

IWCD pile-up

02 May 2022

DATASET

200k events were simulated with WCSim

SINGLE-VERTEX

- 100K events
- MaxVtxPerEvt = 1
- MaxTrkPerEvt = 5
- MinTrkPerVtx = 1

MULTI-VERTEX

- 100K events
- MaxVtxPerEvt = 2
- MaxTrkPerEvt = 5
- MinTrkPerVtx = 1

Production of root files —> Complete
Production of npz files —> Almost Complete
Production of h5 file —>

DISTRIBUTIONS FROM THE NPZ FILES

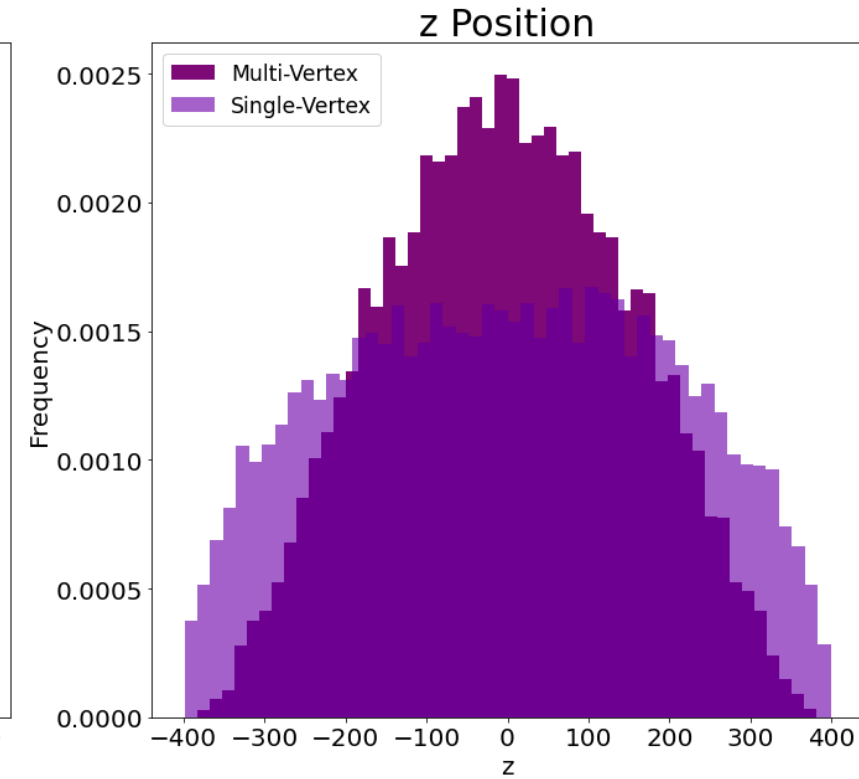
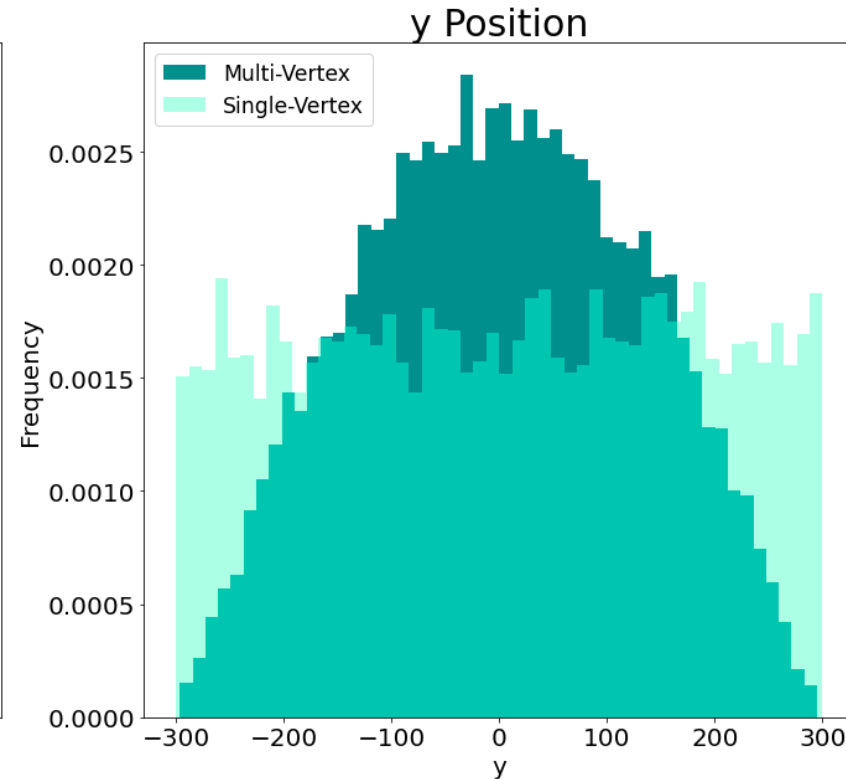
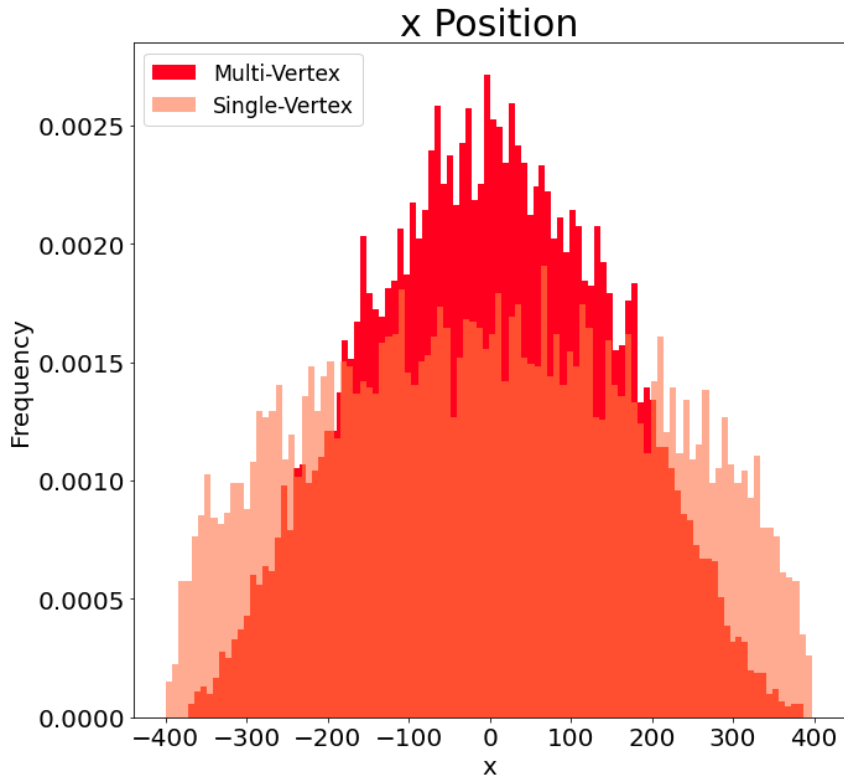


