

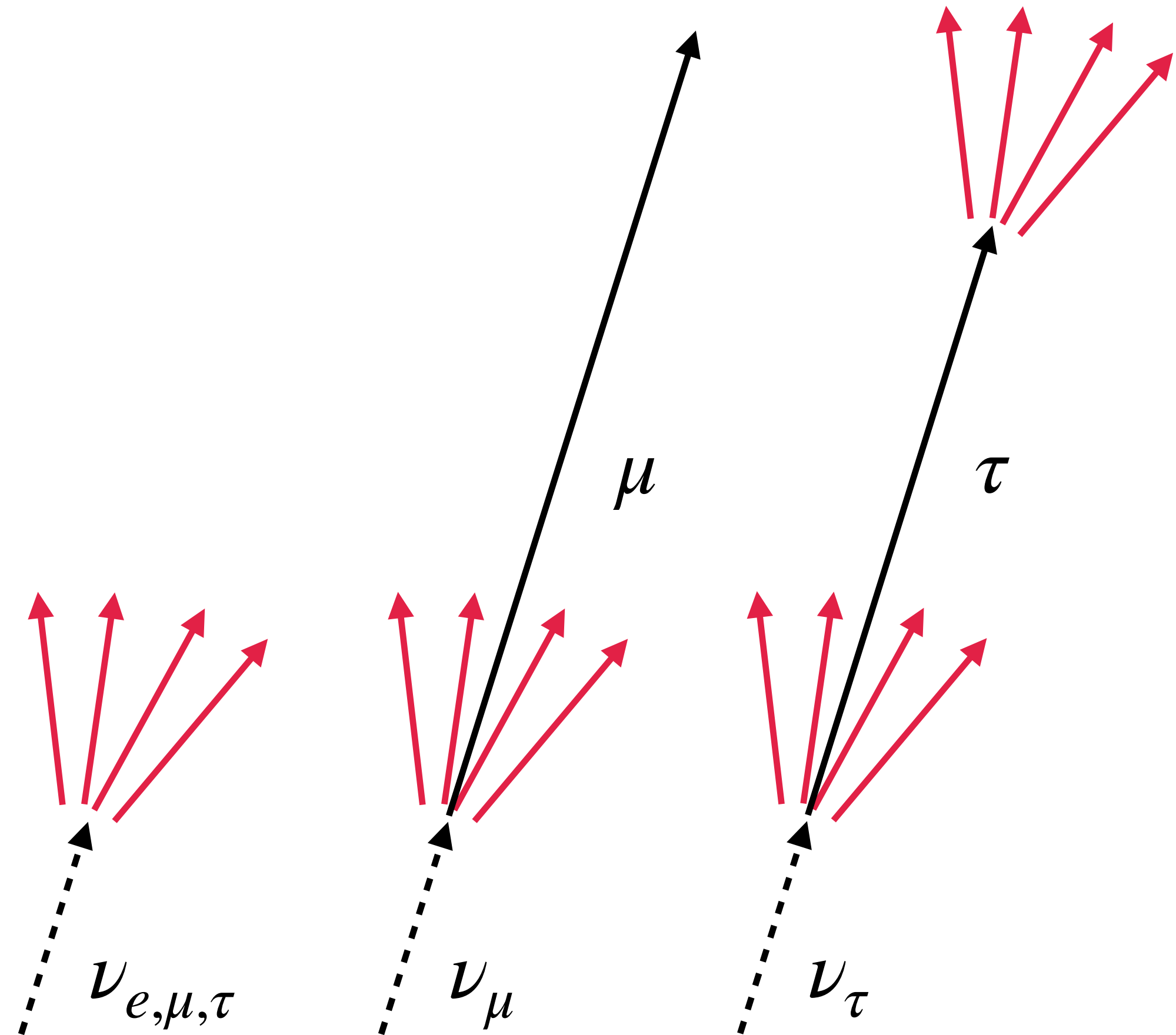
# Coincidences scan

Thijs van Eeden - 2021-01-06

# Looking for Multiple Showers

- Searching for tau neutrino candidates
- Prefit gives start values for likelihood fit

Do we have 1, 2 or multiple showers along the (reconstructed) track?



# Coincidences scan

## Method

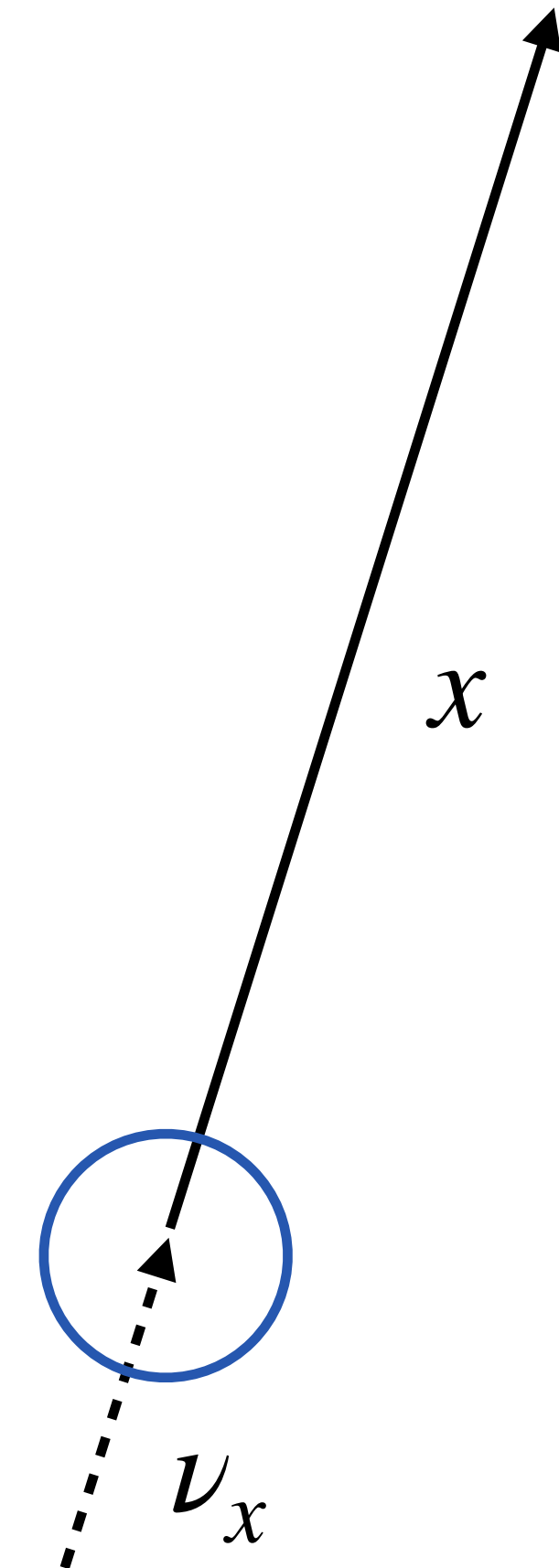
- Select coincidences (2 hits within 20 ns on DOM)
- Select hits with residual  $[-10,15]$  ns from (reconstructed) neutrino vertex position and time

