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SMARTHEP yearly meeting, Milano, 2024  
Sten Åstrand



Image credit: Samuel Joseph Hertzog, CERN

Problem 1: process is rare

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More  
protons →

Increase frequency

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More  
protons →

Increase frequency

Problem 2: process is frequent

Problem 1: process is rare

$\xrightarrow{\text{More protons}}$

Increase frequency

Problem 2: process is frequent

$\xrightarrow{\text{Trigger system}}$

Decrease data flow

Problem 1: process is rare

$\xrightarrow{\text{More protons}}$

Increase frequency

Problem 2: process is frequent

$\xrightarrow{\text{Trigger system}}$

Decrease data flow

Problem 3: process is ???

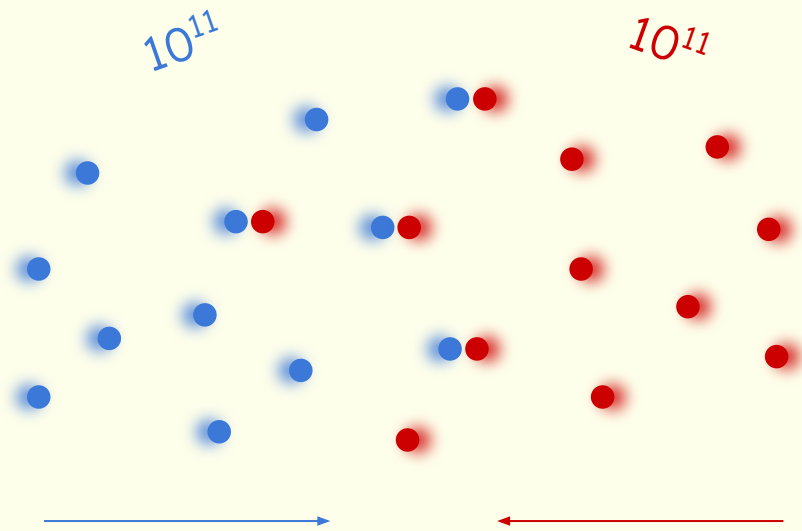
# PHYSICS IN PILEUP

## *Hidden in plain sight*

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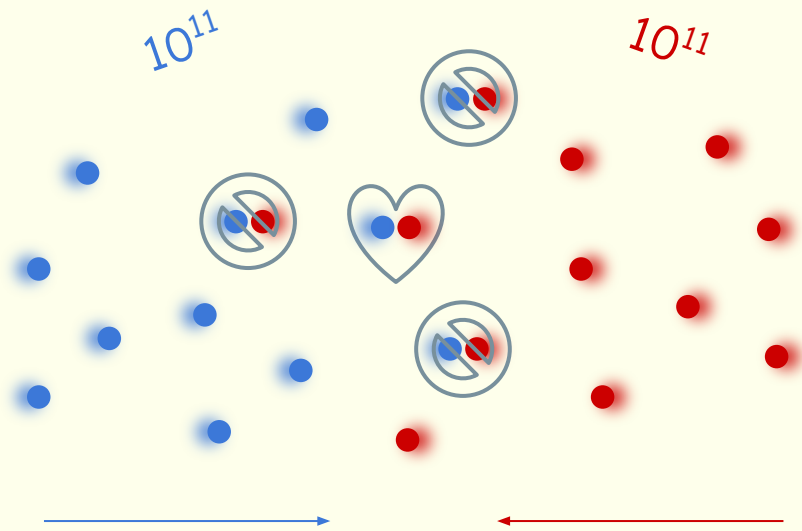
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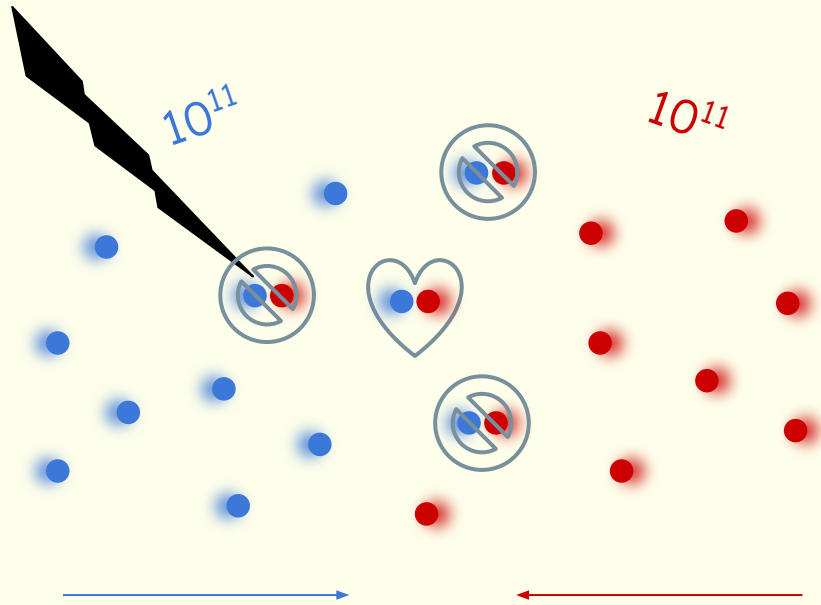
**PILEUP**