SINGLE-VERTEX
10k events



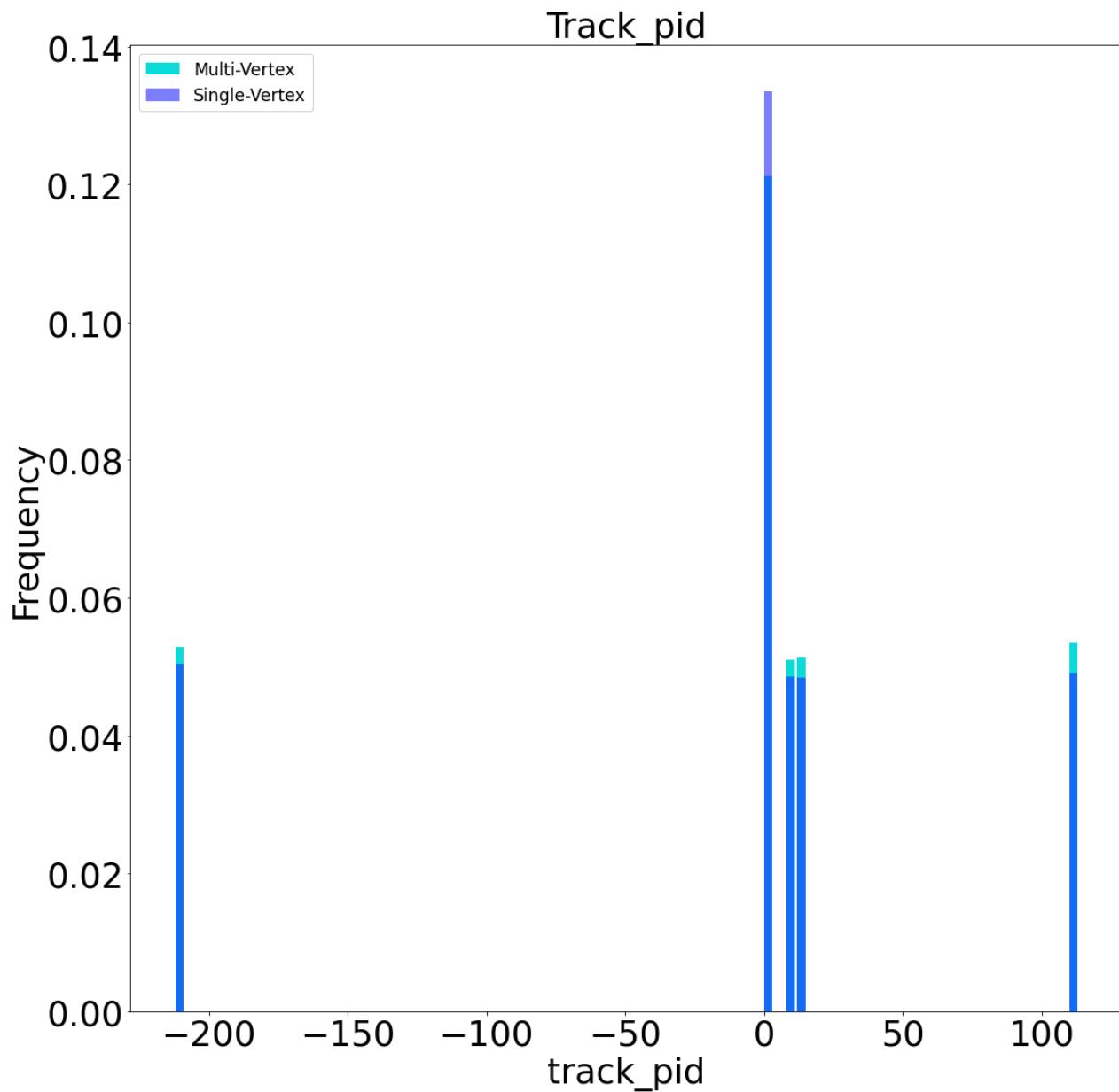
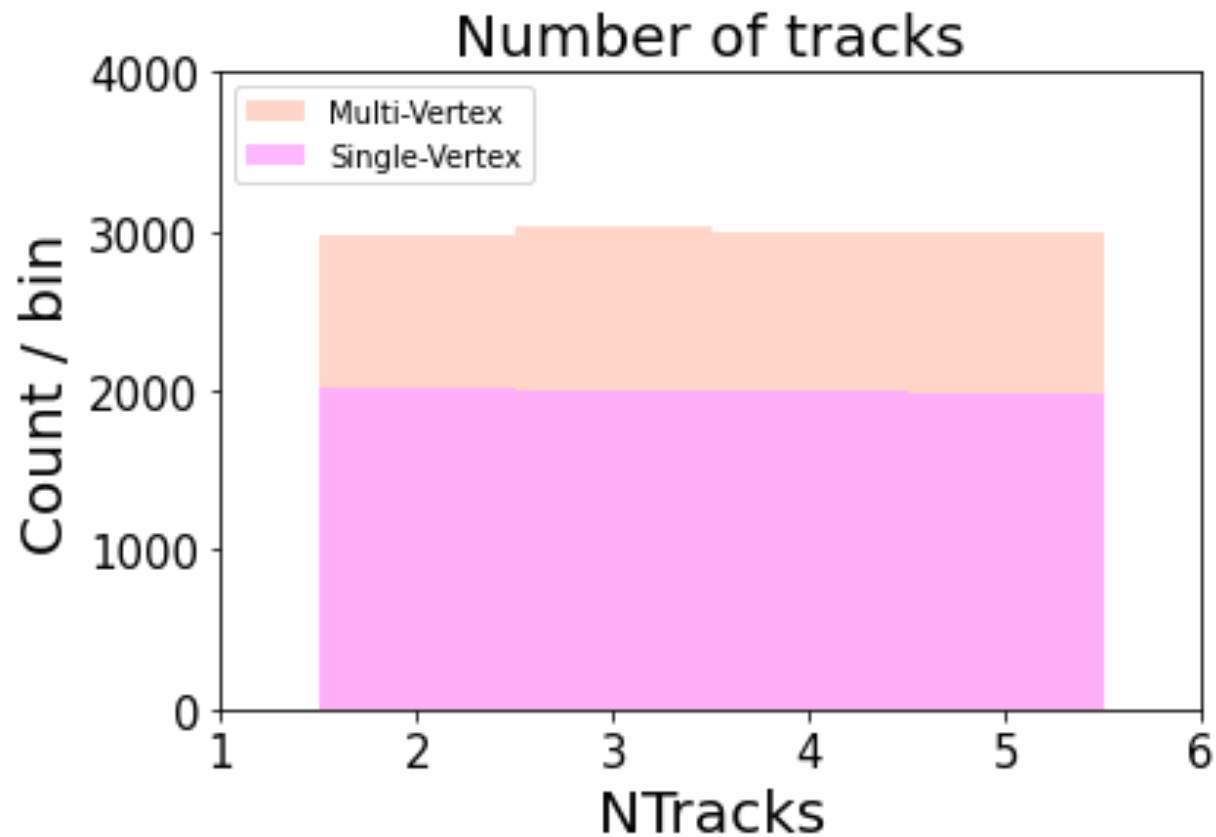
MULTI-VERTEX
12k events

