LCFIPlus with SGV

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Introduction

❖ **What is LCFIPlus?**

- LCFIPlus is a software package for vertex finding, jet clustering and flavour tagging.

https://arxiv.org/abs/1506.08371

- Currently it is largely used in our analyses

❖ **What is SGV**

- A fast detector simulation (Simulation a Grande Vitesse)

https://arxiv.org/abs/1203.0217

- Easy handling with detector model building

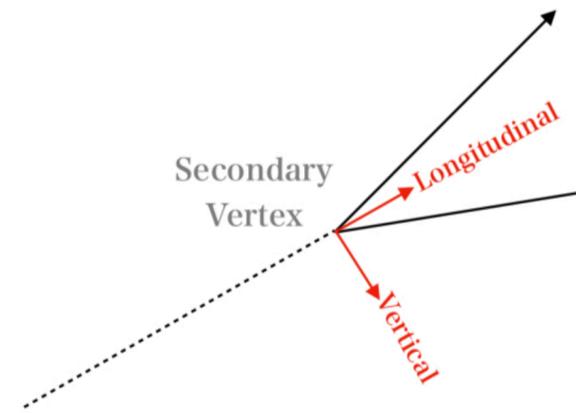- Directly produce LCIO PFO collection —> input for LCFIPlus

❖ **So what?**

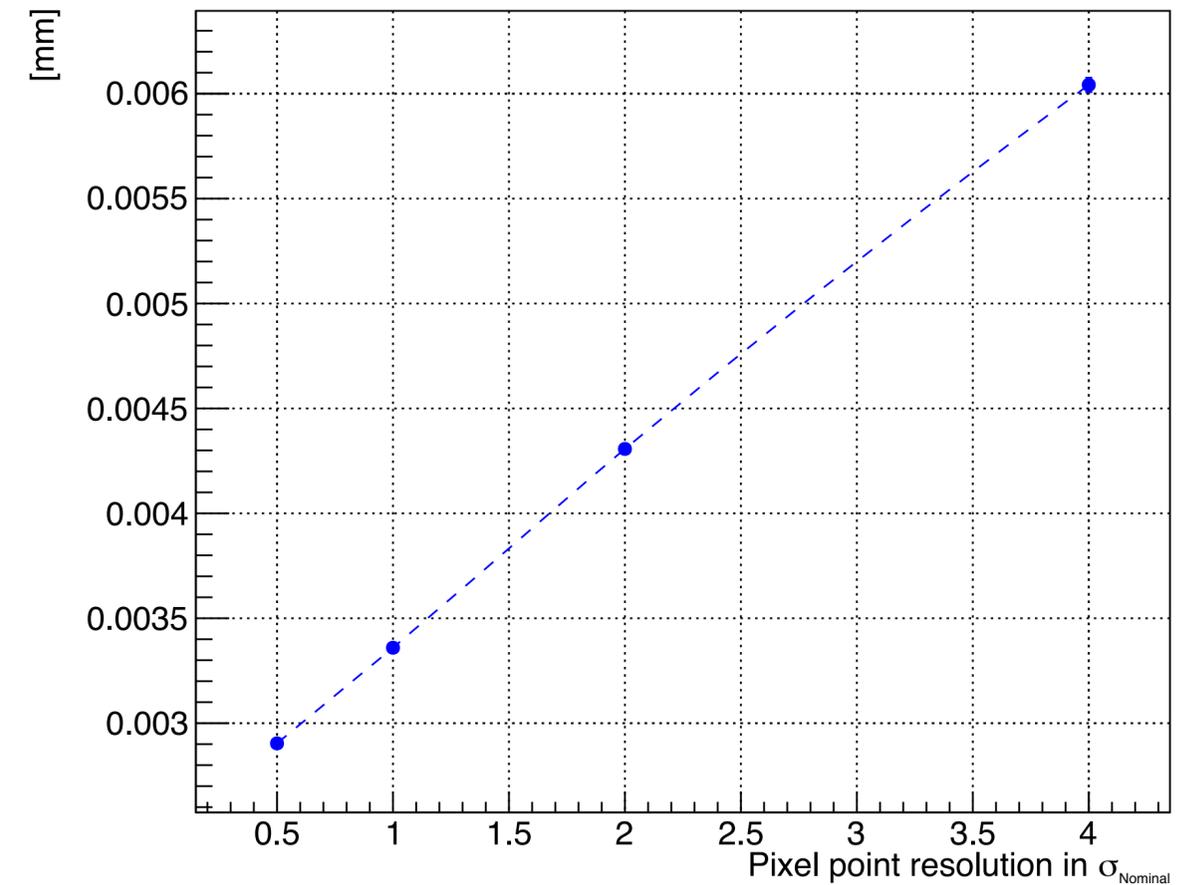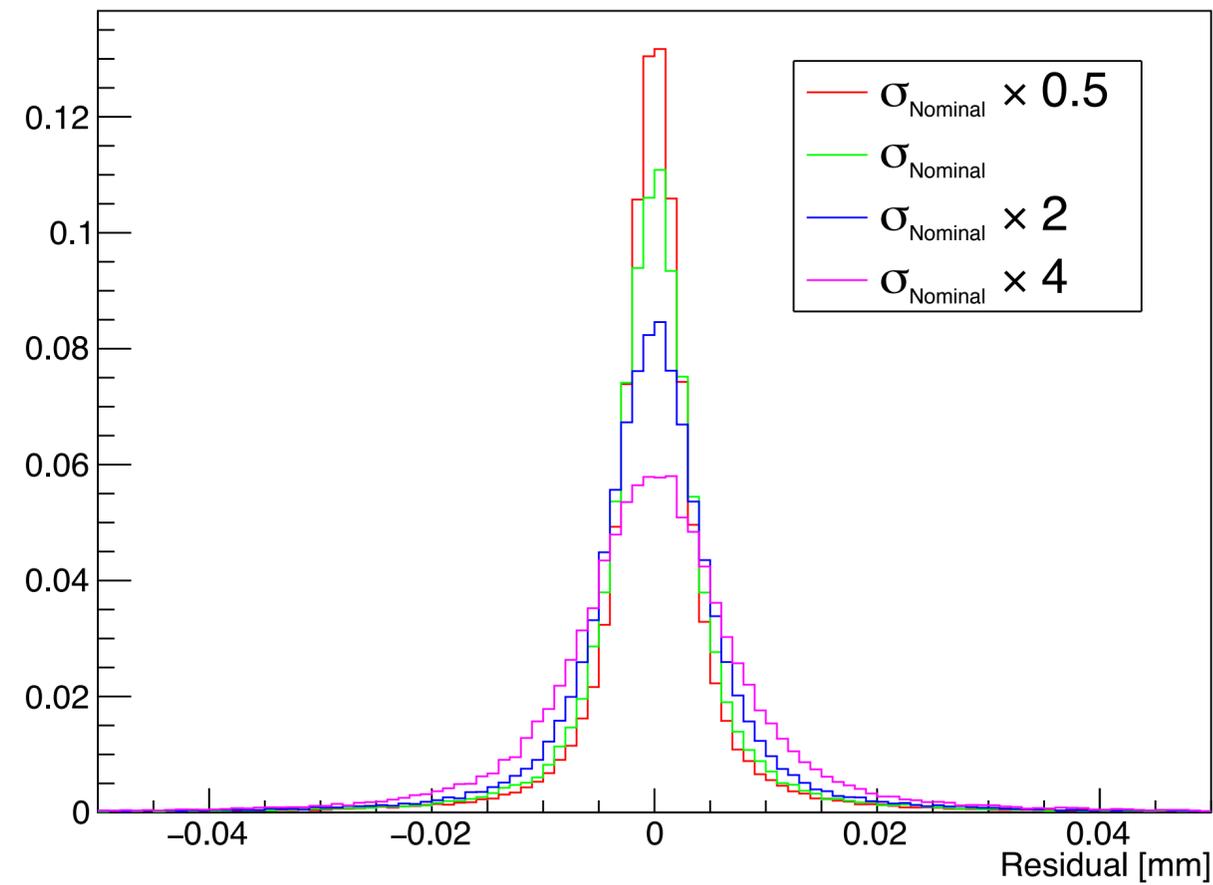Maybe useful to investigate how vertex detector performance affects to flavour tag performance

