TevatronにおけるW+ボゾンを用いた、L-R symmetricモデルの検証

History of Universe

Aug 25th-Sep 15th ,2013

Fumiaki Ito

Tevatron at Fermilab

円周6km
重心系エネルギー1.96TeV

CDF

Fermilab

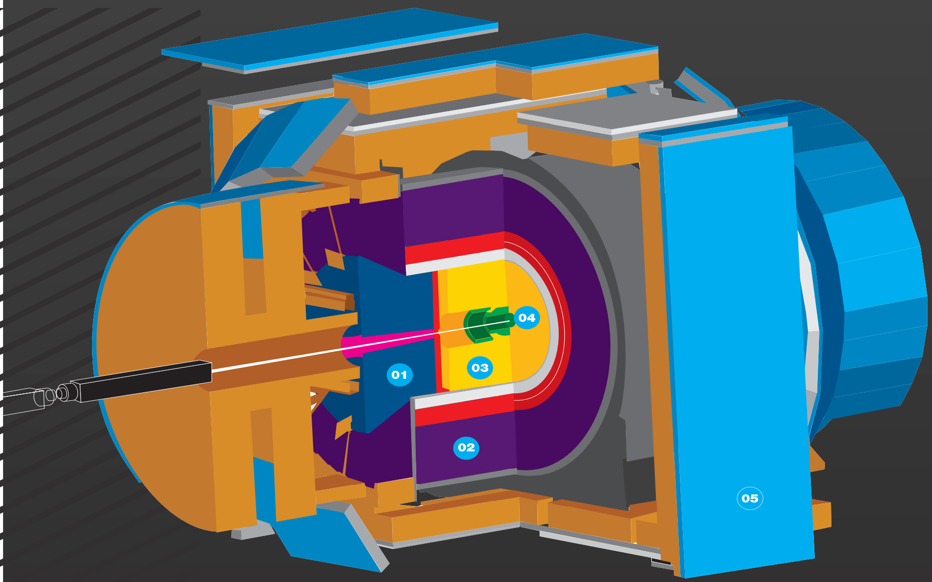
Collider Detector at Fermilab

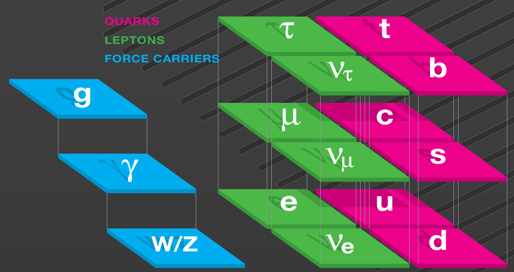
With 800 collaborators representing 62 institutions and 12 countries, CDF in Run 2 at the Fermilab Tevatron is challenging the standard model while searching for dark matter, supersymmetry and other exotic phenomena.

WHAT IS THE NATURE OF THE UNIVERSE AND WHAT IS IT MADE OF?

ARE THERE UNDISCOVERED PRINCIPLES OF NATURE : NEW SYMMETRIES, NEW PHYSICAL LAWS?

CAN WE PRODUCE AND DETECT DARK MATTER, WHOSE MYSTERIOUS PARTICLES FORM 25% OF THE UNIVERSE?





THE STANDARD MODEL AND BEYOND

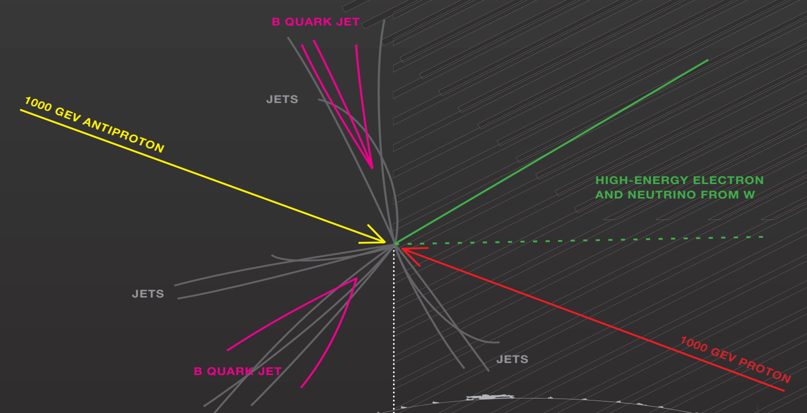
DOES THIS STRIKINGLY SIMPLE PICTURE OF NATURE'S FUNDAMENTAL PARTICLES TELL THE WHOLE STORY?

Discoveries at CDF—the 175 GeV top quark in 1995, the precision measurement of **B mesons** and **W bosons**—have helped to shape the Standard Model, the theory that embodies our most profound understanding of the particles and forces of matter.

Today, CDF measurements of the masses of the **W boson** and the **top quark** probe the origin of mass itself and the nature of the Higgs boson.

Exploring **B mesons** will help unlock the mystery of matter-antimatter asymmetry.

CDF scientists look for signals for new particles using characteristic signatures, like those of the **tau**, the heaviest lepton, and the **top**, the heaviest quark.