$$r = \text{hit.t} - \text{vertex.t} - d(\text{pmt}, \text{vertex})/v$$

- Repeat while moving along (reconstructed) track

$$\text{position} \rightarrow \text{position} \pm \text{direction} \times \text{displacement}$$

$$\text{time} \rightarrow \text{time} \pm \text{displacement}/c$$



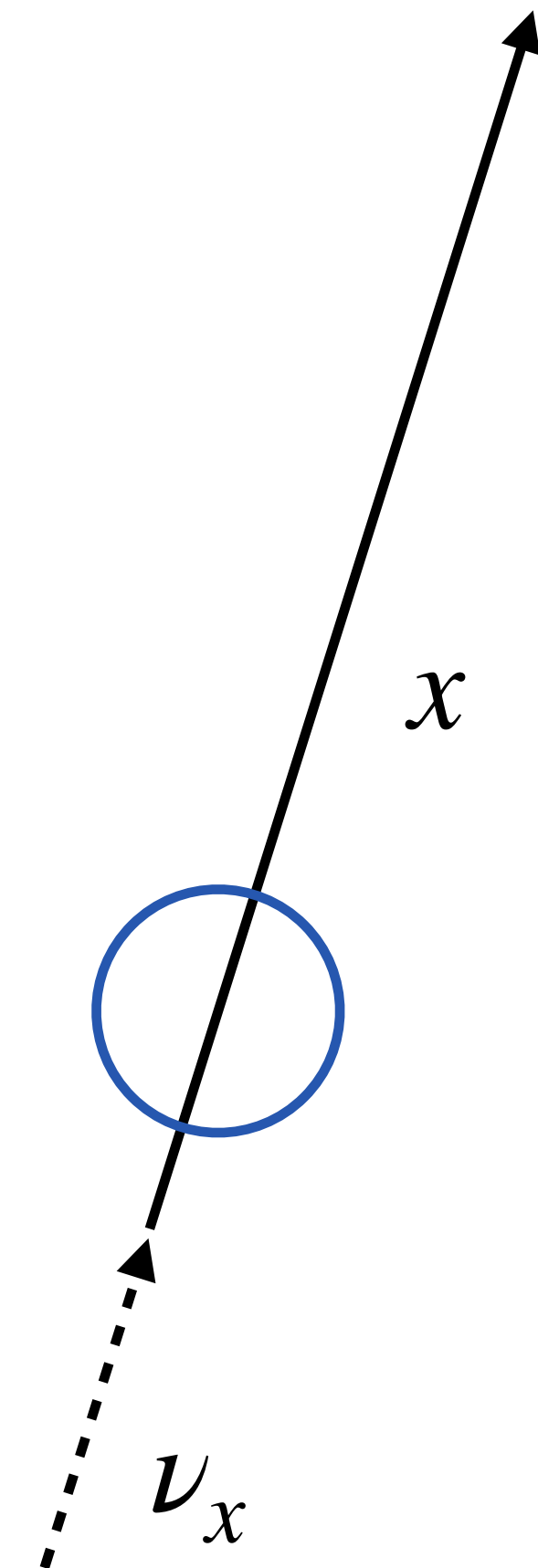
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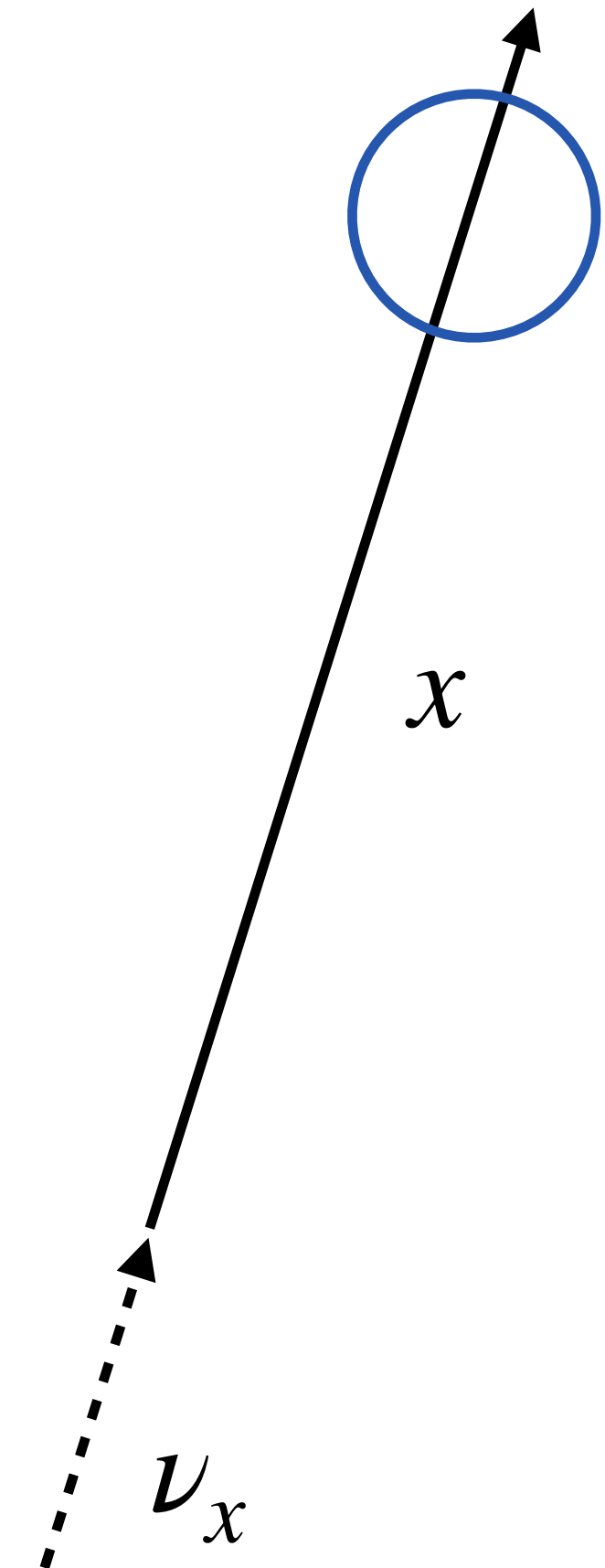
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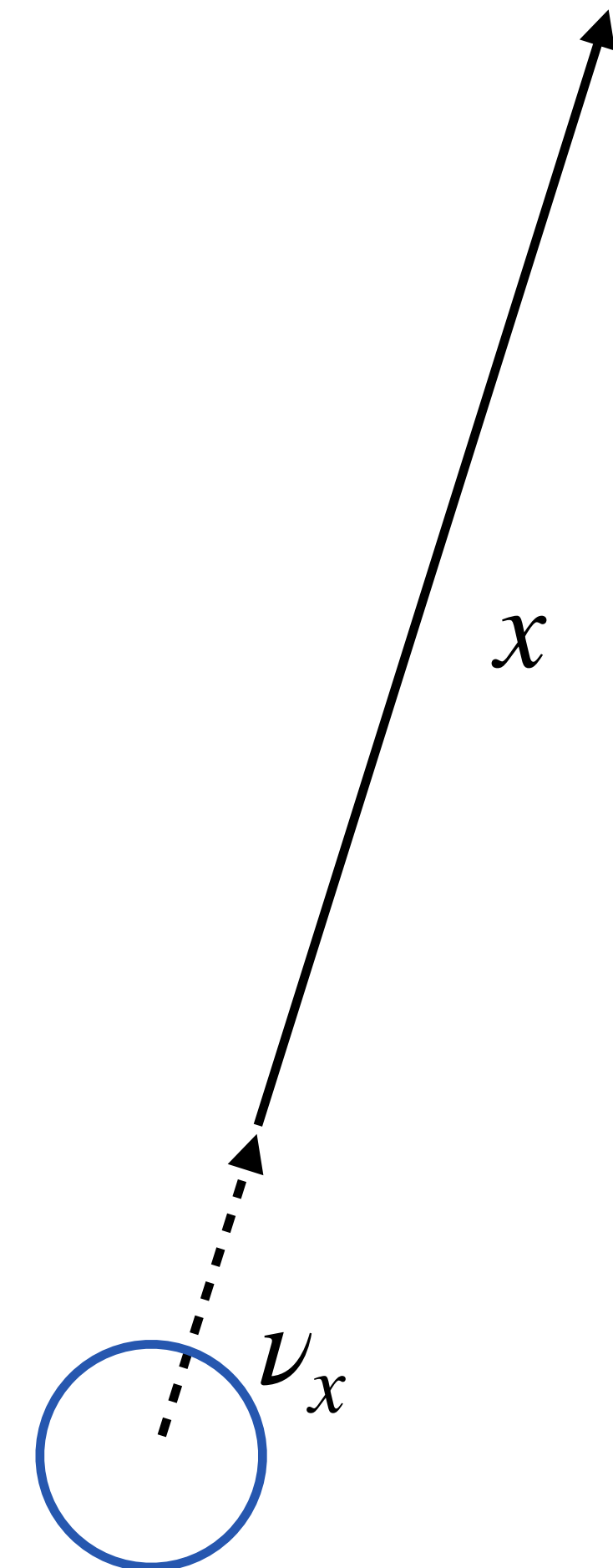
