

The status of the FROST experiment

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on behalf of the FROST run group

The George Washington University

CLAS Hadron Spectroscopy Group Meeting

June 12, 2009

Outline

1. FROST Overview

Motivation

g9a experiment

2. Calibration Status

Tagger, TOF, ST, DC, EC

NMR (Target polarization)

Cooking

3. Sample analysis

Motivation

Study of excited nucleon states (N^* and Δ)

-> Understand the structure of the nucleon

-> Analyze decay products due to short lifetime

Double polarization experiment is important

E02-112: $\gamma p \rightarrow KY$ ($K^+\Lambda$, $K^+\Sigma^0$, $K^0\Sigma^+$)

E03-105/E04-102: $\gamma p \rightarrow \pi^0 p$, $\pi^+ n$

E05-012: $\gamma p \rightarrow \eta p$

E06-013: $\gamma p \rightarrow \pi^+ \pi^- p$

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g9a - series of experiments -

Photon	Target			Recoil			Target + Recoil				
	-	-	-	x'	y'	z'	x'	x'	z'	z'	
	-	x	y	z	-	-	-	x	z	x	z
unpolarized	σ_0	0	T	0	0	P	0	$T_{x'}$	$-L_{x'}$	$T_{z'}$	$L_{z'}$
linear pol.	$-\Sigma$	H	$(-P)$	$-G$	$O_{x'}$	$(-T)$	$O_{z'}$	$(-L_{z'})$	$(T_{z'})$	$(-L_{x'})$	$(-T_{x'})$
circular pol.	0	F	0	$-E$	$-C_{x'}$	0	$-C_{z'}$	0	0	0	0

g1: unpolarized beam and target (σ_0)

g8: linearly polarized beam and unpolarized target (Σ)

g9a: circularly and linearly polarized beam

with longitudinally polarized target (E & G)

g9b (2010): circularly and linearly polarized beam

with transversely polarized target (F, H, T, & P)

g9a experiment

(Nov.3, 2007 ~ Feb. 12, 2008)

Photon beam

- Circularly & linearly polarized
- 0.5-2.4 GeV

Target

- Butanol (C_4H_9OH)
- 82 ~ 85% of polarization
- ~30mK
- 0.5T(holding magnet)

Production (10.5 Billion triggers*)

* trigger: at least one charged particle in CLAS ⁵

g9a experiment

Production (10 Billion triggers)