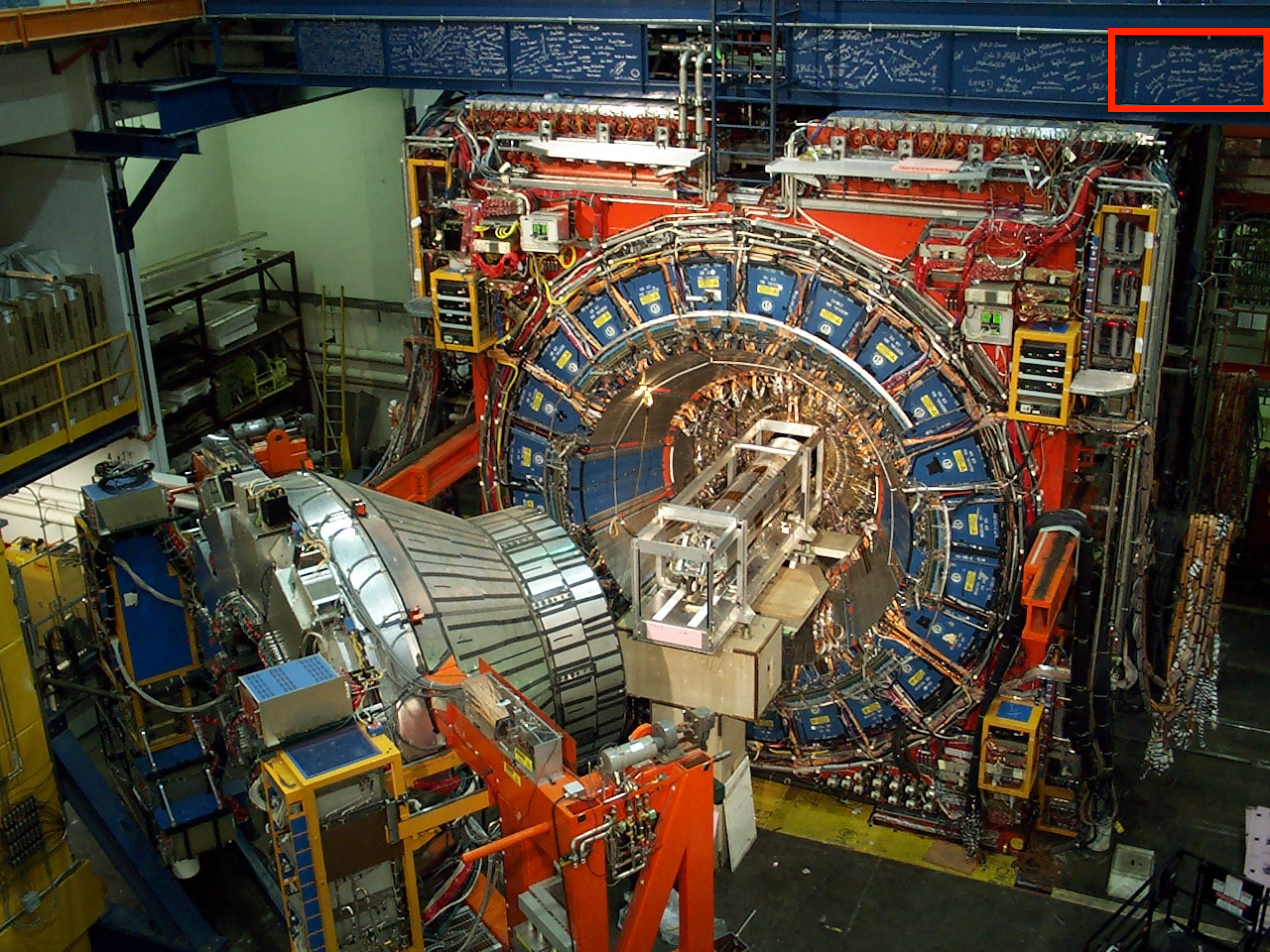


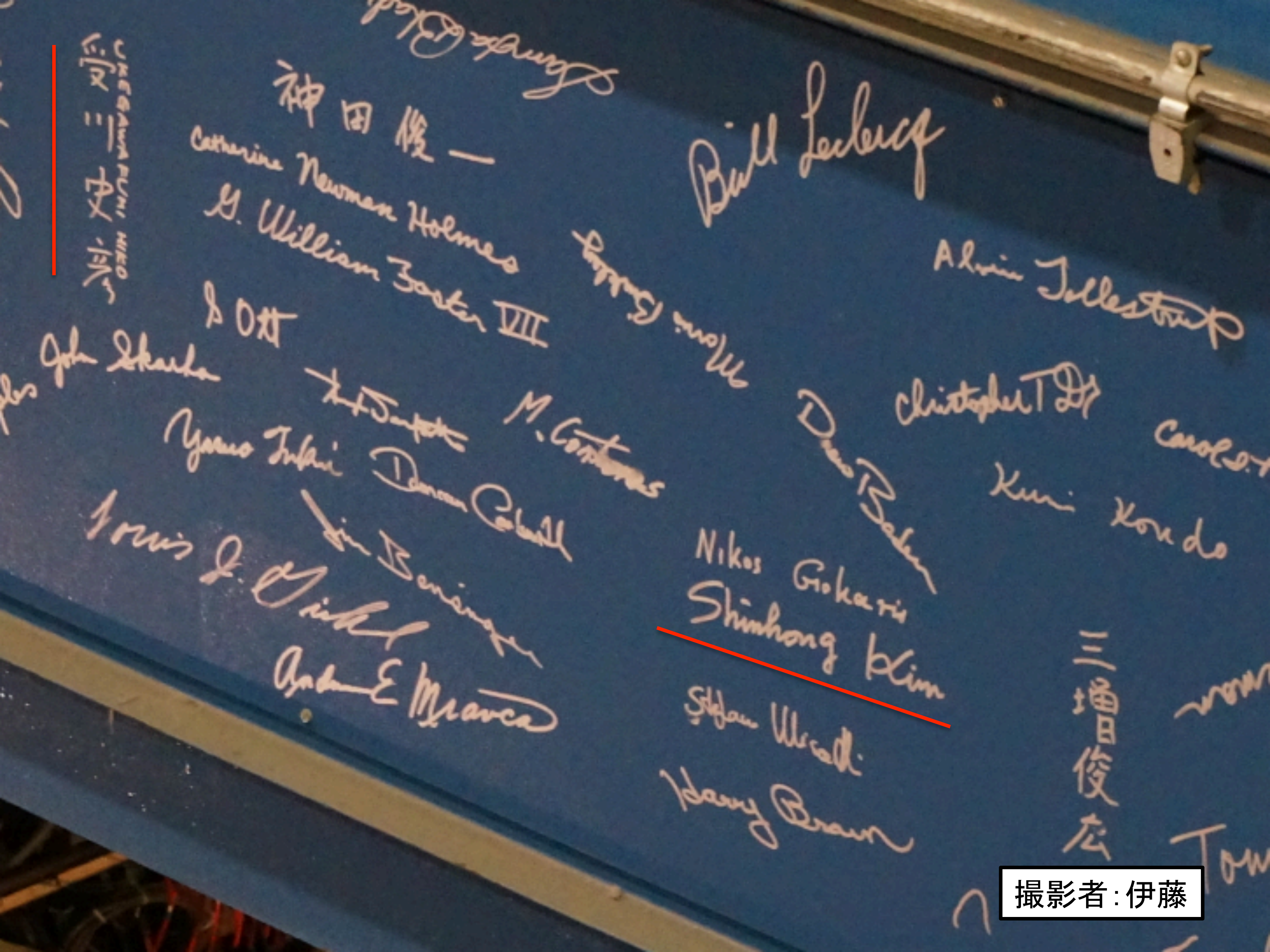
DETECTOR UPGRADES

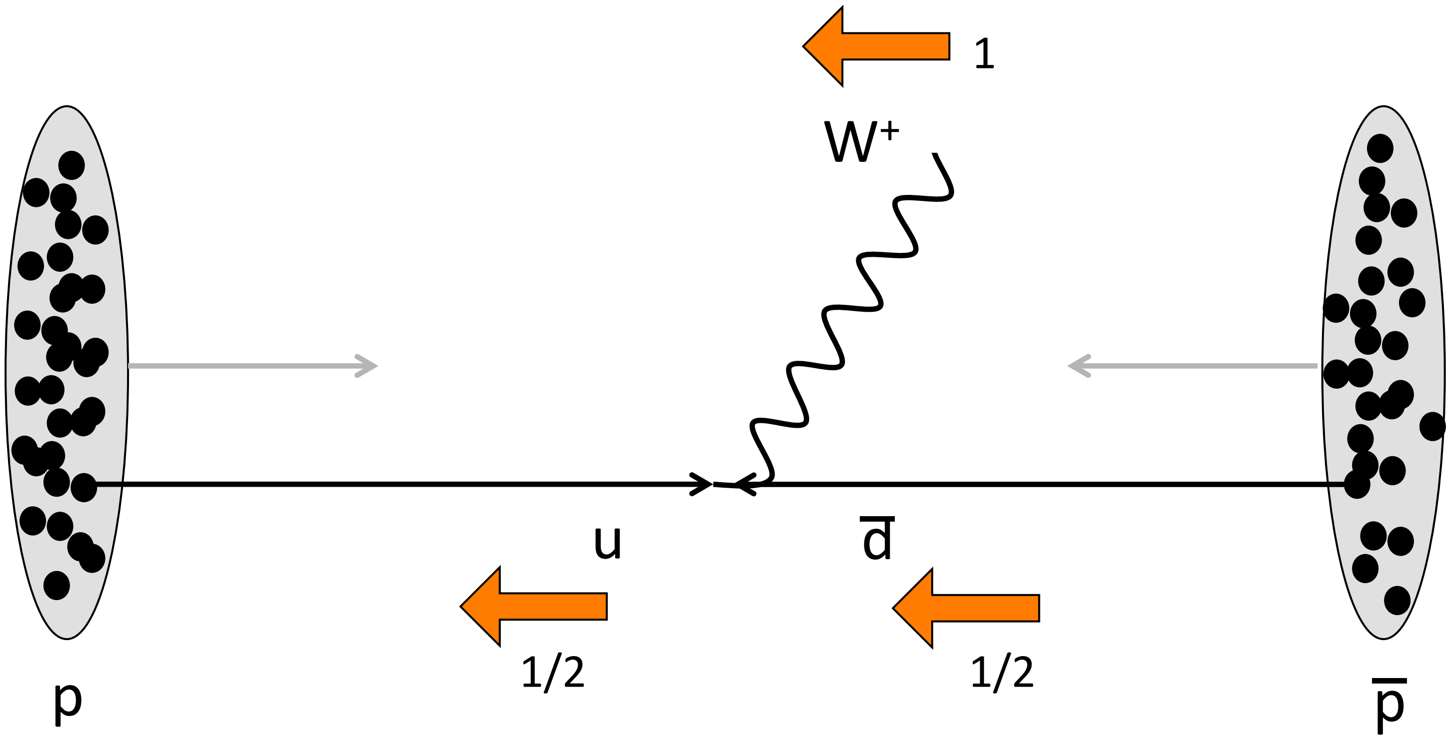
01 NEW SCINTILLATOR TILE ENDCAP CALORIMETER

04 NEW SILICON MICROSTRIP VERTEX DETECTOR—