Work flow

① **Create PFO collection for several detector parameters with SGV**
- As a first trial, I created 4 setups by changing **SIG_RPHI** and **SIG_Z** in **VXD** (Nominal, ×0.5, ×2, ×4) (Ladder geometry also seems to be easily configurable!)
- 300k events for bb, cc, qq (q=u,d,s) at 91.2 GeV (Pythia generator + detector simulation + PFO reconstruction)

② **Run vertex finding and flavour tagging with LCFIPlus**
- with "pseudo" IP smearing in LCFIPlus (smear the position of beam spot constraint) as we did in DBD (=earlier studies around 2012) era
- Training was performed every setup

Transverse resolution of Secondary Vertex

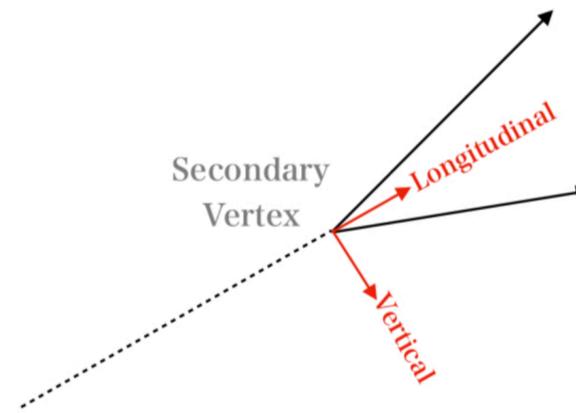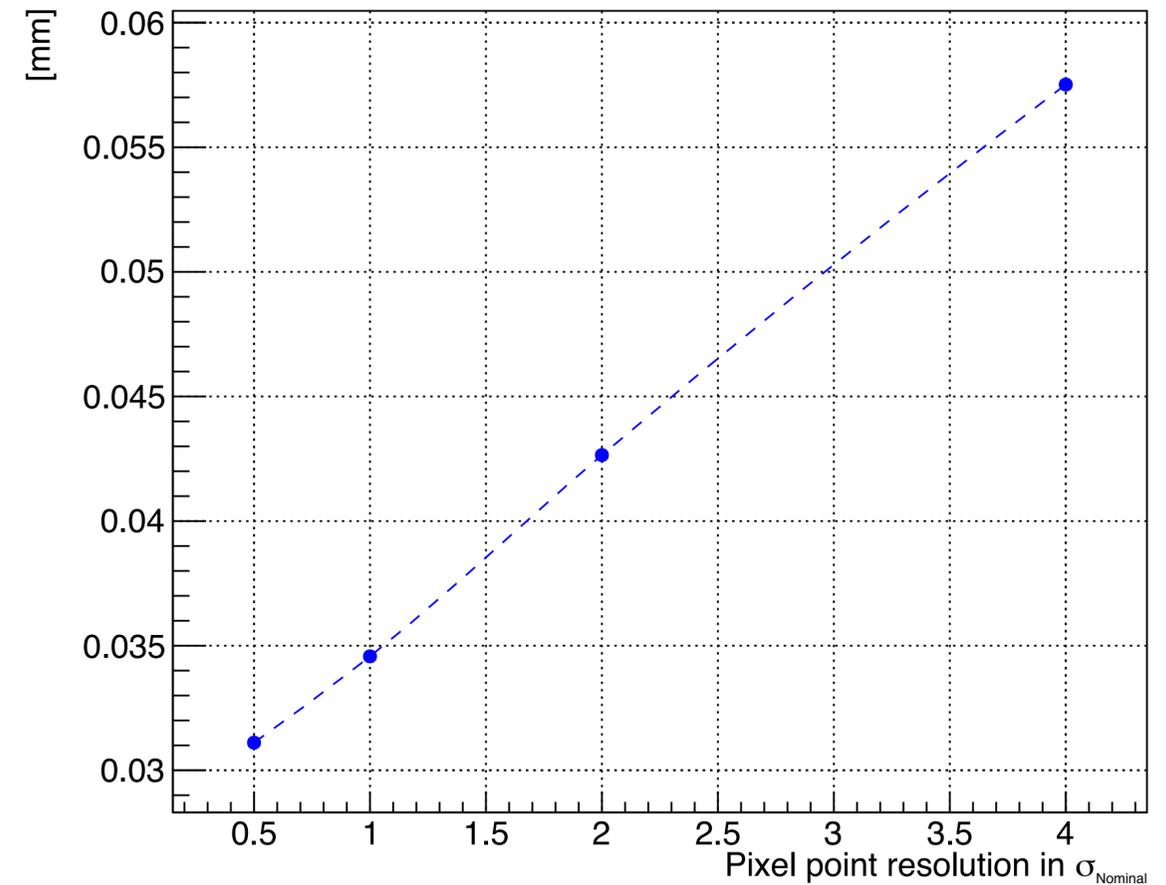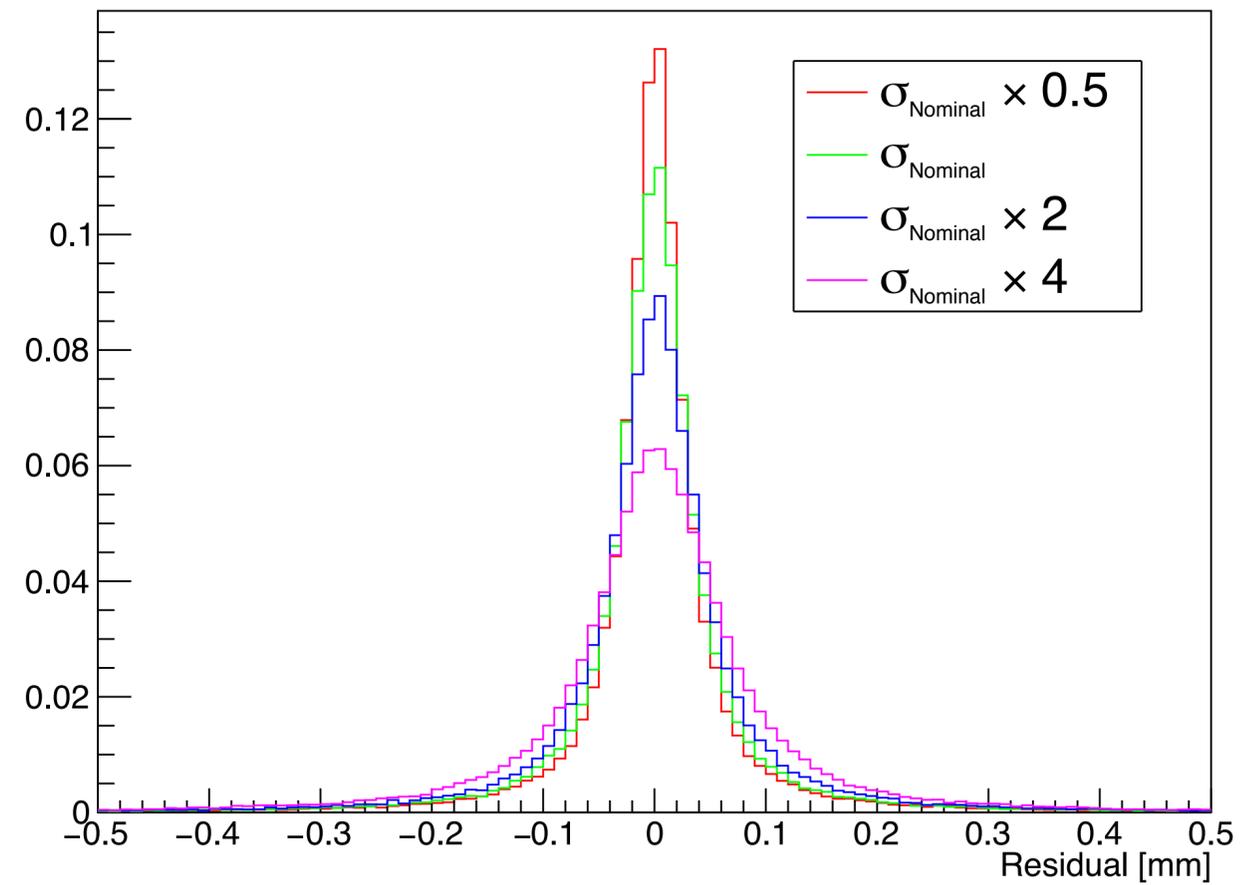Point resolution perpendicular to jet direction