DISTRIBUTIONS FROM THE NPZ FILES

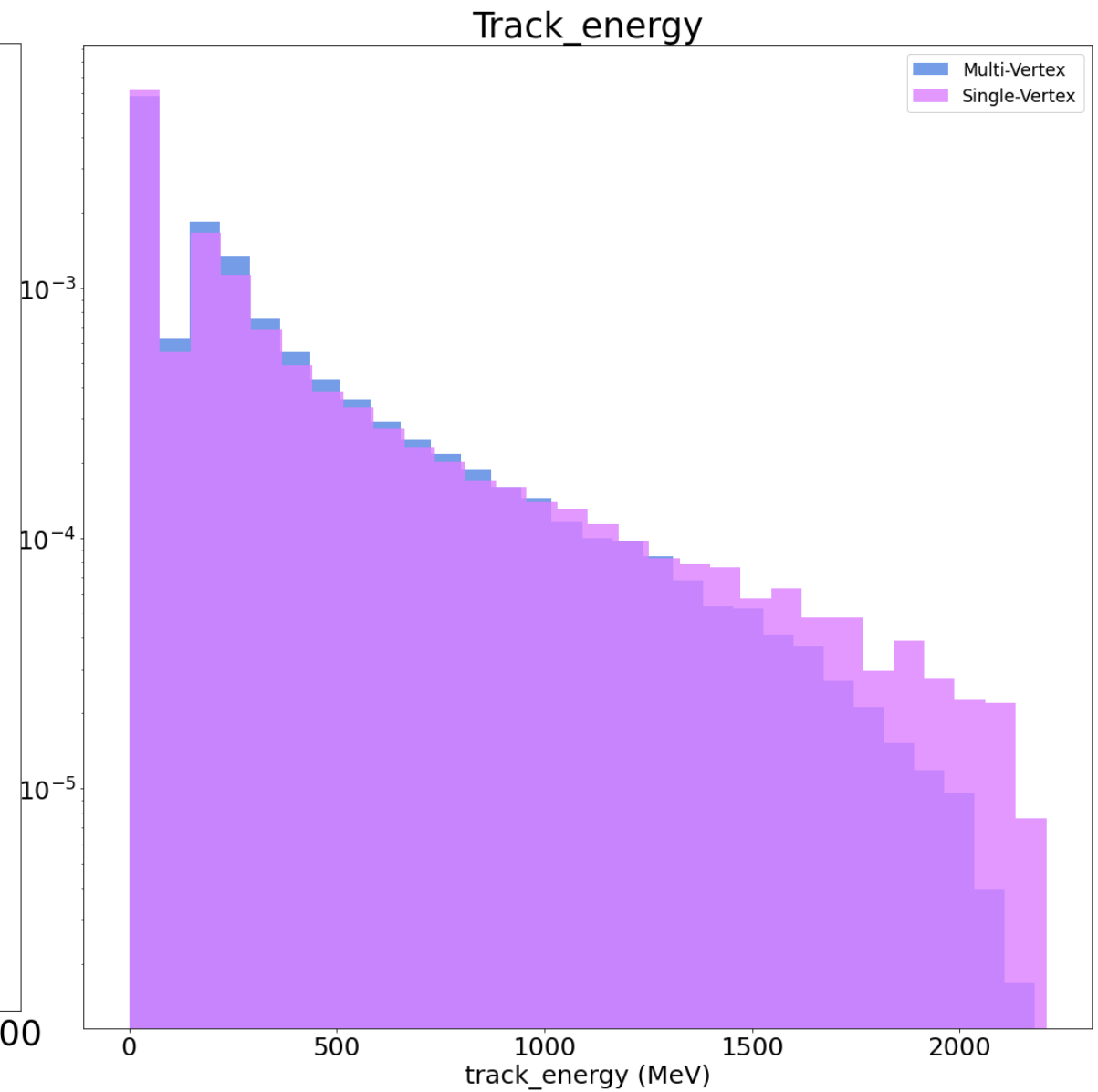
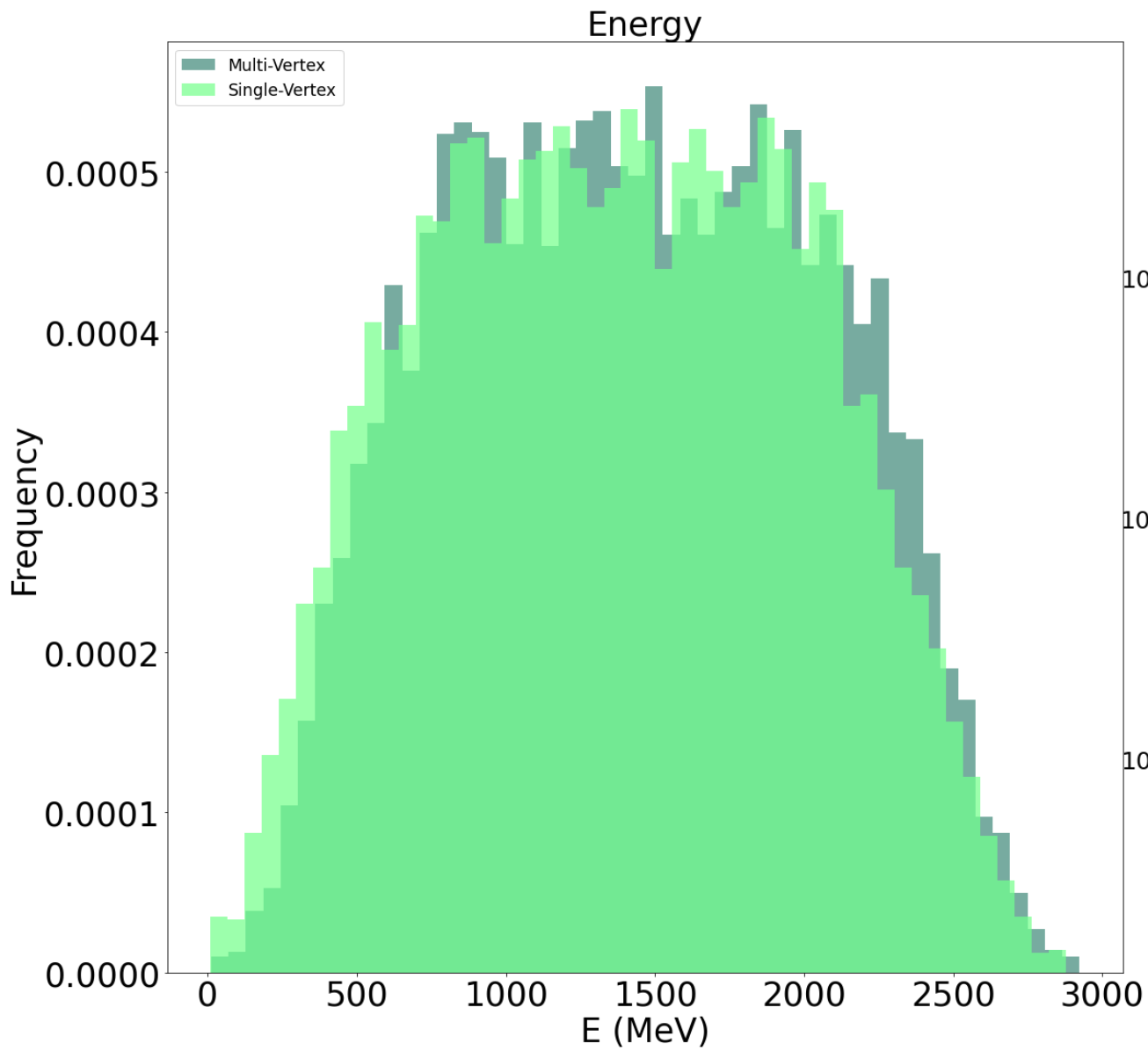