Circularly polarized beam

1.645 GeV	1.1 Billion
2.478 GeV	2.3 Billion

Linearly polarized beam

0.7 GeV	300M	1.7 GeV	850 M
0.9 GeV	500M	1.9 GeV	720 M
1.1 GeV	500M	2.1 GeV	800 M
1.3 GeV	600M	2.3 GeV	780 M
1.5 GeV	600M		

g9a experiment - manpower list -

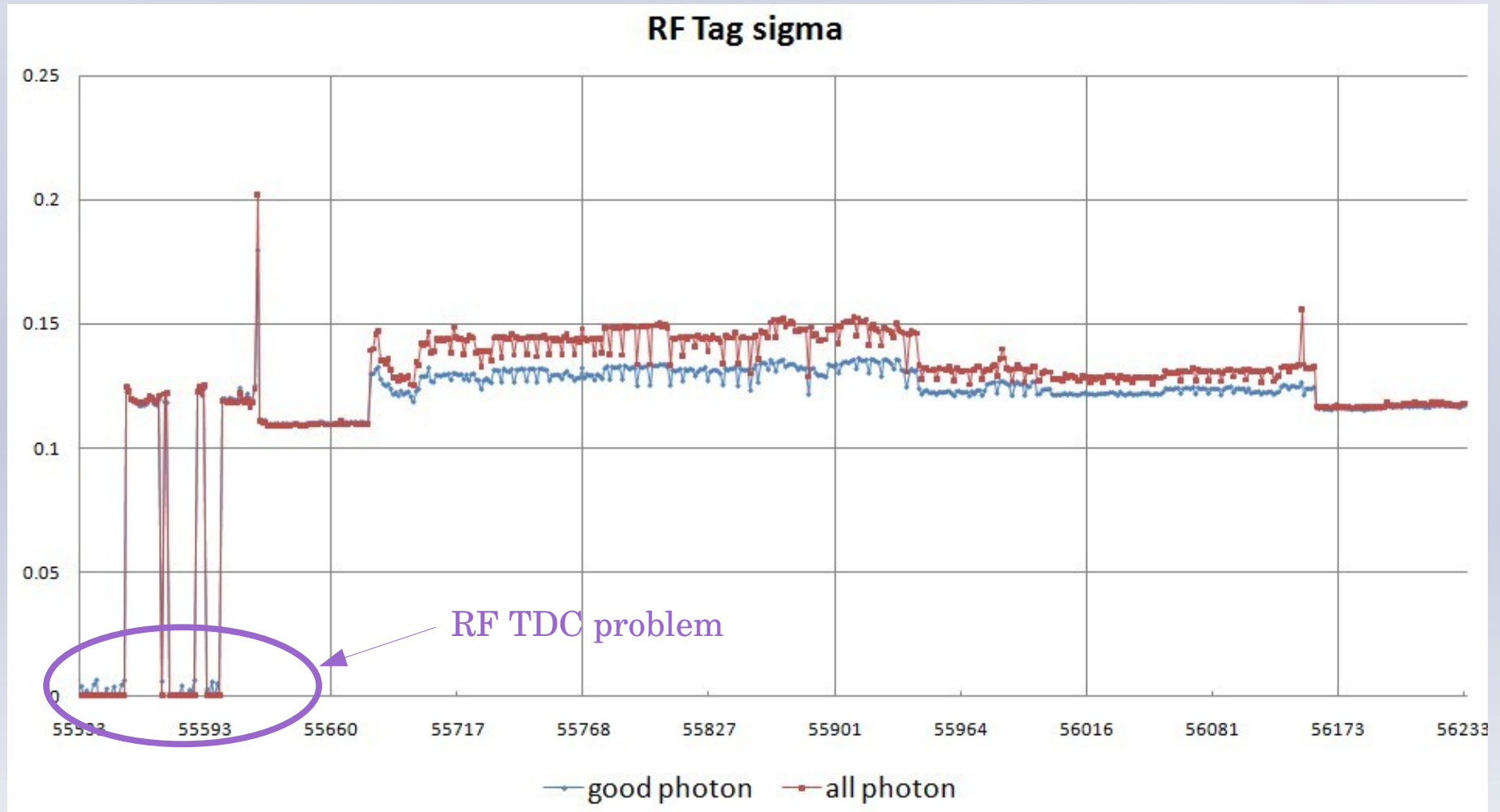
Group leader Eugene Pasyuk (ASU)

Item	Contact
Cooking	Sungkyun Park (FSU)
Tagger Calibration	Liam Casey (CUA), Franz Klein (CUA)
TOF Calibration	Robert Coyne (UMASS), Hideko Iwamoto (GWU), Arthur Sabintsev (GWU)
ST Calibration	Mukesh Saini (FSU)
DC Calibration	Sean Kuvin* (FSU), Evan McClellan* (FSU) Sungkyun Park (FSU), Volker Crede (FSU)
EC Calibration	Simona Malace (USC)
Beam Polarization (Lin.)	Stuart Fegan (Uof Glasgow) Arthur Sabintsev (GWU)
Target Polarization	Jo McAndrew (Uof Edinburgh)
DC Alignment	Franz Klein (CUA)
Energy loss corrections	Brian Morrison, Eugene Pasyuk (ASU)

