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# CERN-DESY FastSim

CERN updates

26.6.24

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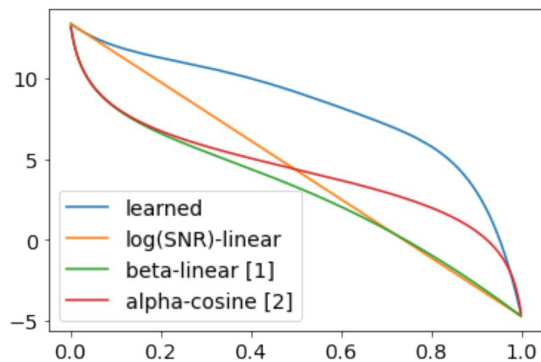
# Data production

We generate data by firing the particle from IP with tracker turned off.

- FCCeeCLD - generated
  - FCCeeALLEGRO - ongoing
  - Par04 SciPb & PbWO<sub>4</sub> validated - will start generation this week
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# IBM updates



(a) log SNR vs time  $t$

- CaloDiT integrated into IBM repository
    - Poor results
    - Probably mismatch of some bits of code
  - IBM got nice results using DDPM + Mixer models
  - Will explore variational diffusion models
    - Learned noise schedule
    - Faster sampling
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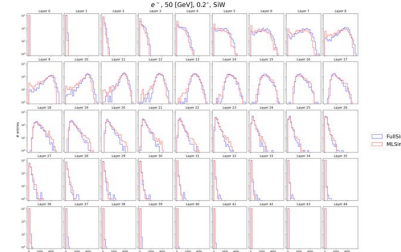
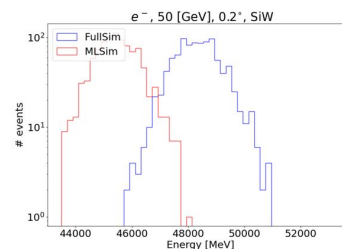
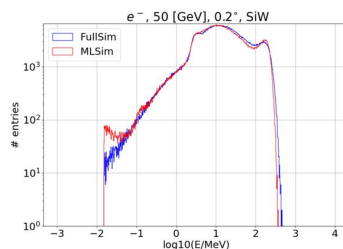
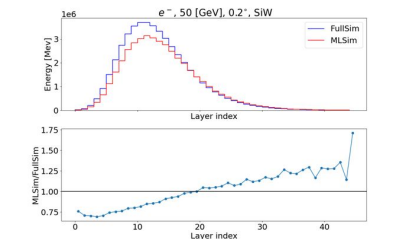
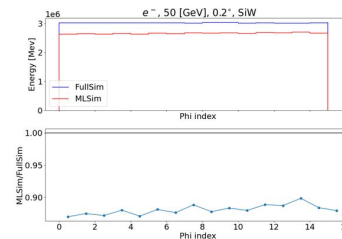
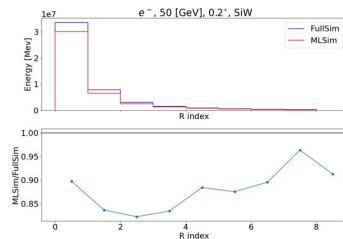
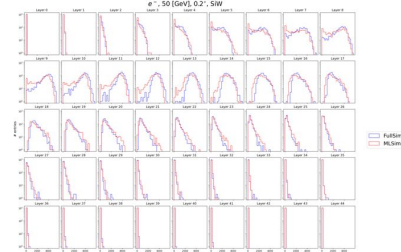
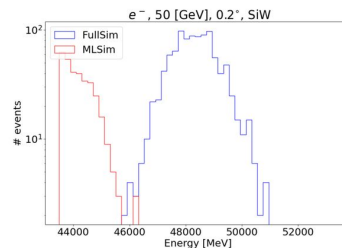
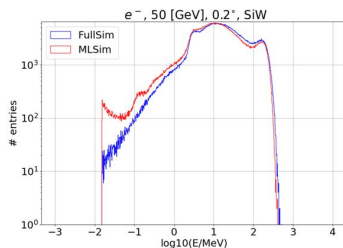
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# GSoC updates