DISTRIBUTIONS FROM THE NPZ FILES

$\pi^- = -211$; $e^- = 11$; $\mu^- = 13$; $\pi^0 = 111$

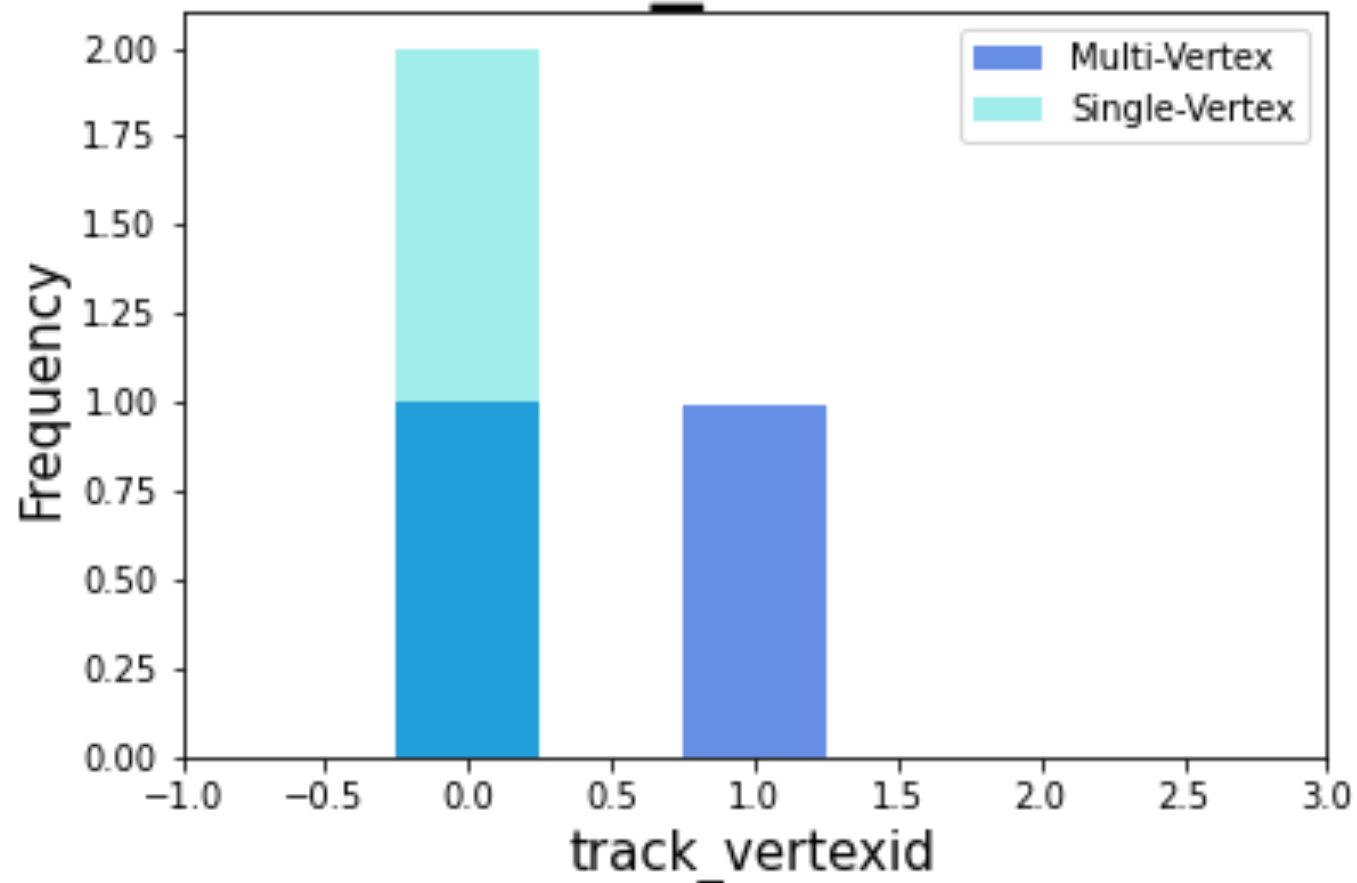


DISTRIBUTIONS FROM THE NPZ FILES

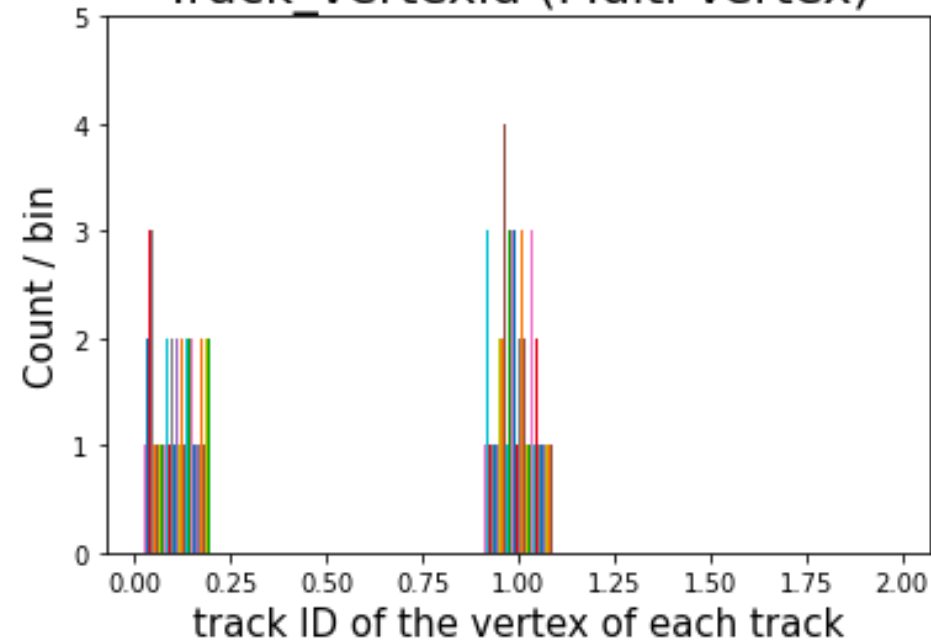


DISTRIBUTIONS FROM THE NPZ FILES

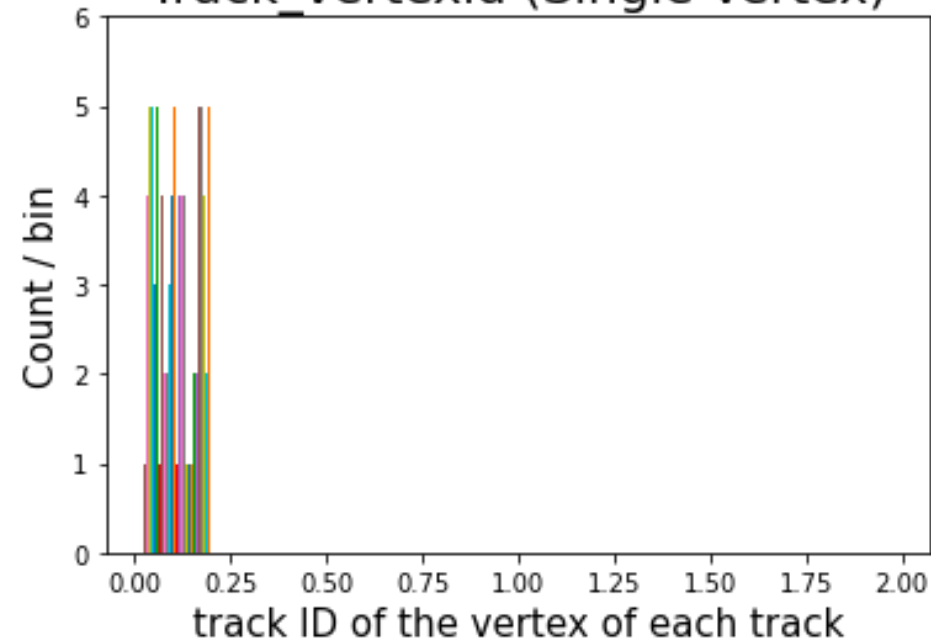
Track_vertexid



Track_vertexid (Multi-Vertex)

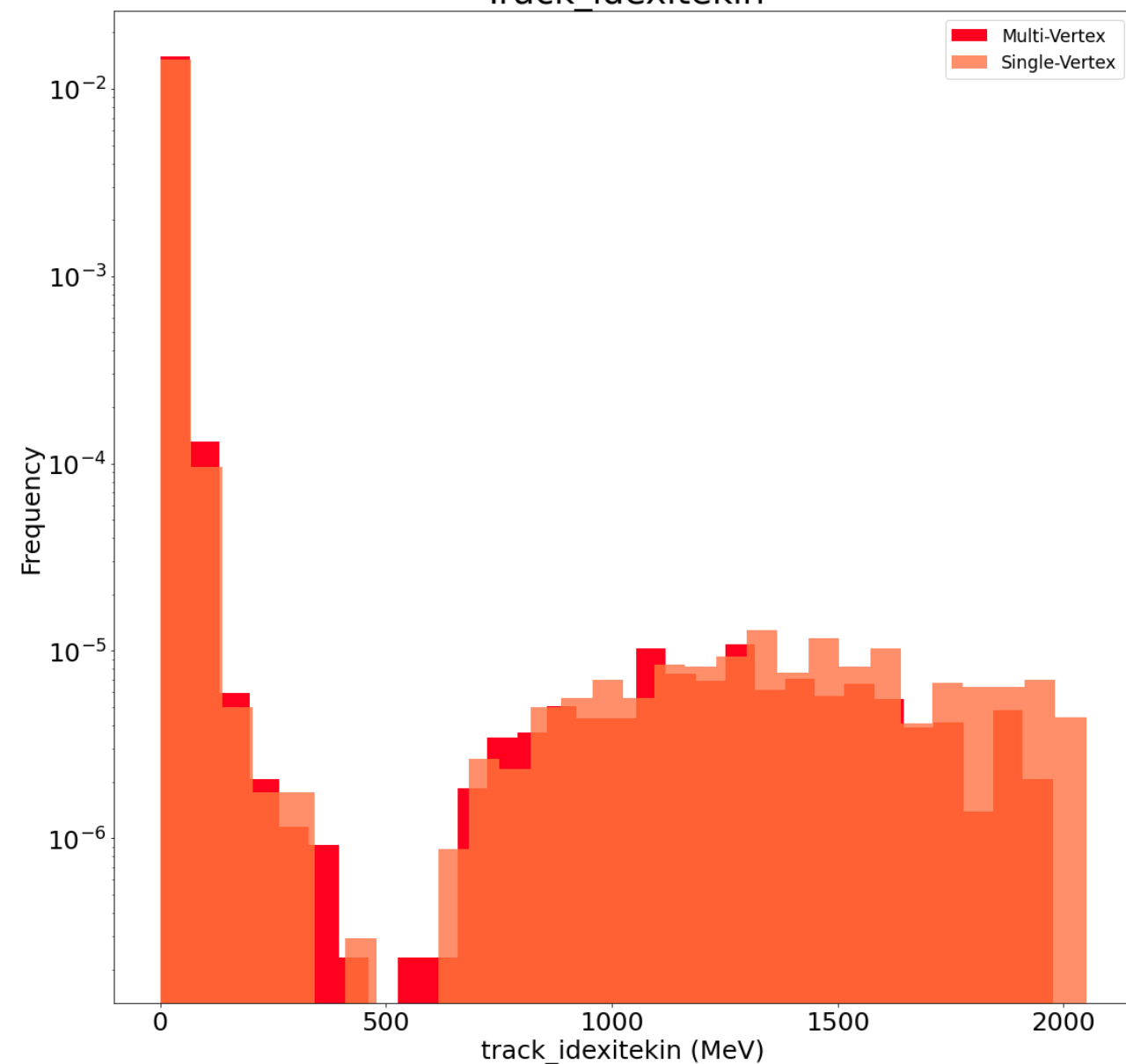


Track_vertexid (Single-Vertex)