Secondary Vertex

Longitudinal

Vertical

σ fitted in left histograms

Legend for left histogram:
- $\sigma_{Nominal} \times 0.5$
- $\sigma_{Nominal}$
- $\sigma_{Nominal} \times 2$
- $\sigma_{Nominal} \times 4$

Left plot axis: Residual [mm]

Right plot y-axis: [mm], x-axis: Pixel point resolution in $\sigma_{Nominal}$

Longitudinal resolution of Secondary Vertex

Point resolution along jet direction

Secondary Vertex

Longitudinal

Vertical

σ fitted in left histograms

Legend for left histogram:
- $\sigma_{Nominal} \times 0.5$
- $\sigma_{Nominal}$
- $\sigma_{Nominal} \times 2$
- $\sigma_{Nominal} \times 4$

Left plot axis: Residual [mm]

Right plot axes: [mm] vs Pixel point resolution in $\sigma_{Nominal}$

b-tag performance
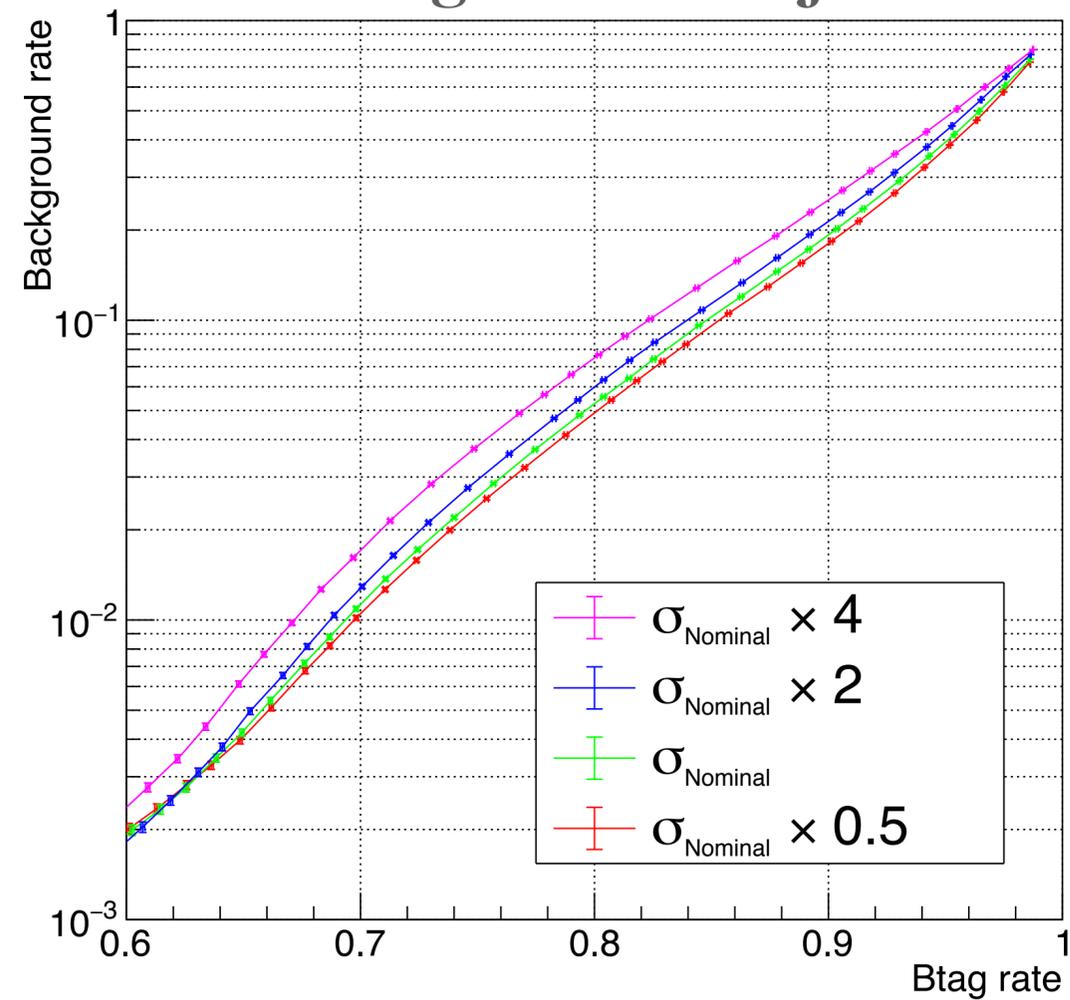
background : c-jets

background : q-jets

c-tag performance

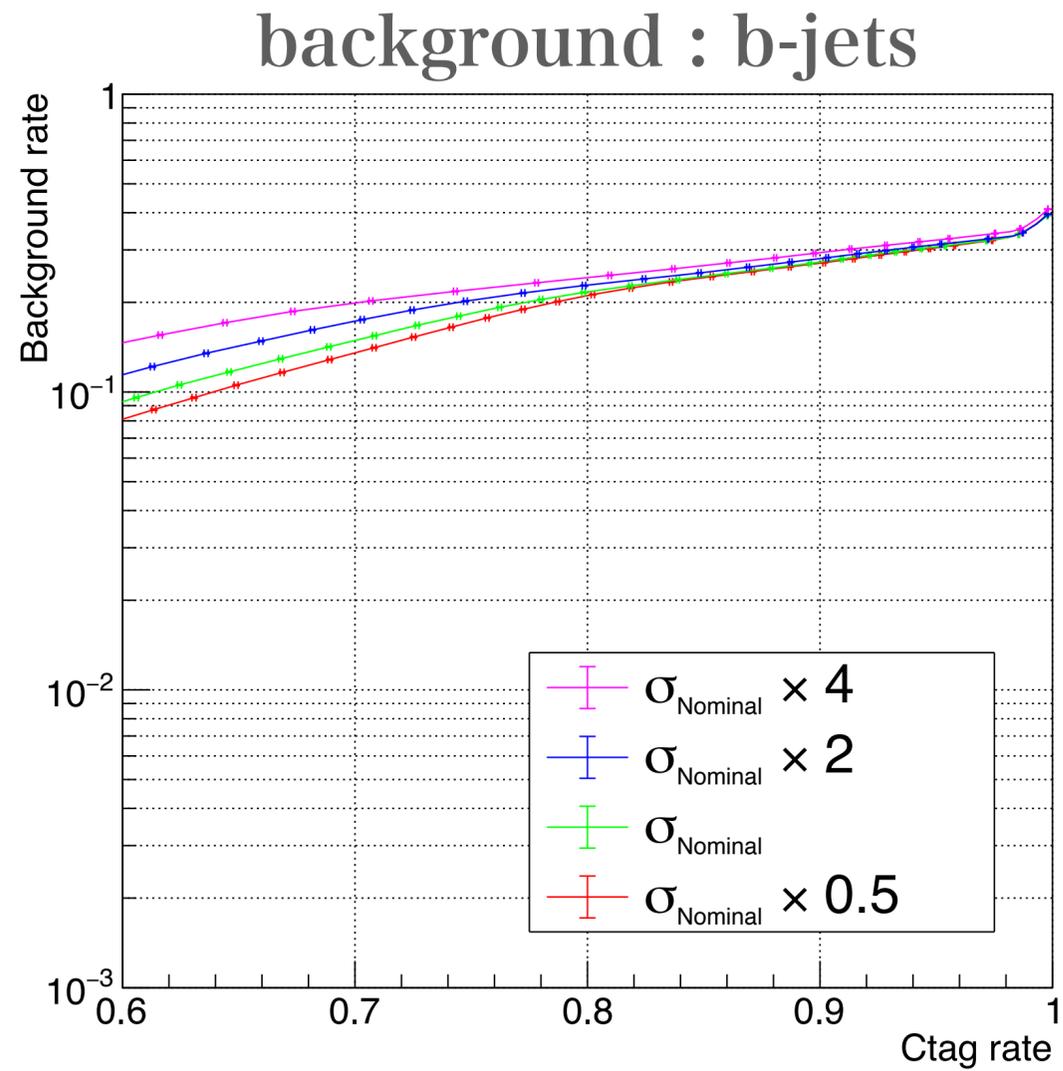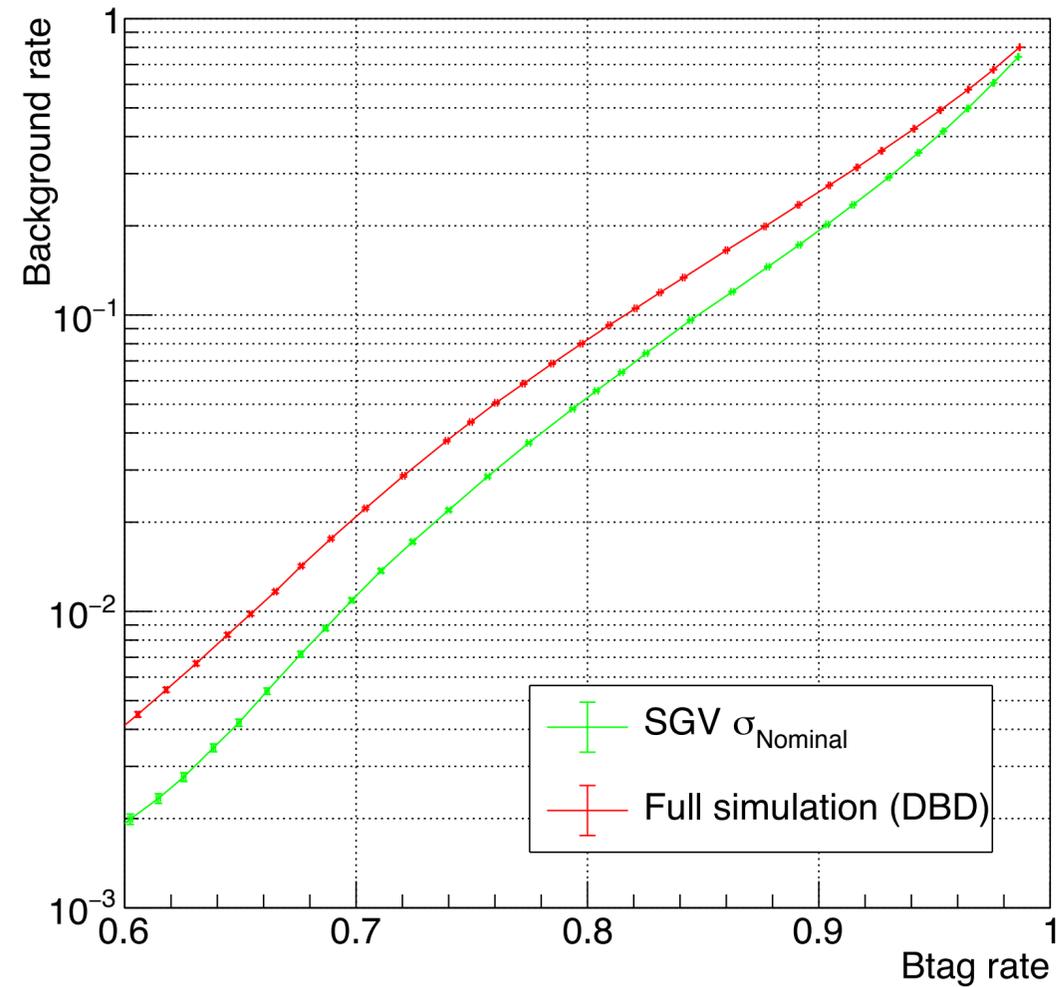**background : b-jets**

