Comparison of BeamCal performance at Different ILC Designs

(Current Study Status)

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Introduction

Physics motivation:

- in some models, amount of DM in the Universe depends on difference between $\tilde{\chi}$ and $\tilde{\tau}_1$ masses

-> one needs to **measure $\tilde{\tau}$ mass** precisely

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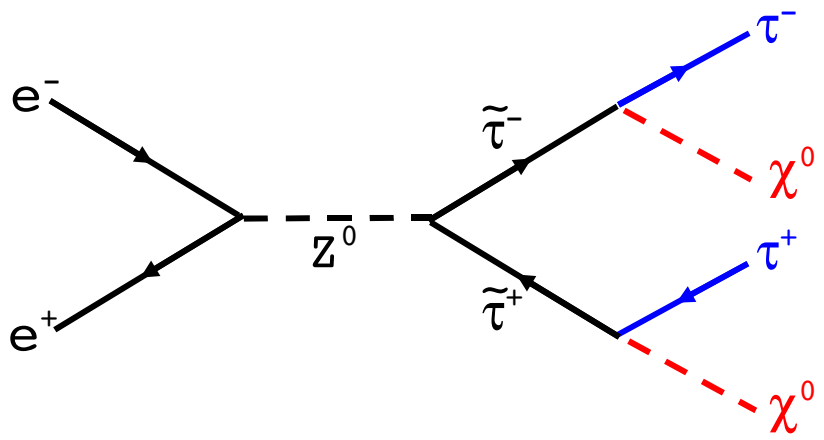
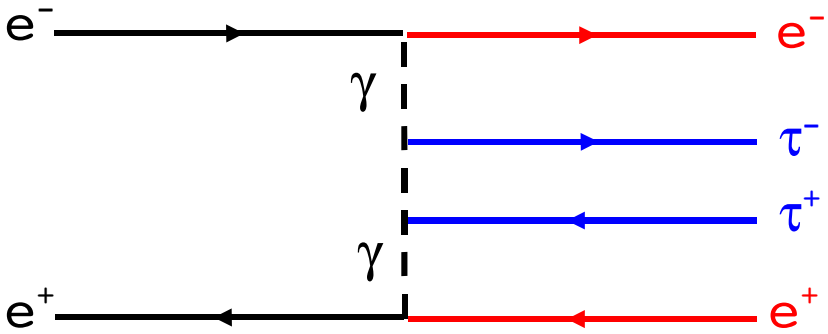
Physics background:

- $\gamma\gamma$ events with 4-fermion final states
- eliminating strategy:
  - **cut on $\tau\tau$ acoplanarity** if $p_t(e)$ is low
  - **electron veto** when $p_t(e)$ is high

New Particle Searches



The Physics:
stau pair production
Signature:
$\tau^+ \tau^-$ + missing energy



The Background:
two-photon events
Signature:
$\tau^+ \tau^-$ + missing energy
(if electrons are not tagged)

i.e. mimic SUSY event

strategy:

- e^+e^- in BP: cut on $\tau\tau$ acoplanarity
- e hits BeamCal: electron veto is vital

