

# Analysis Overview

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Summer 2025 HPS Collab Meeting

June 2, 2025

# Overview

- 2016 SIMPS
- 2021 Displaced Vertex
- 2021+ Bump Hunt
- 2019 Displaced Vertex

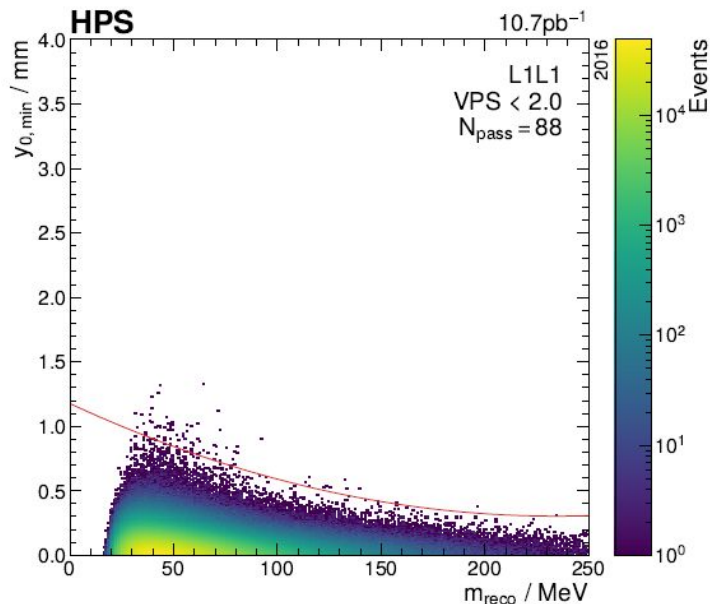
# Overview

- 2016 SIMPS → Alic/Tom (Sarah/Rory/Emrys)
- 2021 Displaced Vertex → Sarah (High pSum), Rory (Low pSum)
- 2021+ Bump Hunt → Emrys & friends
- 2019 Displaced Vertex → Lewis/Elizabeth

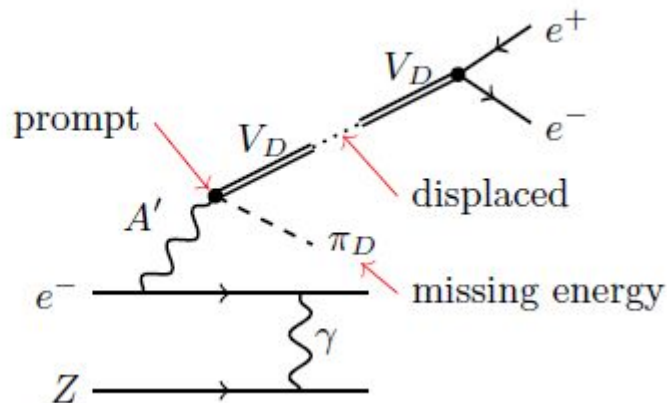
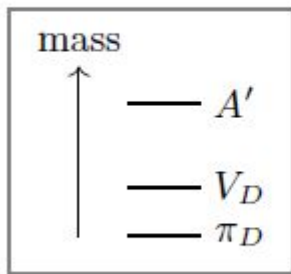
– old folks not listed