background : q-jets
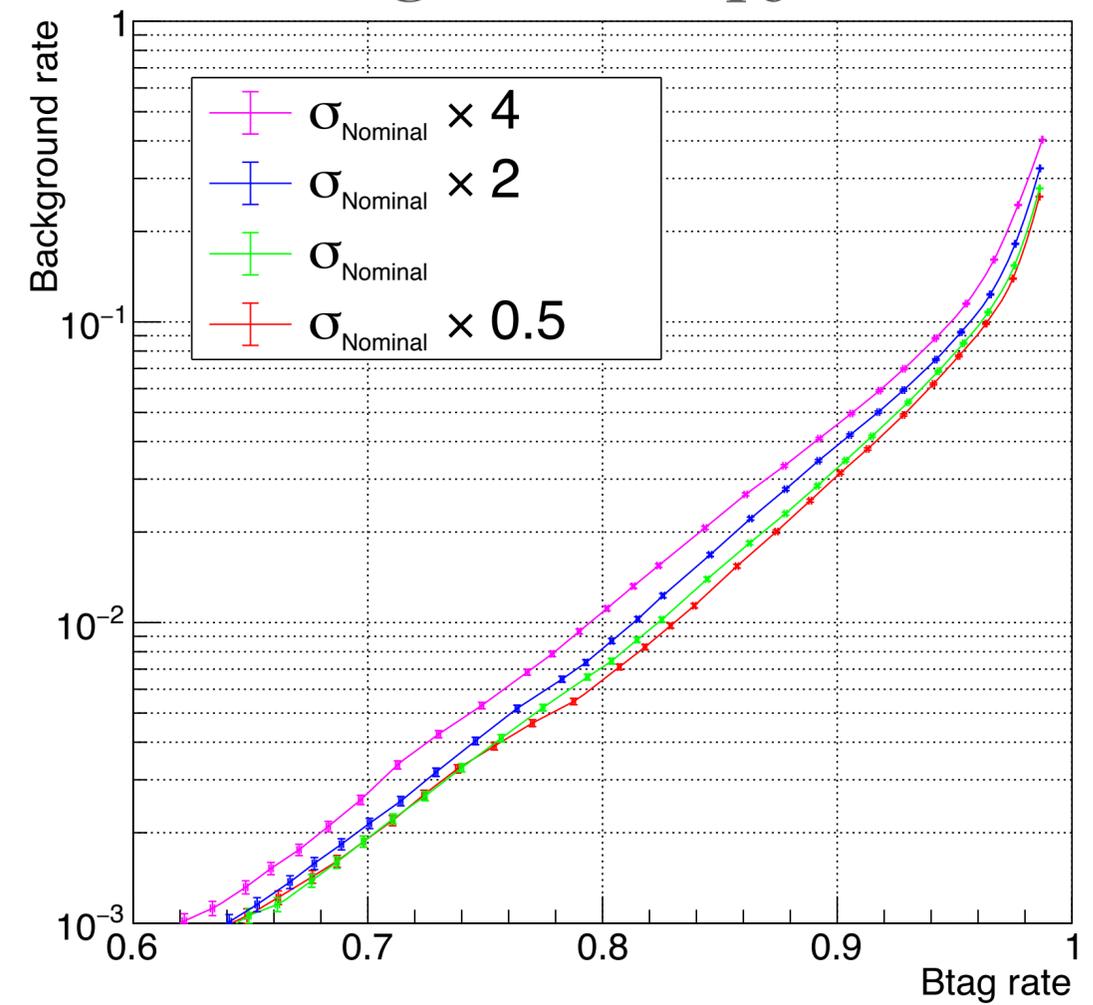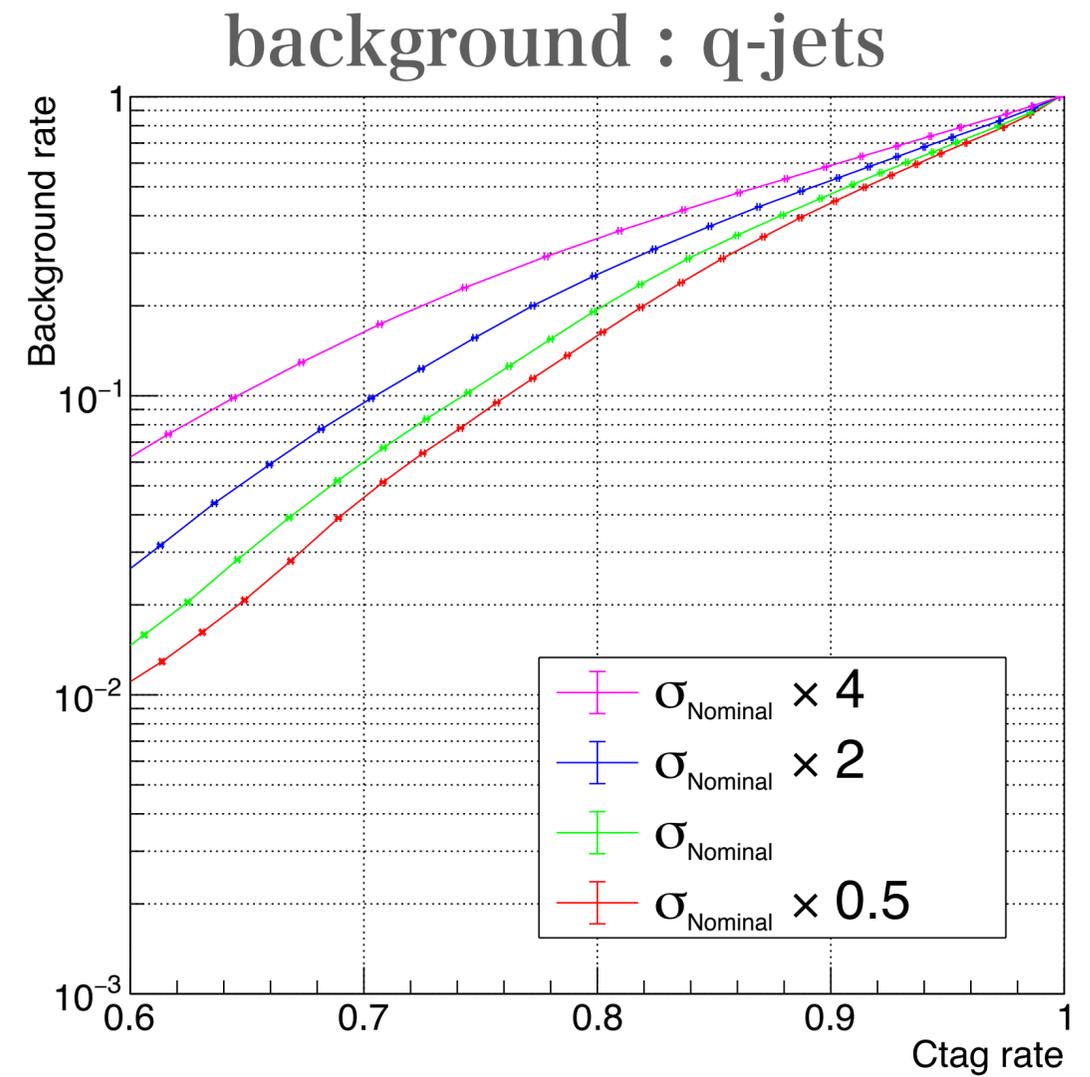
Conclusion 1

- SVG seems to be very useful to optimize vertex detectors
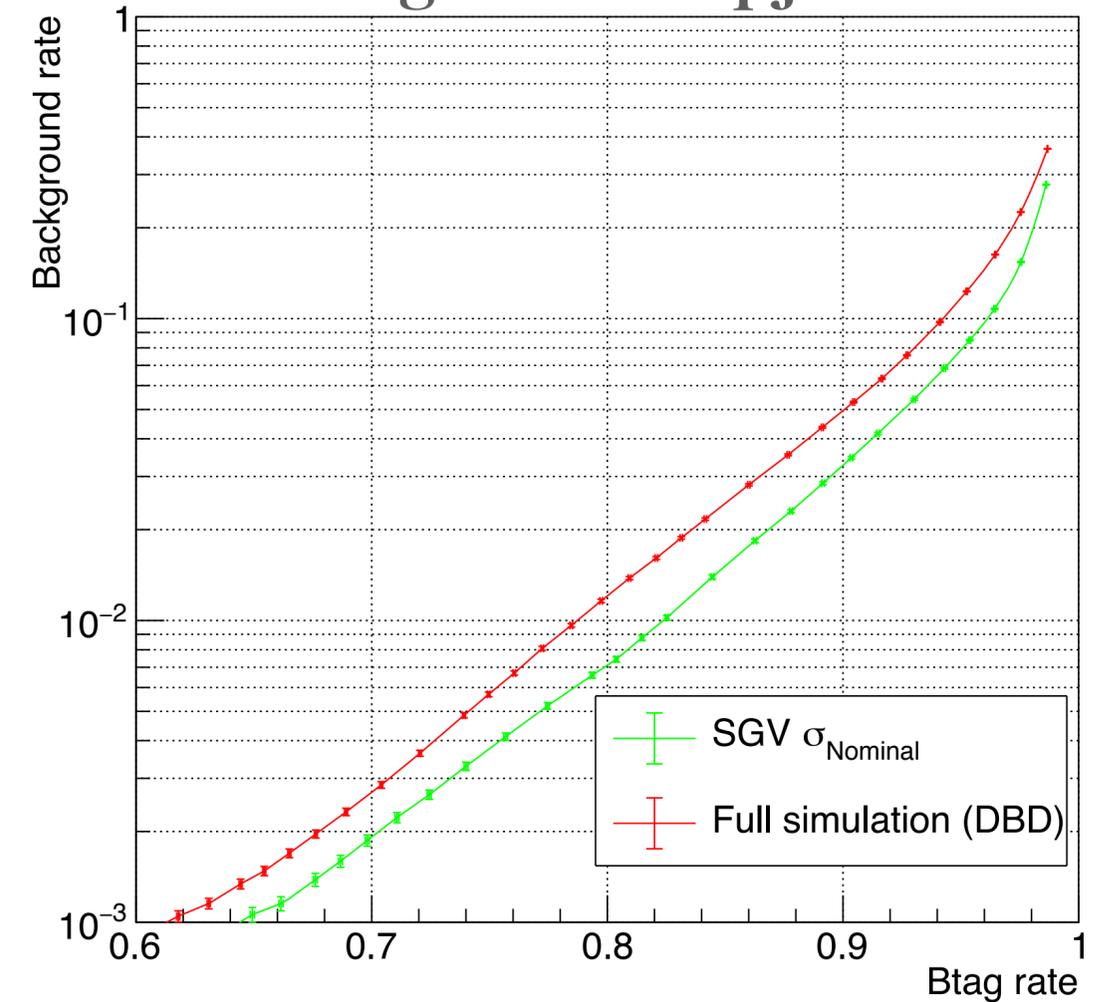- Basic work flow has been confirmed

