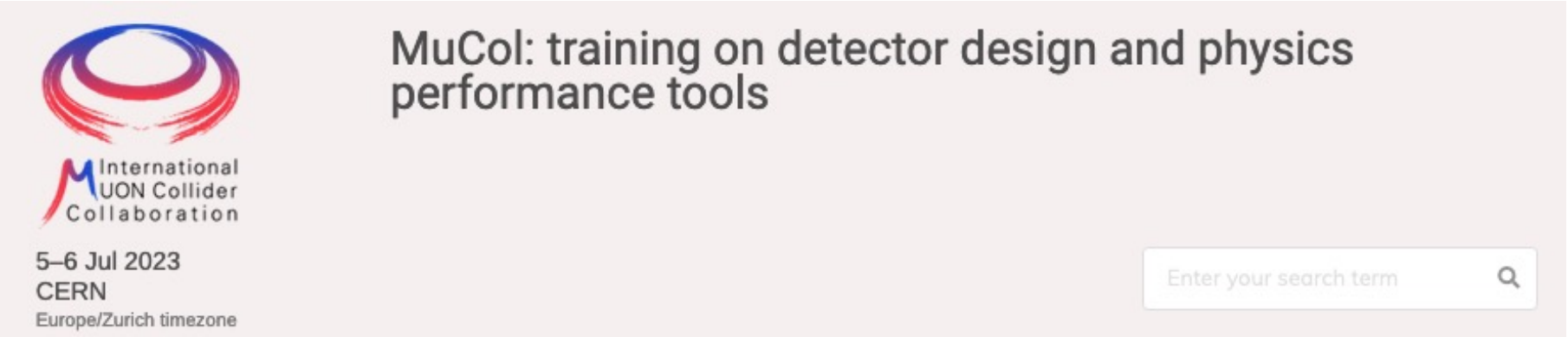
# Introduction to MuCol Project and Tutorial Goals

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For the WP2: Physics and Detectors Requirements

# Welcome from the Physics and Detector Requirements Working Group of the MuCol project

# The project

***The MuCol study will produce a coherent description of a novel particle accelerator complex that will collide muons of opposite charge at the energy frontier. The study will target a centre-of-mass energy ($E_{CM}$) of 10 TeV with 3 TeV envisaged as a first stage.***