* undergraduate students

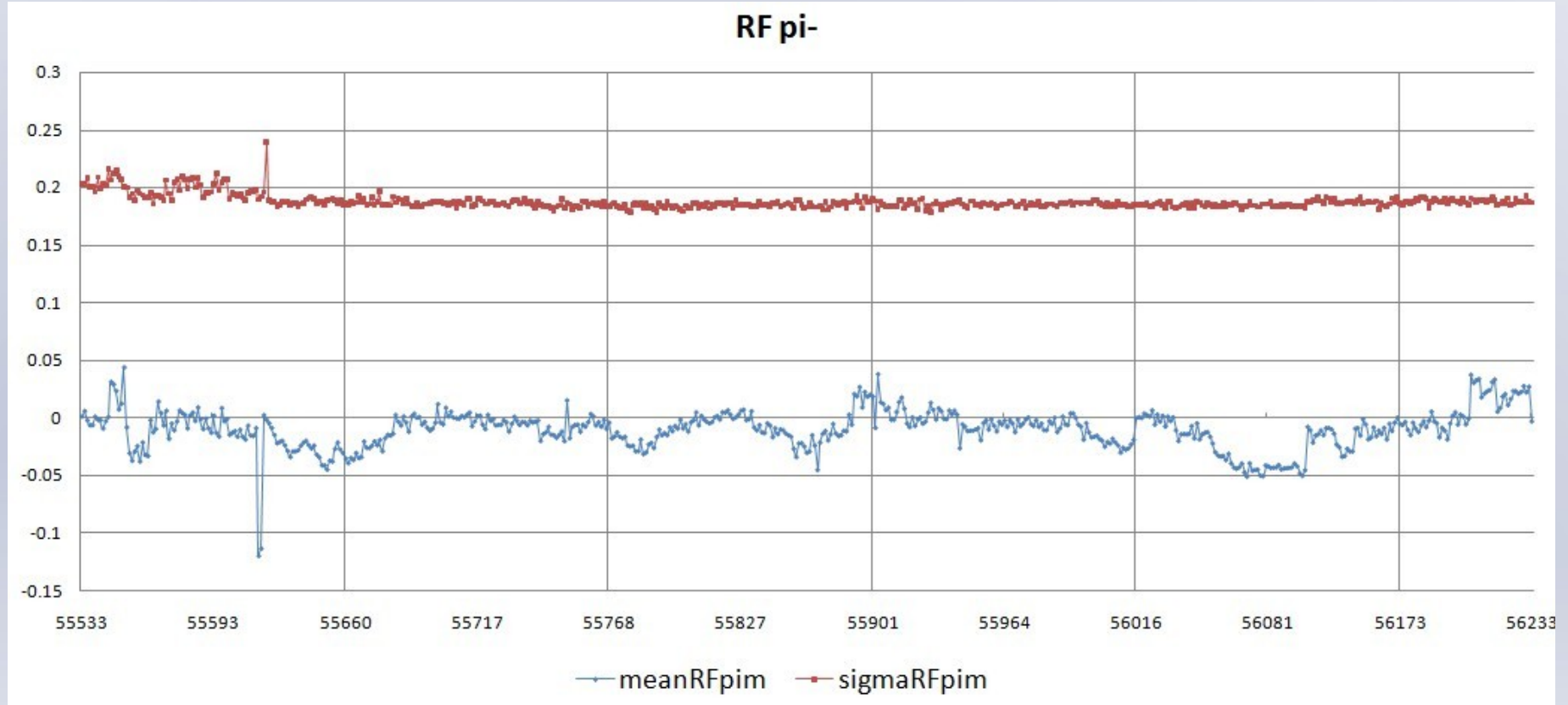
Tagger

Liam Casey , Franz Klein



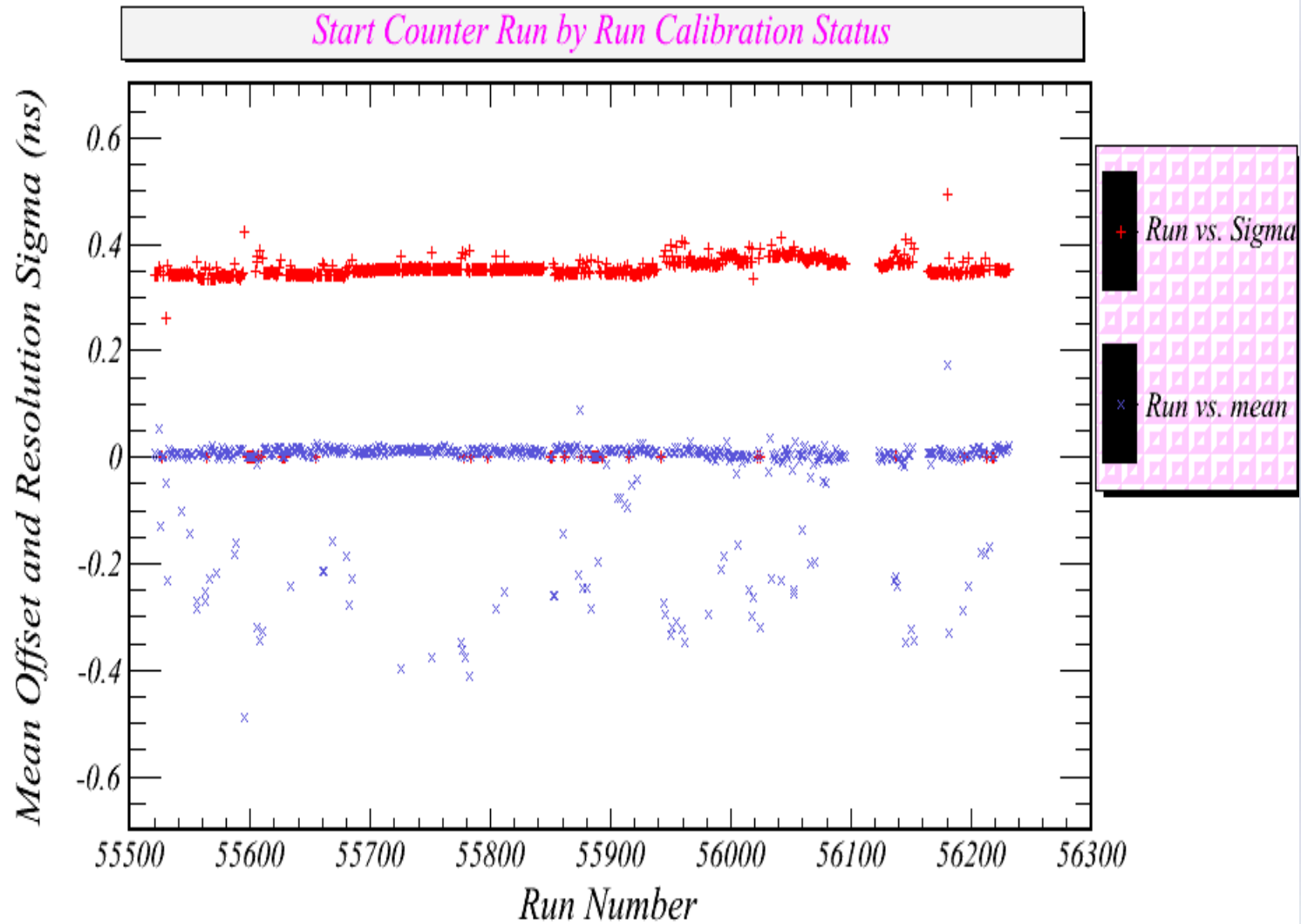
TOF