Natural question: Are these result consistent with full simulation data?
Fortunately we have full simulation data and can compare results.

Comparison with full sim. : b-tag performance
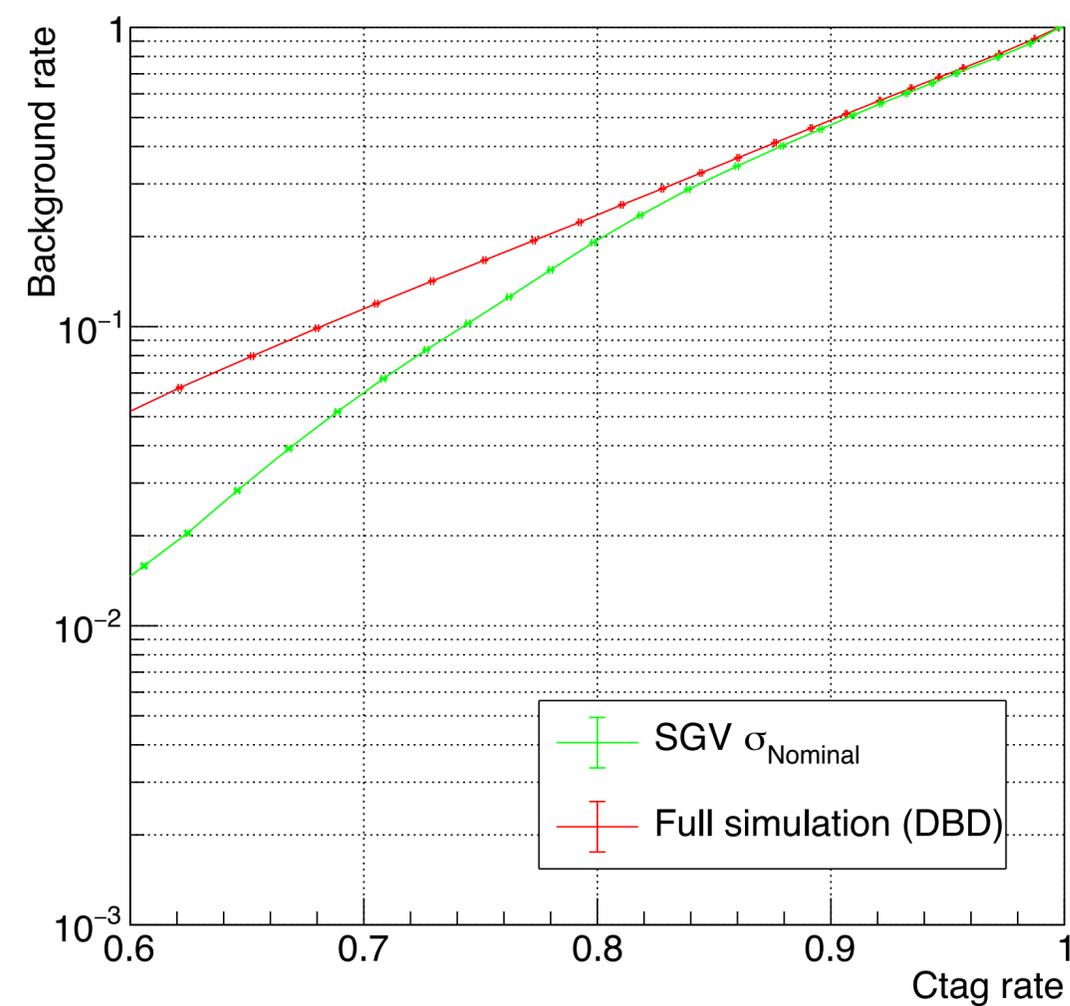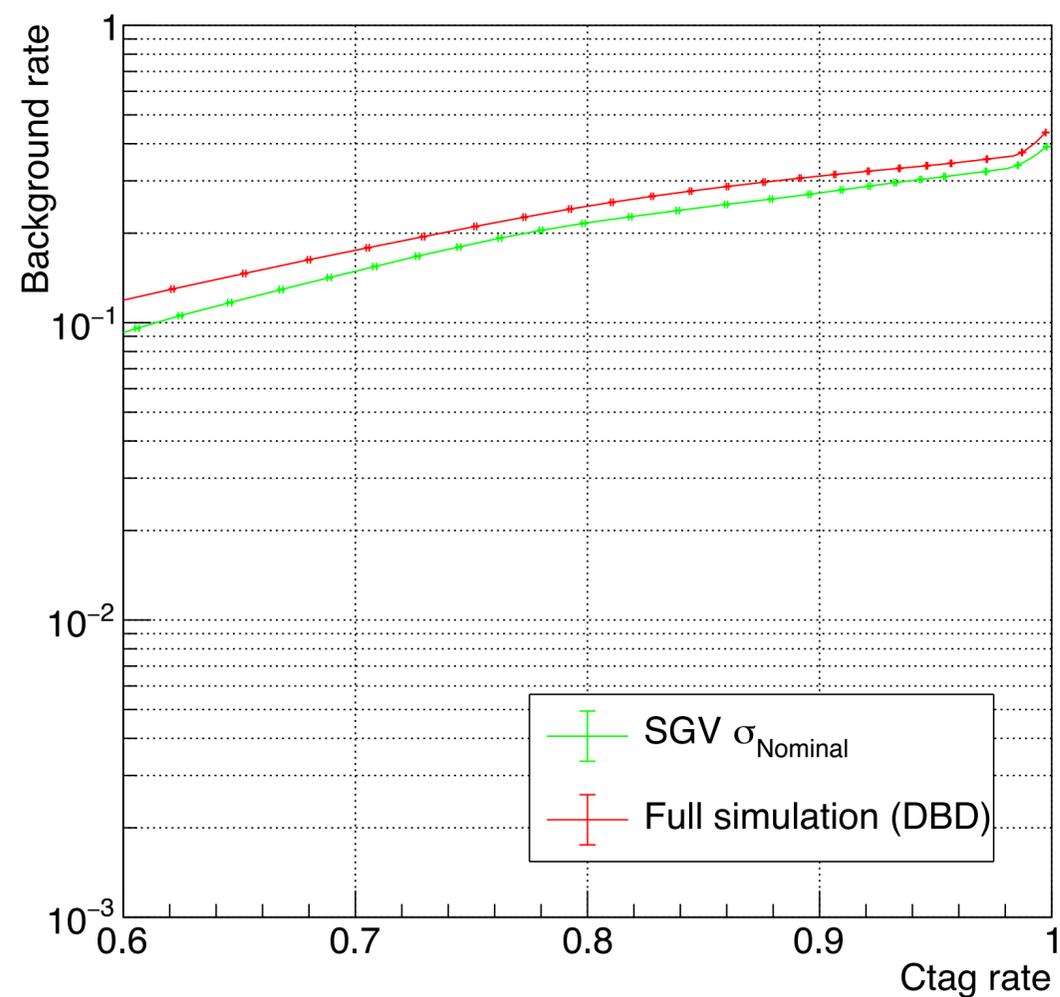
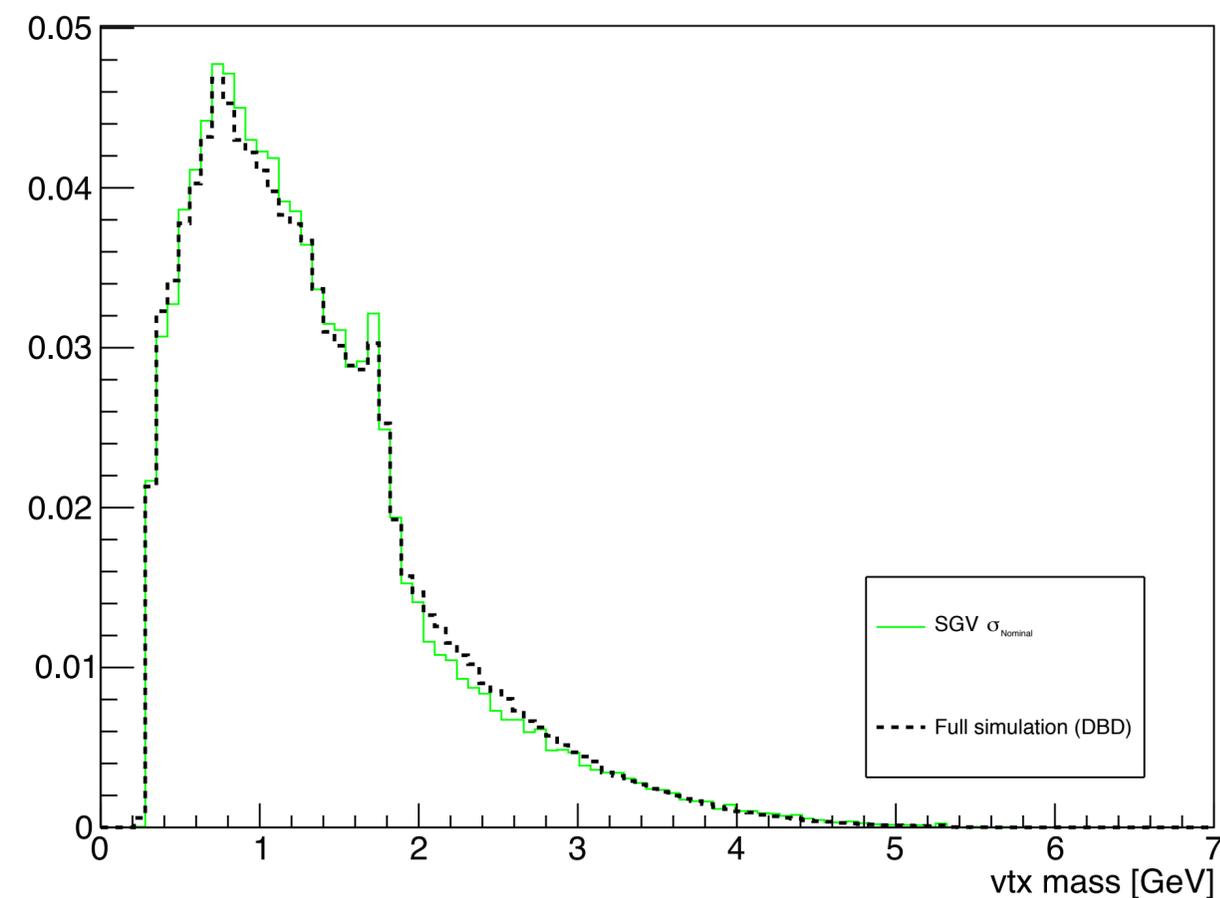**background : c-jets**

