Physics parameters

- Geometry
  - Velo sensors: 80 x 80 mm^2 layers seperated 33 cm in z
  - No “hole” in the center
- Particle generation
  - Particle beam [-0.2 rad, 0.2 rad] generated ”flat” in theta and [0, 2pi] in phi
- Multiple scattering
  - Sensor is 200 micron thick, which for Si X_0 of 9.36 cm gives $X = 0.2\% X_0$ per layer
  - Include ASICS and cooling etc: $X = 0.5\% X_0$ per layer in total
  - Formula for Mult Scatt.: $\sigma_{RMS} = \frac{13.6\ MeV}{p} \times \sqrt{X}$
  - For nominal particle use a 10 GeV particle: $\sigma_{RMS}^{nominal} = 0.0001$ = 0.1 mrad
    - (This gives ~3 micron displacement after 33 mm)
  - Put scattering values at $\sigma_{scatt} = 0\ mrad,\ 0.1\ mrad,\ 0.2\ mrad,\ 0.3\ mrad, 0.5\ mrad, 1\ mrad$
- Hit resolution for 55 micron pitch
  - Put resolution values $\sigma_{res} = 0, 10, 20, 50$ microns
- Window of acceptance
  - Try n=3, 4 and 5 sigma of $\mathrm{n} \times \max(\sigma_{scatt}, \sigma_{res})$
- Inefficient hits
  - Take the inefficiency as: drop rate = 0% , 1%, 2%
- Noise hits: Fraction of noise hits as:
  - 0, 0.0001, 0.001, 0.01

Take reference defaults:
$\boldsymbol{\sigma_{scatt} = 0.1\ mrad}$
$\boldsymbol{\sigma_{res} = 10\ \mu m}$
Hit inefficiency = 0%
Noise hits = 0%

Please us the defaults when scanning other parameters

Defenitions of Performance parameters

- Tracks
  - True tracks N_{true}: Particles generated as input
  - Reconstructed tracks N_{rec}: output of the reconstructed algorithm; the found tracks
  - Good reconstructed tracks N_{rec}^{good}: reconstructed tracks where at least 70% of the reconstructed hits are also present in the matched true track and, optionally, at least 70% of the true hits are included
  - Ghost tracks N_{rec}^{ghost}: Tracks where less than 70% of the reconstructed hits match to any true track
  - Clone tracks N_{rec}^{clone}: Different tracks that have the same true track. I suggest for now to chose the "best" matching clone track and remove the others.
- Hits
  - True hits N_{hits}^{true}: group of true detector hits caused by the true tracks
  - Reconstructed hits N_{hits}^{rec} : the number hits included in the reconstructed tracks
  - Good hits N_{hits}^{good} hits in the reconstructed track that are also present in the matched true track
  - Bad hits N_{hits}^{bad}: hits in the reconstructed track that are not present in the matched track

Calculating performance numbers

- Track efficiency: $\varepsilon_{track}^{eff} = N_{rec}^{good}/N_{true}$
- Track ghost rate: $\varepsilon_{track}^{ghost} = N_{rec}^{ghost}/N_{rec}$
- Hit efficiency per track: $N_{hits}^{good}/N_{hits}^{true}$
- Hit purity per track: $N_{hits}^{good}/N_{hits}^{rec}$

Suggested outline for your talk

1. Intro/motivation: show a LHCb upgrade event display
2. Explain the quantum algorithm
3. Goal of toy Monte Carlo: test the algorithm classically for experimental effects
4. Also show the performance obtained with real MC (Davide result)
5. Mention the HHL optimizations
6. Show the performance on noisefree quantum simulators: i.e. the Qiskit result for the most complicated event
7. Show the noisy simulation results of quantinuum
8. Outlook