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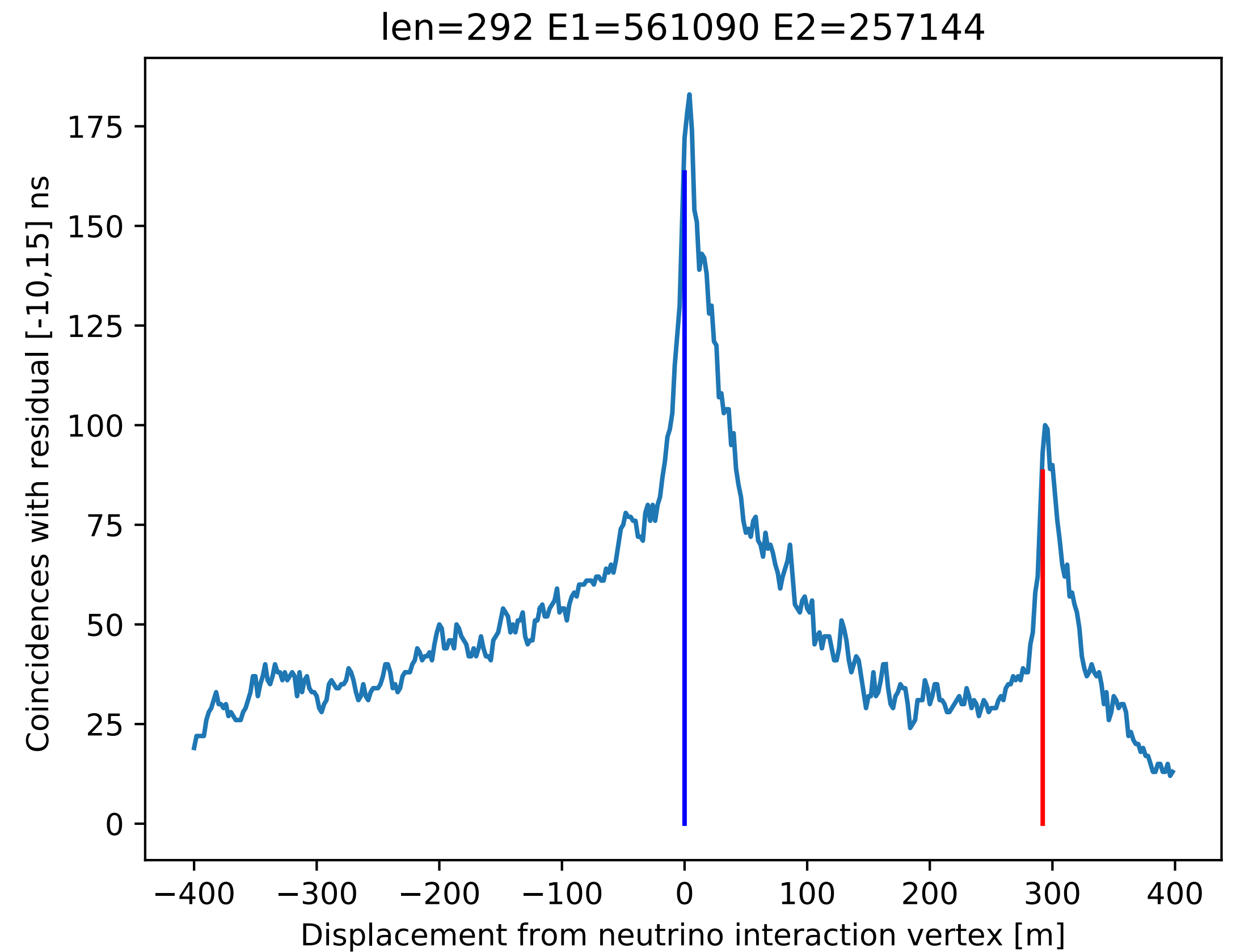
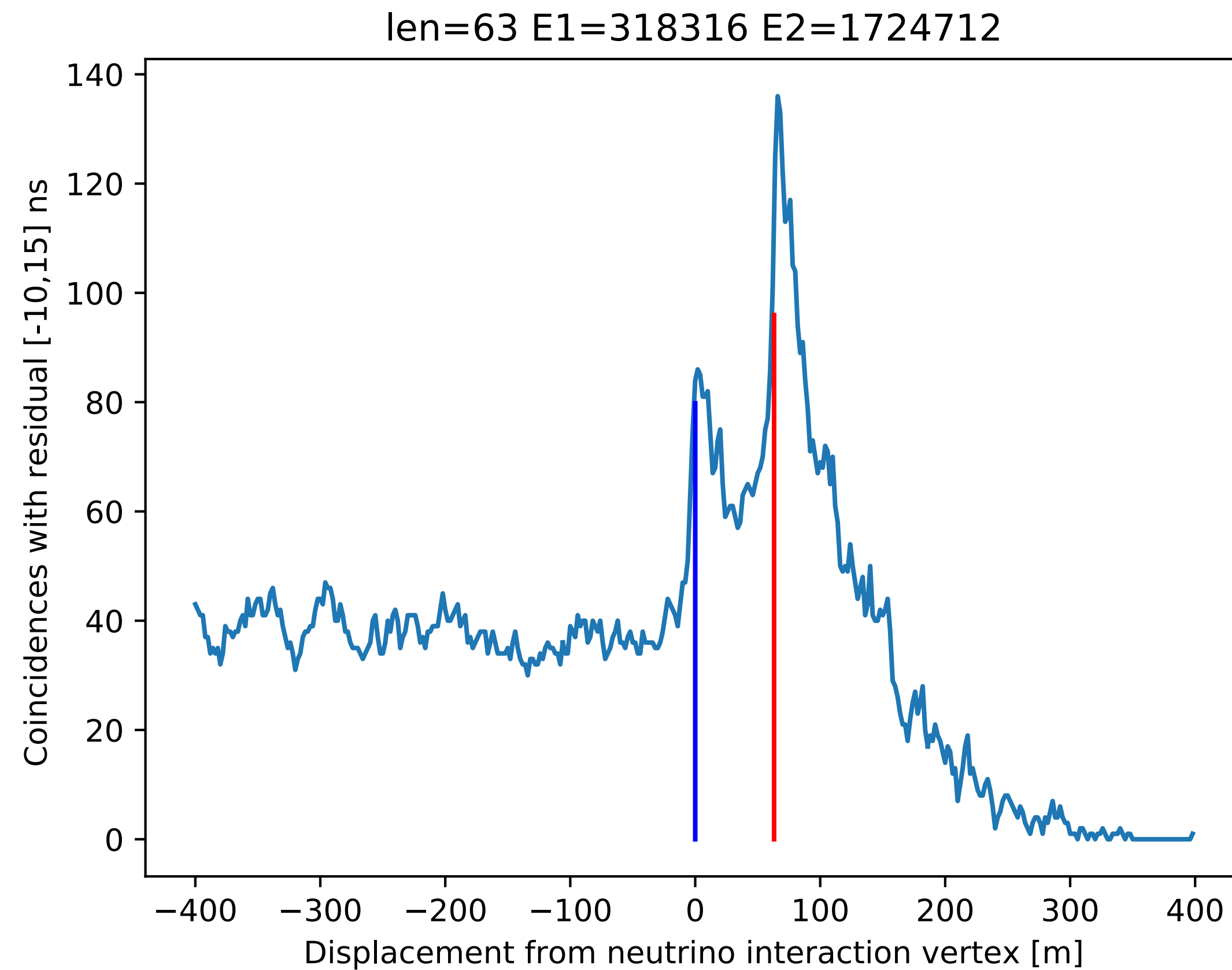
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# Contained double showers