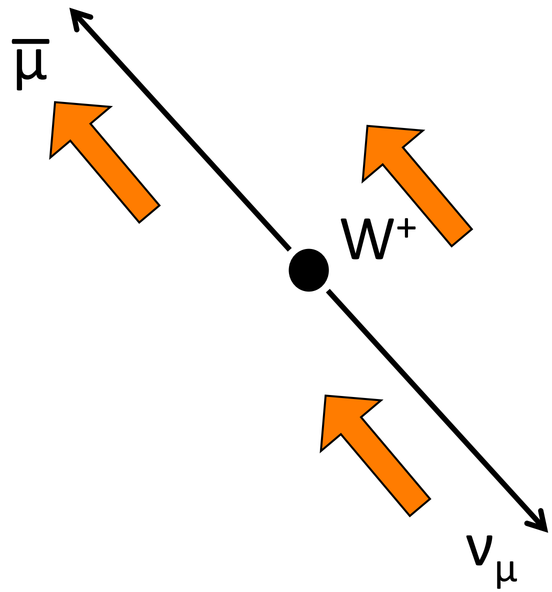
NEW DATA ACQUISITION SYSTEM



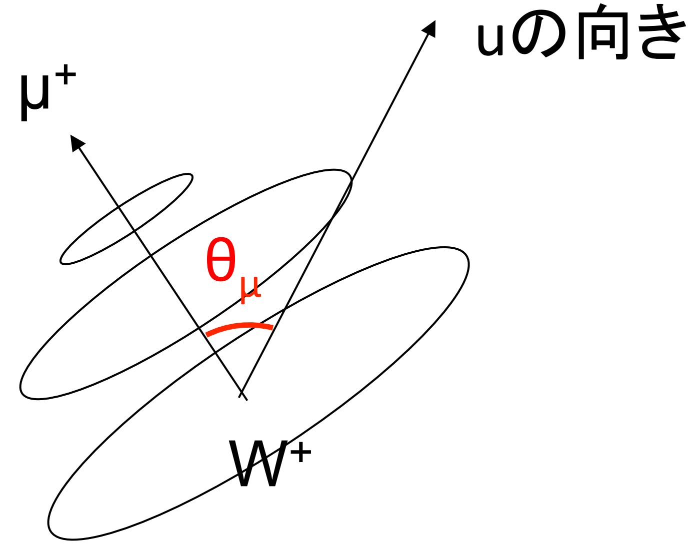

神田俊一
Catherine Newman Holmes
G. William Foster VIII
Alvin Tollestrup
M. Contreras
Nikos Giokaris
Shinhong Kim
三増俊広
Kuni Kondo
撮影者 : 伊藤