# SIMPs analysis for 2016

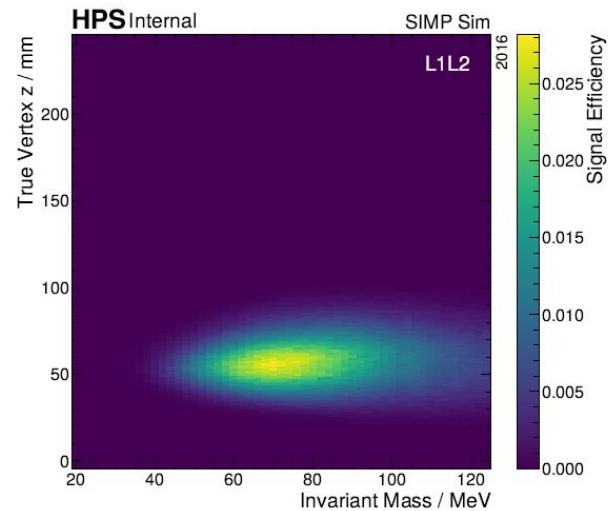
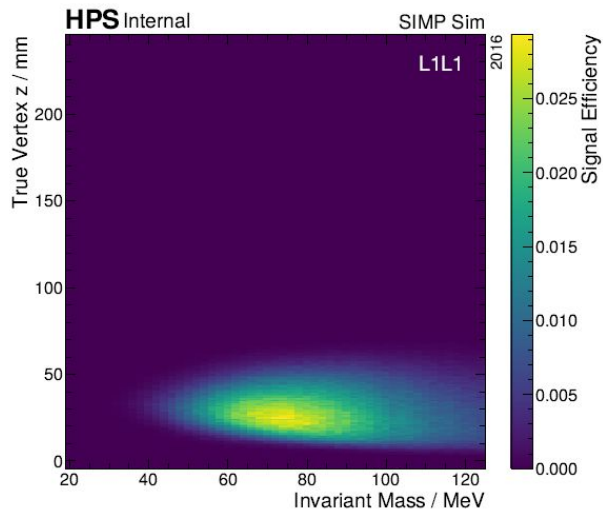
- Recall: Alic did L1L1 for his thesis while Tom did L1L2 and the combination..
- Alic & Cameron developed an optimized tight selection including a hard cut on the minimum vertical impact parameter of the tracks at the target plane.



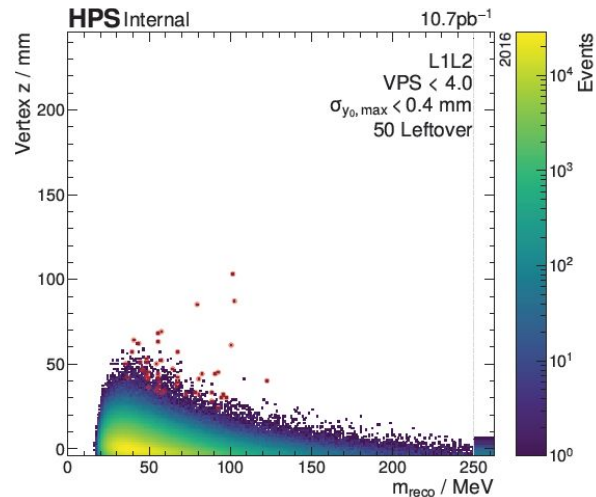
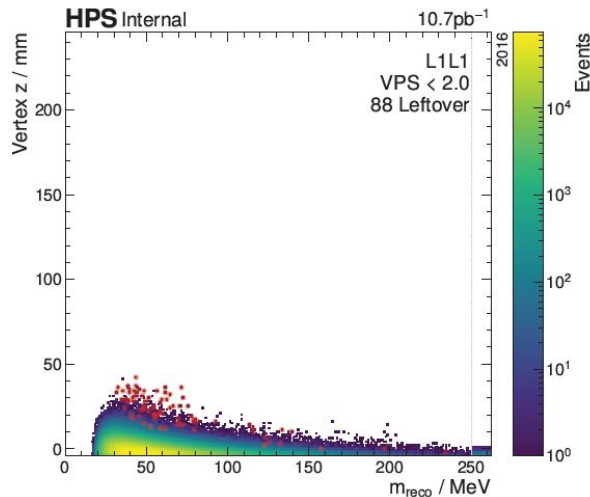
- This cut is in place of a cut on  $V_z$  and leaves **clean efficiency** at lower  $V_z$  than we would cut at.