## WP2: Physics and Detector Requirements

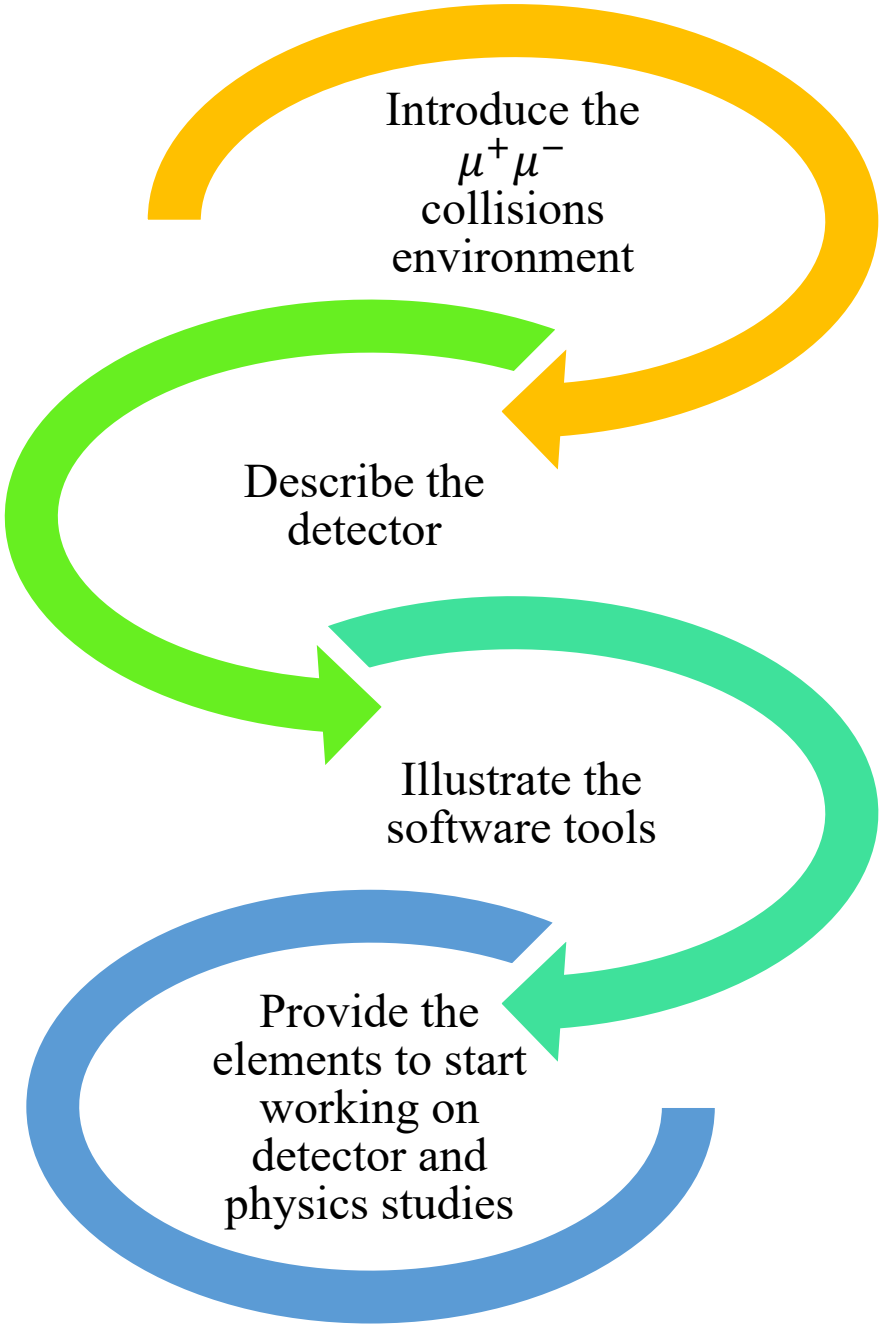
WP2 will study the beam-induced background effects on the detector with different interaction region design to define its optimal configuration which will include the shielding. Event reconstruction algorithms will be developed to exploit 5D information in order to additionally mitigate the beam-induced background effects, in particular the irreducible part. The last objective is the detector performance evaluation by using the most relevant SM measurements and New Physics reaches.

**Task 2.1** Design of detector configurations at $\sqrt{s}$=3 TeV and $\sqrt{s}$=10 TeV with the optimised interaction regions

**Task 2.2** Design and implementation of event reconstruction algorithms in 5D at $\sqrt{s}$=3 TeV and $\sqrt{s}$=10 TeV