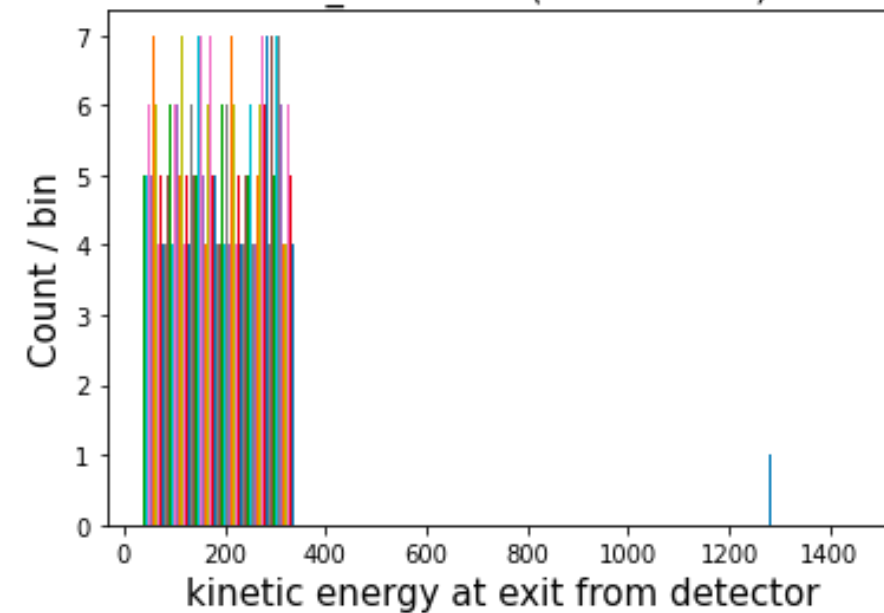


DISTRIBUTIONS FROM THE NPZ FILES

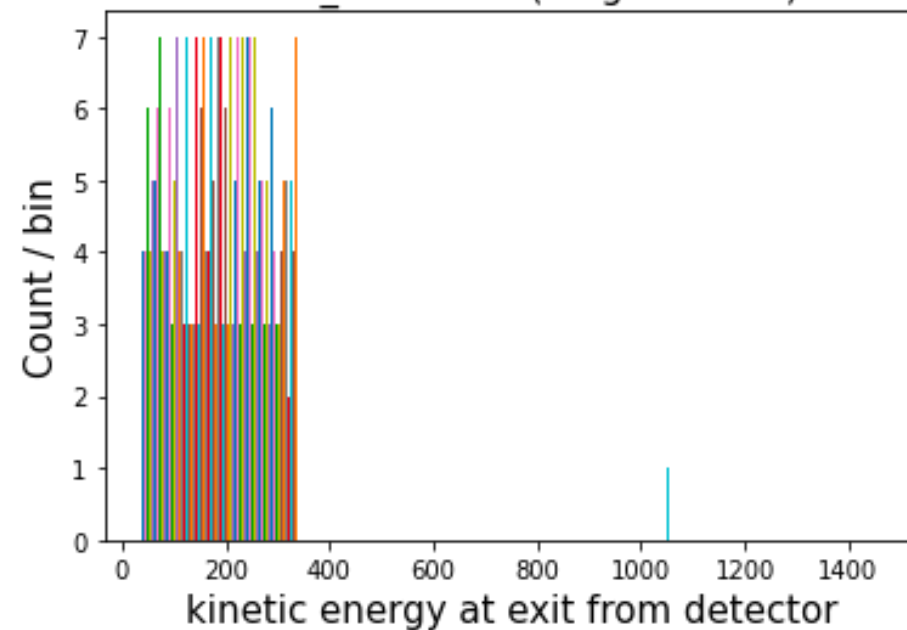
Track_idexitekin



Track_idexitekin (Multi-Vertex)

