Short Report on the Progress of the Dilepton Generator based on GRACE System

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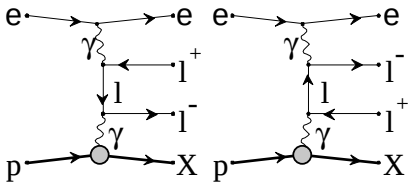
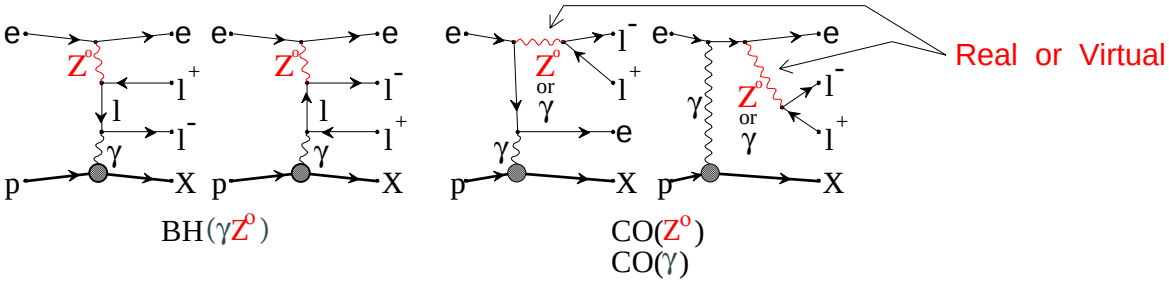
Introduction

Calculated process : $ep \to eXl^+l^-$ in tree level EW

Dominant diagrams
(Bethe-Heitler)



Z^O contribution is also included.



What's done

- Parton level calculation
- Comparison with LPAIR in Bethe-Heitler process
  $\longrightarrow$ Good agreement

Progress this time

- Initial State Radiation for incoming positron
  in the cross section calculation (integration)
  using Structure Function method
  (Suppl. Prog. Theor. Phys. **100** 1990, p285–)
- Interfaced to PYTHIA

ISR using Structure Function Method

Incoming positron collides with proton/quark
after ISR-γ radiation (with zero P_t)
$\longrightarrow$ Cross section and distribution will change.

Example : $ep \to ep\,\mu^+\mu^-$ in Bethe-Heitler process

Detector cuts

- Cut(1) — $15^\circ < \theta_\mu < 164^\circ$, $E_\mu > 2\,\mathrm{GeV}$ (for both muons)
- Cut(2) — $15^\circ < \theta_\mu < 164^\circ$, $E_\mu > 2\,\mathrm{GeV}$ (for both muons) & $15^\circ < \theta_e < 164^\circ$, $E_e > 4\,\mathrm{GeV}$ (for scattered positron)