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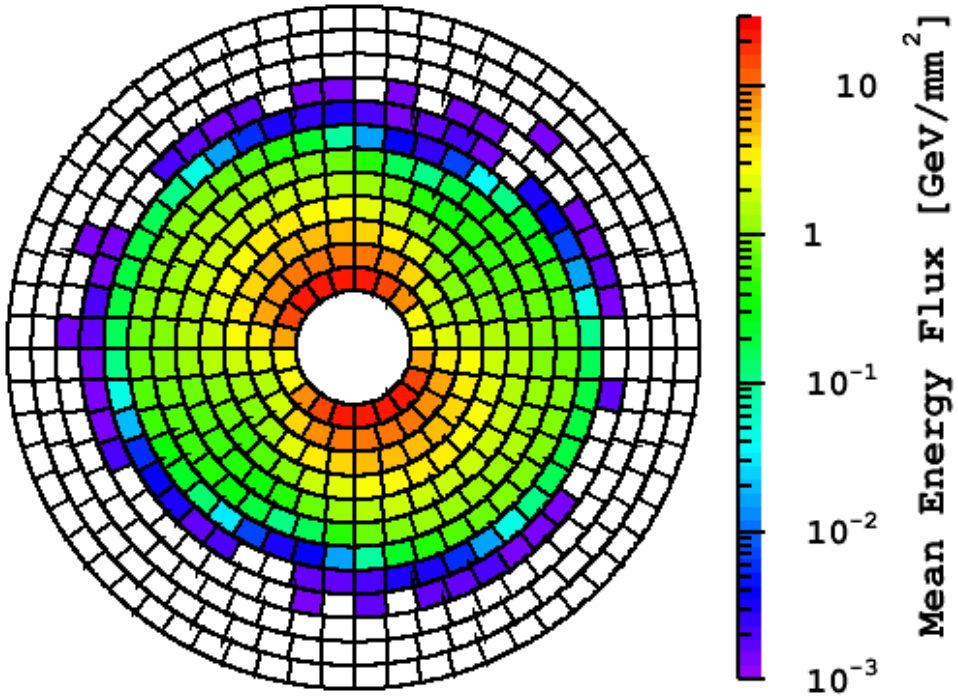
Electron veto:

- **problematic near BP**, due to superposition with the beamstrahlung remnants

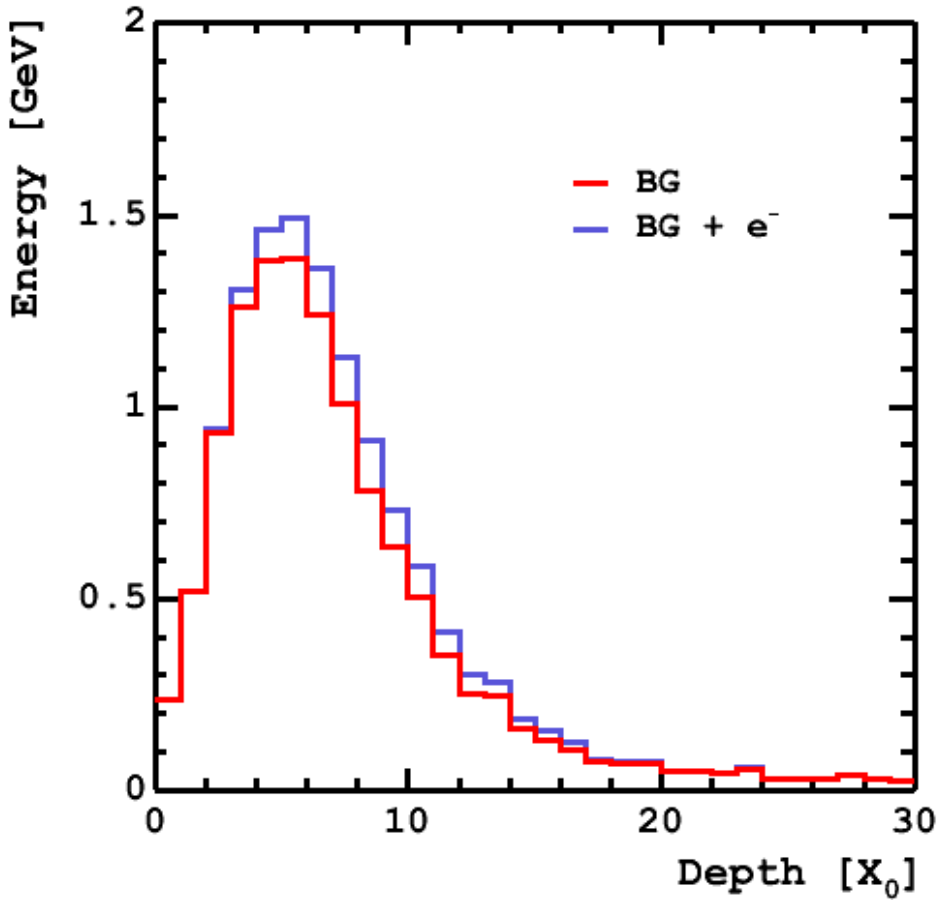
Beamstrahlung remnants. Pairs

BeamCal will be hit by beamstrahlung remnants carrying about 20 TeV of energy per bunch crossing.