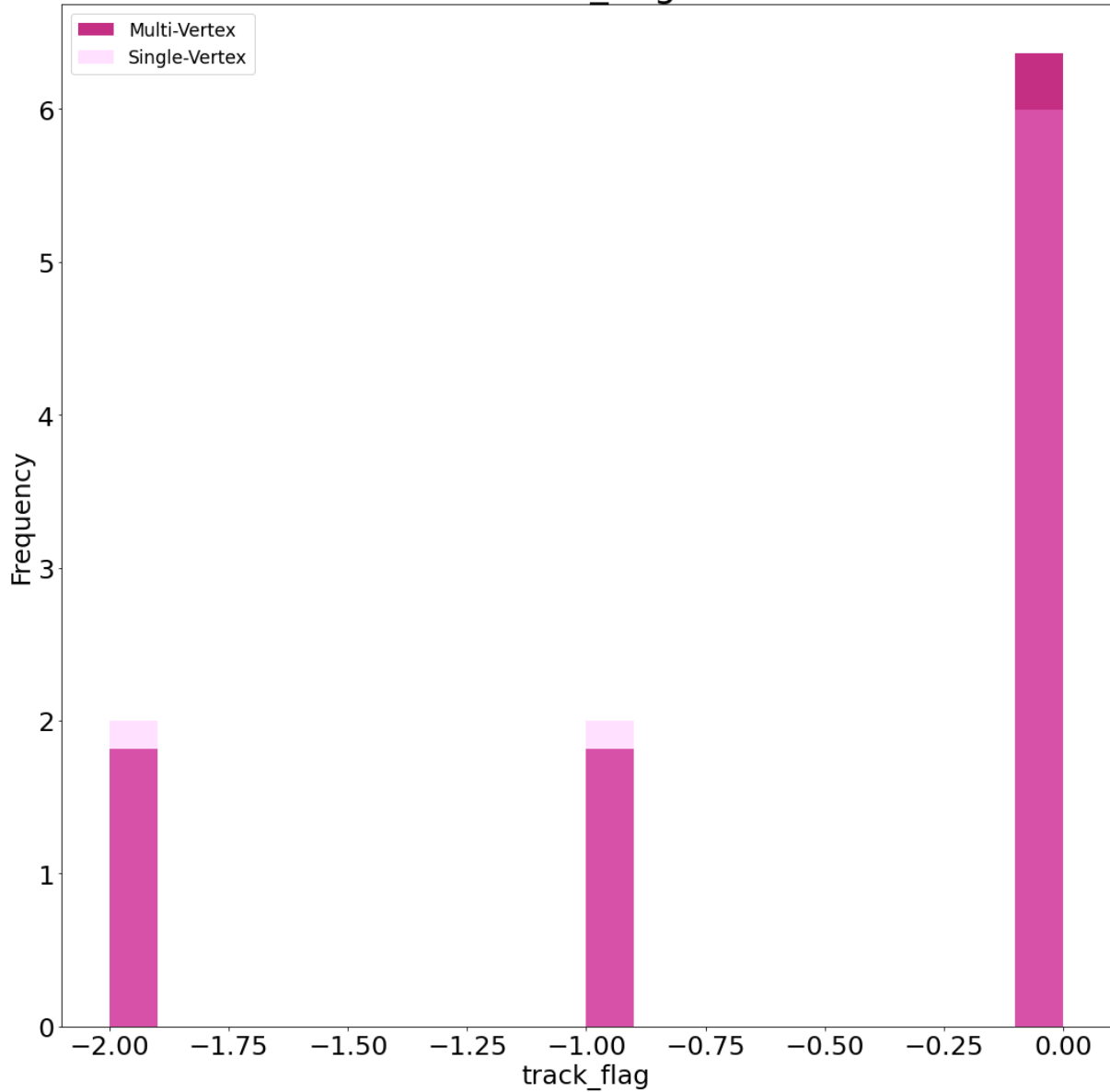


Track_idexitekin (Single-Vertex)