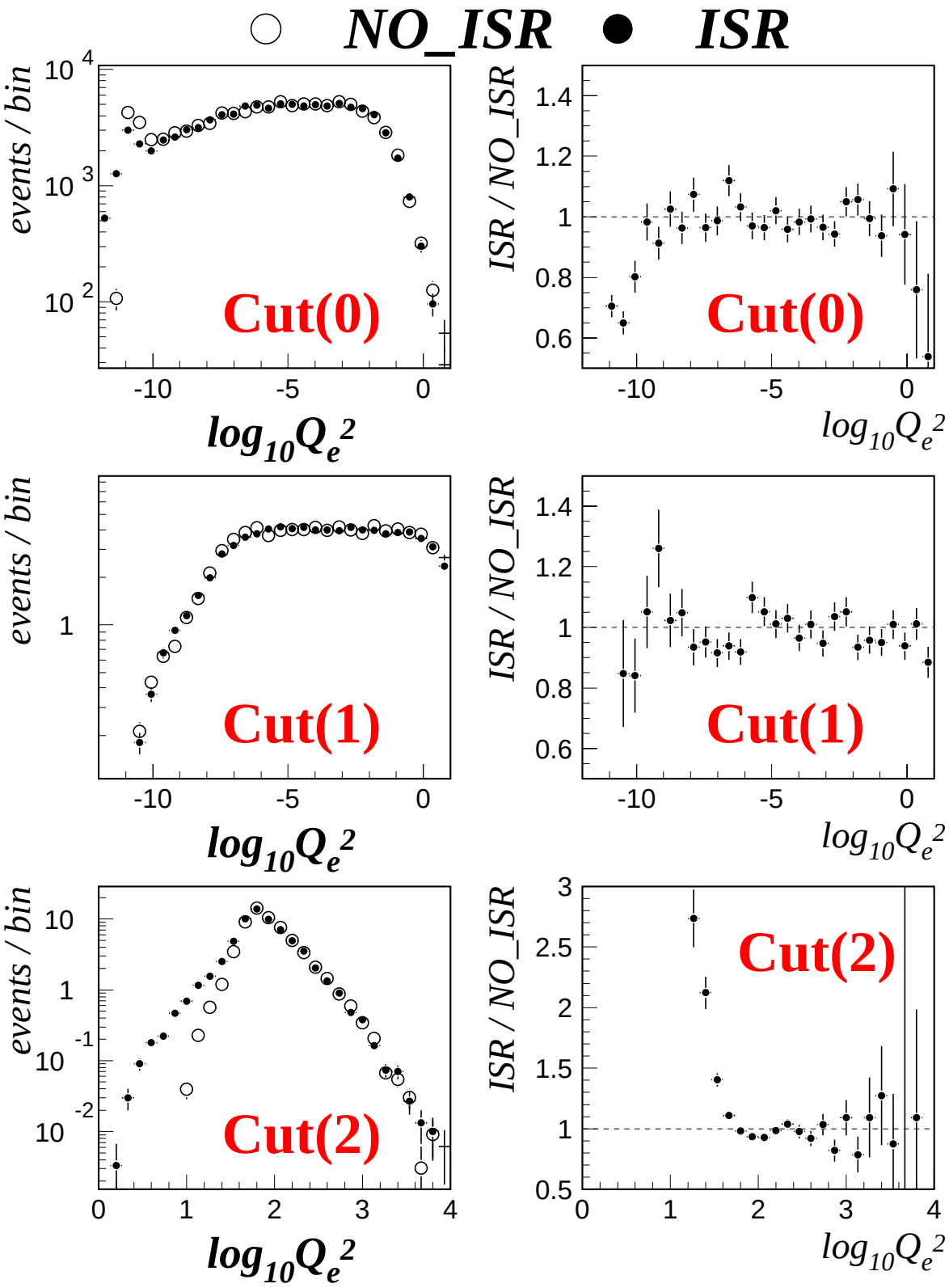
Elastic Di-muon

	NO ISR	ISR
No cut	$9.742(\pm 0.003) \times 10^4$	$9.617(\pm 0.003) \times 10^4$
Cut(1)	$8.493(\pm 0.005) \times 10$	$8.373(\pm 0.009) \times 10$
Cut(2)	$6.094(\pm 0.008) \times 10^{-1}$	$6.661(\pm 0.007) \times 10^{-1}$

(in unit of pb)