the distribution of this energy per bunch crossing at $\sqrt{s}$ = 500GeV



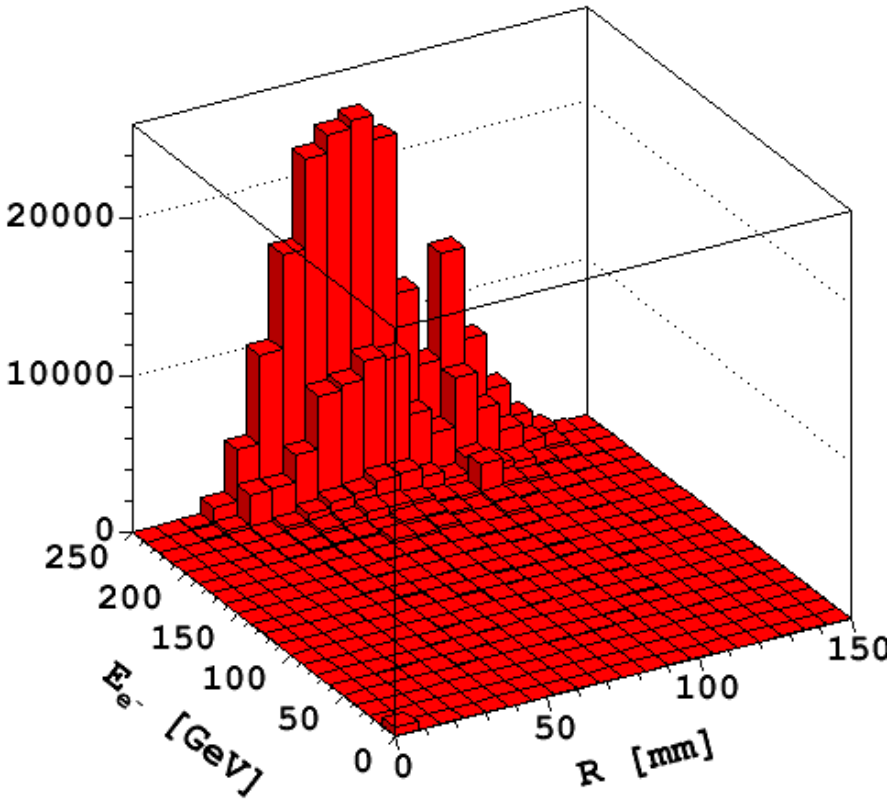
100GeV electron on top of beamstrahlung



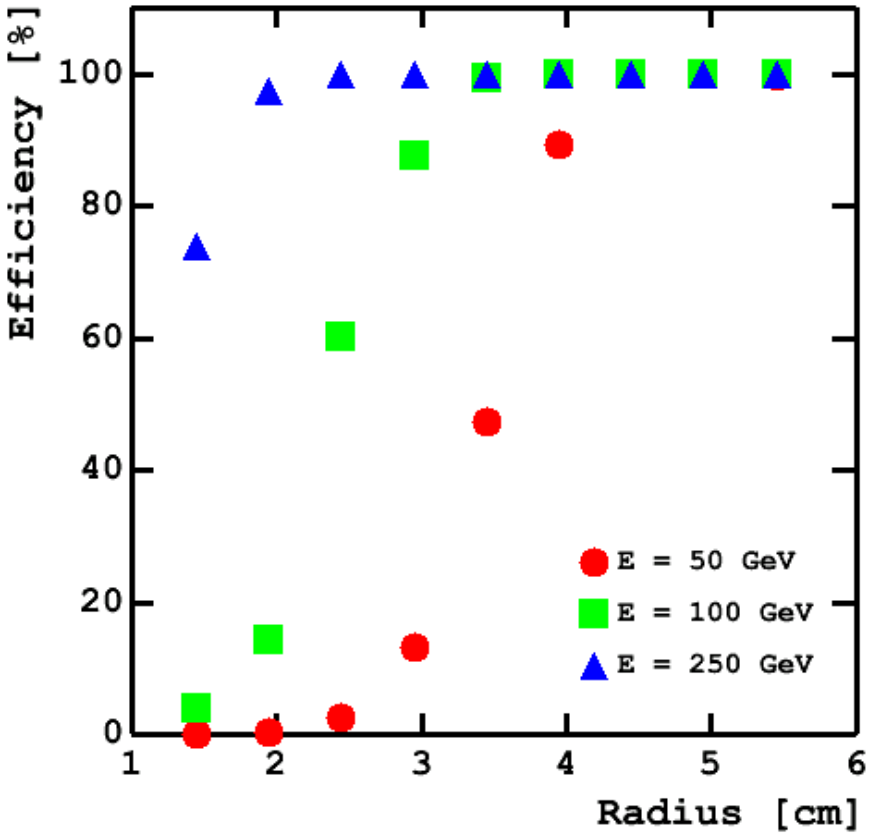
Severe background for electron recognition

Veto requirements and performance

the electrons from γγ events passed all cut except veto