Robert Coyne, Hideko Iwamoto, Arthur Sabintsev



ST

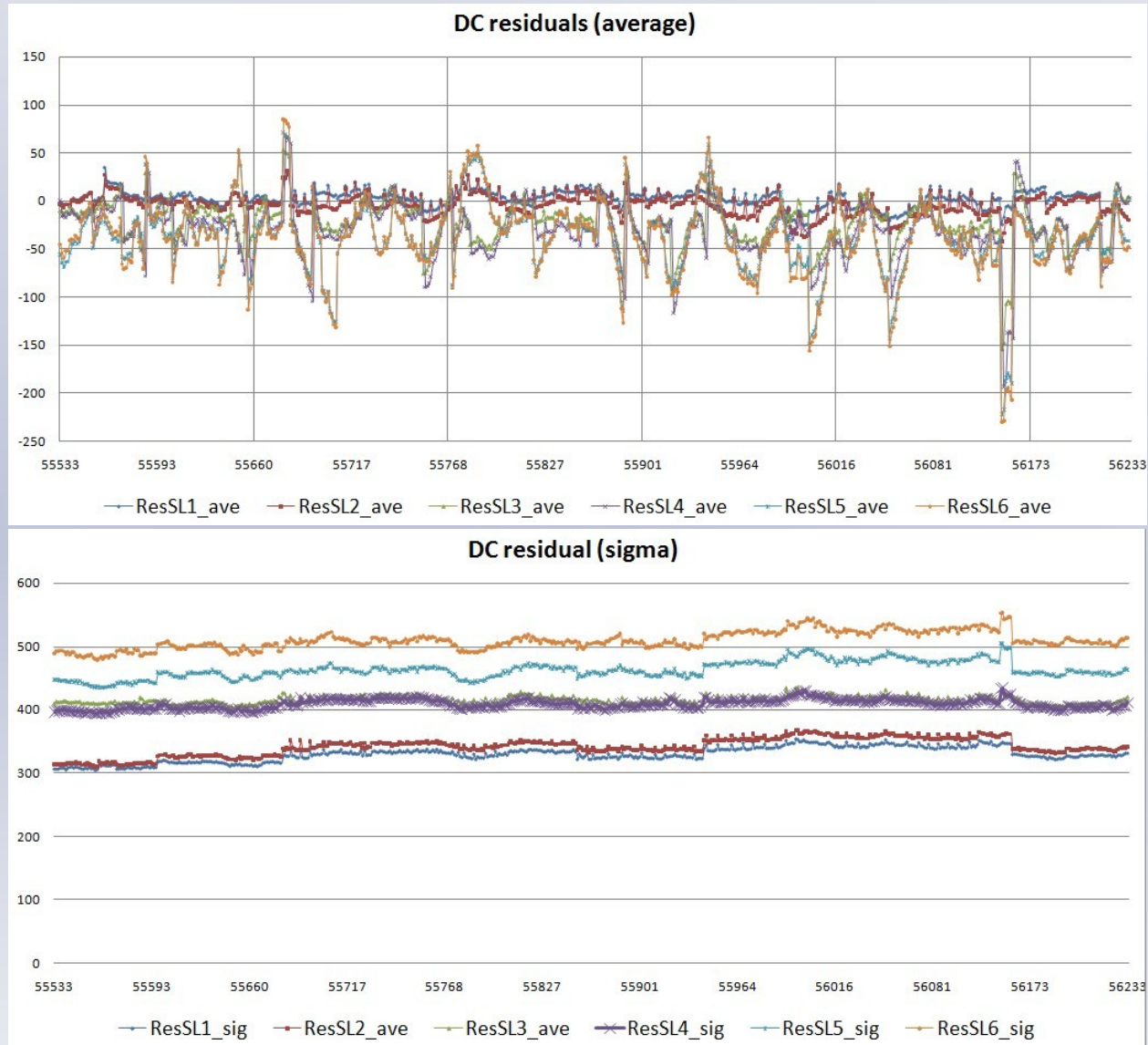
Mukesh Saini



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