1
W+
u
d̄
1/2
1/2
p
p̄

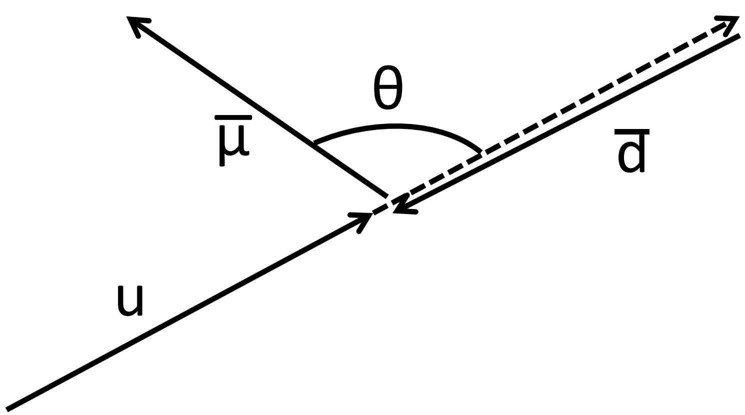


$\bar{\mu}$
W$^+$
ν_μ

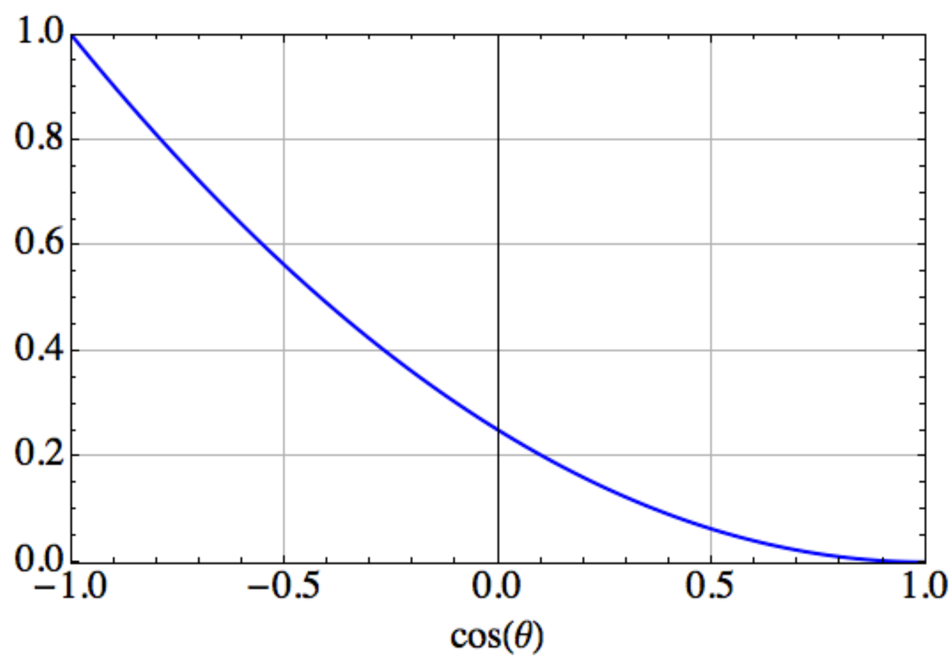


uの向き
μ^+
θ_μ
W$^+$

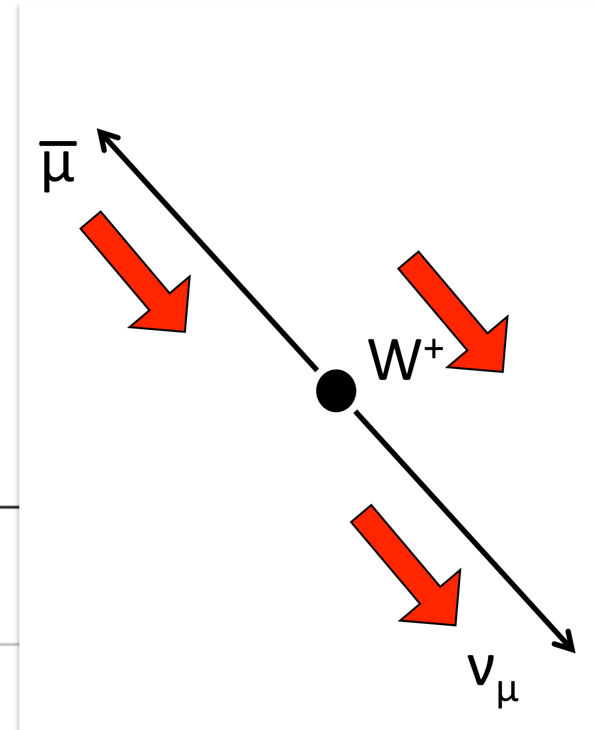
W$^+$慣性系

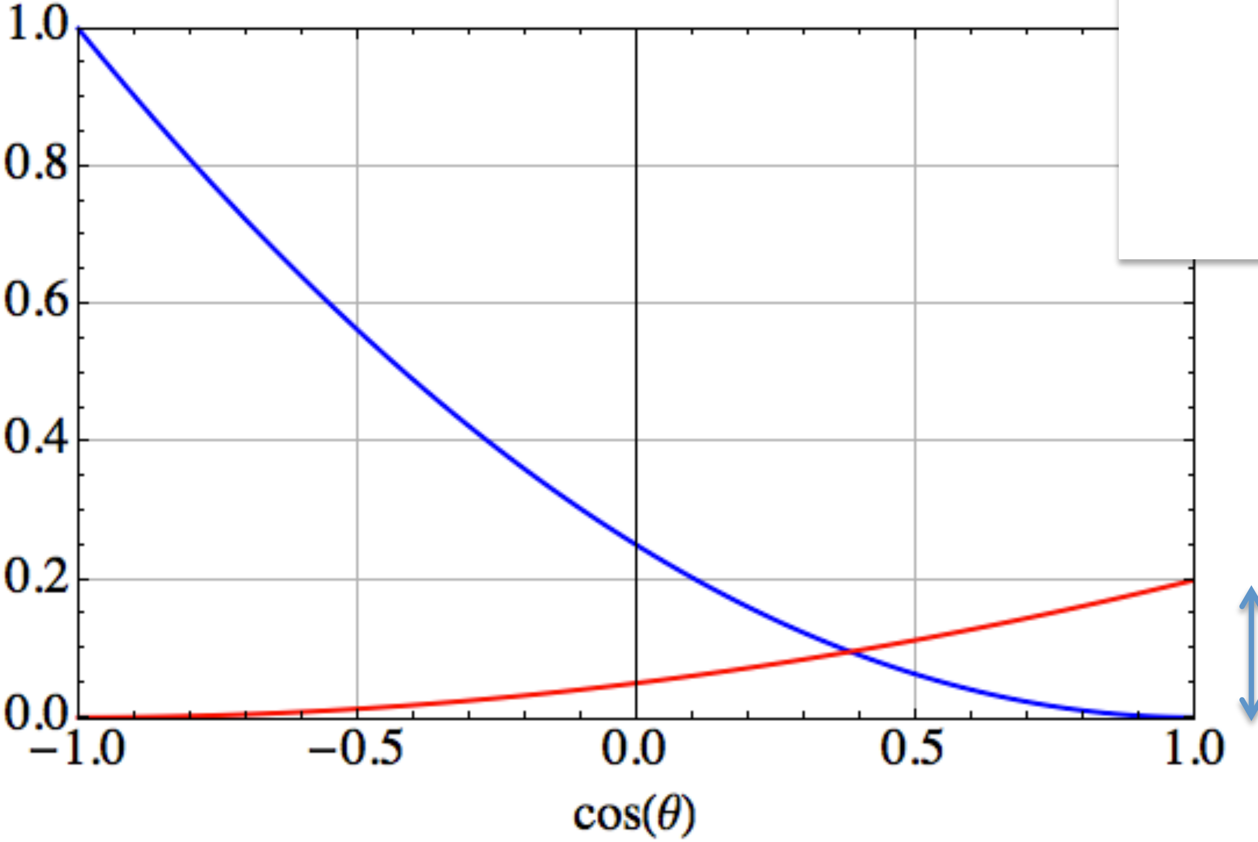


θ
$\bar{\mu}$
$\bar{d}$
u



1.0
0.8
0.6
0.4
0.2
0.0
−1.0
−0.5
0.0
0.5
1.0
cos(θ)