BeamCal veto performance



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Electron veto:

- problematic near BP, due to superposition with the beamstrahlung remnants

Study:

- S/N is benchmark in **comparison of different designs**

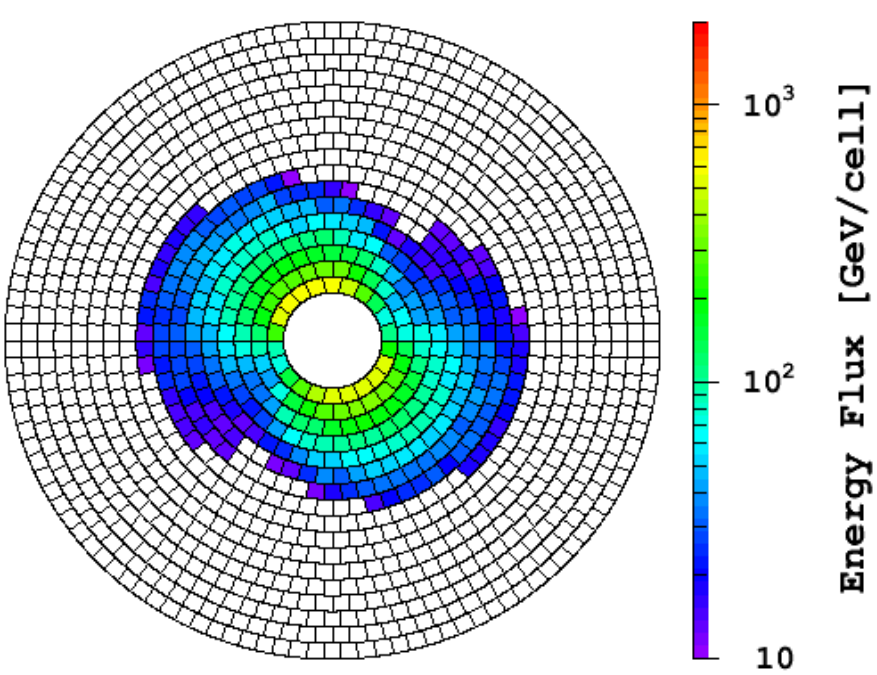
Strategy

Physics program:

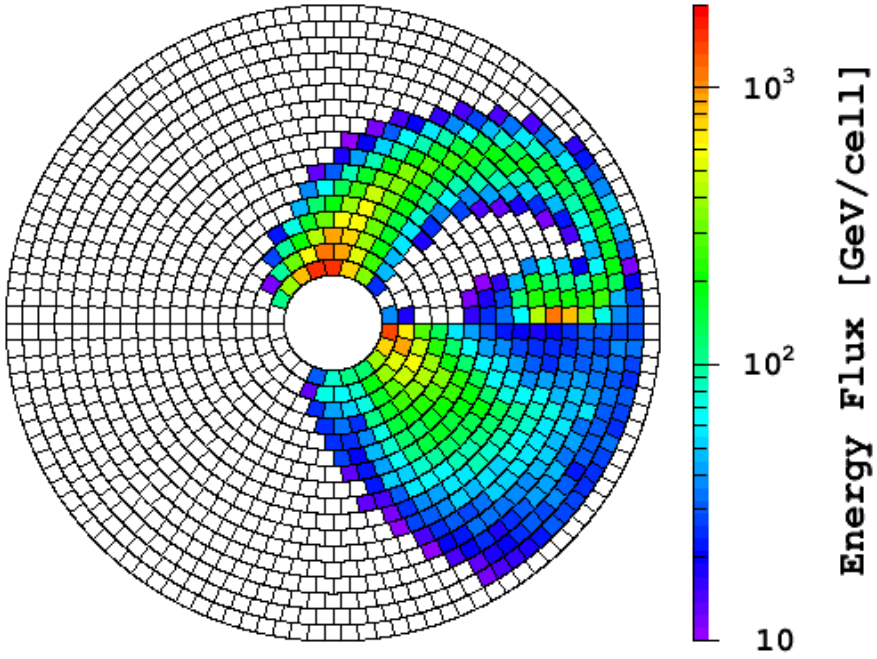
- **head-on** vs. 20 mrad **X-angle**

X-angle

head-on



X-angle



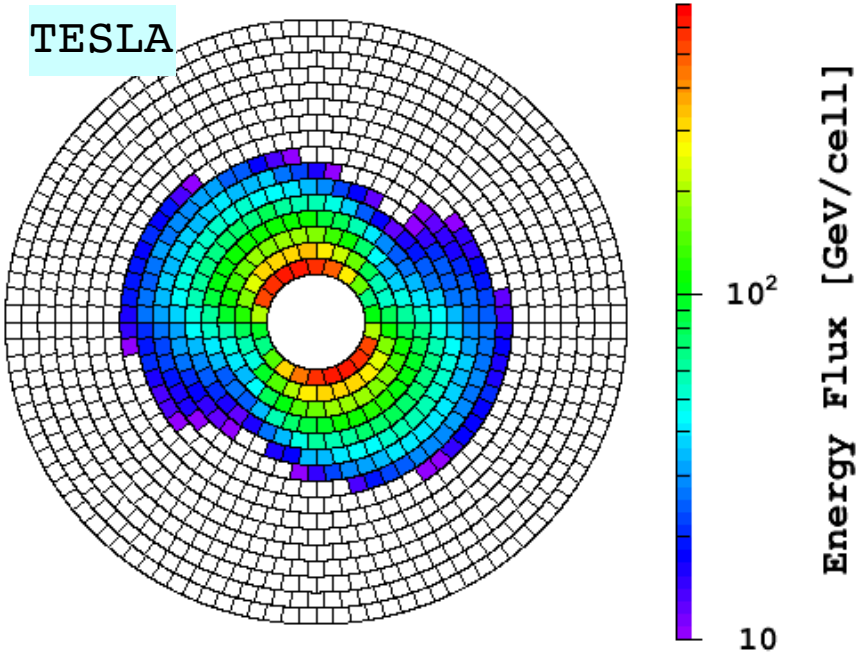
Strategy

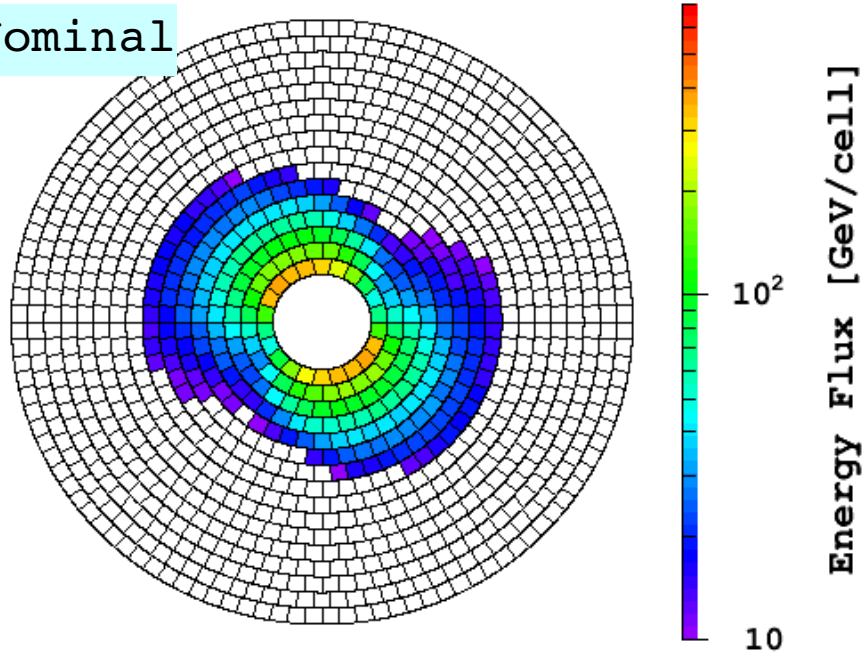
Physics program:

- head-on vs. 20 mrad X-angle
- compare different **beam parameter sets**