*signal efficiency  
after all cuts*



*data (red dots  
are after all cuts)*



(a) L1L1

(b) L1L2

# SIMPs 2016 Results

data after all cuts and background estimate  
for L1L1 and L1L2 samples

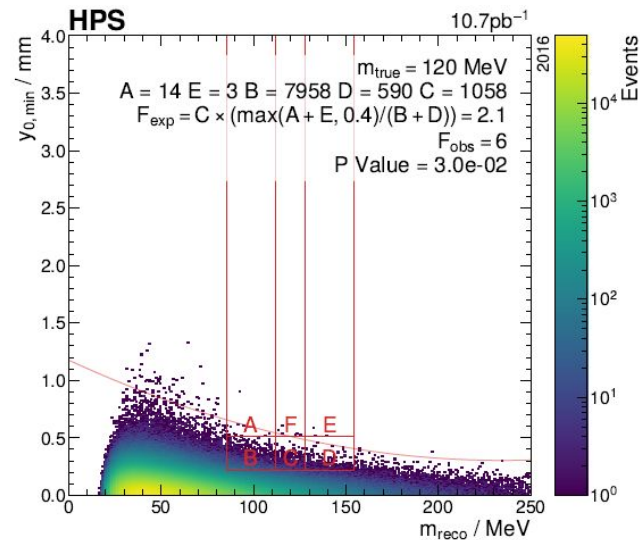
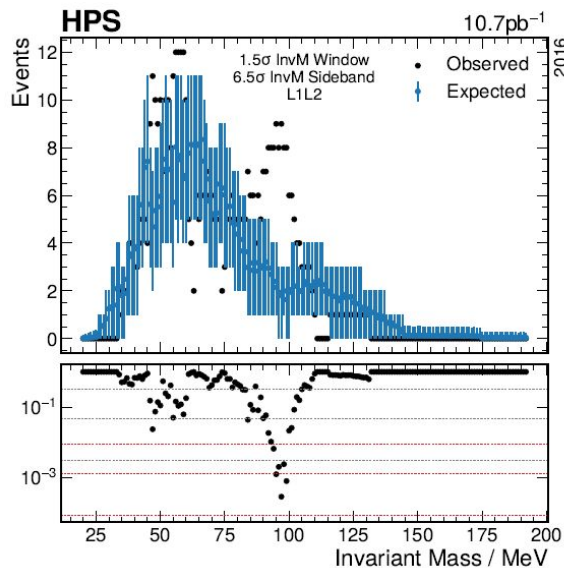
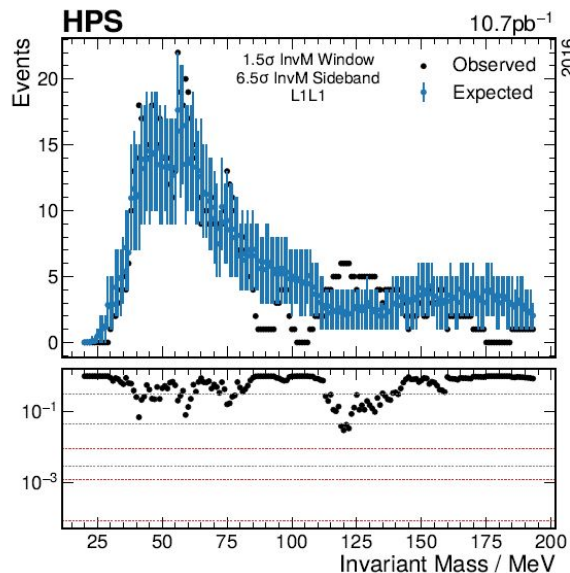
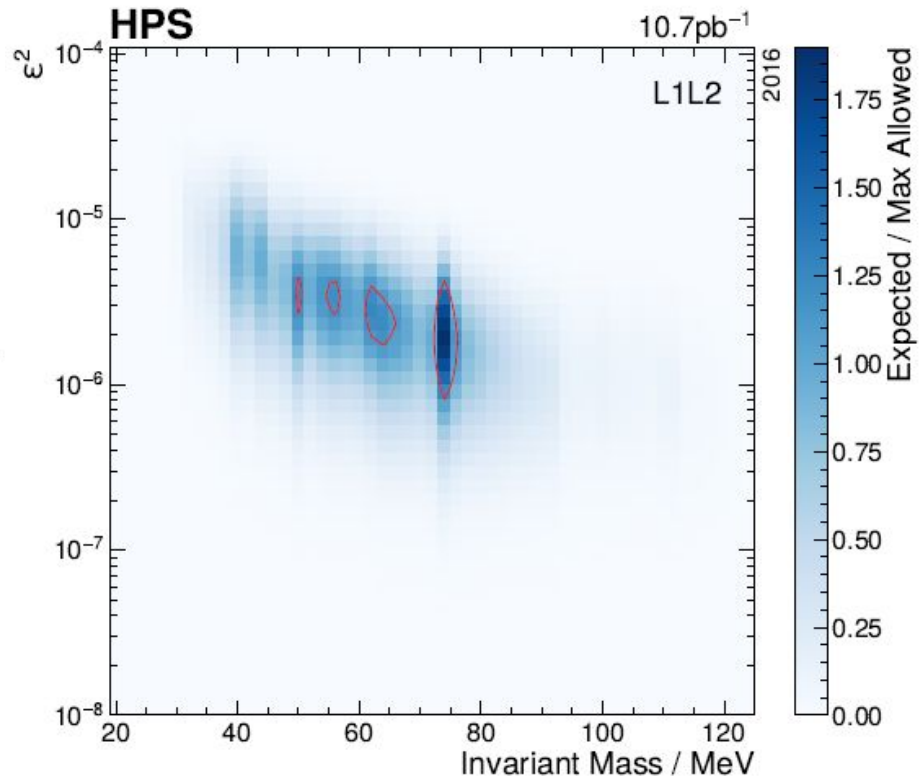
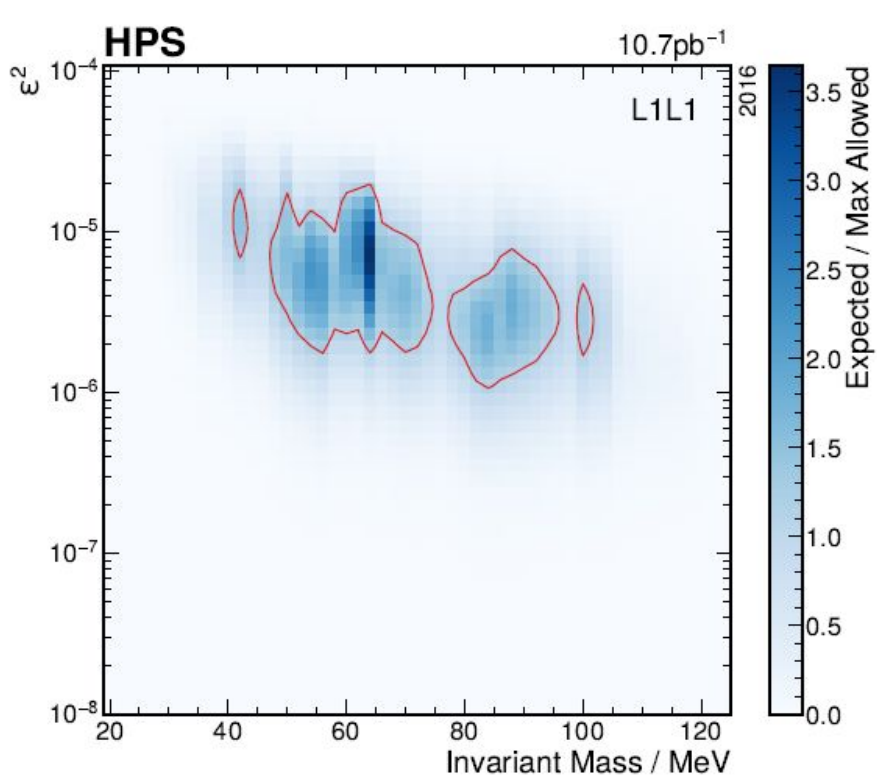