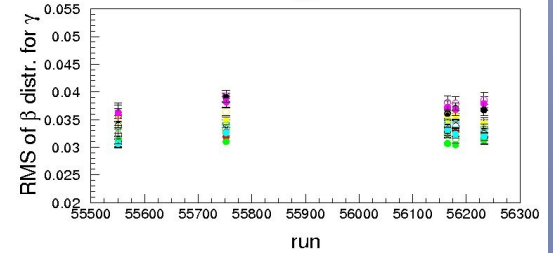
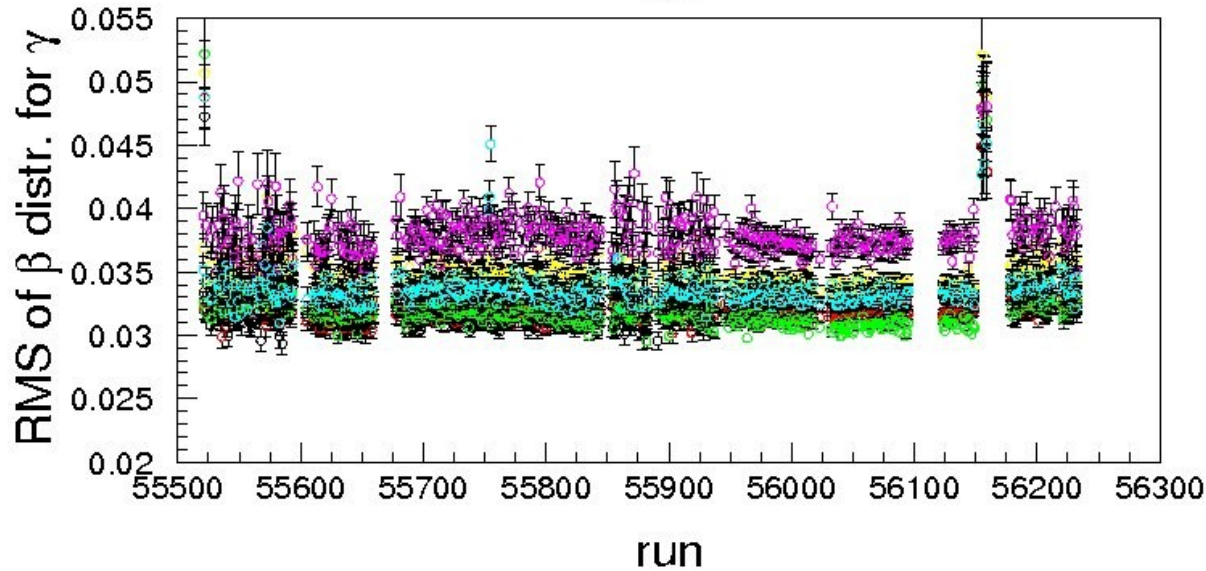
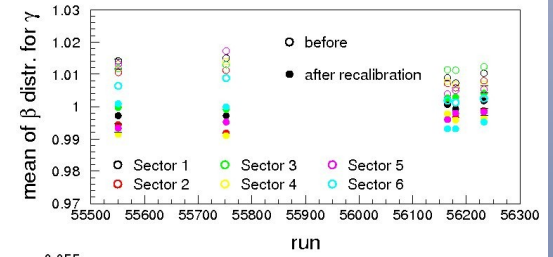
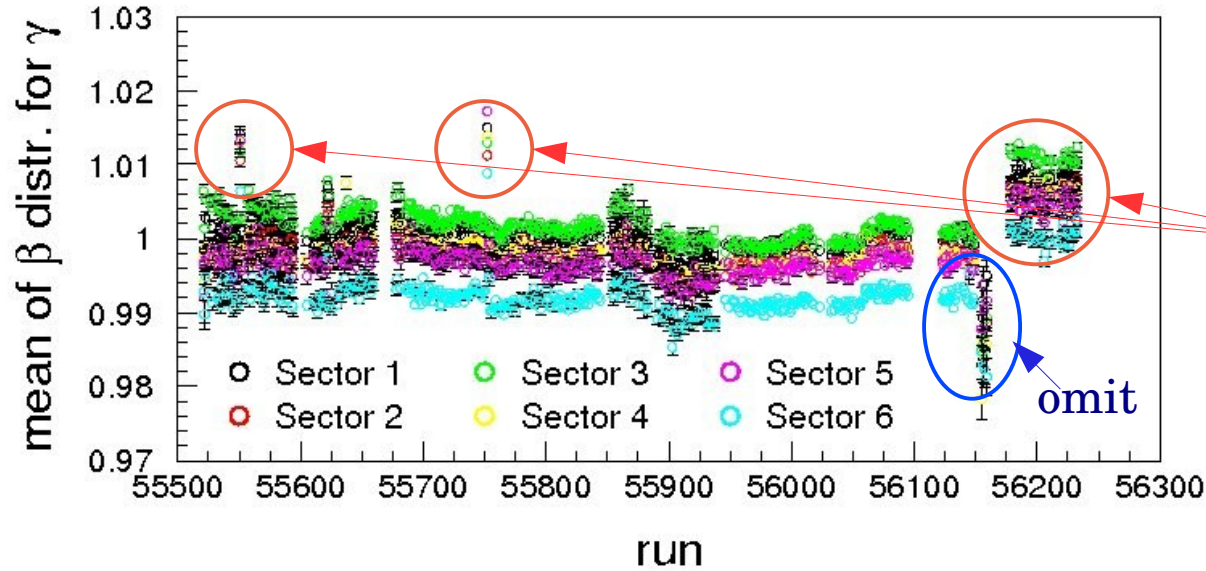
DC

