ATLAS PUB Note

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Summary Plots for Heavy Particle Searches and Long-lived Particle Searches – March 2022

The ATLAS Collaboration

The results of searches for heavy particles from the Exotics and HDBS physics groups and long-lived particles from the Exotics and SUSY physics groups are summarized in plots for a representative set of models. The latest results, up to March 2022, are included.

1 Heavy Particle Searches Summary Plot

Searches for heavy new particles have been carried out with the Run 1 and Run 2 datasets in proton–proton collisions at $\sqrt{s} = 8$ and 13 TeV.

A representative set of the most sensitive recent results is included in the summary plot shown in Figure 1. Some changes are made to include updated references and to supersede older results with new ones. New entries relative to the July 2021 version of the summary plot [1] are as follows.

- Search for pair production of third-generation vector leptoquarks in events with τ-leptons and b-tagged jets [2].
- Search for pair production of doubly-charged Higgs bosons decaying into same-sign leptons $H^{\pm} \to \ell^{\pm}\ell^{\pm}$ [3].
- Search for WZ resonances in fully-leptonic final state [4], especially in the vector-boson fusion mechanism.

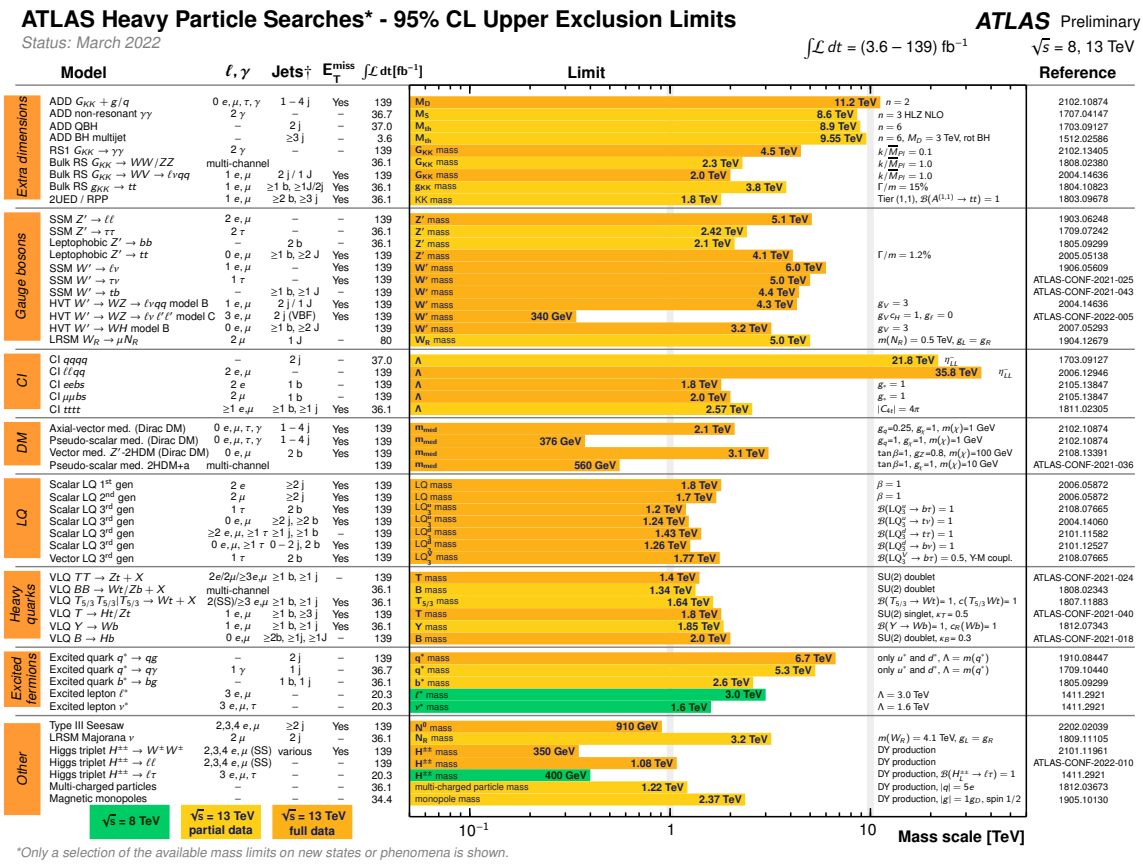

Figure 1: Ranges of new particle masses or energy scales excluded at the 95% confidence level.

2 Long-lived Particle Searches Summary Plot

Searches for long-lived particles have been carried out with the Run 1 and Run 2 datasets in proton–proton collisions at $\sqrt{s}$ of 8 and 13 TeV.

Recent updates of the results are included in the summary plot shown in Figure 2. Some changes are made to include updated references and to supersede older results with new ones. New entries relative to the July 2021 version of the summary plot [1] are as follows.

- Search for heavy long-lived charged particles with large ionisation energy loss [5].
- Search for long-lived particles decaying into hadronic jets in the calorimeter [6].
- Search for long-lived particles decaying into hadronic jets in the muon spectrometer [7].
- Search for long-lived particles decaying into displaced lepton-jets [8].
- Search for long-lived heavy neutral leptons using a dilepton displaced vertex [9].