$\langle \mu \rangle = 60$  simultaneous inelastic collisions



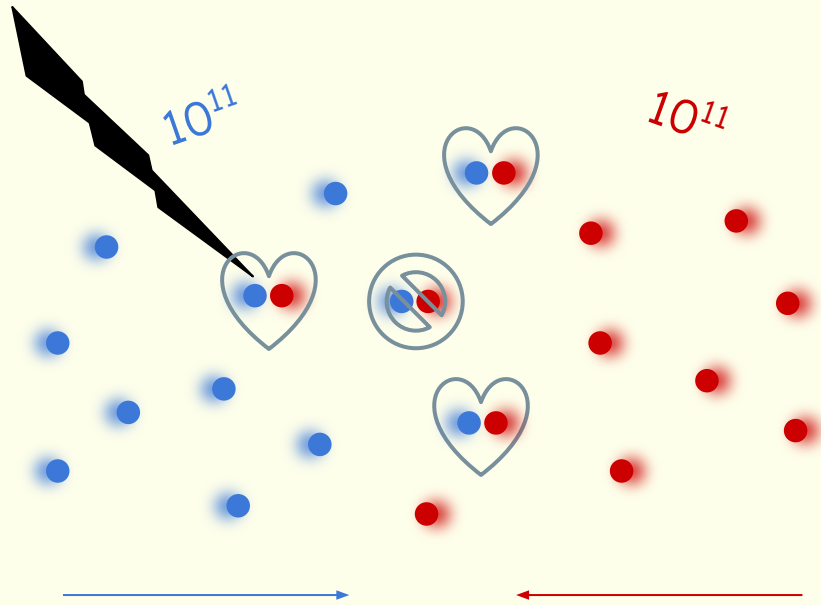
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# PILEUP