Sean Kuvin, Evan McClellan, Sungkyun Park, Volker Crede



EC

Simona Malace



NMR (Target)

Jo McAndrew

Calibration is **complete**
Working on run by run

Cooking status

Sungkyun Park

Pass 1

v1 (Circularly polarized beam)

27 days, 4198 BOS files

Complete

v2 (Linearly polarized beam)

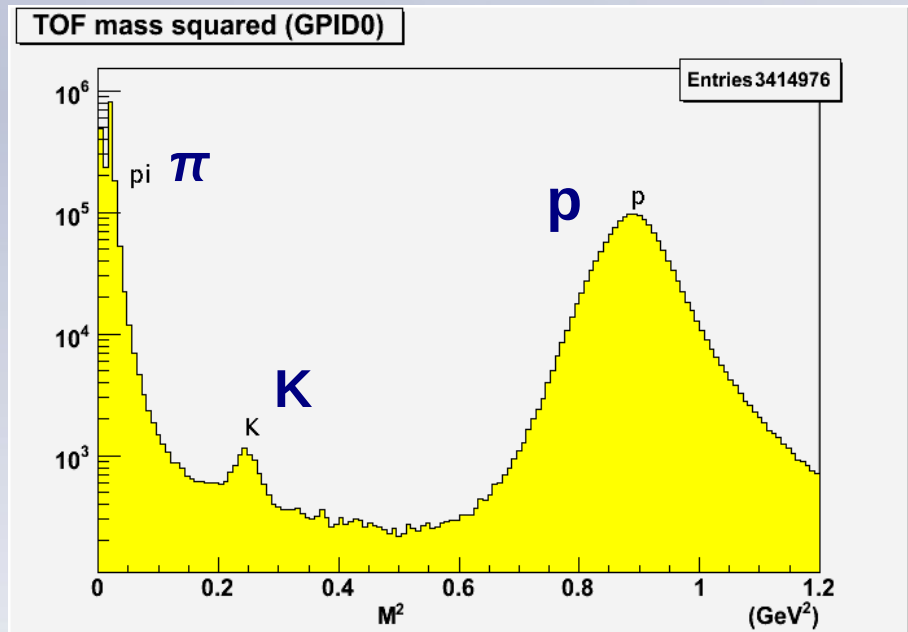
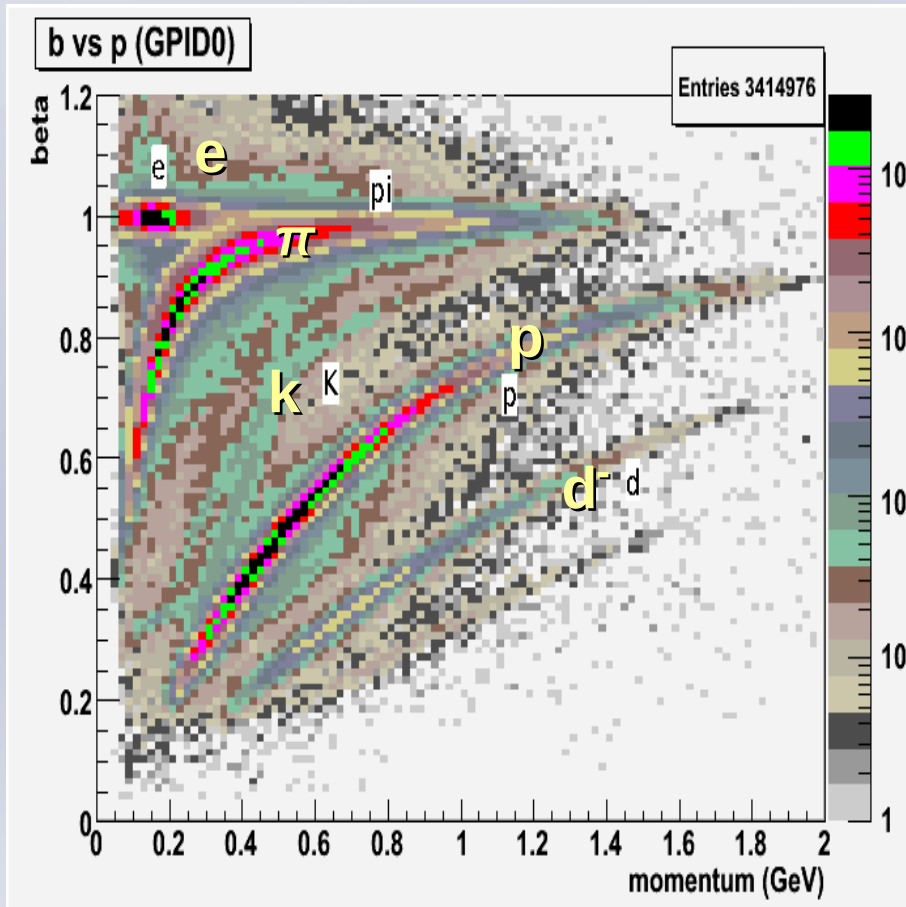
38 days, 11359 BOS files