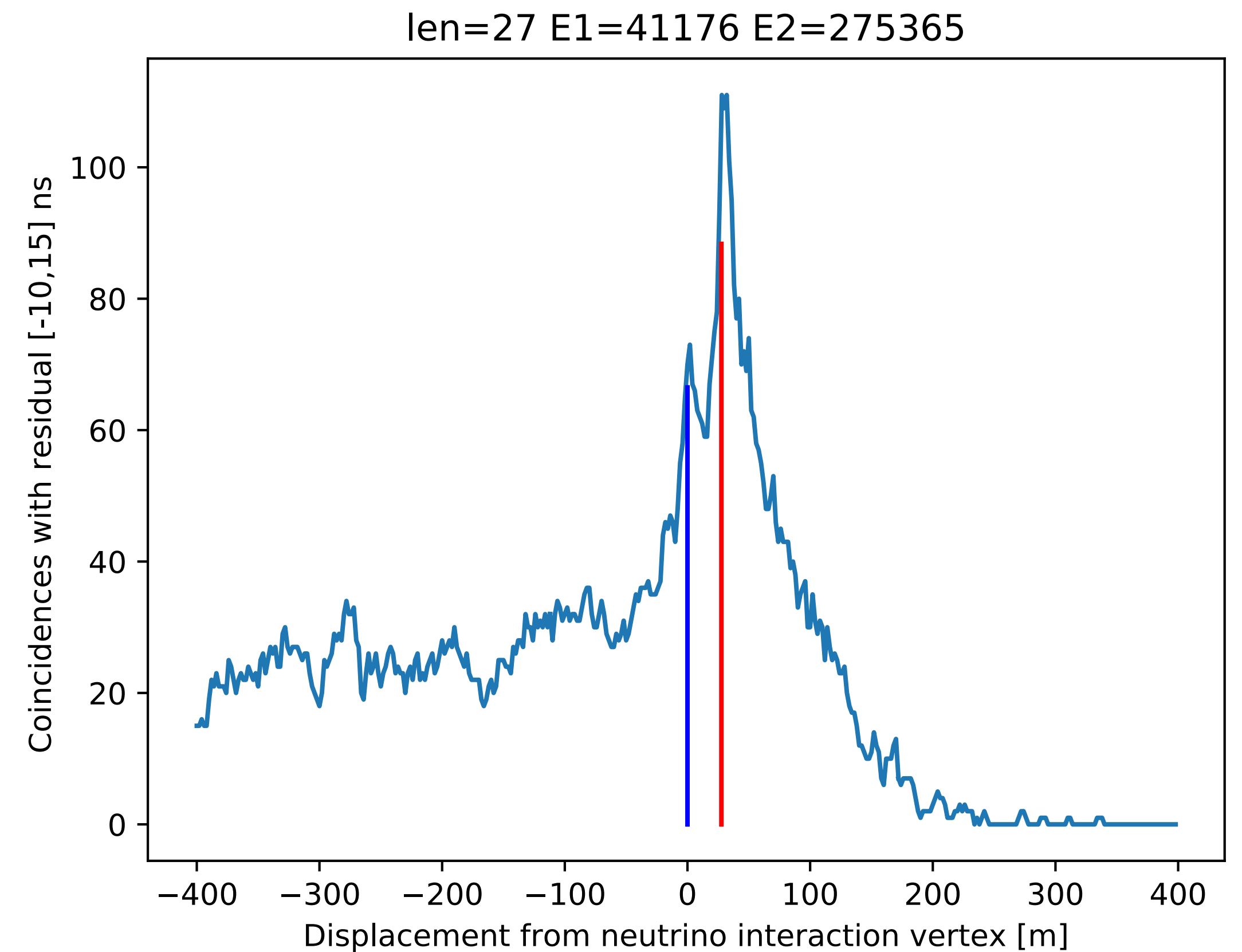
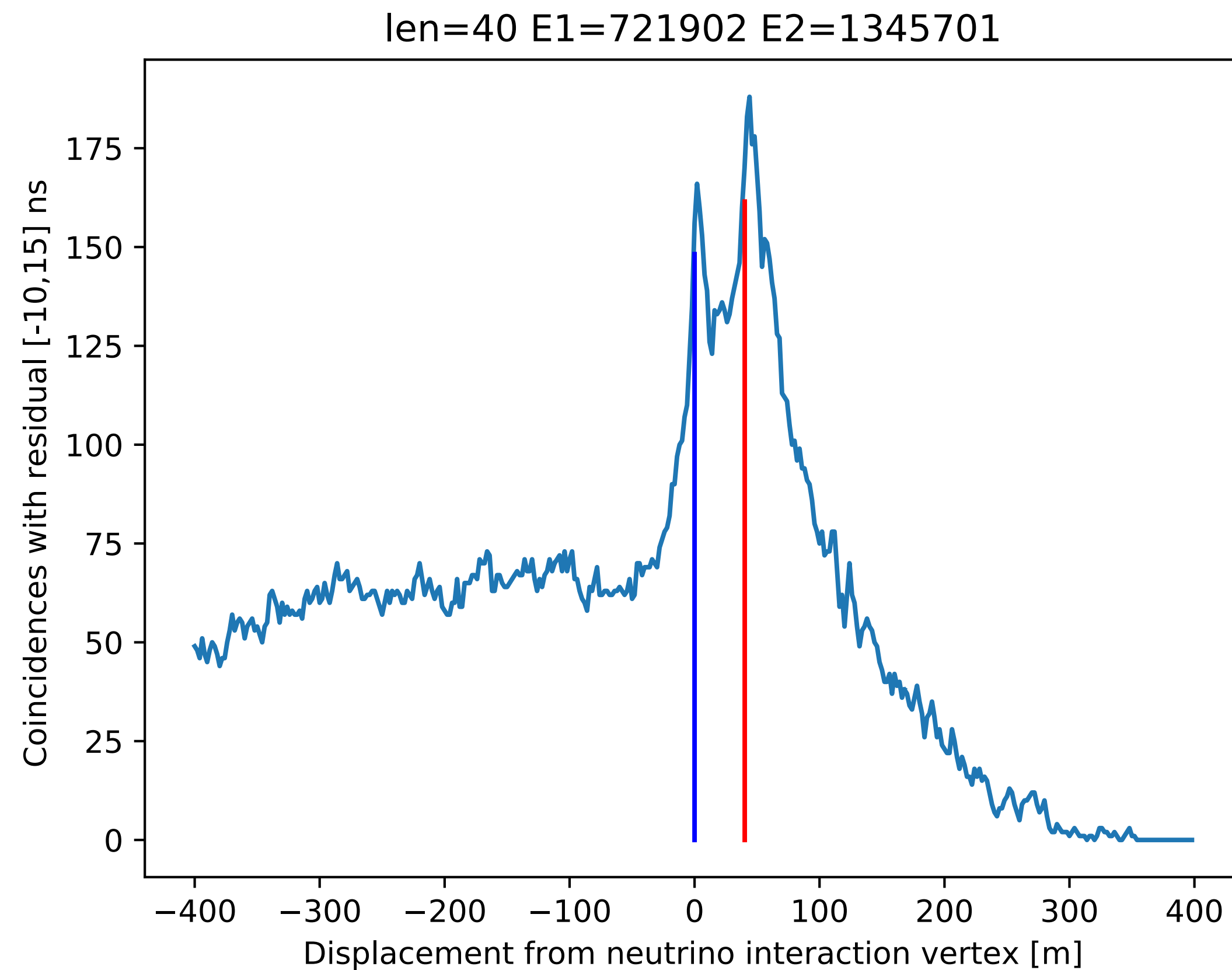
Moving along the true track