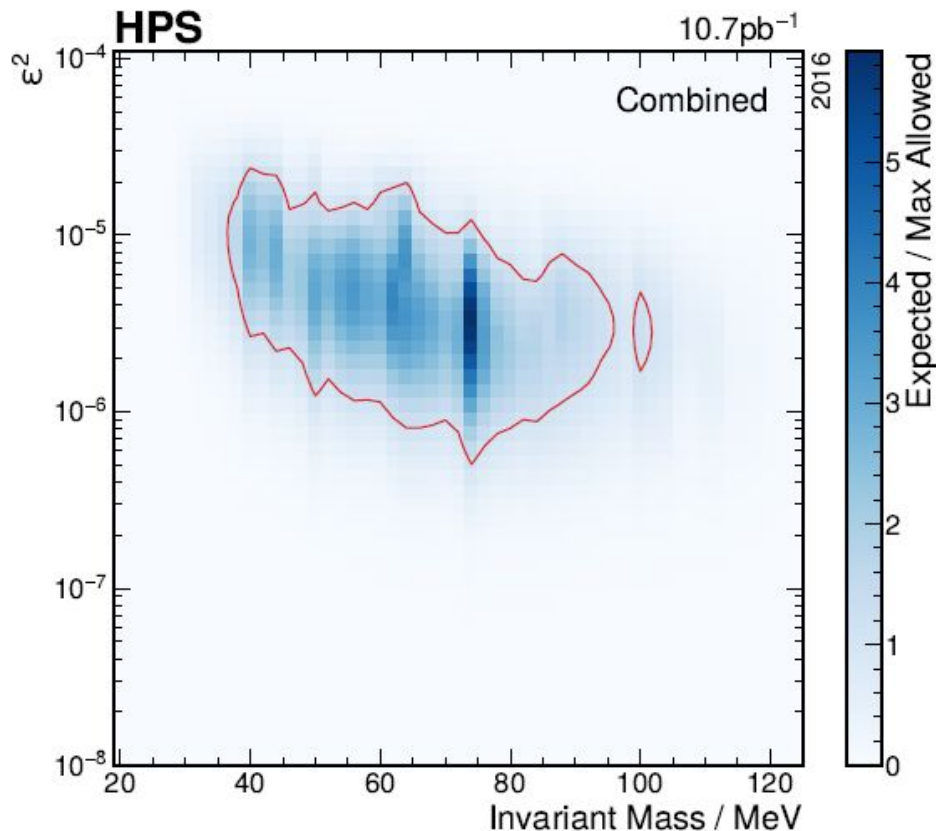
illustration of the ABCD method  
used for background estimate