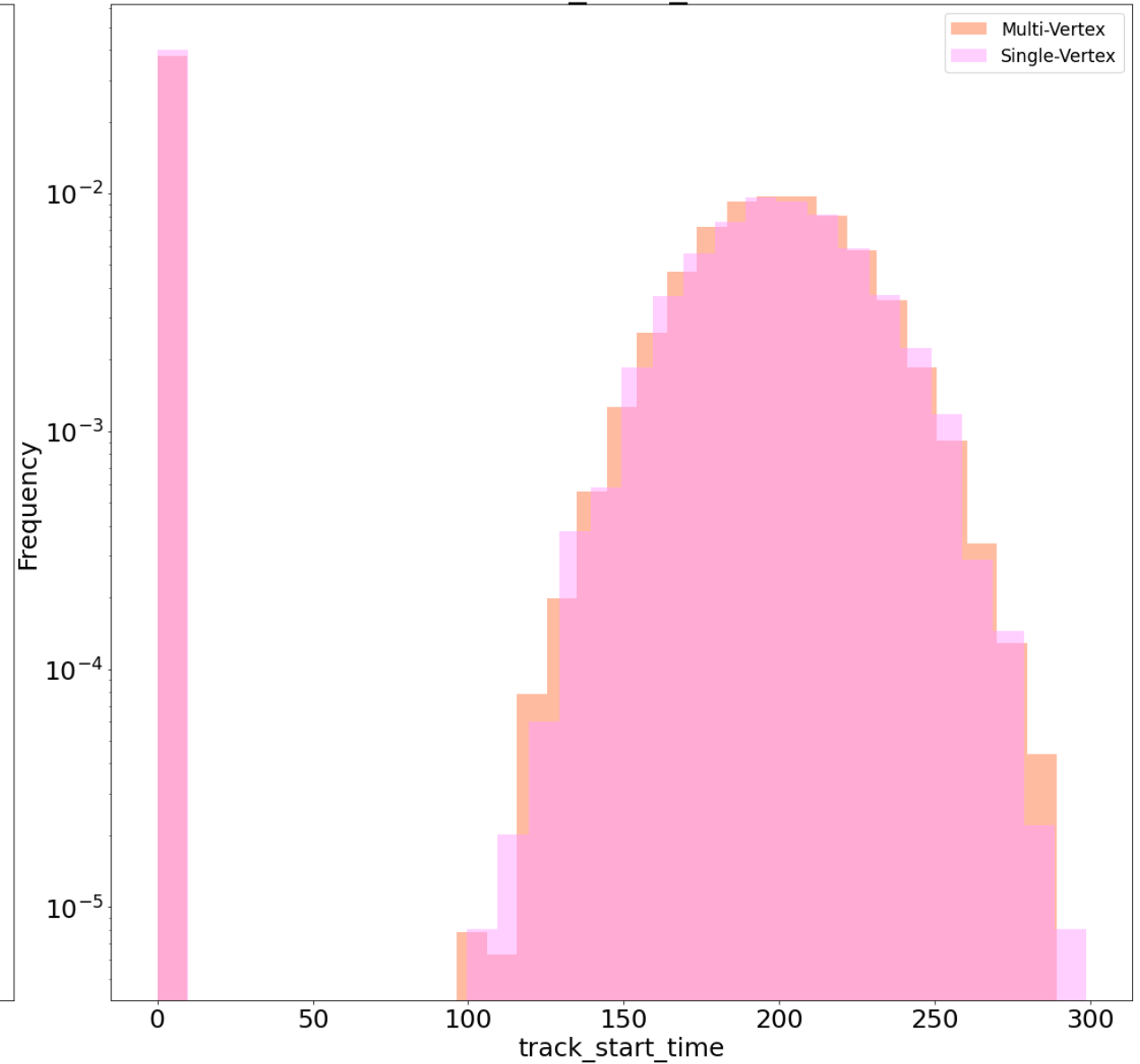


DISTRIBUTIONS FROM THE NPZ FILES

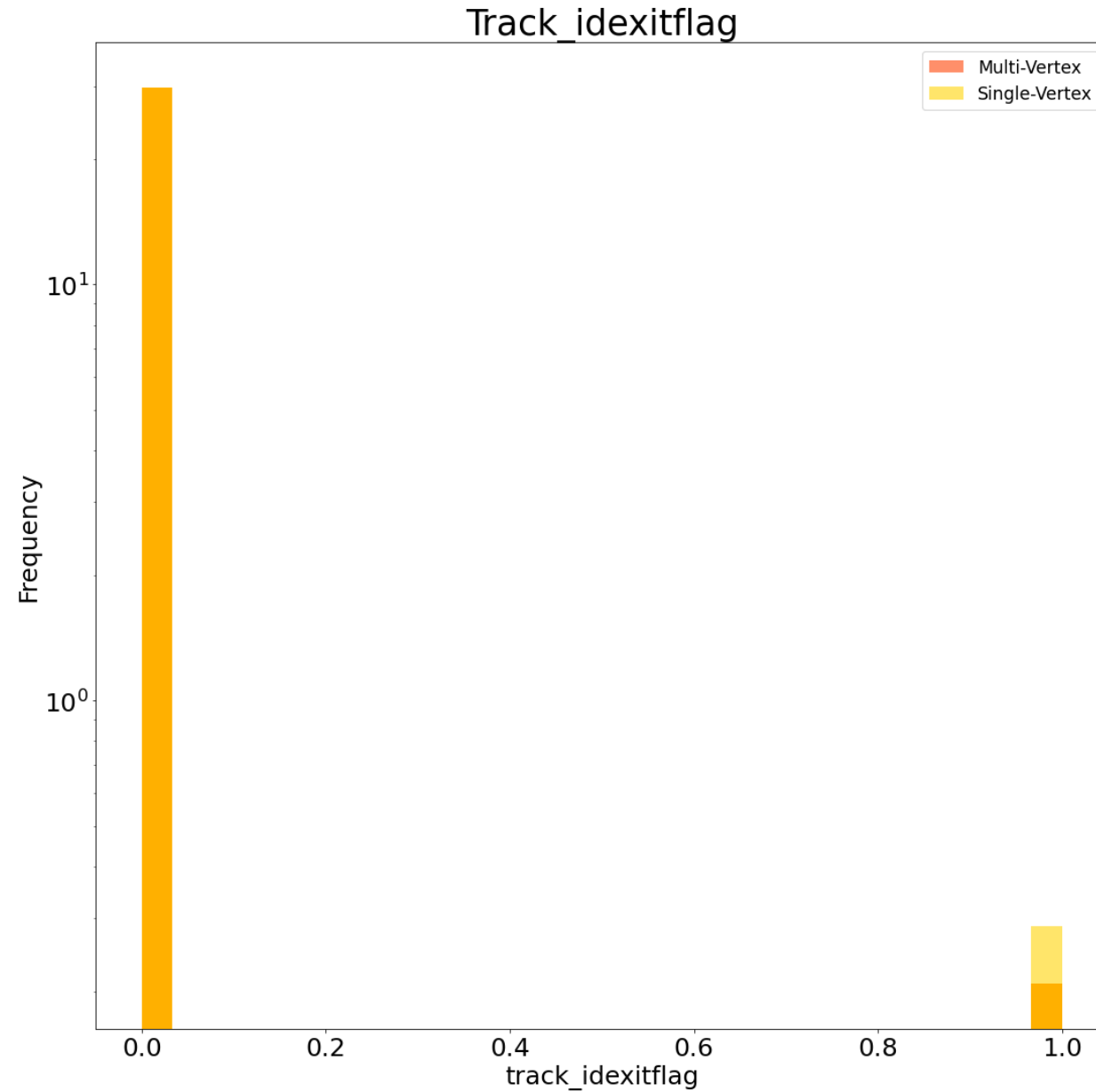
Track_flag



Track_start_time



DISTRIBUTIONS FROM THE NPZ FILES



Backup Slides

NPZ FORMAT - MULTI-VERTEX EVENTS (I)

Name	Shape	Data type	Each element contains
event_id	(n_events,)	int32	ID of the event in the ROOT file
root_file	(n_events,)	object	File name and location of the ROOT file
pid	(n_events,)	int32	Particle type simulated (PDG code, 11 for electron, 13 for muon...) # there's more than one particle so just use pid 0
position	(n_events, 3)	float32	Initial (x, y, z) position of simulated particle # average position
direction	(n_events, 3)	float32	Initial (x, y, z) unit vector direction of simulated particle # direction of sum of momenta
energy	(n_events,)	float32	Initial total energy of simulated particle # sum of energies
digi_hit_pmt	(n_events,)	object	Numpy array [shape(n_digi_hits,), dtype=int32] of hit PMT ID of each digitized hit
digi_hit_charge	(n_events,)	object	Numpy array [shape(n_digi_hits,), dtype=float32] of charge of each digitized hit
digi_hit_time	(n_events,)	object	Numpy array [shape(n_digi_hits,), dtype=float32] of time of each digitized hit
digi_hit_trigger	(n_events,)	object	Numpy array [shape(n_digi_hits,), dtype=int32] of trigger ID of each digitized hit
true_hit_pmt	(n_events,)	object	Numpy array [shape(n_true_hits,), dtype=int32] of hit PMT ID of each true hit
true_hit_time	(n_events,)	object	Numpy array [shape(n_true_hits,), dtype=float32] of the time of each true hit
true_hit_pos	(n_events,)	object	Numpy array [shape(n_true_hits,3), dtype=float32] of (x, y, z) position on the PMT where the photon produced each true hit (centre of PMT for dark noise hits)

NPZ FORMAT - MULTI-VERTEX EVENTS (II)

true_hit_parent	(n_events,)	object	Numpy array [shape(n_true_hits,), dtype=int32] of the track ID of the parent track producing the Cherenkov photon that produced each true hit (-1 for dark noise hits)
track_id	(n_events,)	object	Numpy array [shape(n_tracks,), dtype=int32] of the ID of each track saved by WCSim
track_pid	(n_events,)	object	Numpy array [shape(n_tracks,), dtype=int32] of the PDG code for particle type of each track