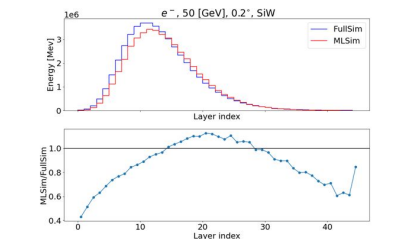
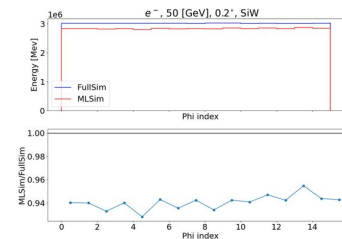
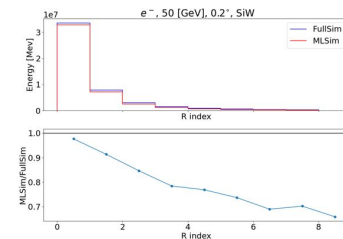
- Explored DDIM (Denoising diffusion implicit models)
  - Option to do deterministic sampling
  - Can skip some sampling steps, hence faster
- Unexpected results
  - More stochastic the sampling, better the results (for less timesteps)
  - Less timesteps doesn't hold the shower observables
- Started looking into consistency models
  - Exploring EDM
  - What diffusion process did you use?
  - Experimented with different ones?

# DDIM results

Deterministic sampling (20 steps)



Stochastic sampling (20 steps)



# Summer student - Paul

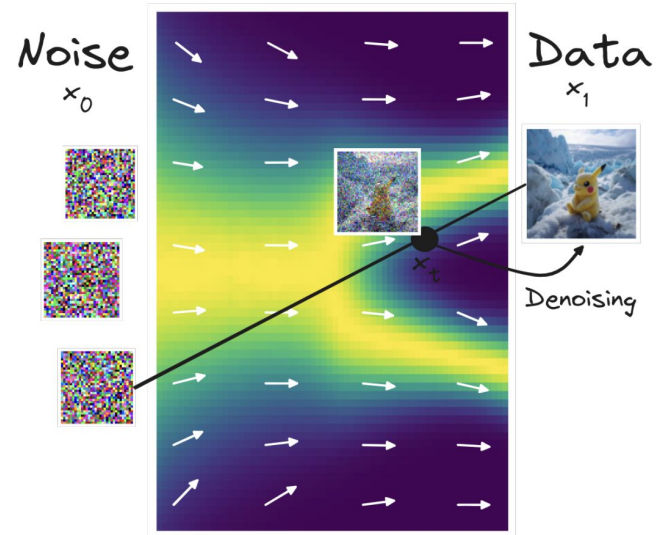
- Exploring Flow Matching
- A scalable approach for training continuous normalizing flows

## Flow Matching

- Sample noise  $x_0$ , data  $x_1$
- Interpolate with  $t \in [0, 1]$ 
$$x_t = tx_1 + (1 - t)x_0$$
- Model the denoising direction

$$E_{x_t, t} [x_1 | x_t, t]$$

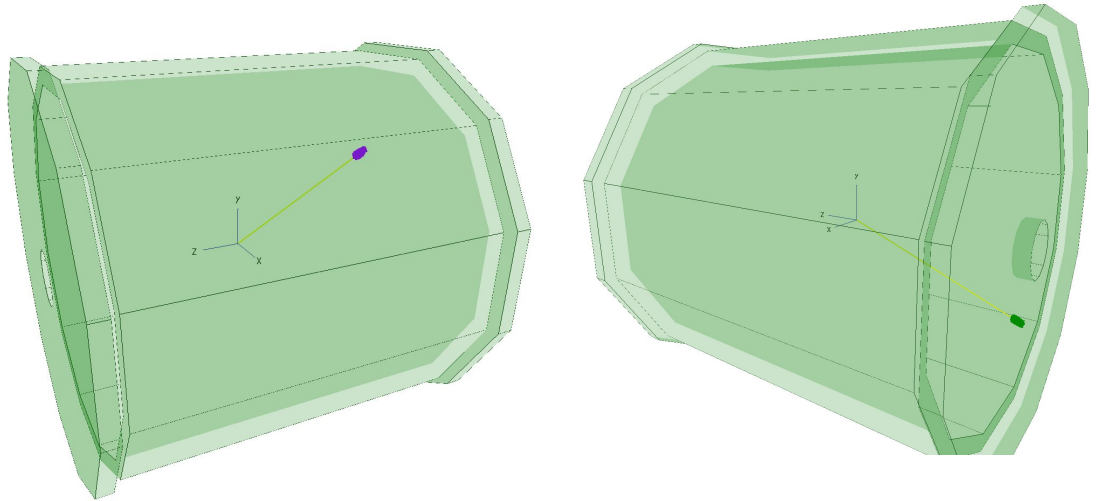
- Flow  $v_\theta$  points in that direction



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# Summer student- Cinyu

- Continuing work on integrating cylindrical scoring mesh, first for CLD
- First, validate that physics is the same as in python world
- What do the showers look like in the readout geometry?
- Start looking at effects of reconstruction if time allows...



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# Other updates

- Openlab student joining next week
  - Will work on low energy showers [100MeV - 1GeV]