# SIMPs 2016 Results

Here are the individual L1L1/L1L2 exclusion contours where *Expected/Max Allowed* > 1 event is excluded



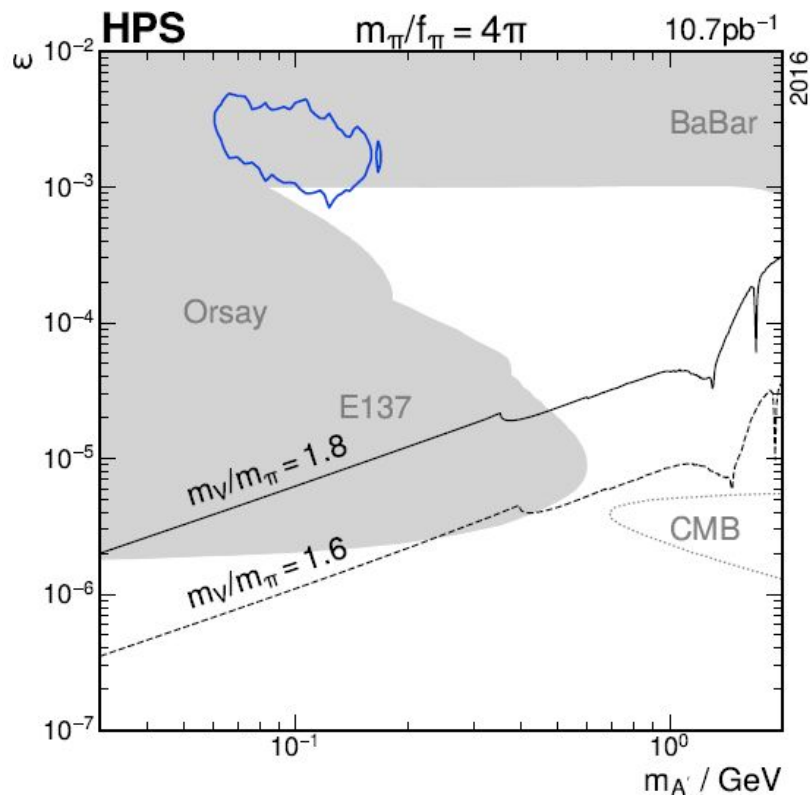
# SIMPs 2016 Results



Tom used the “*minimum-limit*” method in Yellin’s paper [Some ways of combining optimum interval upper limits](#)