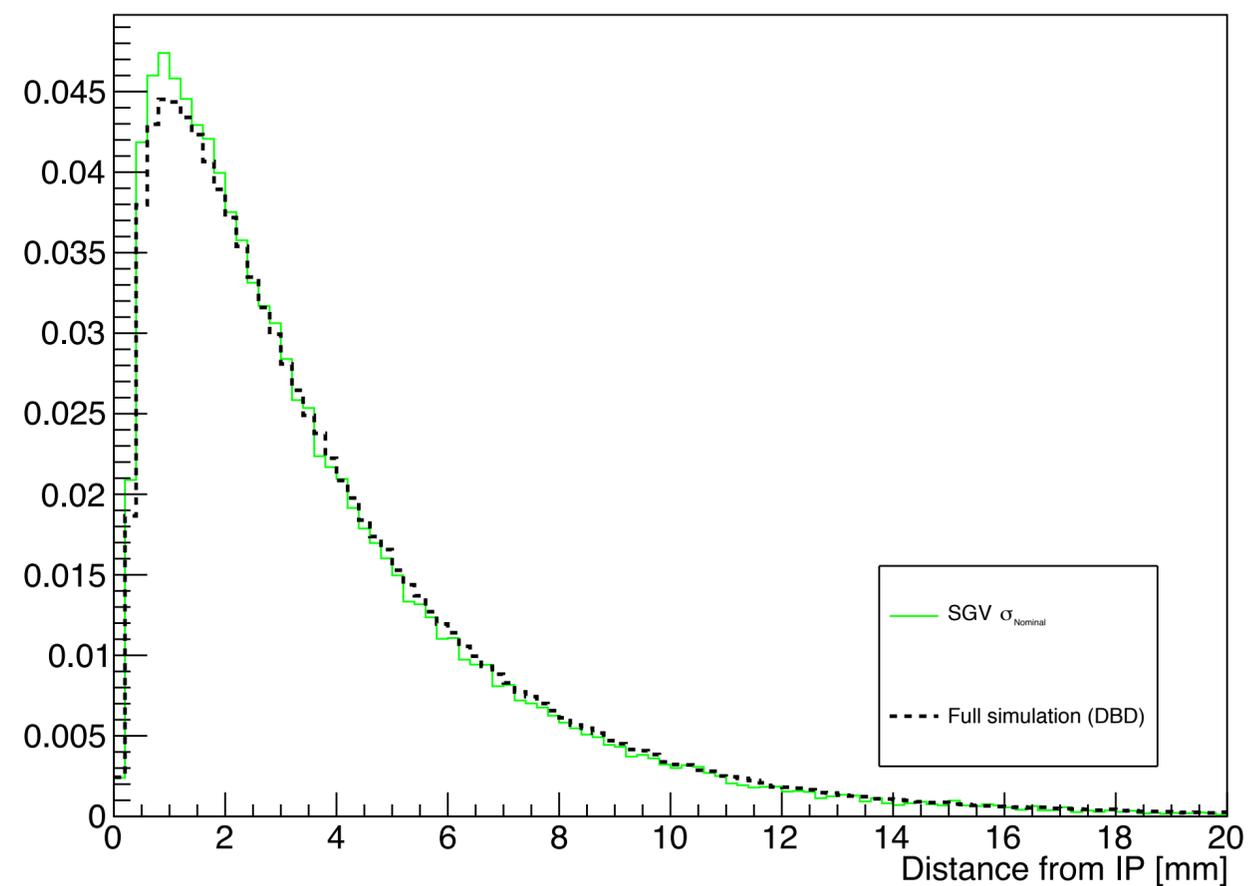**background : q-jets**

~ 60% difference

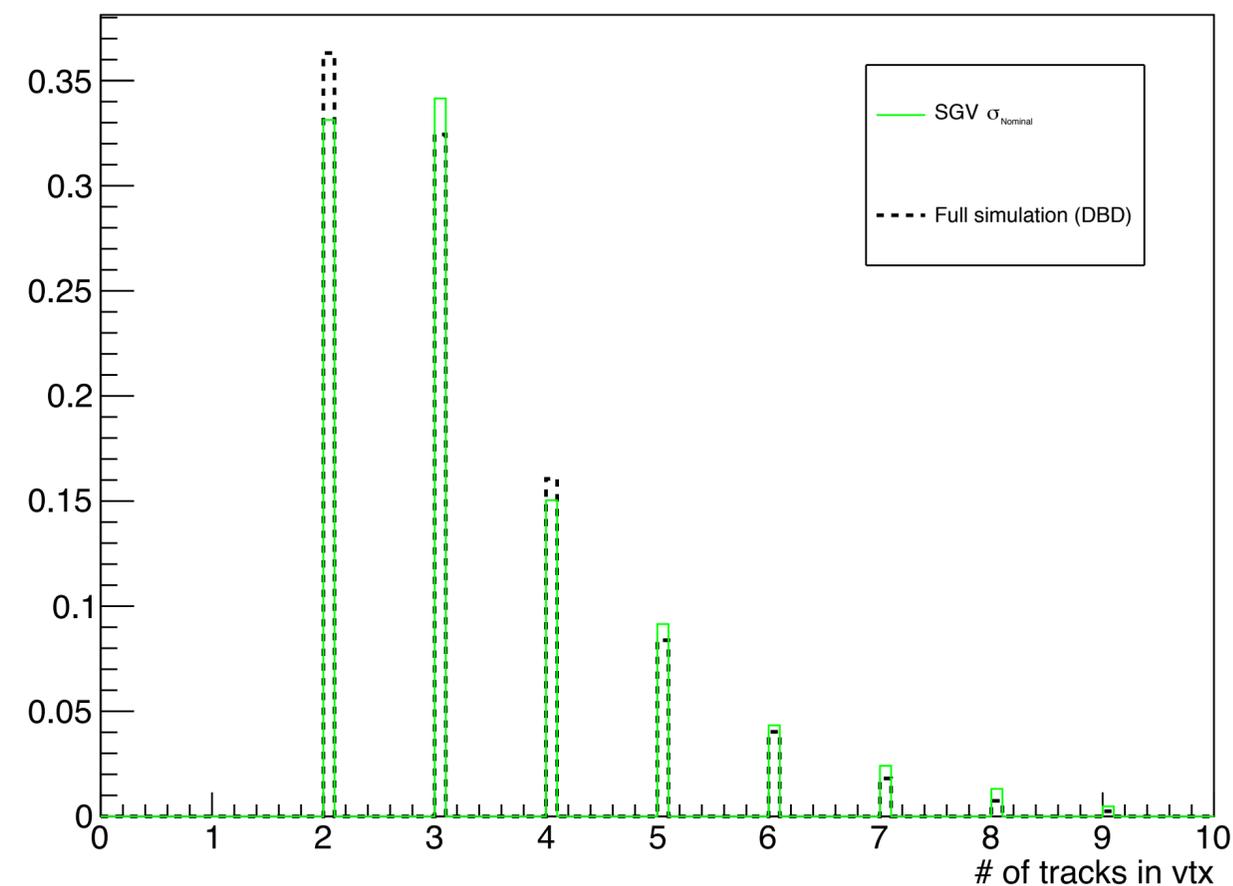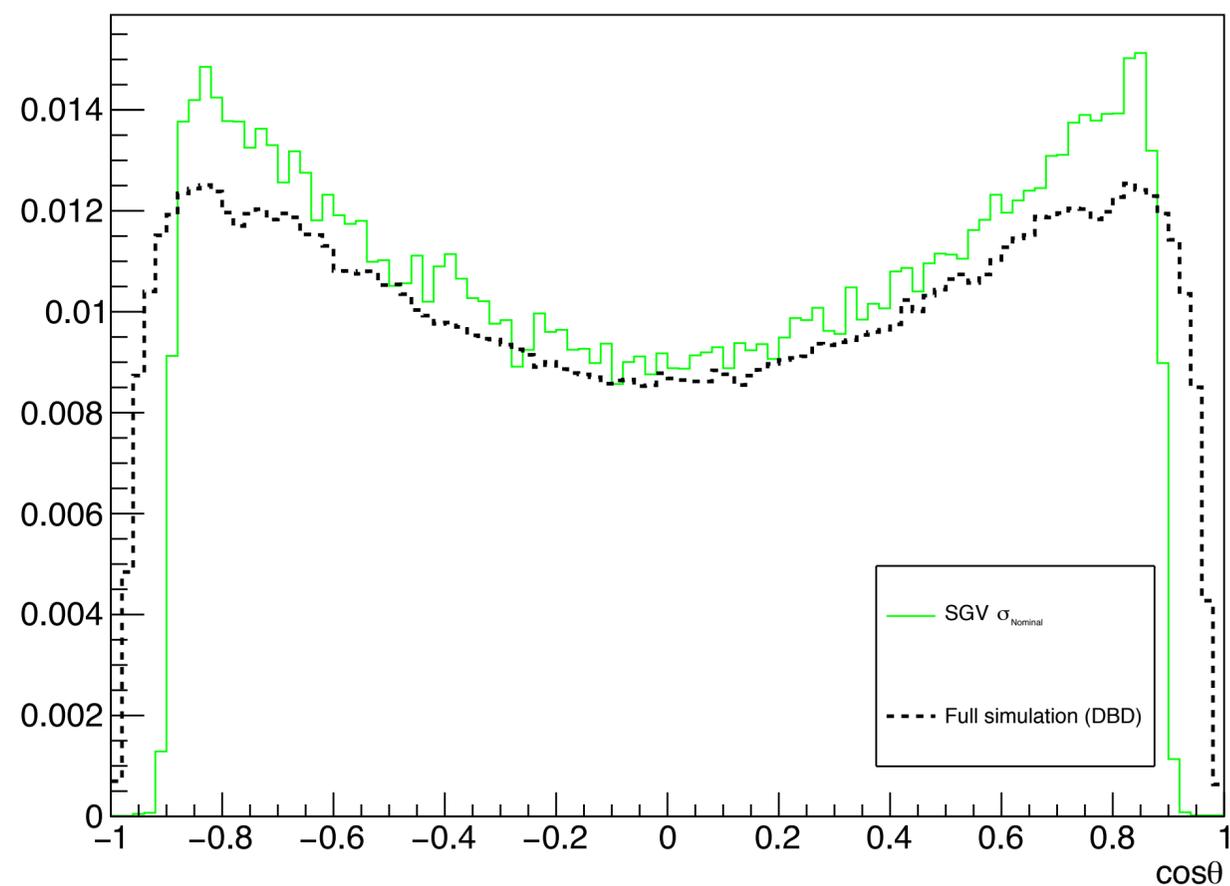# Comparison with full sim. : c-tag performance

Look better than b-tag

Comparison with full sim. : Secondary vertex

Look consistent

Comparison with full sim. : Secondary vertex

Some differences in detector acceptance?

Conclusion 2

- Found a discrepancy between SGV and full simulation
- Clear difference in (jet) polar angle distribution (This may be a clue)
- I will discuss these results with M. Berggren

Summary

- Investigated a possibility to optimize vertex detector with SGV
- Basic work flow seems to be OK
- Validity checks are still needed