# Analysis Overview

Matt Graham Summer 2025 HPS Collab Meeting June 2, 2025

## Overview

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

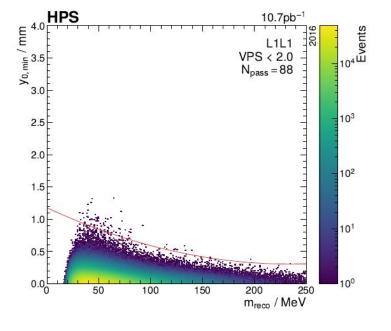
## Overview

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

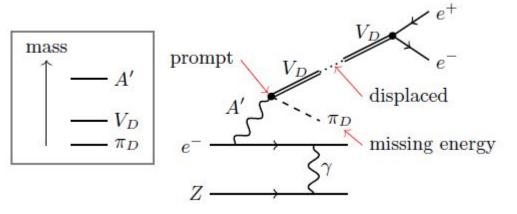
– old folks not listed

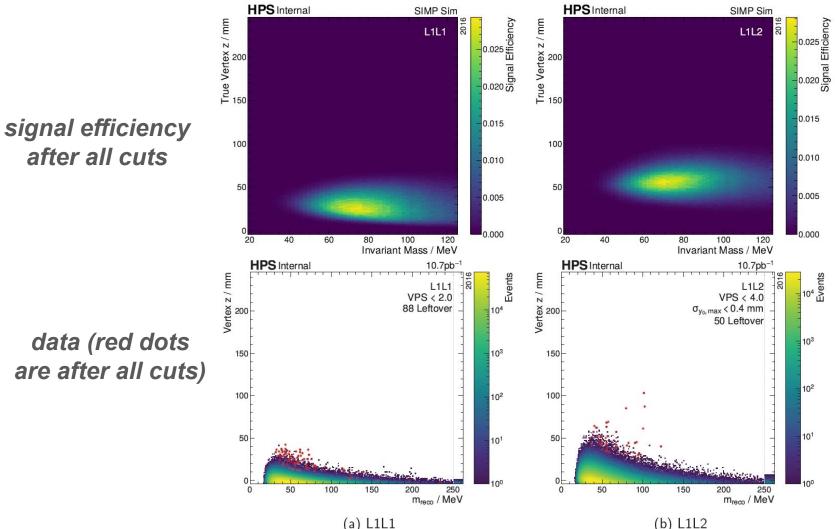
## SIMPs analysis for 2016

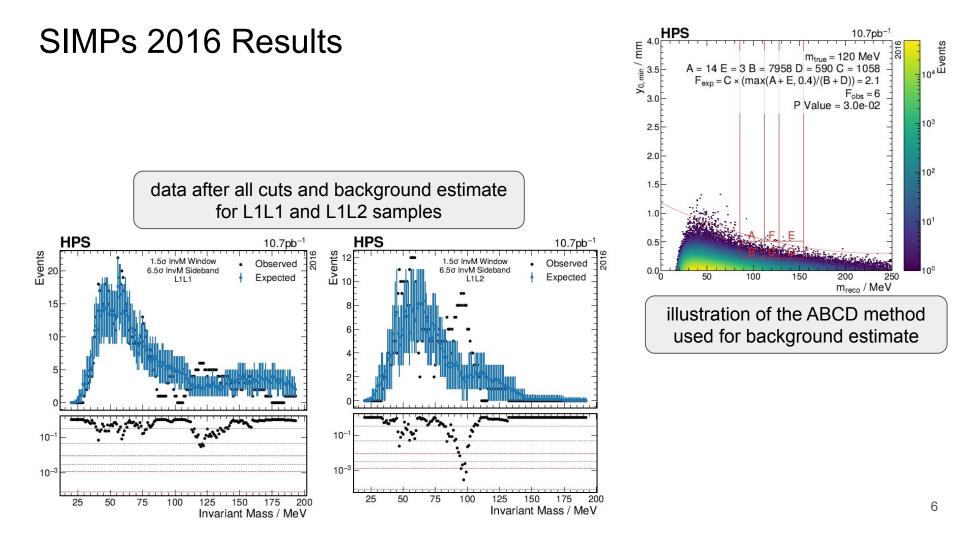
- Recall: Alic did L1L1 for his thesis while Tom did L1L2 and the combination..
- Alic & Cameron developed an optimized tight selection including a hard cut on the minimum vertical impact parameter of the tracks at the target plane.