Complete

Sample analysis - identify particles -

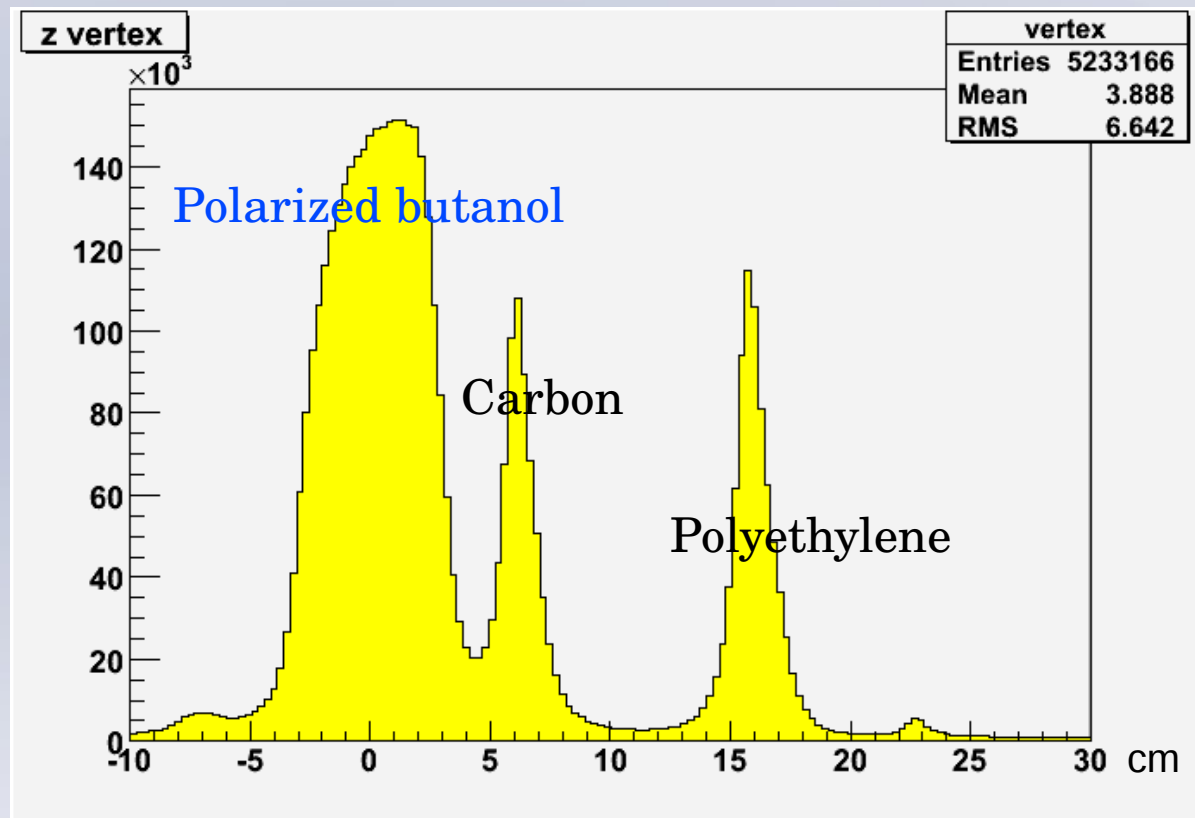
Franz Klein

Use tagger and TOF for β



Sample analysis - vertex cut -

Three targets



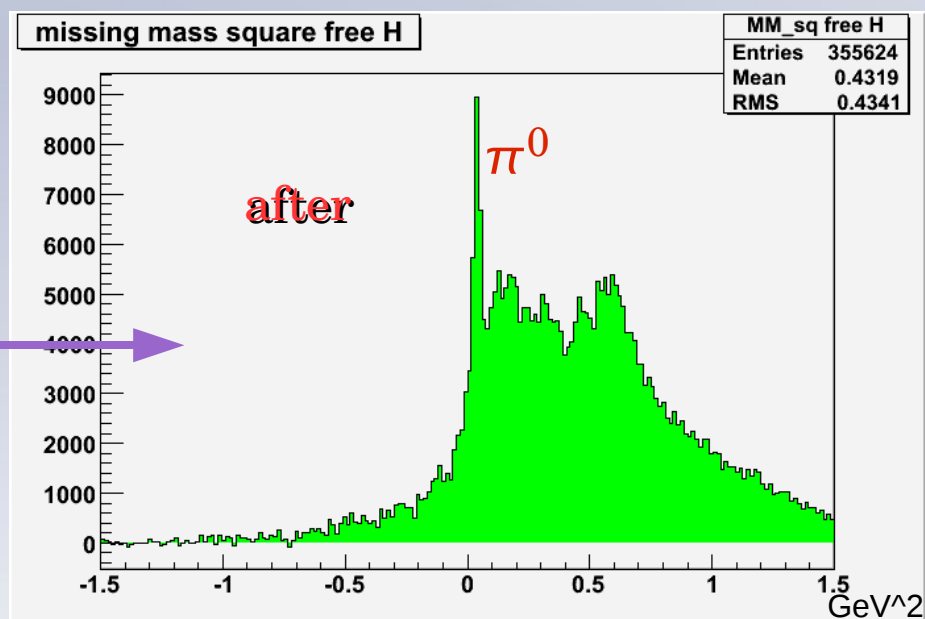