**Task 2.3** Evaluate detector performance at different collision energies by using major physics processes

# Goals of this Training

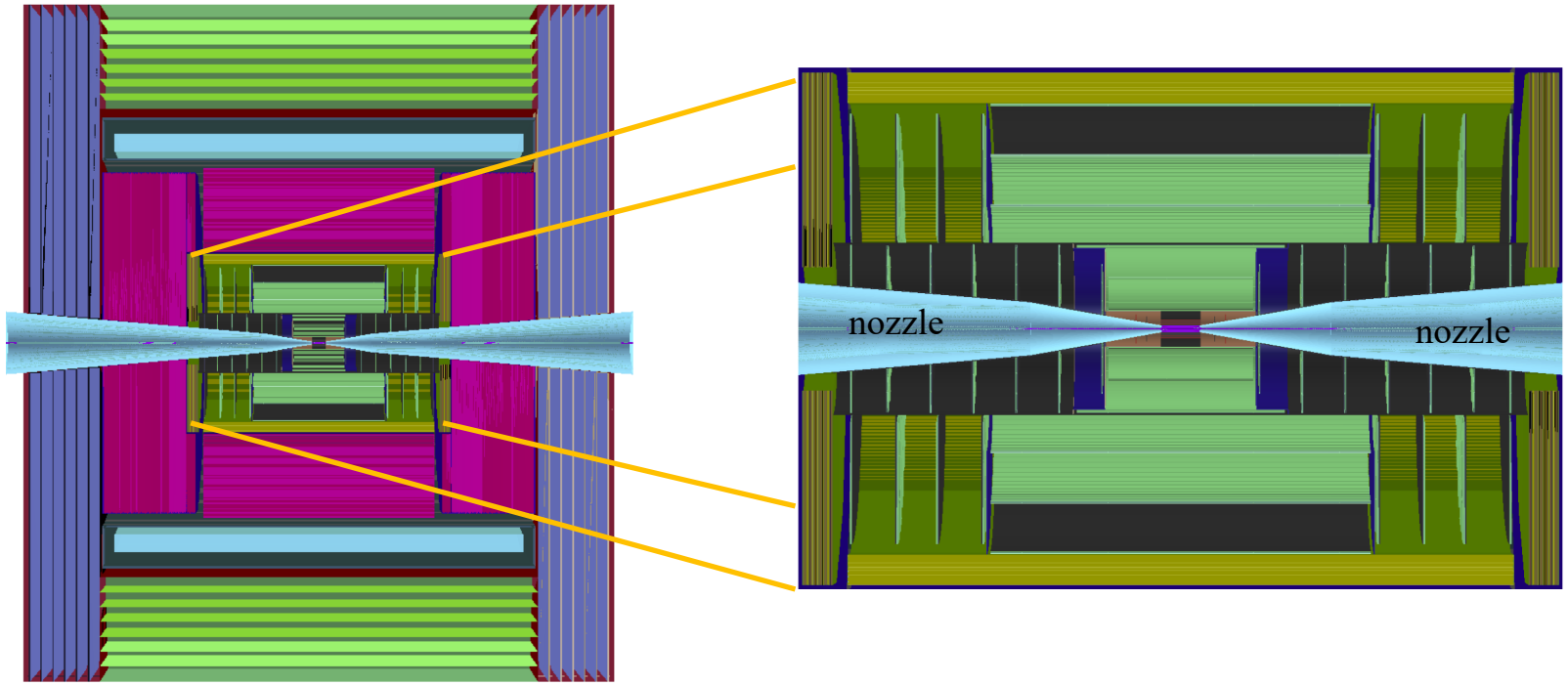


# Beam-Induced Background

High luminosity requires, among other, high number of muons per bunch ($N_\mu \sim 2 \cdot 10^{12}$)

Muons decay particles: $2\times10^5$ decays per meter of lattice, $E_{beam}$= 1.5 TeV ($\sqrt{s} = 3$ TeV), $2\times10^{12}\mu$/bunch
mainly: electrons/positrons, photons, neutrons, charged hadrons and muons

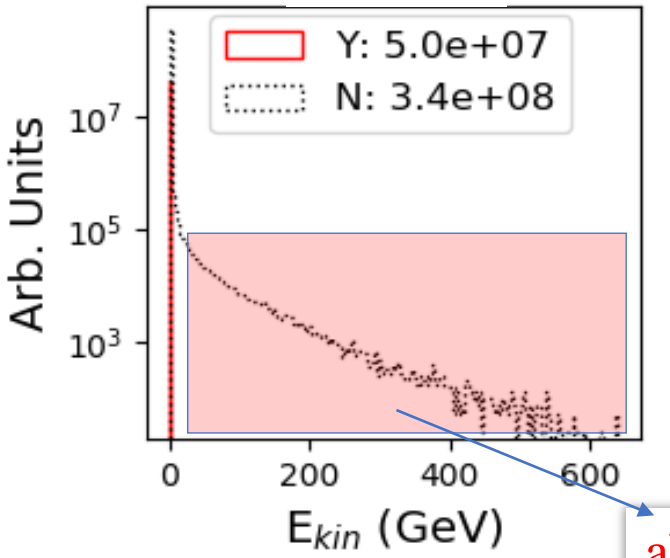
So far, the best way to mitigate the particle fluxes effects on detector is to use two shielding cones entering in the detector, the nozzles.