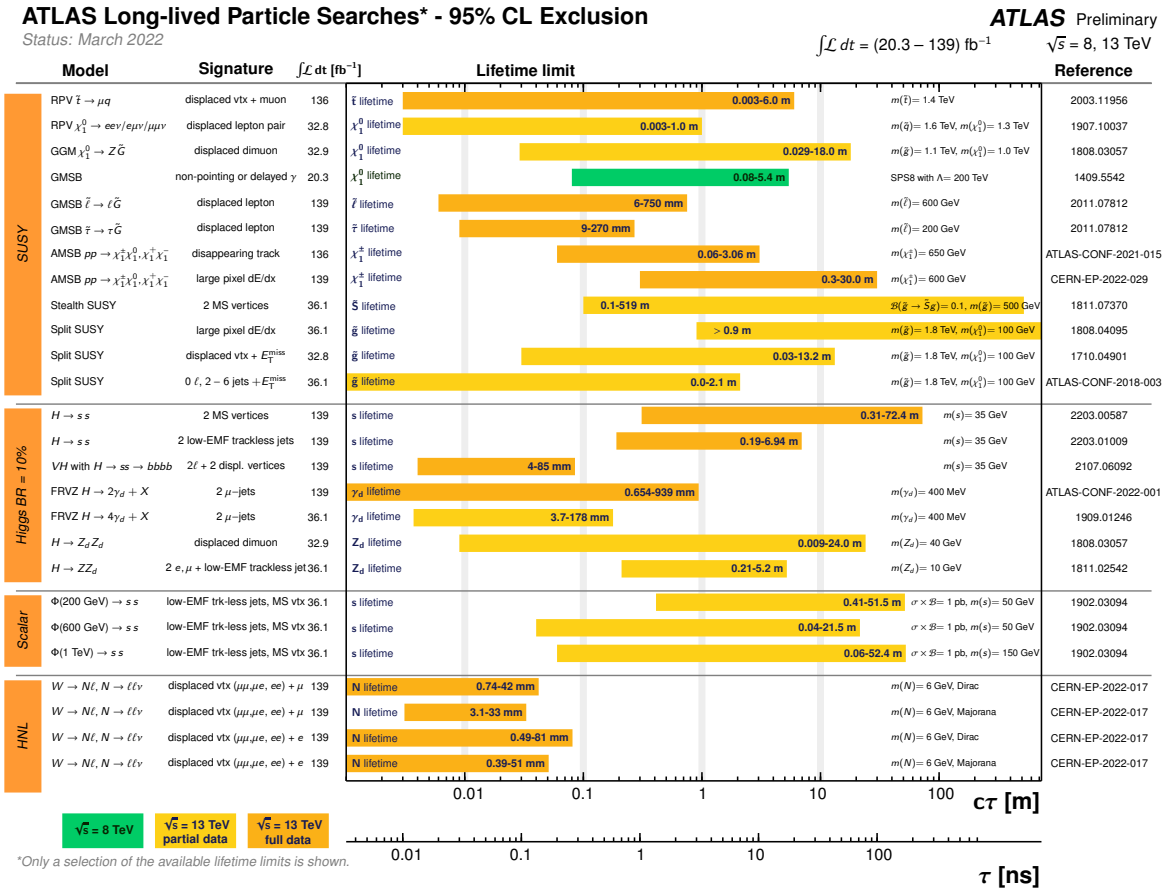

Figure 2: Ranges of new particle lifetimes excluded at the 95% confidence level.

References

[1] ATLAS Collaboration,
Summary Plots for Heavy Particle Searches and Long-lived Particle Searches – July 2021,
ATL-PHYS-PUB-2021-033, 2021, URL: https://cdsweb.cern.ch/record/2777015
(cit. on pp. 2, 3).

[2] ATLAS Collaboration, *Search for new phenomena in pp collisions in final states with tau leptons, b-jets, and missing transverse momentum with the ATLAS detector*, Phys. Rev. D **104** (2021) 112005, arXiv: 2108.07665 [hep-ex] (cit. on p. 2).

[3] ATLAS Collaboration, *Search for doubly charged Higgs boson production in multi-lepton final states using 139 fb^{-1} of proton–proton collisions at $\sqrt{s}$ = 13 TeV with the ATLAS Detector*, ATLAS-CONF-2022-010, 2022, URL: https://cds.cern.ch/record/2805214 (cit. on p. 2).

[4] ATLAS Collaboration, *Search for Resonant $WZ \to \ell\nu\ell'\ell'$ Production in Proton-Proton Collisions at $\sqrt{s}$ = 13 TeV with the ATLAS Detector*, ATLAS-CONF-2022-005, 2022,
URL: https://cds.cern.ch/record/2803929 (cit. on p. 2).

[5] ATLAS Collaboration, *Search for heavy, long-lived, charged particles with large ionisation energy loss in pp collisions at $\sqrt{s}$ = 13 TeV using the ATLAS experiment and the full Run 2 dataset*, CERN-EP-2022-029, 2022 (cit. on p. 3).

[6] ATLAS Collaboration, *Search for neutral long-lived particles in pp collisions at $\sqrt{s}$ = 13 TeV that decay into displaced hadronic jets in the ATLAS calorimeter*, 2022, arXiv: 2203.01009 [hep-ex] (cit. on p. 3).

[7] ATLAS Collaboration,
Search for events with a pair of displaced vertices from long-lived neutral particles decaying into hadronic jets in the ATLAS muon spectrometer in pp collisions at $\sqrt{s}$ = 13 TeV, 2022,
arXiv: 2203.00587 [hep-ex] (cit. on p. 3).

[8] ATLAS Collaboration, *Search for light long-lived neutral particles that decay to collimated pairs of leptons or light hadrons in pp collisions at $\sqrt{s}$ = 13 TeV with the ATLAS detector*,
ATLAS-CONF-2022-001, 2022, URL: https://cdsweb.cern.ch/record/2799602
(cit. on p. 3).

[9] ATLAS Collaboration, *Search for heavy neutral leptons in decays of W bosons using a dilepton displaced vertex in $\sqrt{s}$ = 13 TeV pp collisions with the ATLAS detector*, CERN-EP-2022-017, 2022
(cit. on p. 3).