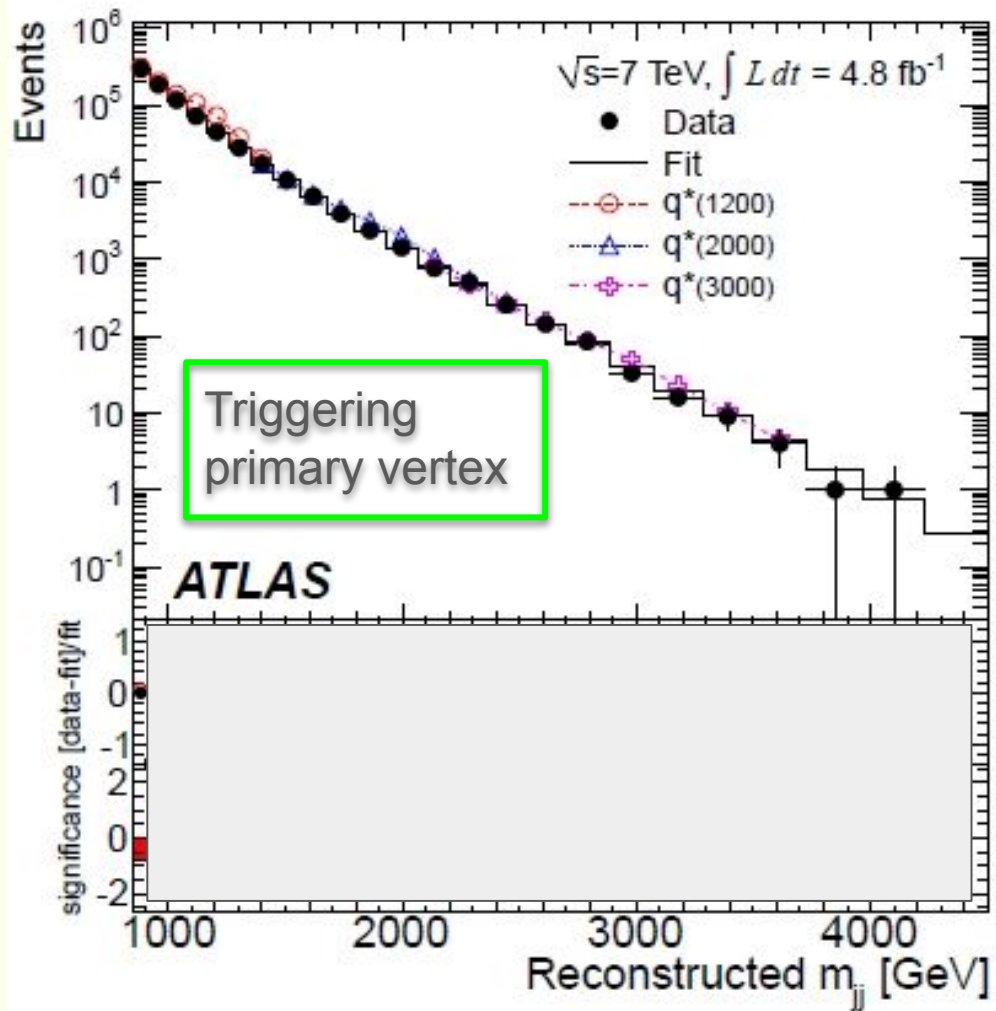
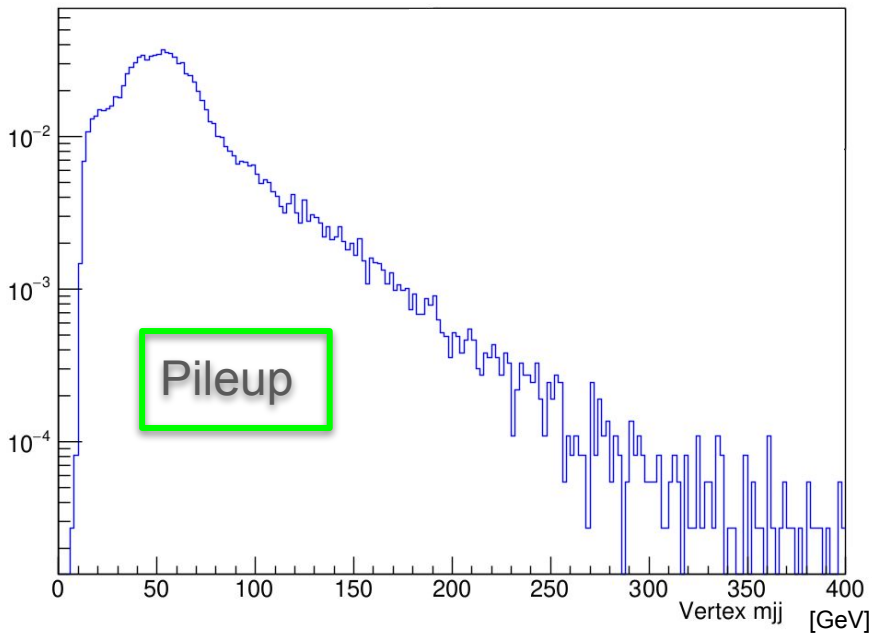
$\langle \mu \rangle = 60$  simultaneous inelastic collisions