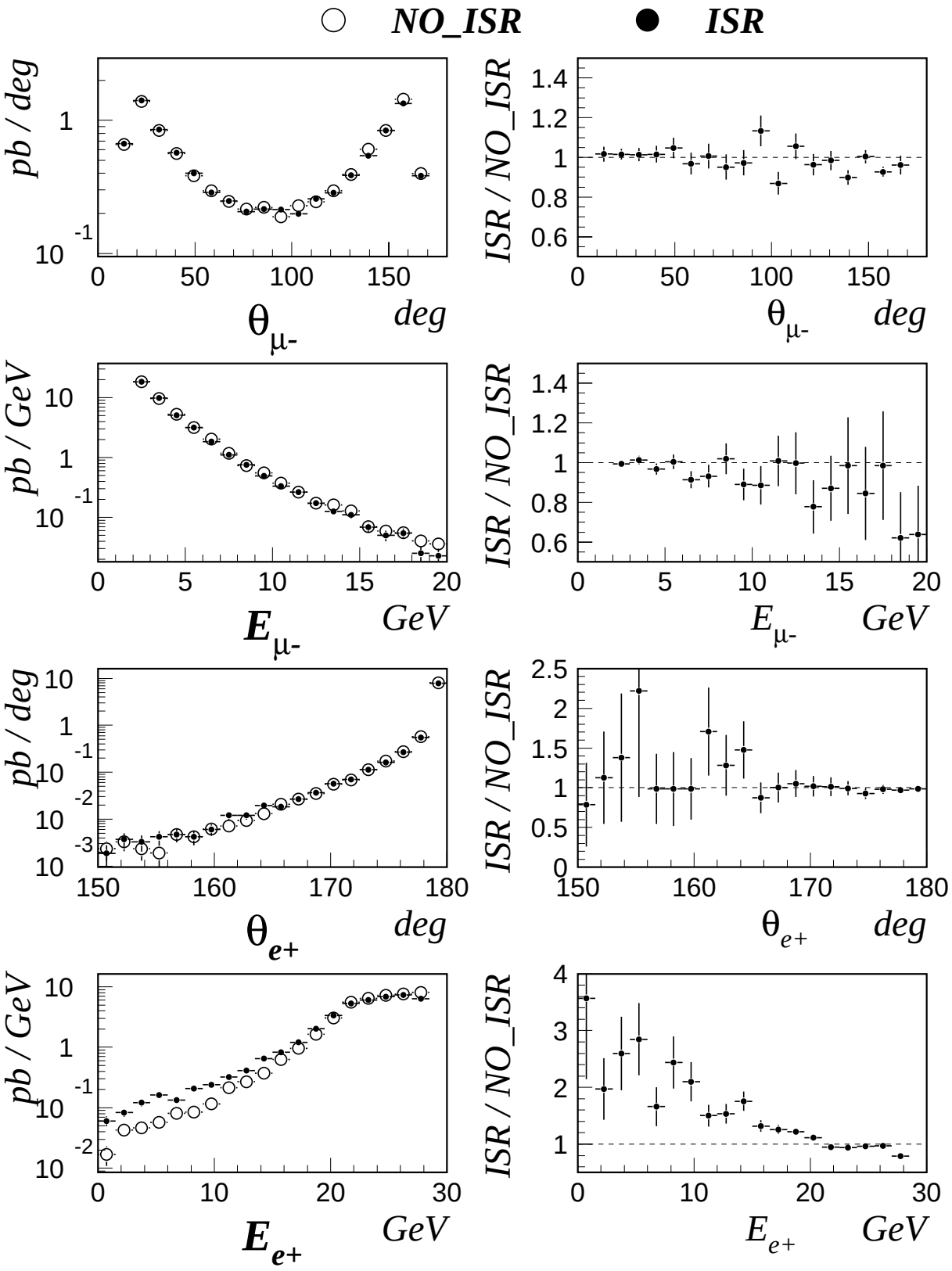
Cut(0) $\longrightarrow \sim$ 1 % $\downarrow$
Cut(1) $\longrightarrow \sim$ 1 % $\uparrow$
Cut(2) $\longrightarrow \sim$10 % $\uparrow$

