smartBKG

smartBKG
= smart background

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General problem in high energy physics analysis

Which of the data we observe really originates from the process of interest (“signal”) and which is “background” we cannot distinguish ?

⟶ Simulation of particle collisions

The simulation knows what it does, i.e. which process is which

- compare simulation to data
- gives a hint for the shape of the data to be expected
- helps us understand contributions from “background” and “signal”

Necessary for the analysis of real data

⟶ Largest simulation volume is background

Takeaway

We need a good simulation of particle physics processes to analyse them

But: The simulation costs time and resources

- Especially that of all the backgrounds

From simulation to analysis at Belle II

- EventMetaData
- MCInitialParticles
- **MCParticles**

- EventMetaData
- **MCParticles***
- ECLHits
- CDCHits
- ...

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- **MCParticles***
- ECLClusters
- Tracks
- V0s
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MC	Monte-Carlo generation of processes
Det. Sim.	Simulation of particle interactions with detector components
Reco	Conversion of detector info to particle candidates
Skim	Filter out those that satisfy constraints (analysis dependent)
Analyse	Analyse

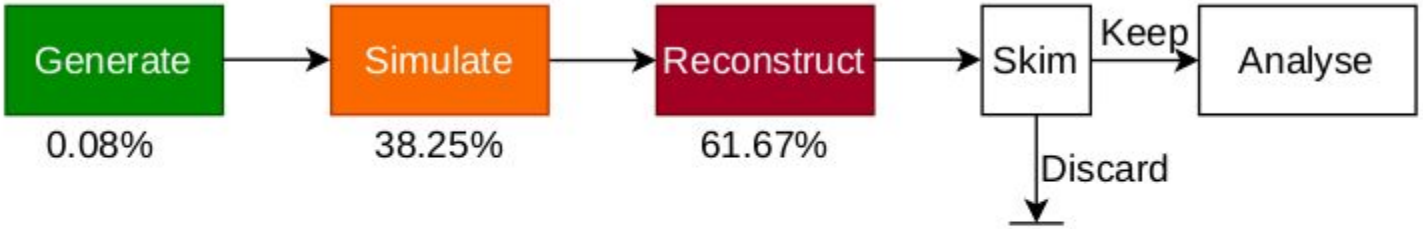


Figure 1. Steps in the Monte Carlo event simulation process. The figures shown under the first three stages indicate the percent of simulation time required by the given step before the skim.

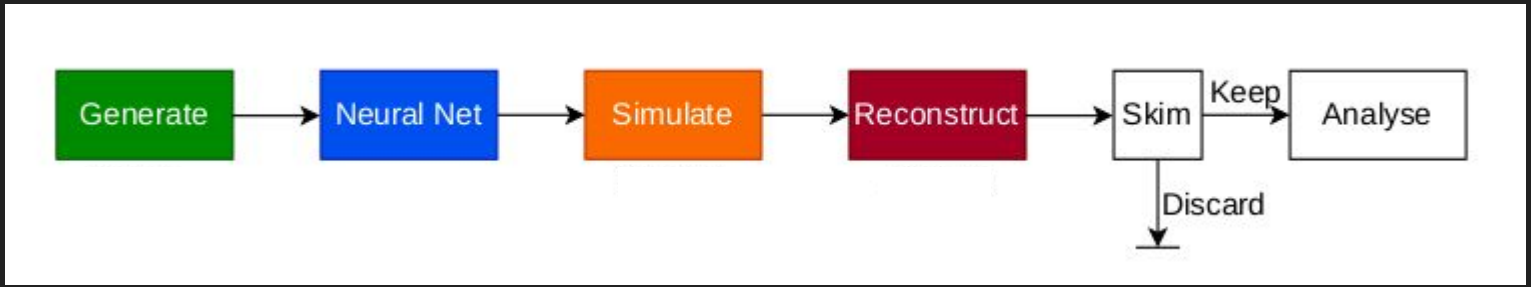
The skims keep only very few processes (~5%)

This is where we, the skimulators, join the game.

We aim to avoid the detector simulation and reconstruction of unnecessary physics events.

 fewer background to be simulated

Therefore our neural net classifies Monte-Carlo generated events according to their probability to pass a certain skim.



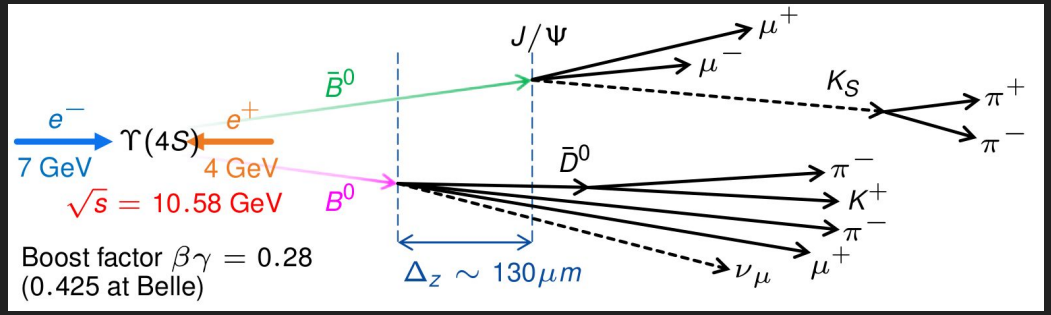
save time and computing resources

or simulate more good stuff for better analysis

Goals

Up to now: Supervised learning using CNNs

➔ As physics decays have graph (tree) structure



⟶ Implement graph NNs

➔ Mitigate bias (don’t change the overall physics simulated)