# SIMPs 2016 Results



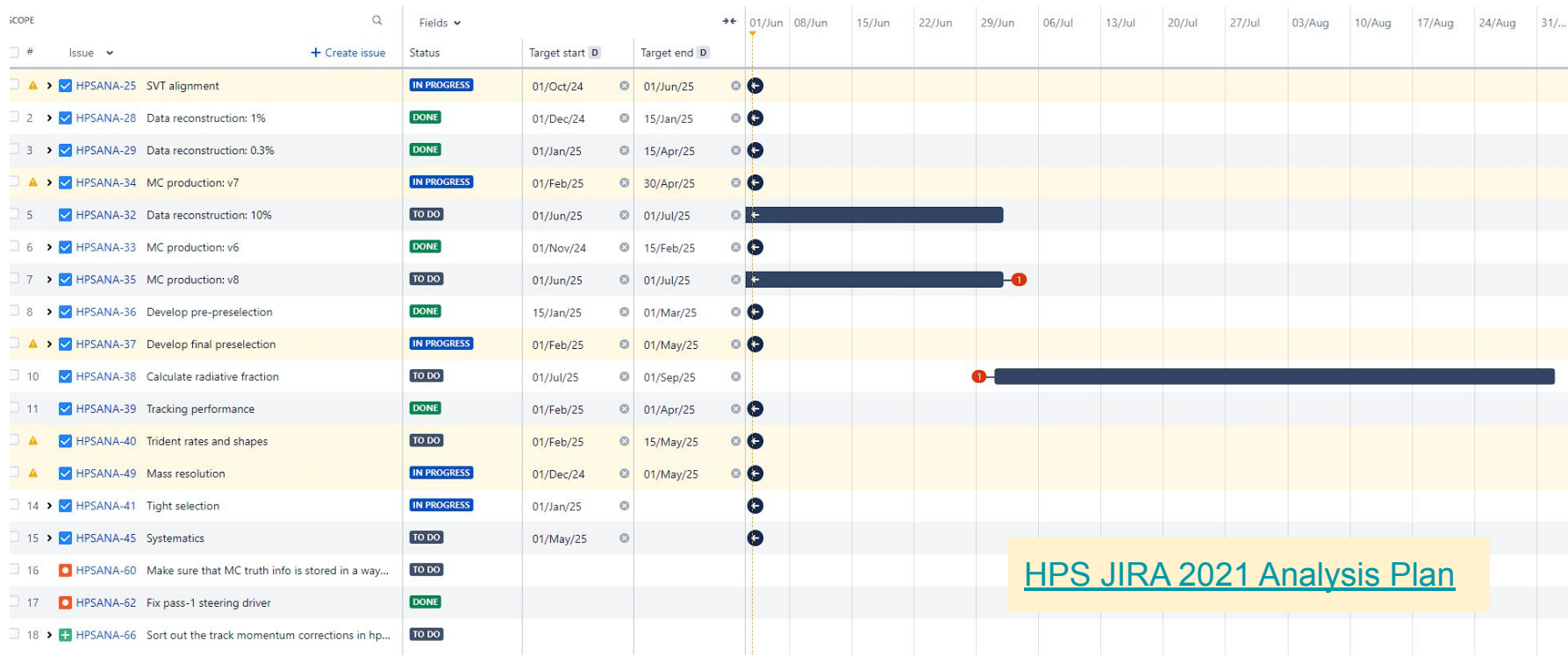
...and here we are.

*This is HPS' very first unique exclusion of dark-sector phase space!*

# SIMP 2016 Paper Status

- Tom, Sarah, Rory & Emrys have done a lot of work putting the paper draft together
- Lauren & John agreed to be readers and sent their comments on May 19
  - Stepan also send comments on May 22
- We are currently going through the comments and hope to have a new draft??? End of the week? Next week?
- [The draft we sent the readers is here](#)
- [For the up-to-date, quickly changing draft go here \(overleaf\)](#)
- [Review confluence page](#) with these links & the comments received

# Displaced analysis 2021



# Displaced analysis 2021 status

- The bulk of our hours are spent on getting the 2021 data, recon software & displaced analysis tools ready for publication...you will see many talks at this CM
  - Matt Gignac – 2021 SVT alignment
  - Lewis – Moller scattering and mass resolution
  - Zhaozhong – track-cluster matching
  - Sarah – selection and data/MC comparisons
  - Rory – using AI for displaced vertex selection
  - Elizabeth – MC tweaking to match data
- I think we are making great progress towards our goal of getting a result out by the end of the calendar year (famous last words)

# Bump hunt status

- We have two talks on fitting the background for the entire mass region to a limited number of parameters
  - Emrys – using a function (or small number of functions)
  - TJ & Aiden – using [Gaussian Process Regression](#) (GPR)
- Likely, along with getting a 2021 result, we will want to re-fit the 2016 data as well (and maybe 2015)
- I would like the event selection for 2021 BH to be the same as the displaced vertex unless there is a good reason

# TL;DR

- SIMPs paper is getting close!
- The analysis of 2021 is making great progress and physics results should be coming soon!
- We have grad students are thinking about getting the 2019 data up to our standards and physics analysis started!
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