- Very clear peak from both showers

# Contained double showers

Moving along the true track

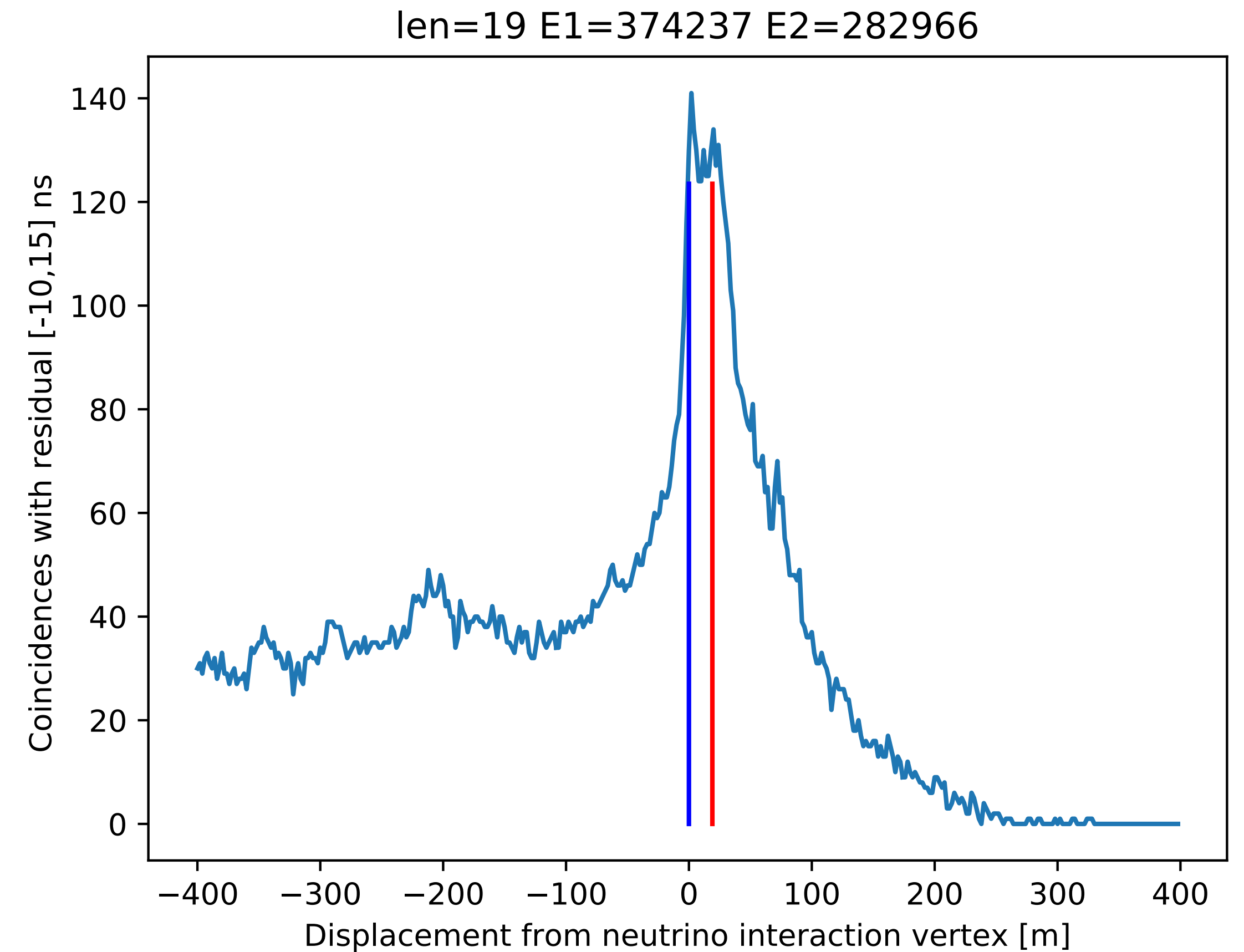
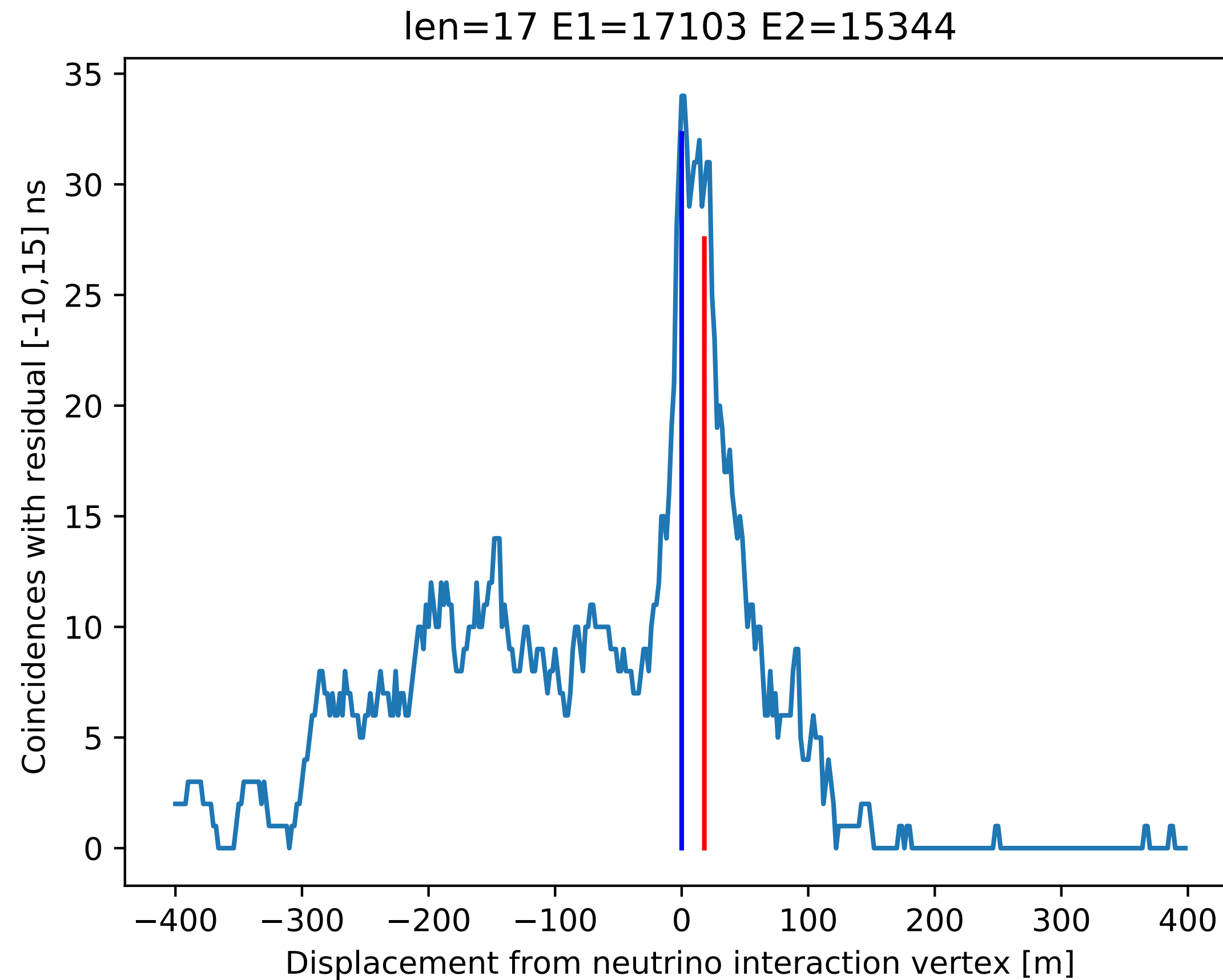