# PILEUP

$\langle \mu \rangle = 60$  simultaneous inelastic collisions

m<sub>jj</sub>



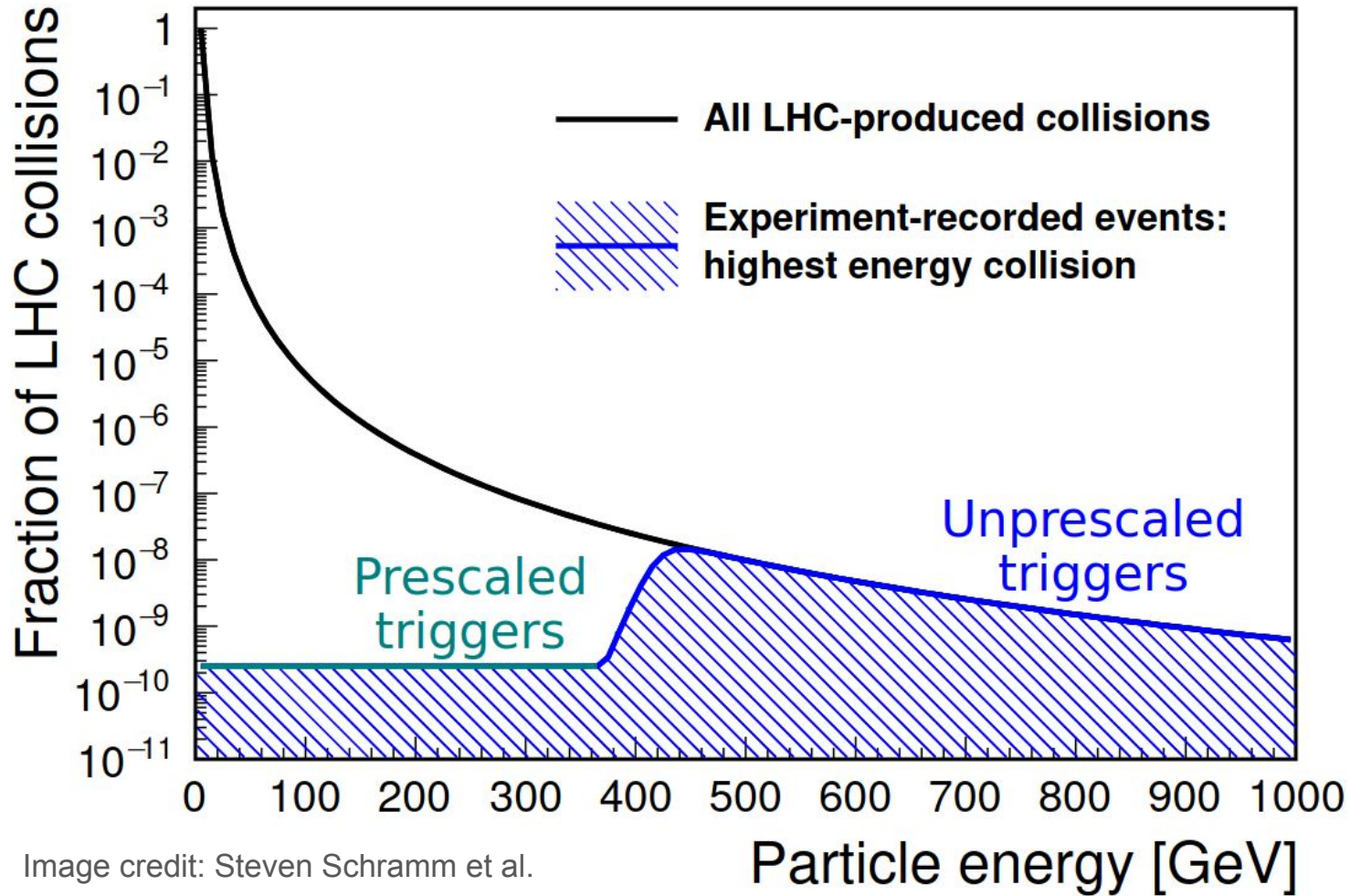


Image credit: Steven Schramm et al.