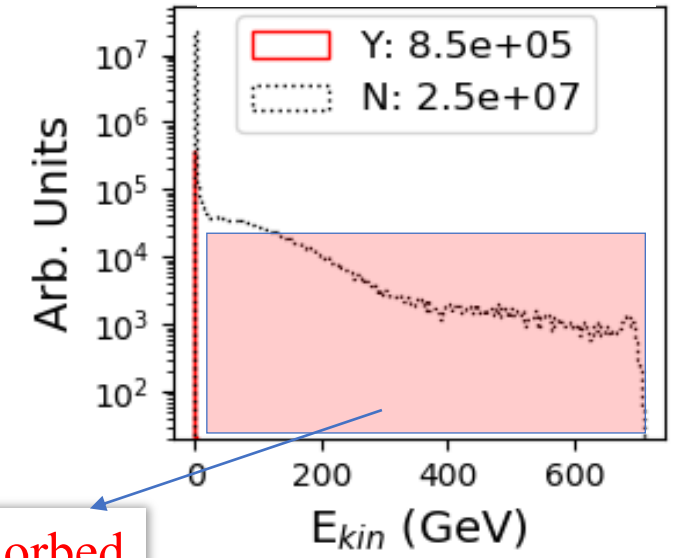
# Nozzle effect

Muon beam 0.75 TeV

Photons



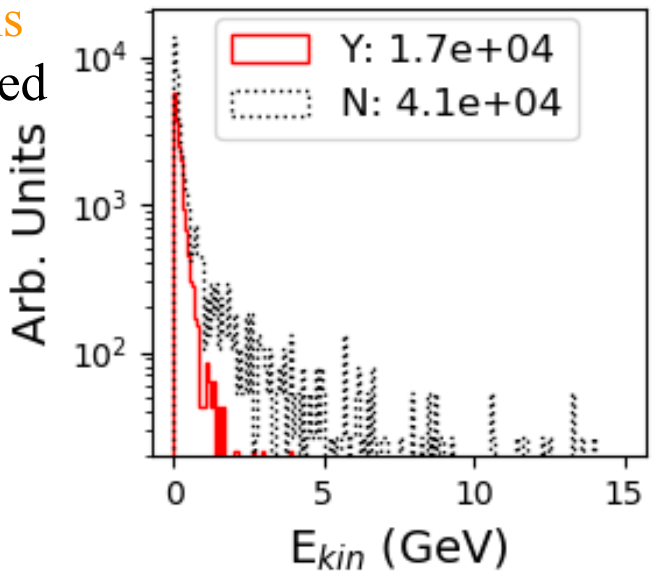

electrons/positrons



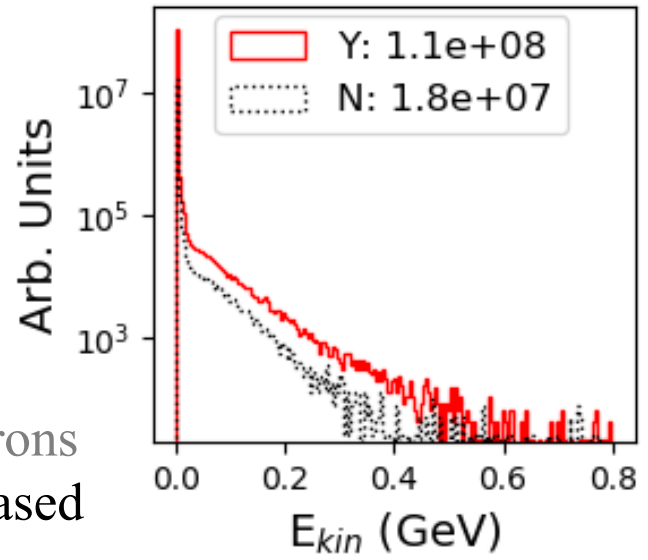

absorbed