ISR Effect on Q_e^2



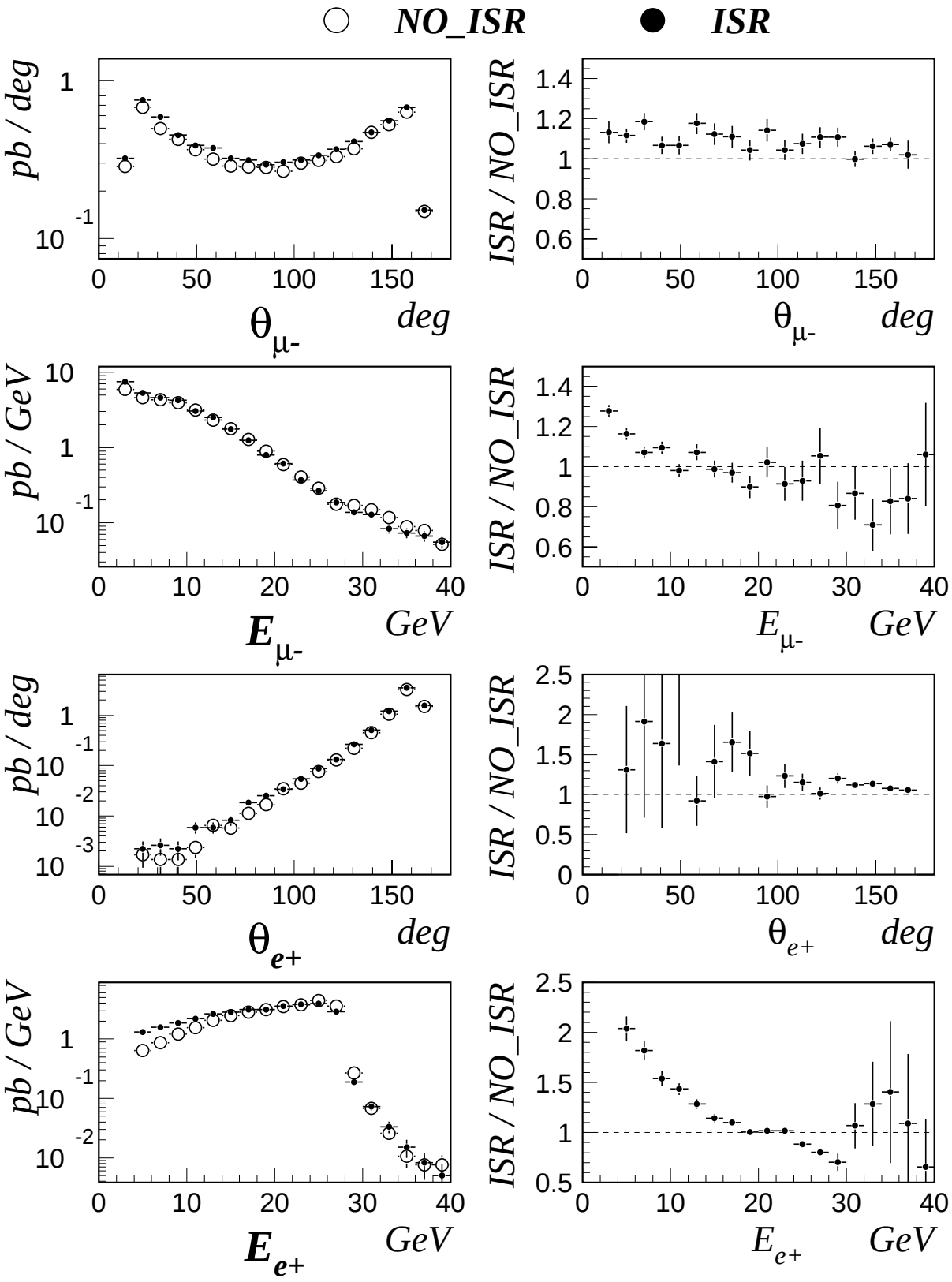
ISR Effect

Elastic Di-muon (cut1)



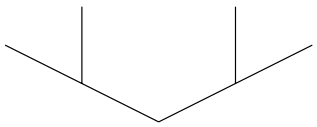
ISR Effect

Elastic Di-muon (cut2)



