



ATLAS PUB Note
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Summary Plots for Heavy Particle Searches and Long-lived Particle Searches

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 May 2020, 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 Fig. 1. Changes included in the May 2020 version of the summary plot relative to the May 2019 version are:

- The search for heavy resonances decaying into a $t\bar{t}$ pair with a fully-hadronic state has been updated using the full Run 2 dataset, see Ref. [1].
- The search for heavy resonances decaying into a diboson pair (VV) with a semi-leptonic final state has been updated using the full Run 2 dataset, see Ref. [2].
- The search for heavy resonances decaying into a weak boson and Higgs boson pair (VH) with a fully hadronic final state has been updated using the full Run 2 dataset, see Ref. [3].
- The search for contact interactions in the non-resonant dilepton final state has been updated with the full Run 2 dataset, see Ref. [4].

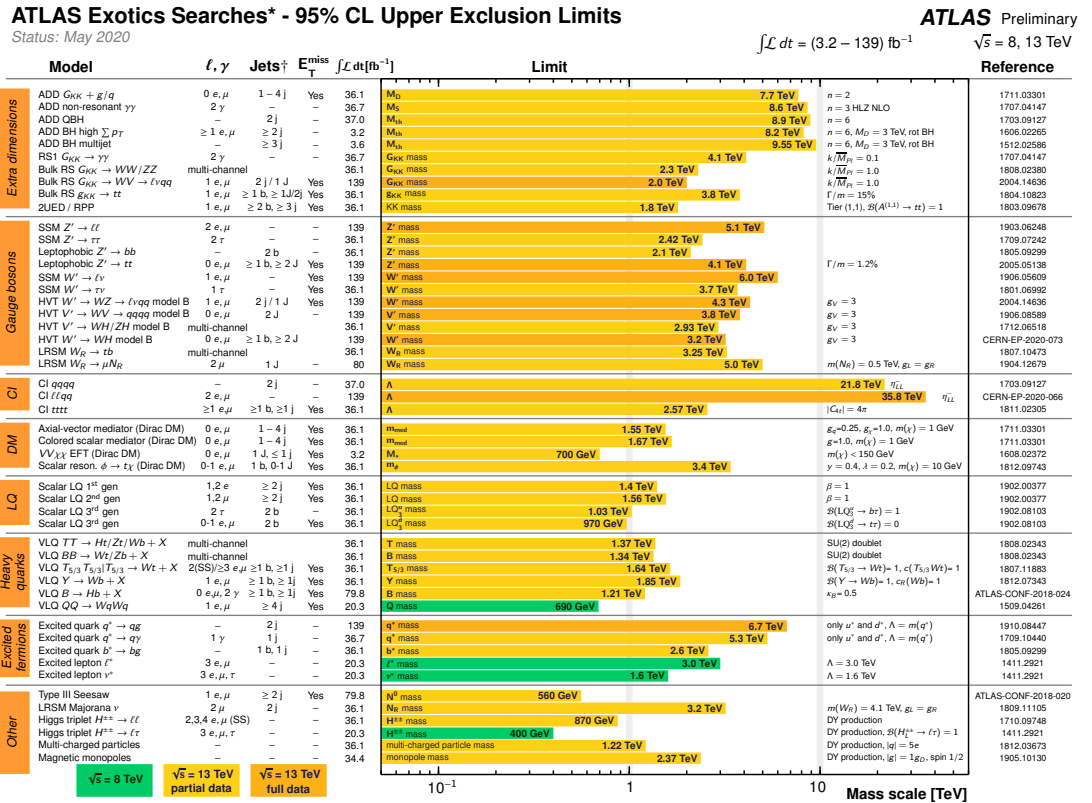


Figure 1: Ranges of new particle masses or energy scales excluded at the 95% confidence level.

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 Fig. 2. Changes relative to the July 2019 version of the summary plot are:

- The search for long-lived top squarks in RPV SUSY has been updated with the analysis selecting displaced vertices in the inner detector accompanied with a muon in the full Run 2 dataset, see Ref. [5].
- The search for long-lived neutralinos with displaced dileptons has been updated with the 2016 dataset, see Ref. [6].
- The search for long-lived scalars from Higgs boson or heavy scalar decays with the analysis of displaced vertices in the inner detector combined with a vertex in the muon spectrometer has been updated with the 2015–2016 dataset, see Ref. [7].
- A new search for long-lived heavy neutral leptons with the analysis of three-lepton events has been carried out with the 2015–2016 data, see Ref. [8].