CDFで観測できるか

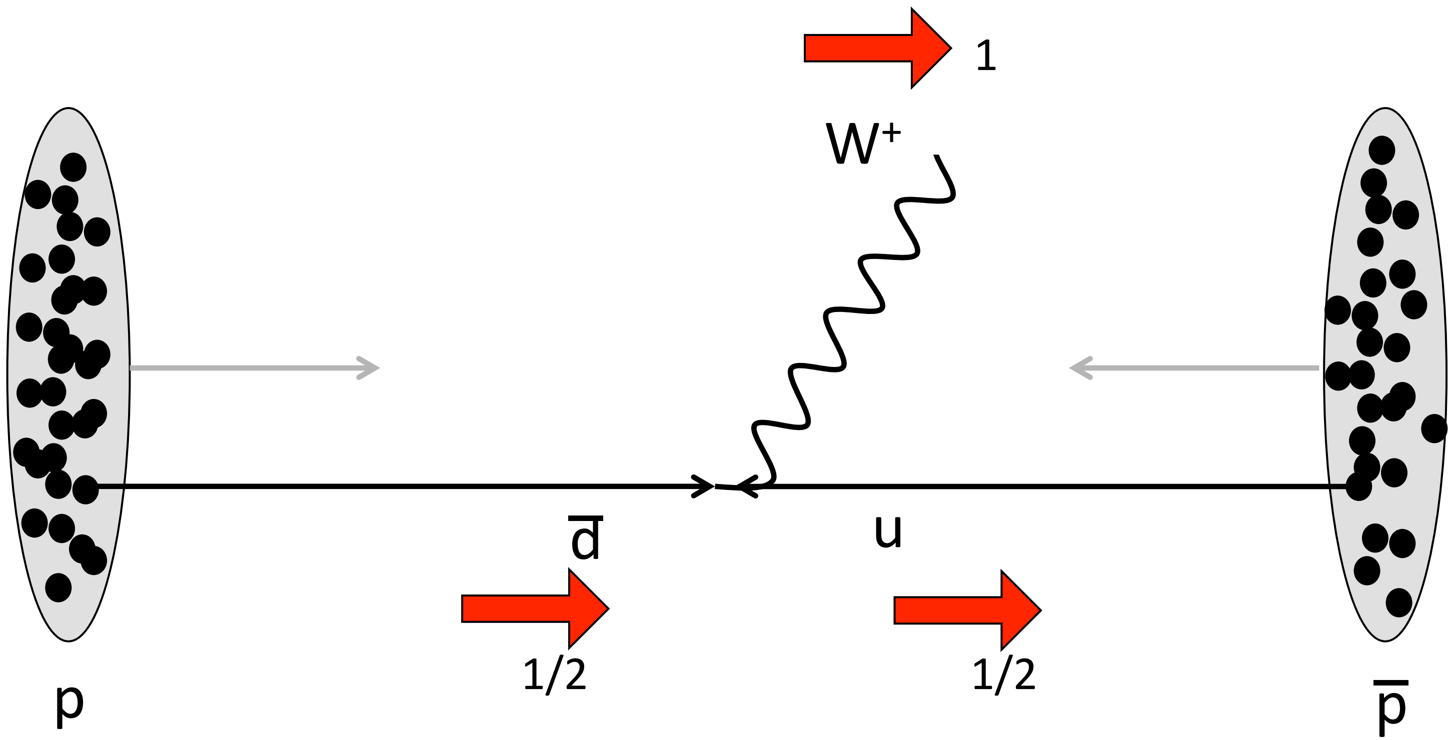
ジェネレーターレベルからPYTHIAを用いてシミュレーションを行う。

PYTHIA

高エネルギーの物理イベントを発生させるためのプログラム

重心系エネルギー1.96 TeVのppber衝突でW+が
生成される事象のみを発生させた。

バックグラウンド



1/8ほどの割合で含まれる

PDFセットはCTEQ5Lを使用時

$$(x_1 p + x_2 \overline{p})^2 = m_W^2$$

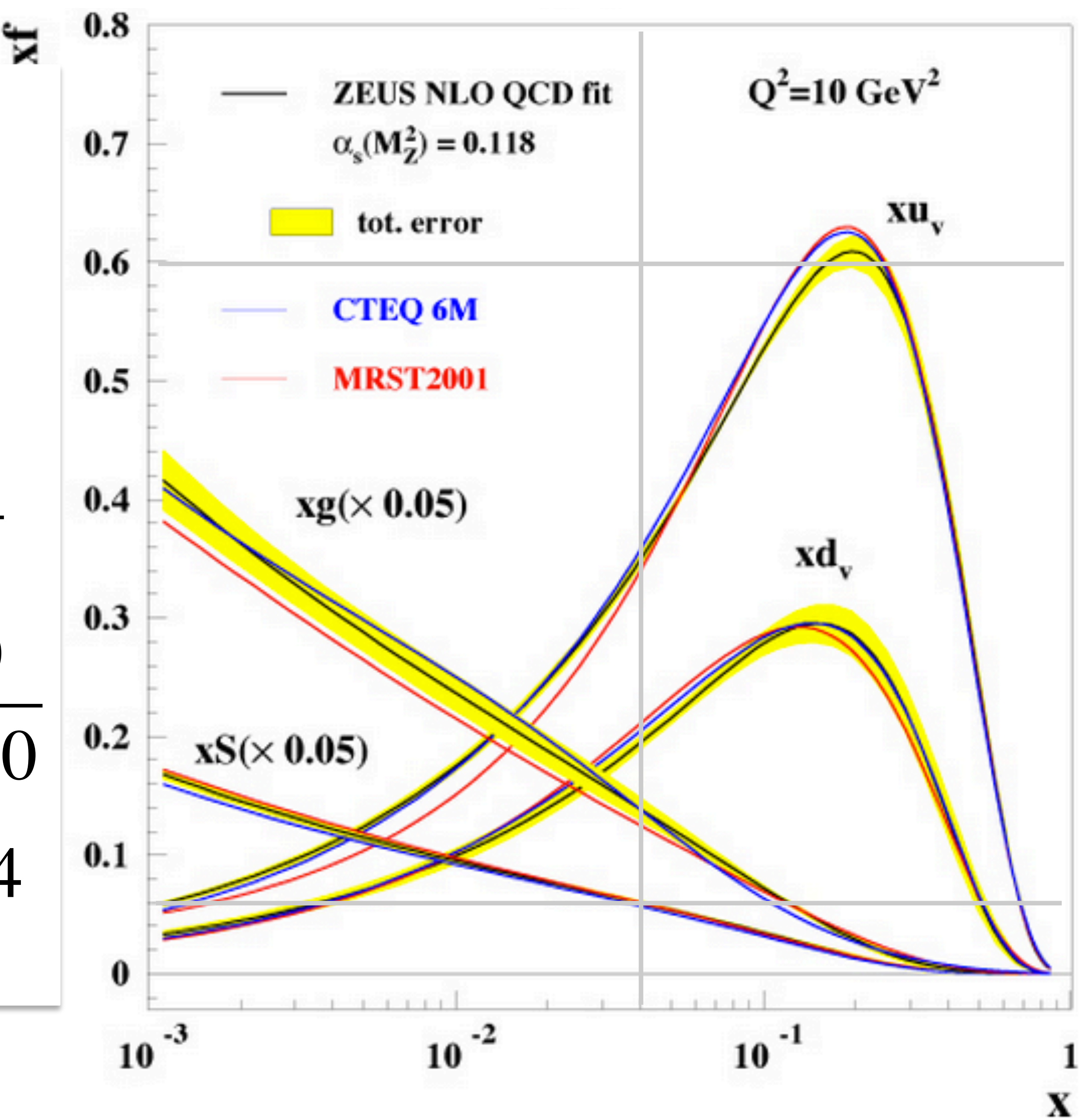
$$2x_1 x_2 p \cdot \overline{p} = m_W^2$$