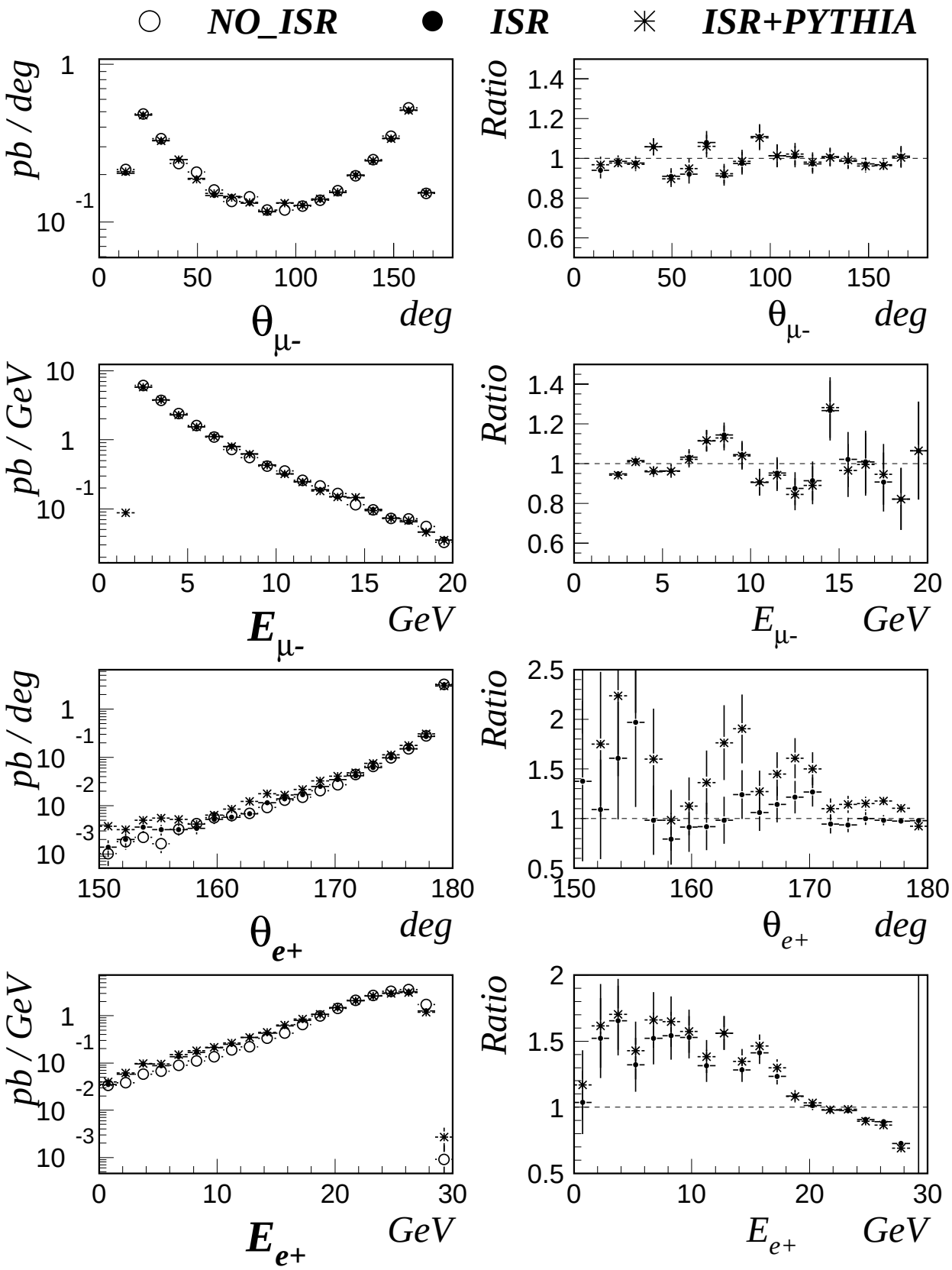
Interfaced to PYTHIA

- Defining GRACE output as a user-defined external process in PYTHIA
  $\longrightarrow$ PYTHIA functions can be used.
  - Initial state QED/QCD radiation with $P_t \neq 0$ (backward evolution parton shower)
  - Final state QED/QCD radiation (forward evolution parton shower)
  - Making proton remnant
  - Hadronization