("Suggested ILC Beam Parameter Range" Rev. 2/28/05)

Beam Parameter Sets

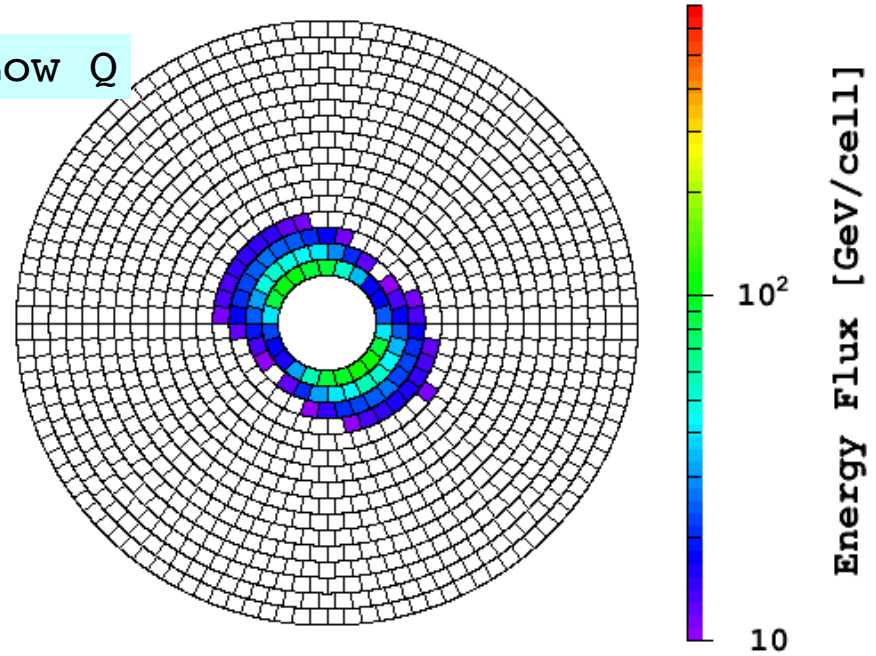




TESLA – TDR beam parameters
$L = 3*10^{34}\ cm^{-2}s^{-1}$

Nominal – new beam parameters
$L = 2*10^{34}\ cm^{-2}s^{-1}$

Low Q - ½ charge
$L = 2*10^{34}\ cm^{-2}s^{-1}$



Strategy

Physics program:

- head-on vs. 20 mrad X-angle
- compare different beam parameter sets

Strategy:

- calculate veto efficiency table for each design
  - full simulation chain to be done for each design
- include this MC into stau analysis

(to be done by LAL group)

Simulation Features

- "nominal" **beam parameter** set

- **tracking:** GEANT4 instead of GEANT3
  -> more **powerfull** tool
  -> more **flexible**
  -> much **faster**

- **geometry:**
  - head-on: $\mathbf{R_{min}}$=15mm; X-angle: $\mathbf{R_{min}}$=20mm
  - **blind area:** –15 degree < ϕ < 15 degree;
    this blind area is **excluded** from
    the efficiency calculation

- pairs from **500BX** are simulated for head-on and X-angle

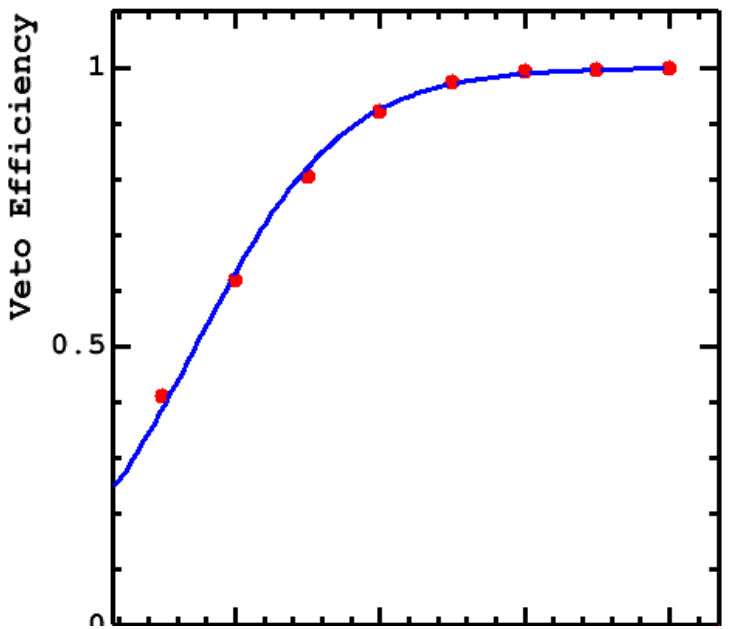
- **algorithm** tuned with common energy threshold and fake rate (5%) for head-on and 20 mrad (may not be fully optimal)

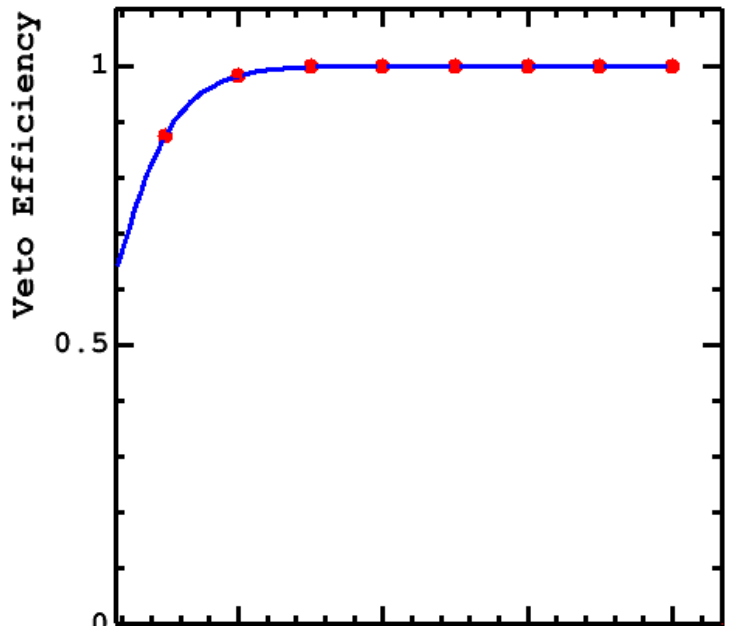
- **efficiency calculation:** per ring instead of per cell
  -> smaller **statistical error**