$$2p \cdot \overline{p} = S$$

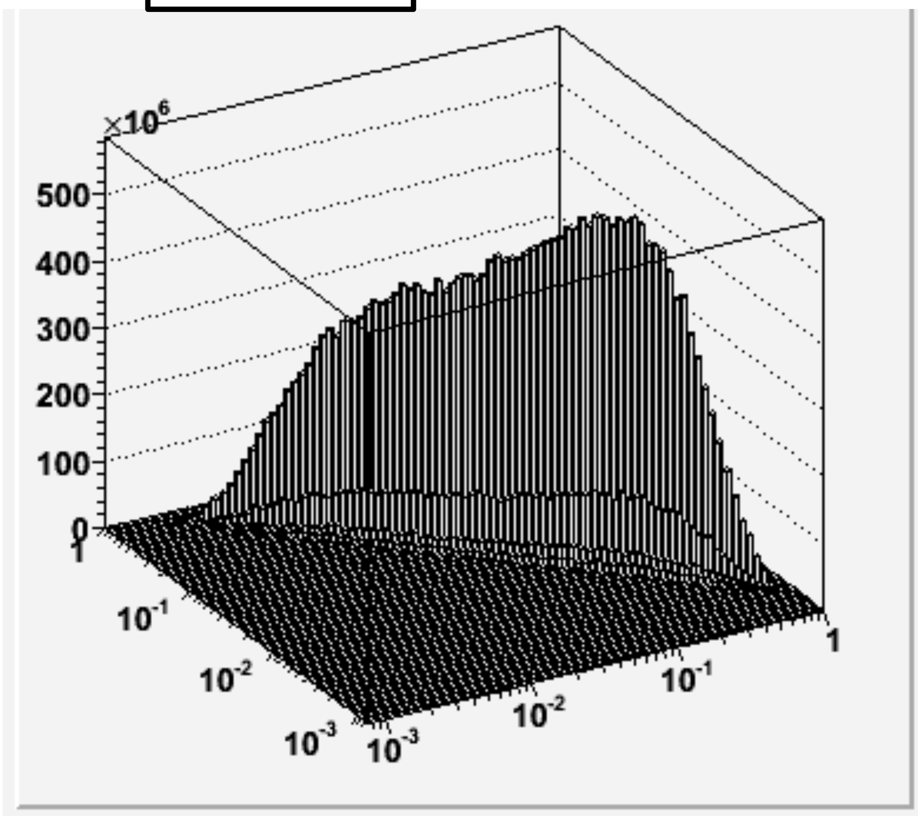
$$x_1 x_2 = \frac{m_W^2}{S}$$

$$\sqrt{x_1 x_2} = \frac{80}{1960}$$

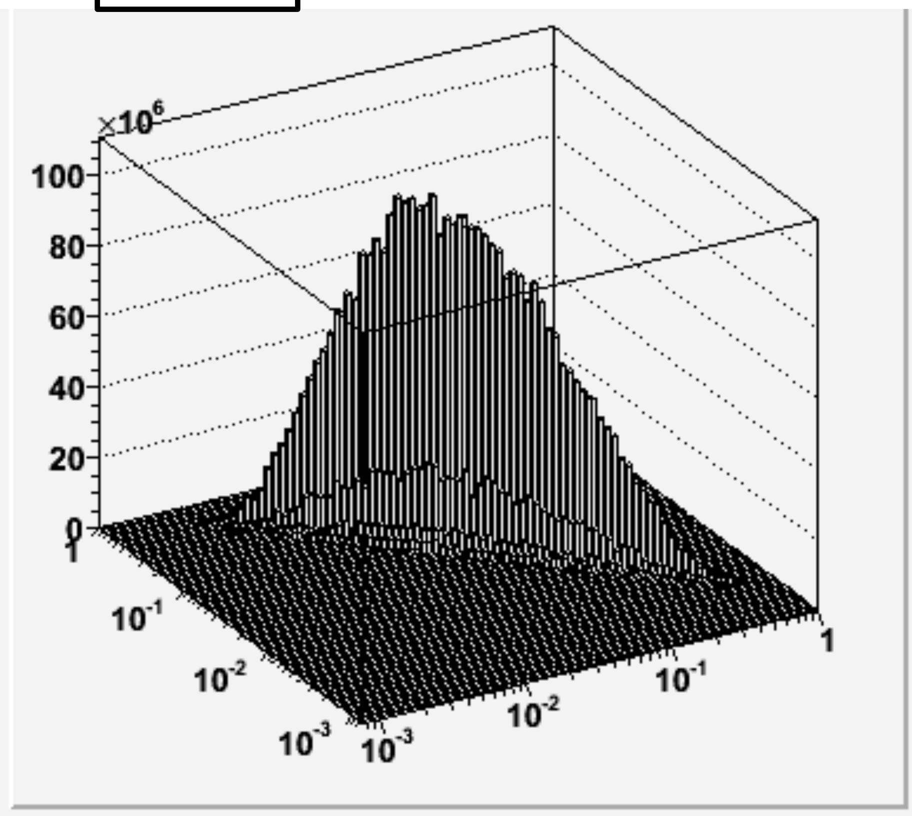
$$\overline{x} = 0.04$$



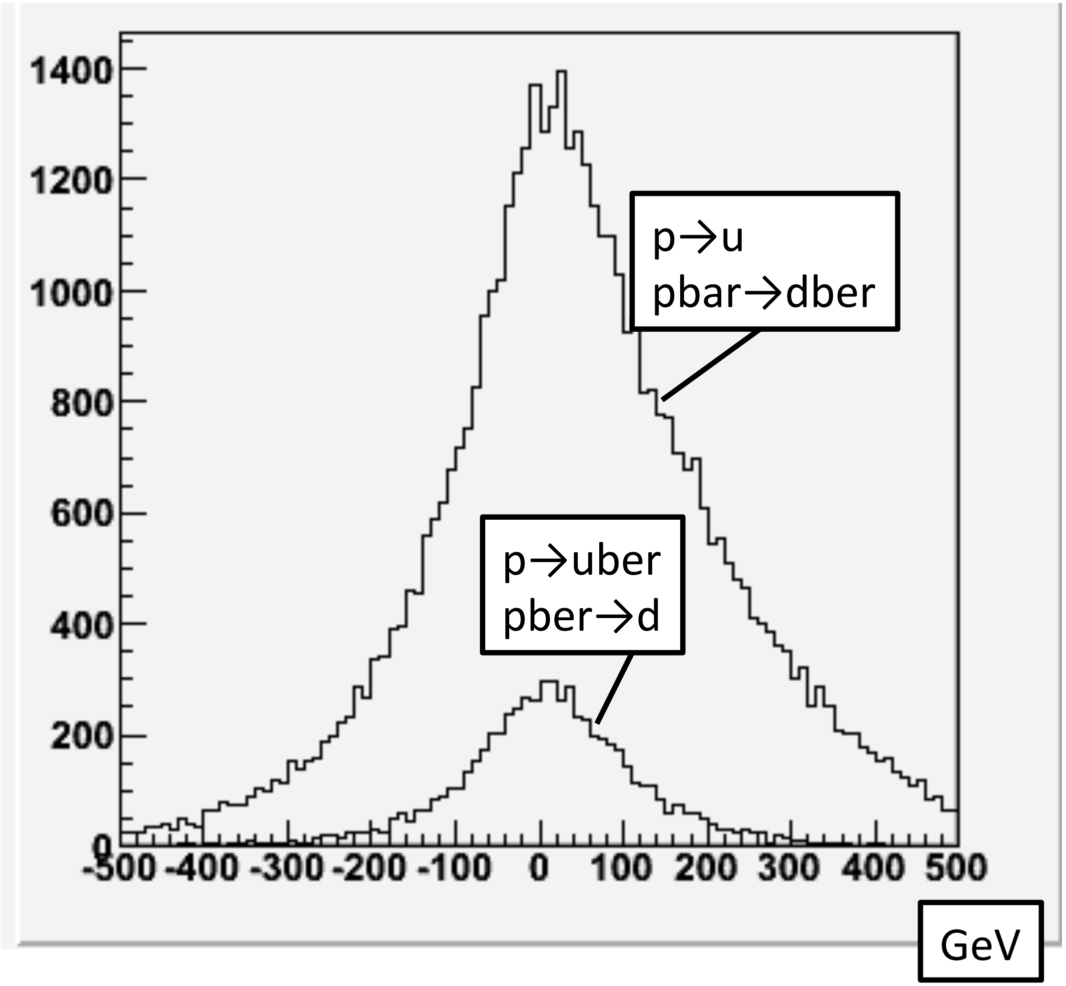
p→u
pbar→dber



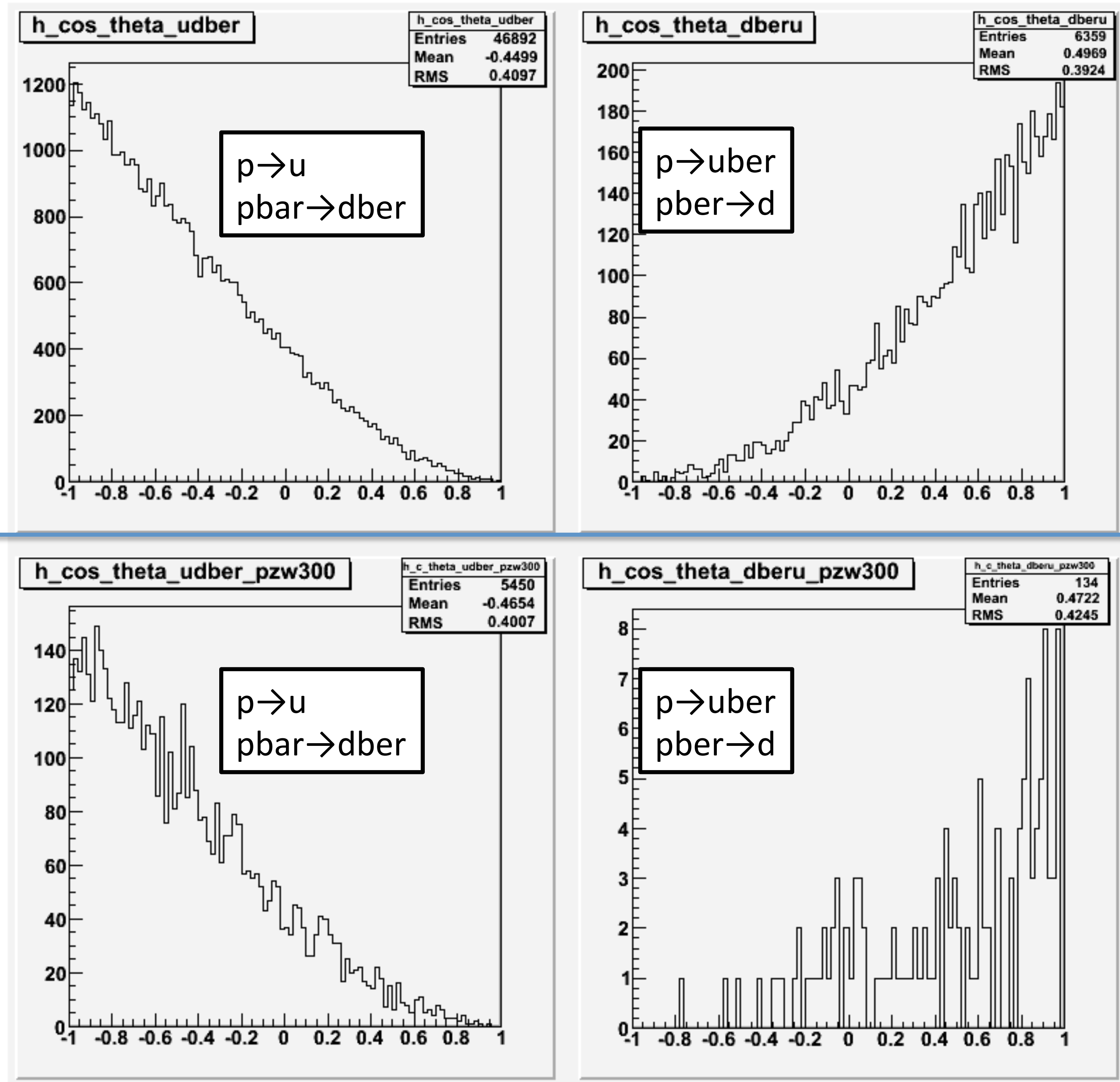
p→uber
pber→d