- Smaller travelling lengths, peaks still visible



# Contained double showers

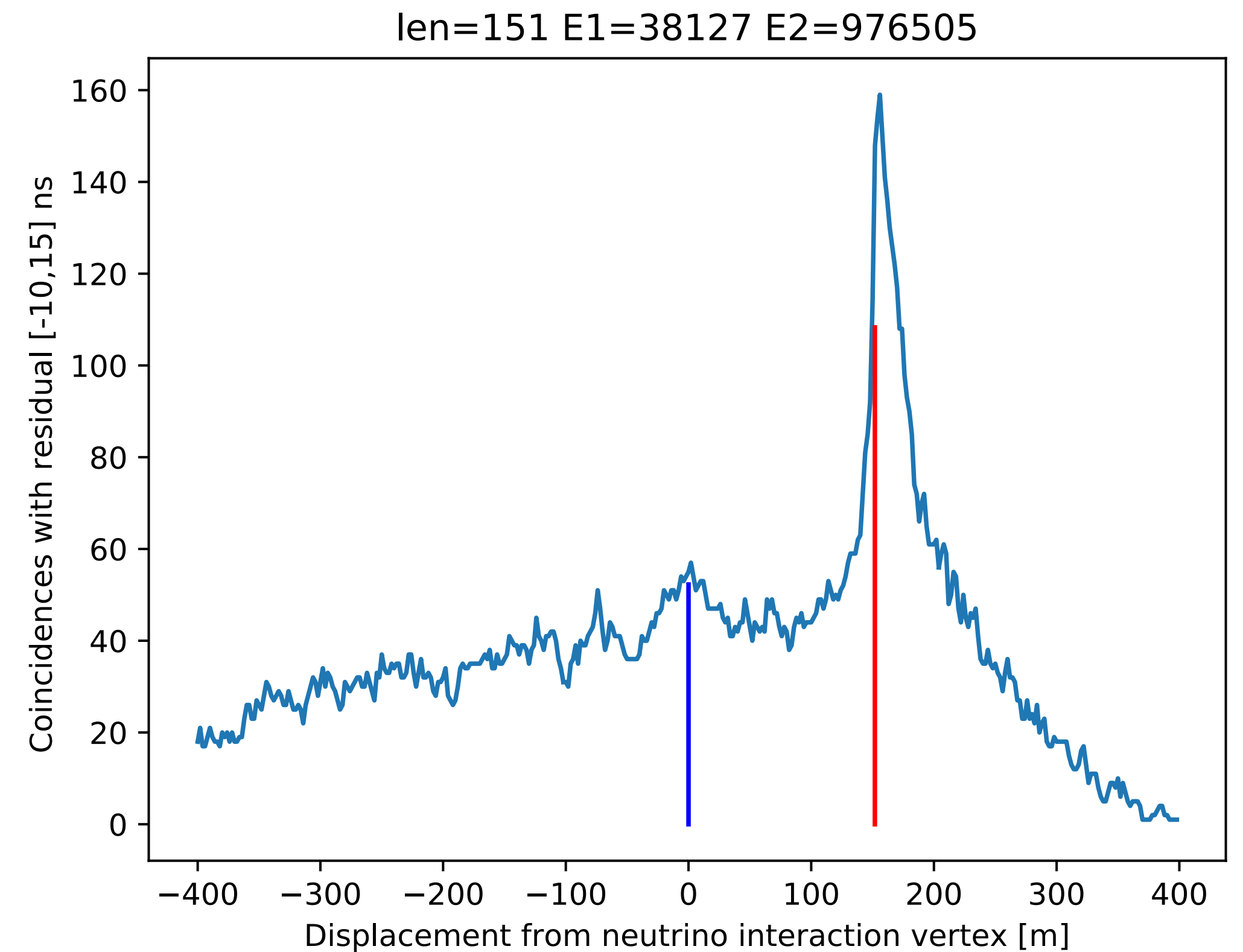
## Moving along the true track



- For displacement  $\gg 0$ , coincidences  $\rightarrow 0$ , but not for displacement  $\ll 0$ ?