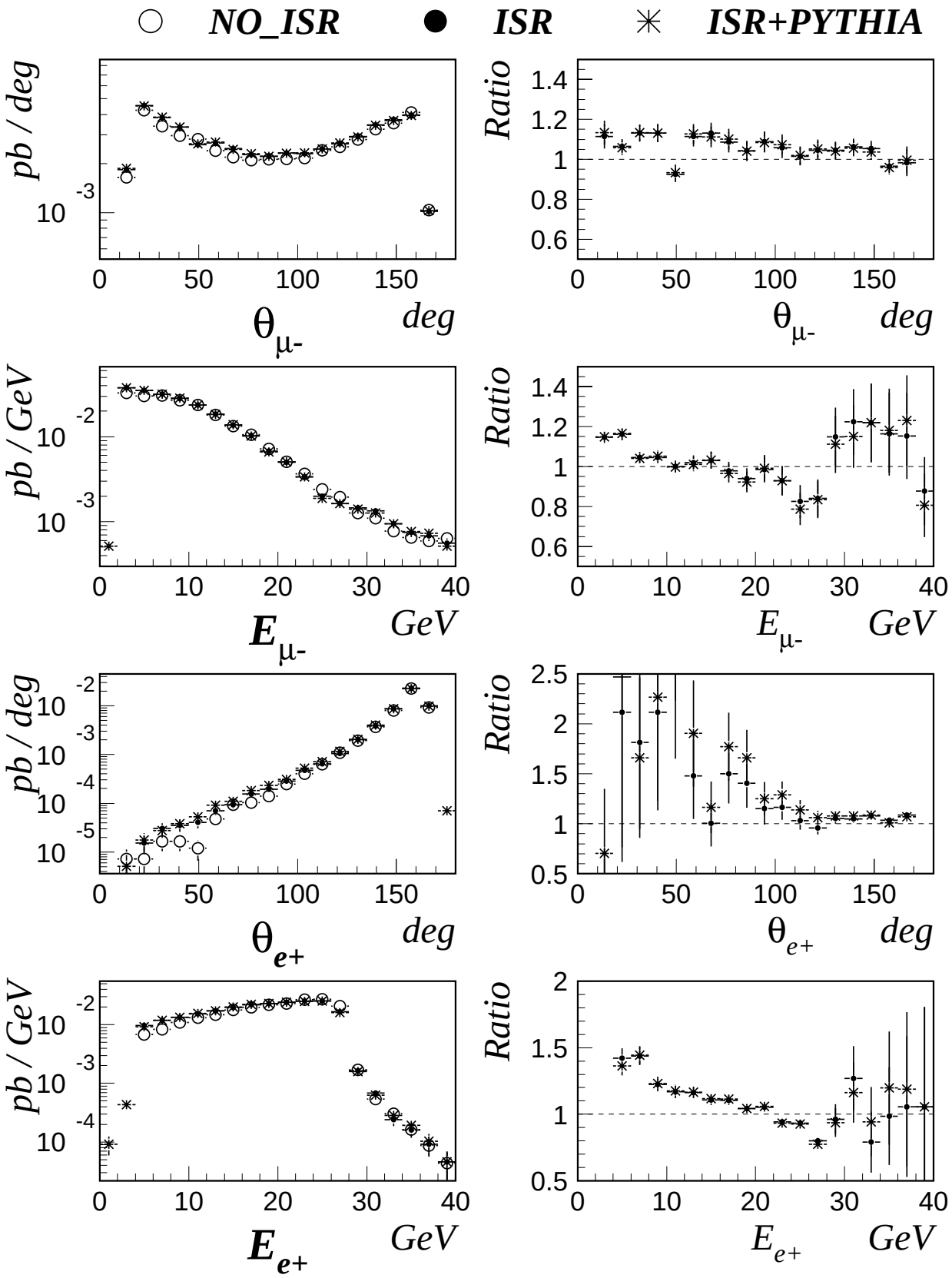


Complete Final State

DIS Di-muon (cut1)



DIS Di-muon (cut2)



Summary

- **ISR for incoming positron installed**
  - Total cross section does not change.
  - Small effect for produced muons.
  - In case of applying cuts, energy distribution of scattered positrons shows a clear difference between ISR-on/off.
- **Interfaced to PYTHIA**
  - Complete final state can be obtained.
  - Almost no effect on final state leptons.

Next Step

- Installing a so called *'resolved process'* as in EPVEC
- Comparison with EPVEC in Z^o production process