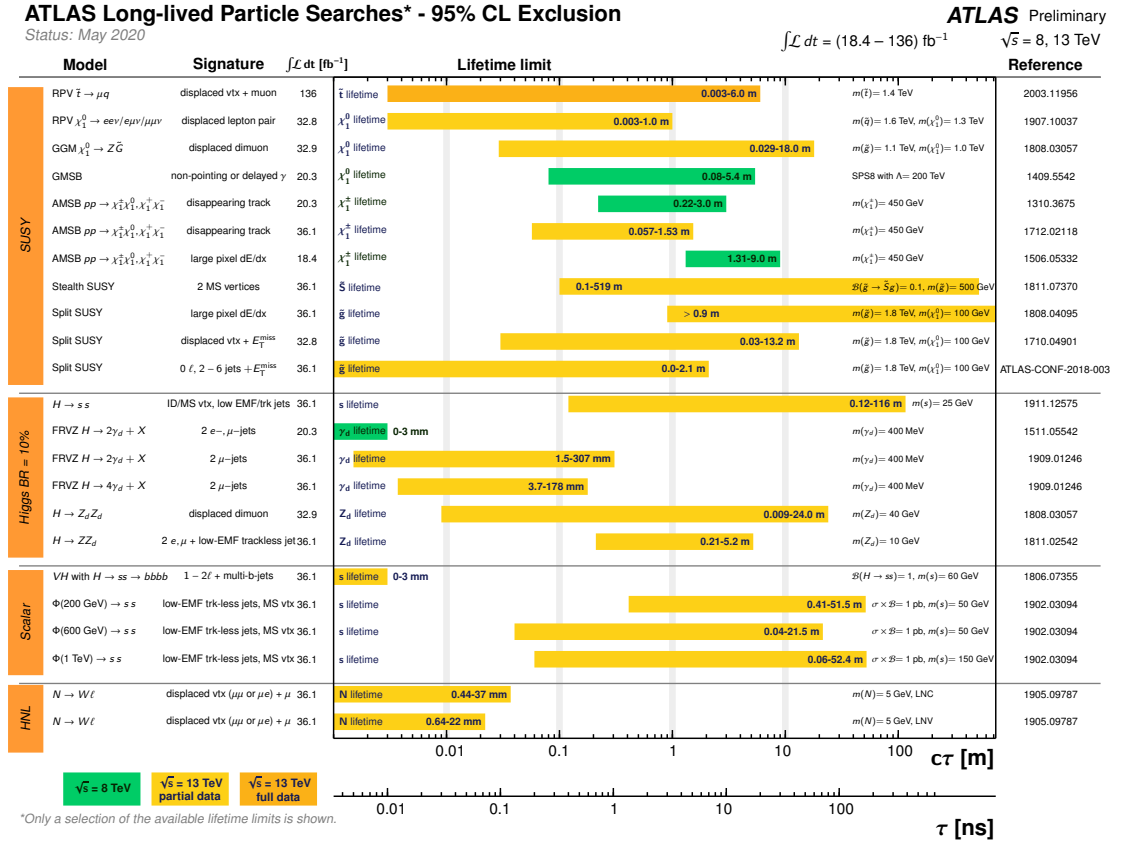


Figure 2: Ranges of new particle lifetimes excluded at the 95% confidence level.

References

- [1] ATLAS Collaboration, *Search for $t\bar{t}$ resonances in fully hadronic final states in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, 2020, arXiv: [2005.05138 \[hep-ex\]](#) (cit. on p. 2).
- [2] ATLAS Collaboration, *Search for heavy diboson resonances in semileptonic final states in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, 2020, arXiv: [2004.14636 \[hep-ex\]](#) (cit. on p. 2).
- [3] ATLAS Collaboration, *Search for resonances decaying into a weak vector boson and a Higgs boson in the fully hadronic final state produced in proton–proton collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, 2020, CERN-EP-2020-073 (cit. on p. 2).
- [4] ATLAS Collaboration, *Search for new non-resonant phenomena in high-mass dilepton final states with the ATLAS detector*, 2020, CERN-EP-2020-066 (cit. on p. 2).
- [5] ATLAS Collaboration, *Search for long-lived, massive particles in events with a displaced vertex and a muon with large impact parameter in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, 2020, arXiv: [2003.11956 \[hep-ex\]](#) (cit. on p. 3).
- [6] ATLAS Collaboration, *Search for displaced vertices of oppositely charged leptons from decays of long-lived particles in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, [Phys. Lett. B **801** \(2020\) 135114](#), arXiv: [1907.10037 \[hep-ex\]](#) (cit. on p. 3).
- [7] ATLAS Collaboration, *Search for long-lived neutral particles produced in pp collisions at $\sqrt{s} = 13$ TeV decaying into displaced hadronic jets in the ATLAS inner detector and muon spectrometer*, [Phys. Rev. D **101** \(2020\) 052013](#), arXiv: [1911.12575 \[hep-ex\]](#) (cit. on p. 3).
- [8] ATLAS Collaboration, *Search for heavy neutral leptons in decays of W bosons produced in 13 TeV pp collisions using prompt and displaced signatures with the ATLAS detector*, [JHEP **10** \(2019\) 265](#), arXiv: [1905.09787 \[hep-ex\]](#) (cit. on p. 3).