Background Mixing In Production

Jan 16, 2025

Signal Background Merger

4 backgrounds need to be mixed with every signal sample:
1) Minbias
2) Electron beamgas
3) Hadron beamgas
4) Synrad

Need a modification to the interface because currently the script only allows 3 types of backgrounds

Summary of Rates

Summary of rates for various sources of particle production in the central detector region (+5.0m to -4.5m from IP). Luminosity values are taken from EIC CDR ↗, Table 3.3 (high divergence luminosity configuration - most-conservative numbers with highest rates). Total cross section taken from Pythia6.

cross-section	5x41 GeV	5x100 GeV	10x100 GeV	10x275 GeV	18x275 GeV
Total ep	28.5ub	35ub	41ub	50ub	54ub
hadron beam (p) gas	77.3mb	76.8mb	76.8mb	78.5mb	78.5mb
electron beam gas	622.158 +/- 0.036 mb	622.158 +/- 0.036 mb	699.393 +/- 0.041 mb	699.393 +/- 0.041 mb	768.343 +/- 0.049 mb
DIS eA	ub	ub	ub	/	/
hadron beam (Au) gas	3418mb	3440mb	3440mb	/	/

This table shows the rates for electron+proton beam configurations:

Electron beam-gas rates consider larger region of -5 to +15 meters along the IP, hadron beam-gas rates consider region of -5.5 to +5 meters.

rates in kHz	5x41 GeV	5x100 GeV	10x100 GeV	10x275 GeV	18x275 GeV	Vacuum
Total ep	12.5 kHz	129 kHz	184 kHz	500 kHz	83 kHz	
hadron beam gas	12.2kHz	22.0kHz	31.9kHz	32.6kHz	22.5kHz	10000Ahr
	131.1kHz	236.4kHz	342.8kHz	350.3kHz	241.8kHz	100Ahr
electron beam gas	2181.97 kHz	2826.38 kHz	3177.25 kHz	3177.25 kHz	316.94 kHz	10000Ahr
DIS eA	kHz	kHz	kHz	/	/	
hadron beam (Au) gas	7.36kHz	10.3kHz	10.3kHz	/	/	10000Ahr
	79.1kHz	110.7kHz	110.7kHz	/	/	100Ahr
electron SR					14 MHz	

Background - Electron-Proton/Ion Collider Experiment

Talks on rate calculations

Peak Luminosity Config

Rate = Luminosity x Cross-section

These frequencies in kHz are used as inputs parameters to the signal background merger

Method

1) Added frequency table to datasets repository

2) Download and parse table at submit step

```bash
#!/bin/bash
set -Euo pipefail
trap 's=$?; echo "$0: Error on line "$LINENO": $BASH_COMMAND"; exit $s' ERR
IFS=$'\n\t'

# Set url for frequency tables
EGAS_URL=https://raw.githubusercontent.com/eic/simulation_campaign_datasets/${DETECTOR_VERSION}/con
fig_data/egas_freq.csv
HGAS_URL=https://raw.githubusercontent.com/eic/simulation_campaign_datasets/${DETECTOR_VERSION}/con
fig_data/hgas_freq.csv
MINBIAS_URL=https://raw.githubusercontent.com/eic/simulation_campaign_datasets/${DETECTOR_VERSION}/
config_data/minbias_freq.csv

# Download tables
EGAS_TABLE=$( curl -L ${EGAS_URL} )
HGAS_TABLE=$( curl -L ${HGAS_URL} )
MINBIAS_TABLE=$( curl -L ${MINBIAS_URL} )

# Initialize associative arrays (maps) for each type of background
declare -A EGAS_MAP
declare -A HGAS_MAP
declare -A MINBIAS_MAP
```

Need to tag datasets repository

Method (continued)

3) Run and label output location accordingly to distinguish between background mixed and regular outputs

```
Current directory structure:
root://dtn-eic.jlab.org//work/eic2/EPIC/RECO/24.12.0/epic-craterlake/
<TAG_PREFIX>/DIS/NC/..../<TAG_SUFFIX>_<FileName>
Example: TAG_PREFIX= BKG/10000AHr, TAG_SUFFIX=BKG_10000AHr

We will use nested directory structure to indicate different configs.

Starting with just background mixed DIS for now
```