Charged hadrons absorbed

charged hadrons



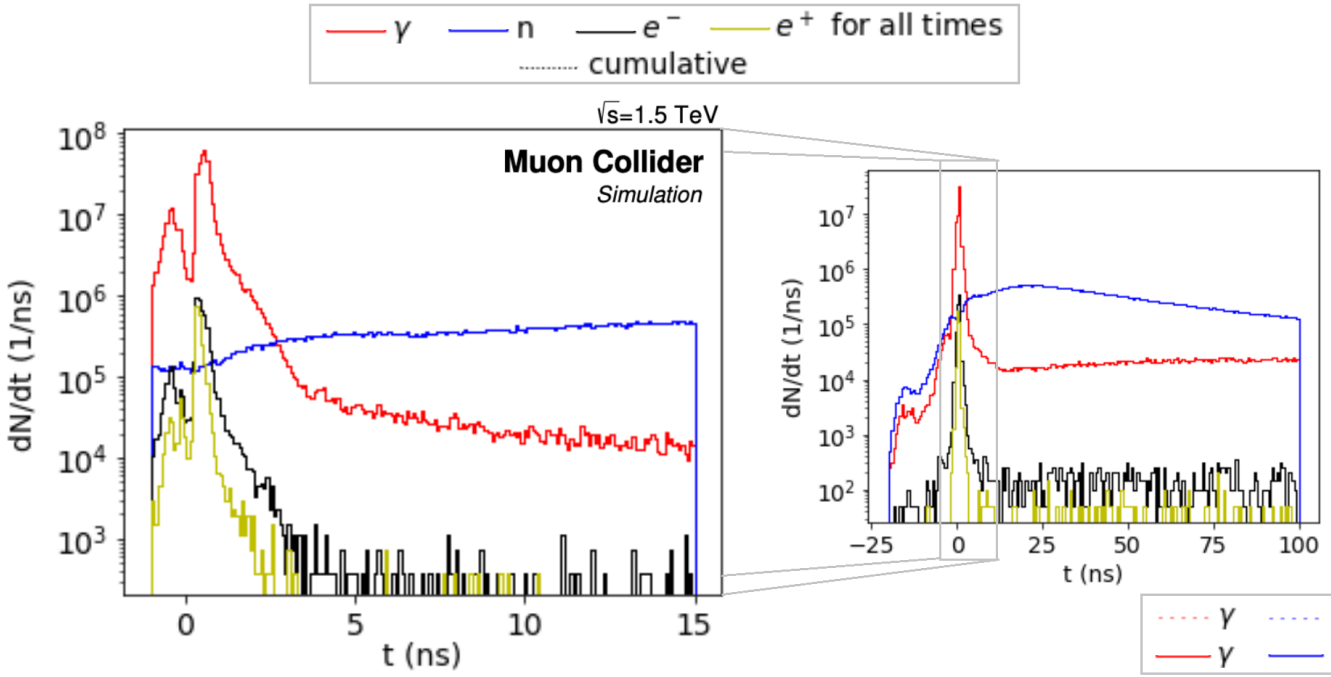

neutrons




Neutrons increased

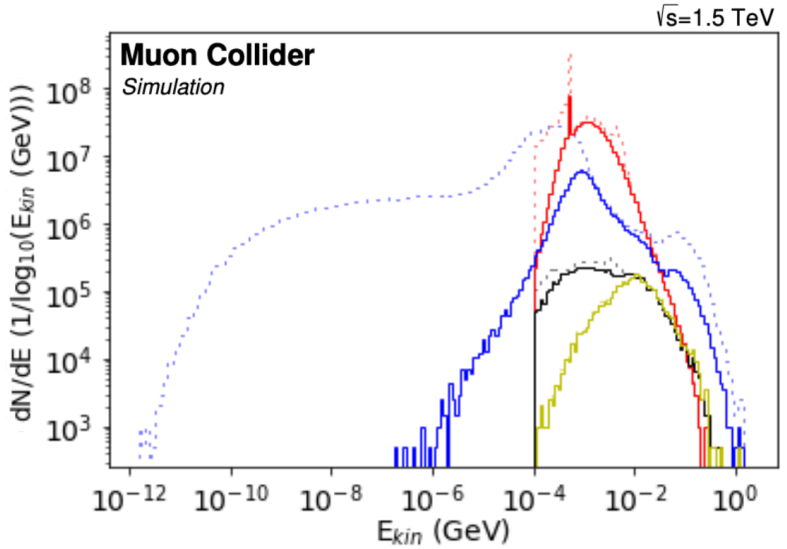
F. Collamati et al. 2021 JINST 16 P11009