W+のPz分布



バックグラウンド源を大幅にカットできる


h_cos_theta_udber
Entries 46892
Mean -0.4499
RMS 0.4097
p→u
pbar→dber
h_cos_theta_dberu
Entries 6359
Mean 0.4969
RMS 0.3924
p→uber
pber→d
h_cos_theta_udber_pzw300
h_c_theta_udber_pzw300
Entries 5450
Mean -0.4654
RMS 0.4007
p→u
pbar→dber
h_cos_theta_dberu_pzw300
h_c_theta_dberu_pzw300
Entries 134
Mean 0.4722
RMS 0.4245
p→uber
pber→d

|Pzw|>300GeV

W+のPzを得るためには

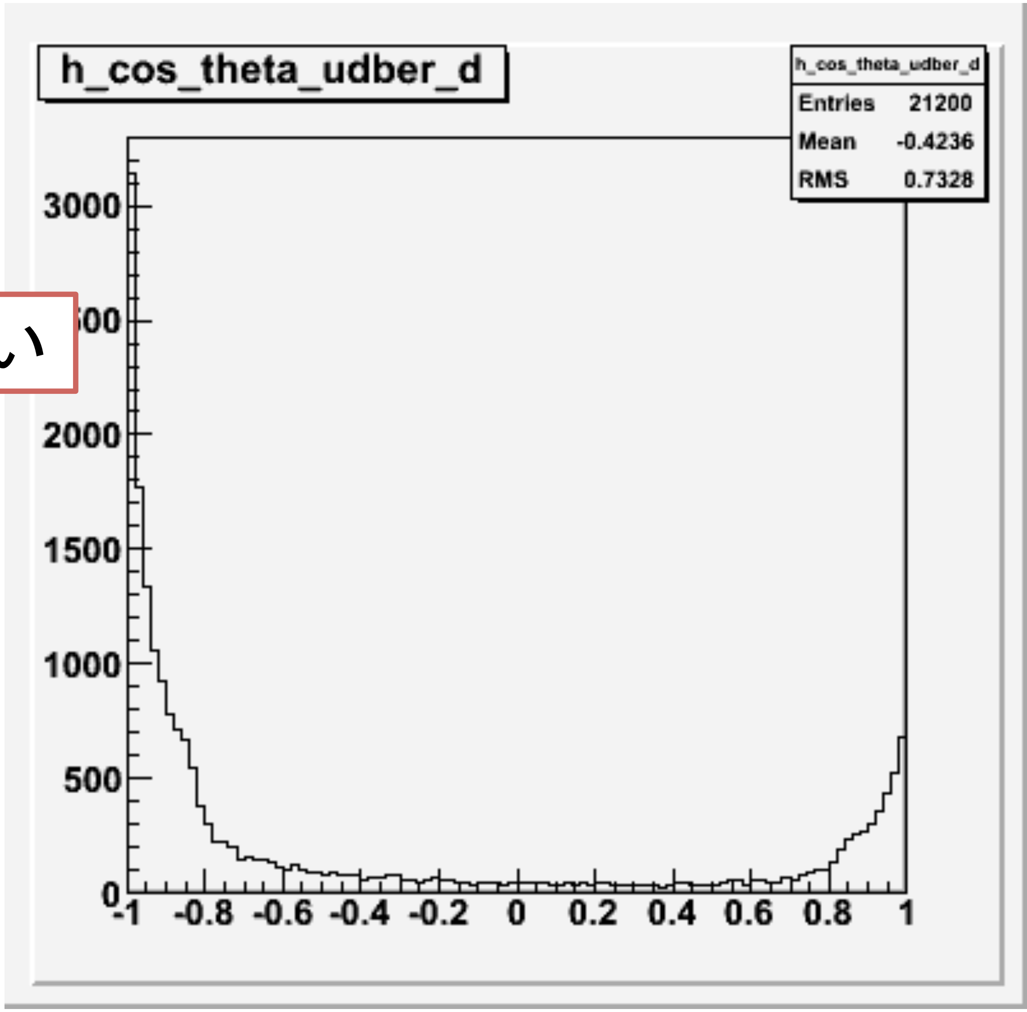
ニュートリノのPzを求める必要がある

$$(P_\mu + P_\nu)^2 = m_W^2$$

解が2つ出てきてしまう

正しい解を選ばなければならない

選べていない



まとめ

- PYTHIAをダウンロードしW+生成イベントを発生させた
- 発生させたイベントを解析し、L-R symmetricモデルの検証がCDFのデータを用いて調べることができるかどうかの確認を行った
- ニュートリノのPzを求める等の課題もあるが、可能性は示せた