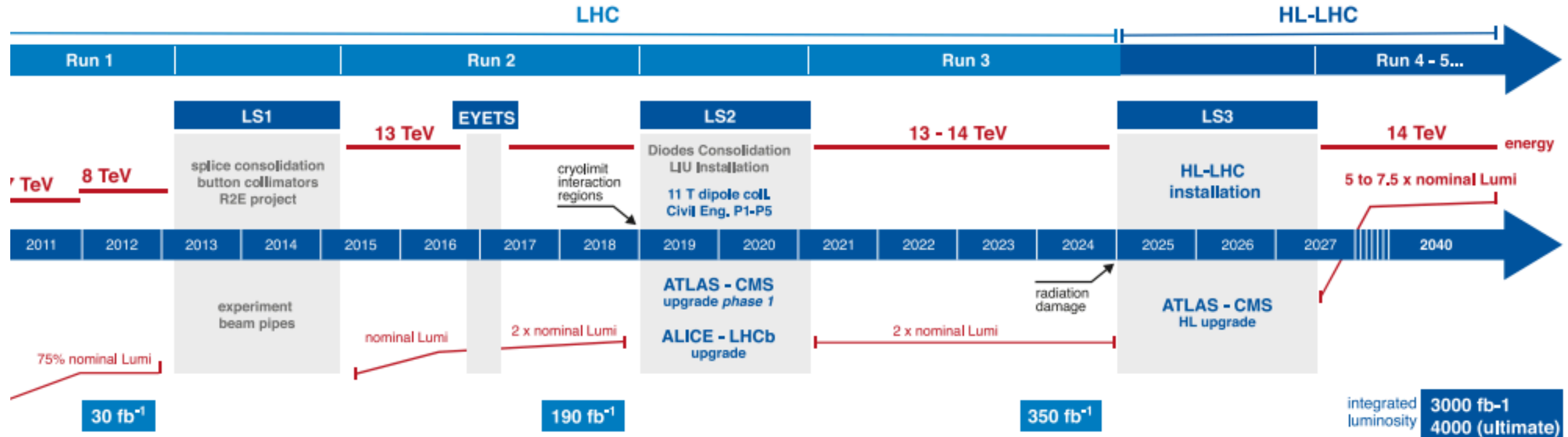
the lightest supersymmetric particle (LSP) has the pertinent properties to be a dark matter particle.

SUSY searches at ATLAS/LHC focus on events with high transverse missing energy:

SUSY searches being led out of Adelaide

Working for the Future of ATLAS/LHC:

- ATLAS/HL-LHC preparations part of the Australian effort in ATLAS
- Melbourne Adelaide (and Sydney) producing >200 EndCap modules for the replacement inner tracking detector - ITK.



Awaiting ARC results on critical LIEF2021 Grant Proposal