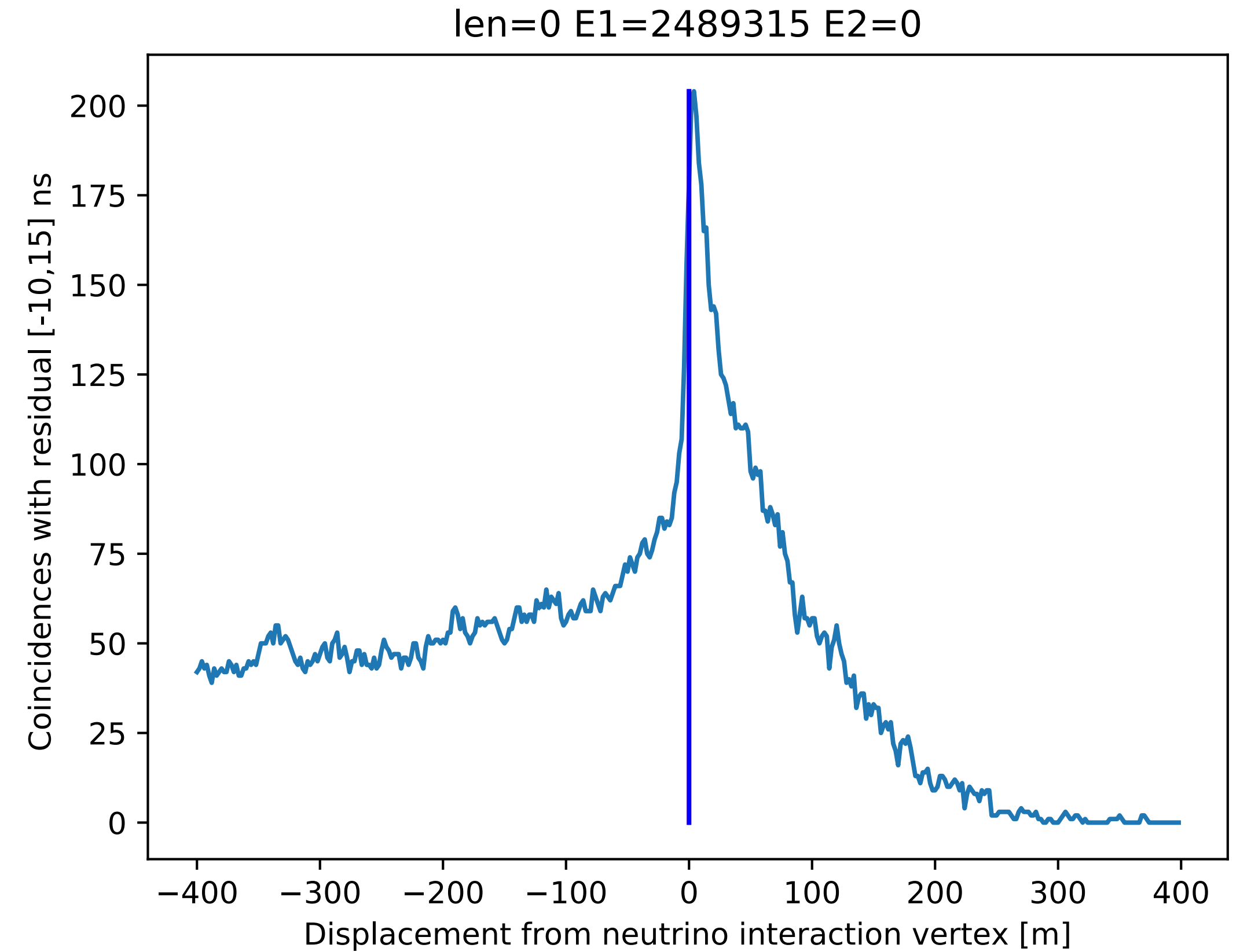
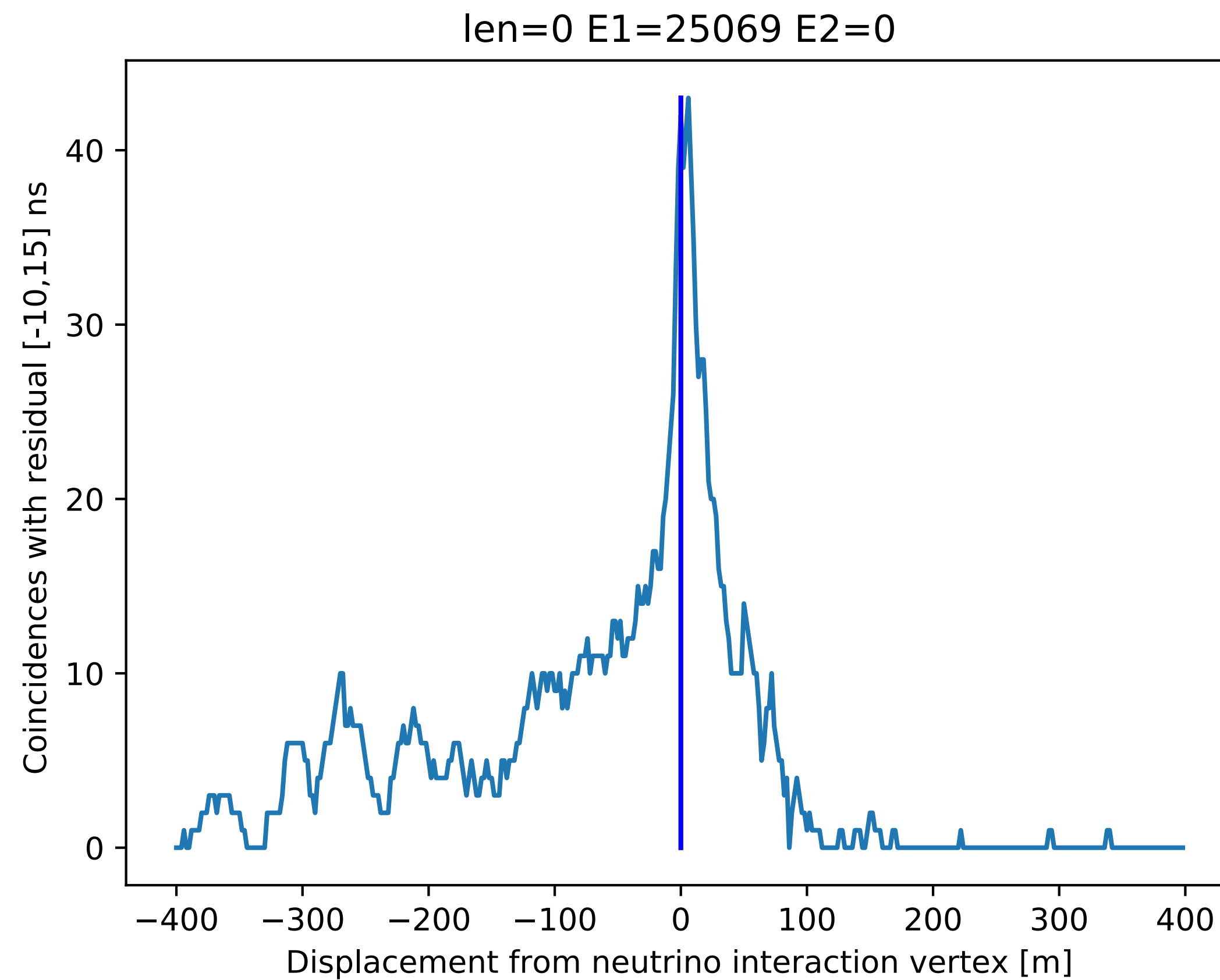
# Contained double showers

- The 2 peaks can also be less visible  
*One of the 2 showers is much brighter*
- *For displacement  $\gg 0$ , coincidences  $\rightarrow 0$ ,  
but not for displacement  $\ll 0$ ?*
- How do single showers look like?  
( $\nu$ eCC MC)



# Contained single showers

## Moving along the true track



# Outlook

- Algorithm can help finding double showers
- Gives starting values for the fit
  - Tau length
  - Energy distribution
- To-do: how do muon tracks look like?