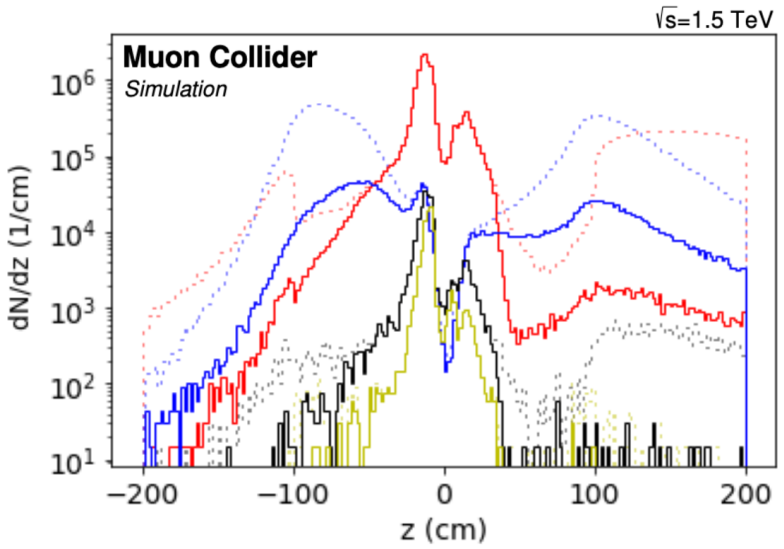
# The irreducible BIB



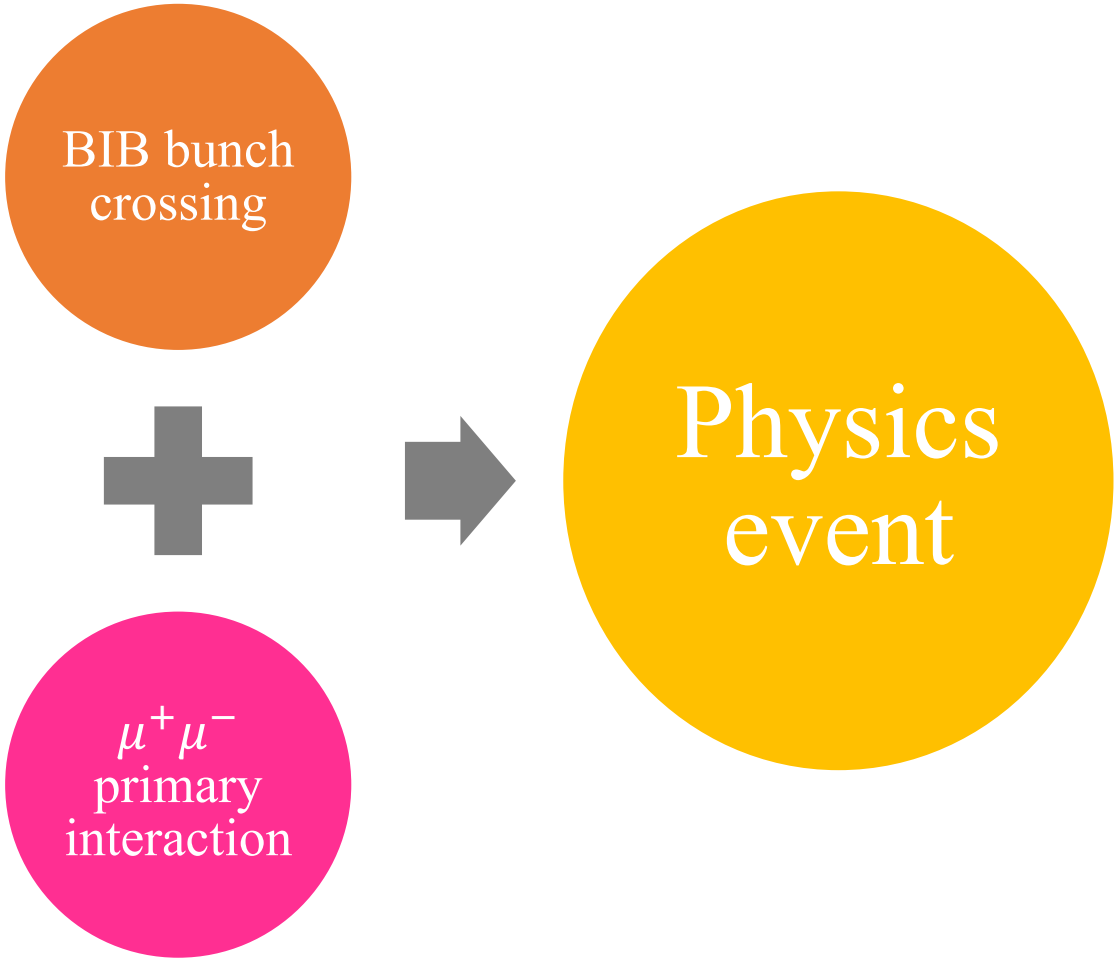

t: time distribution of particles exiting the machine


$E_{kin}$: kinetic energy distribution
z: longitudinal exit coordinate distribution



# Muon Collider "event"




Two samples are generated by using different Monte Carlo programs by different groups and then overlayed

# Goals of this Training