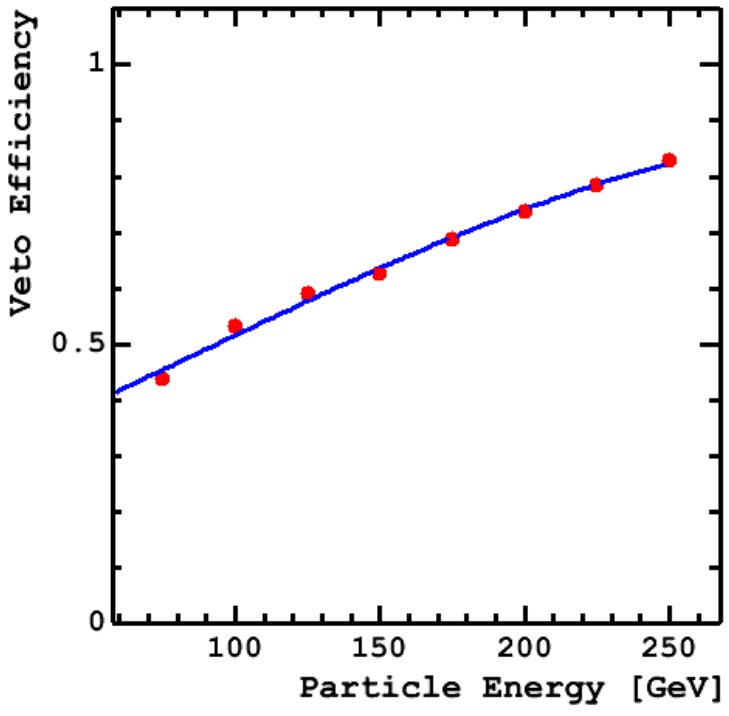
Results

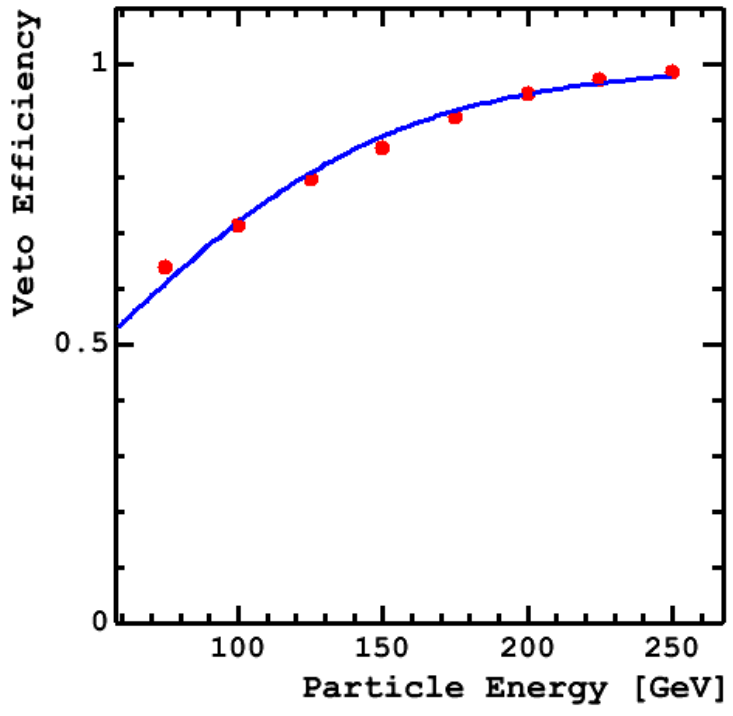
Head-On

X-angle









Summary and Outlook

- new veto efficiency functions are obtained for head-on and 20mrad crossing angle schemes

  -> the results must be included into stau analysis

    -> comparison of BeamCal performance

- comparison of the different beam parameter sets in similar manner is on the way