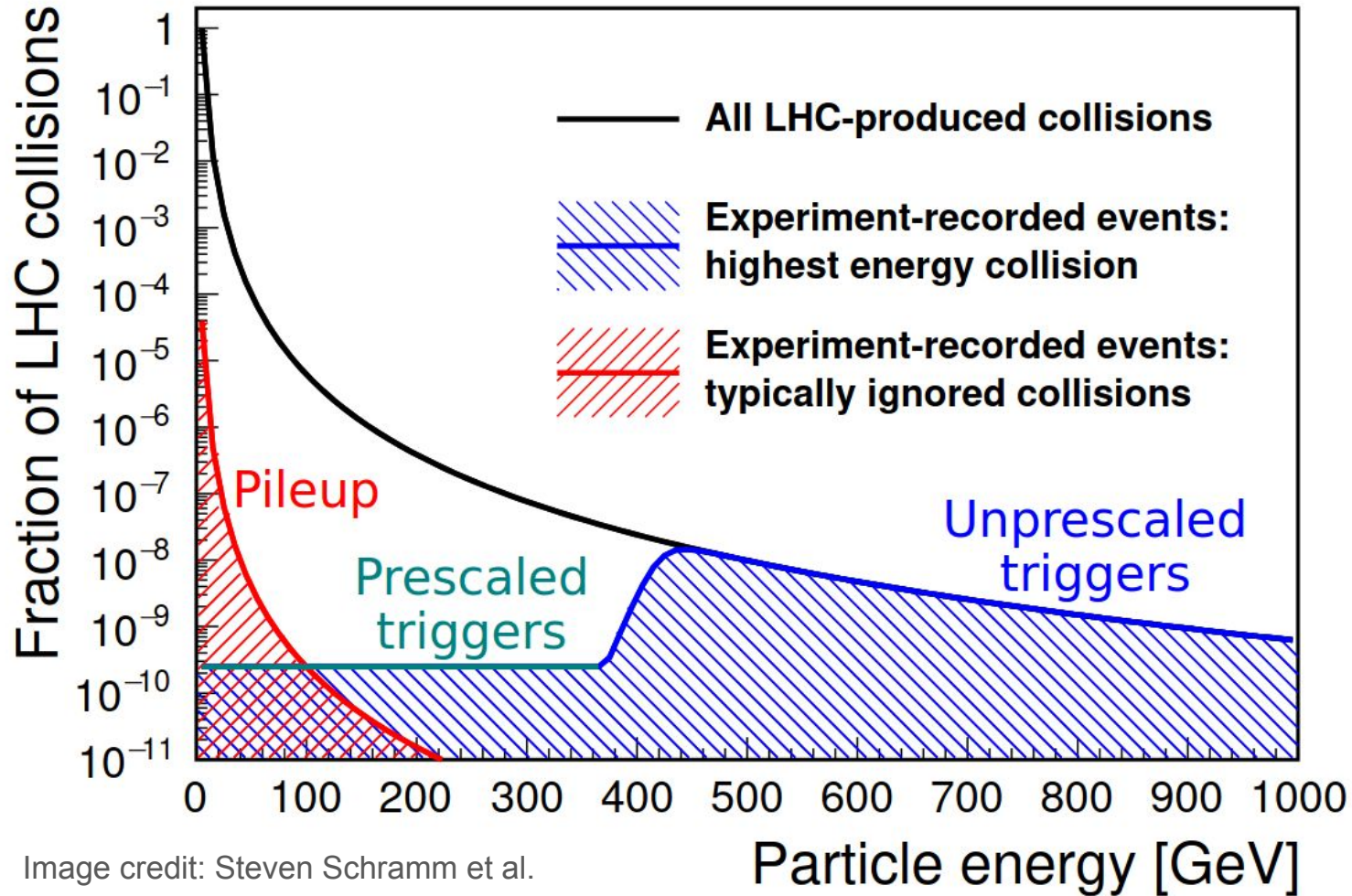


Image credit: Steven Schramm et al.



**The Z boson!**



Run 2 integrated luminosity:  $140 \text{ fb}^{-1}$

Pileup integrated luminosity:  $5 \text{ pb}^{-1}$

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