track_start_time	(n_events,)	object	Numpy array [shape(n_tracks,), dtype=float32] of the start time of each track
track_energy	(n_events,)	object	Numpy array [shape(n_tracks,), dtype=float32] of the start total energy of each track
track_start_position	(n_events,)	object	Numpy array [shape(n_tracks,3), dtype=float32] of the (x, y, z) start position of each track
track_stop_position	(n_events,)	object	Numpy array [shape(n_tracks,3), dtype=float32] of the (x, y, z) stop position of each track
track_parent	(n_events,)	object	Numpy array [shape(n_tracks,), dtype=int32] of the track ID of the parent of each track (currently WCSim does not store actual track IDs; instead it saves 0 for primary particles, PDG particle type code for the parent if it is a known type (e.g. 13 for muon), 999 otherwise)
track_flag	(n_events,)	object	Numpy array [shape(n_tracks,), dtype=int32] WCSim flag of each track (usually 0, but when inputting neutrino vectors it is -1 for incoming neutrino, -2 for target nucleus. -1 will also be used for the incoming gamma for future production runs, where there is currently a dummy neutrino and nucleus)
trigger_time	(n_events,)	object	Numpy array [shape(n_triggers,), dtype=float32] of the time of each trigger
trigger_type	(n_events,)	object	Numpy array [shape(n_triggers,), dtype=int32] of the type of each trigger. 0 is normal nDigits trigger, 2 is for digitised hits saved when there is no trigger. Only available in the newer MC runs, 3 = ?

Need to investigate this value 3

NPZ FORMAT - MULTI-VERTEX EVENTS (III)

New variables

track_parentid	(n_events,)	object	Numpy array [shape(n_tracks,), dtype=int32] of the ID of parent to the track
track_vertexid	(n_events,)	object	Numpy array [shape(n_tracks,), dtype=int32] of the track ID of the vertex of each track (which vertex track belongs to)
track_idexitflag *	(n_events,)	object	Numpy array [shape(n_tracks,), dtype=int32] of flag for the exiting particle
track_idexitpos *	(n_events,)	object	Numpy array [shape(n_tracks,3), dtype=float32] of position (x,y,z) of where the particle exits
track_idexitekin *	(n_events,)	object	Numpy array [shape(n_tracks,), dtype=float32] of kinetic energy at exit from detector