• This cut is in place of a cut on Vz and leaves *clean efficiency* at lower Vz than we would cut at.

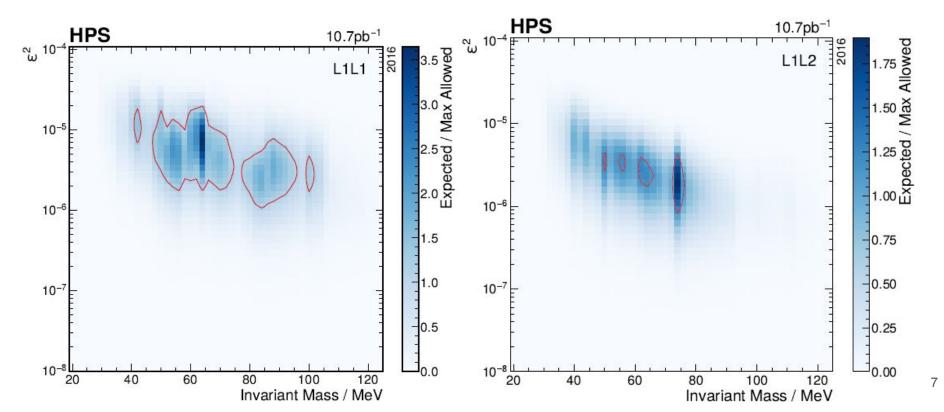




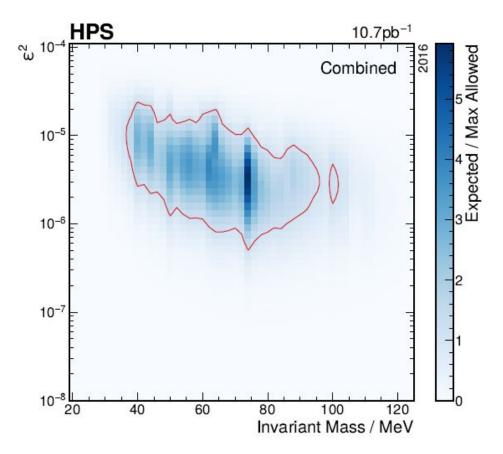


### SIMPs 2016 Results

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

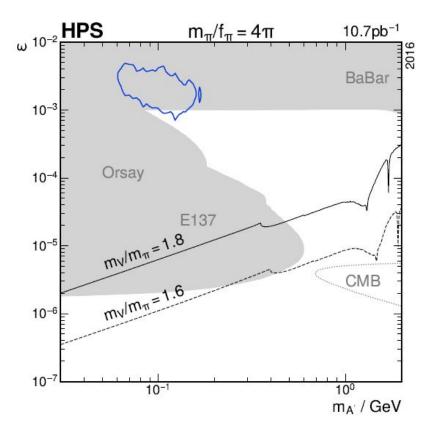


#### SIMPs 2016 Results



Tom used the *"minimum-limit"* method in Yellin's paper <u>Some ways of</u> <u>combining optimum interval</u> <u>upper limits</u>

#### 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)
- <u>Review confluence page</u> with these links & the comments received

## Displaced analysis 2021

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3 > HPSANA-29 Data reconstruction: 0.3%		DONE	01/Jan/25	© 1	15/Apr/25	0	9													
A > HPSANA-34 MC production: v7		IN PROGRESS	01/Feb/25	3	30/Apr/25	0	9													
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## 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
  - $\circ$   $\;$  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 <u>Gaussian Process Regression</u> (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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