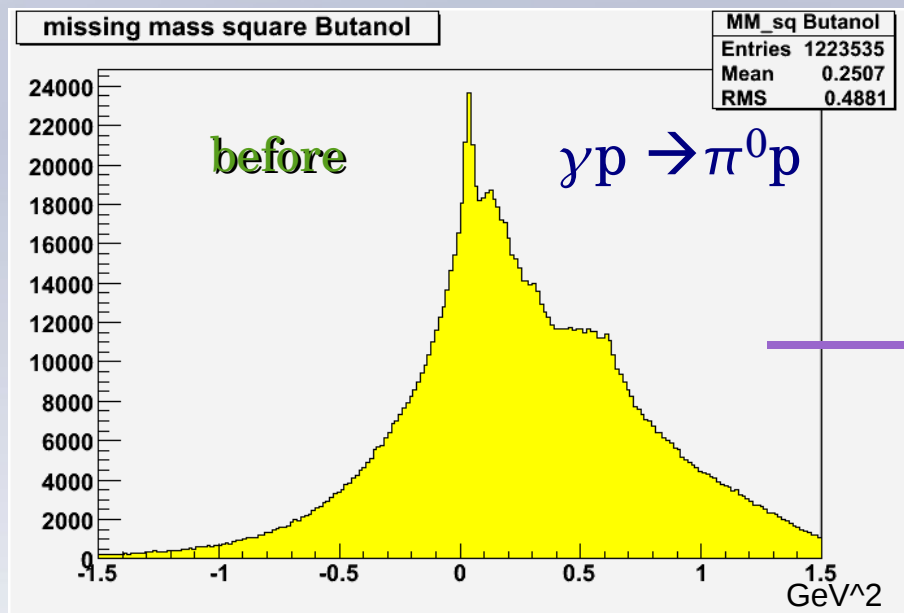
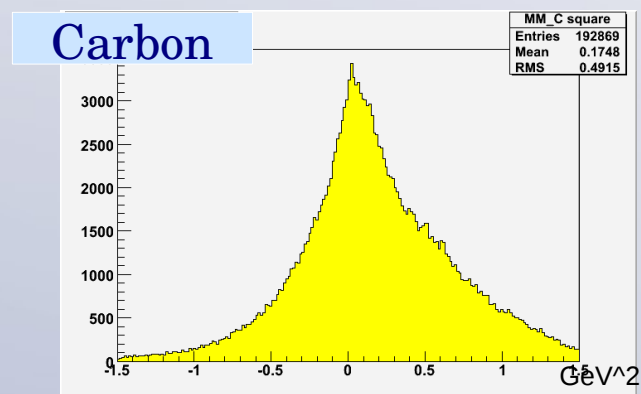
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Sample analysis - missing mass square -

Hideko Iwamoto

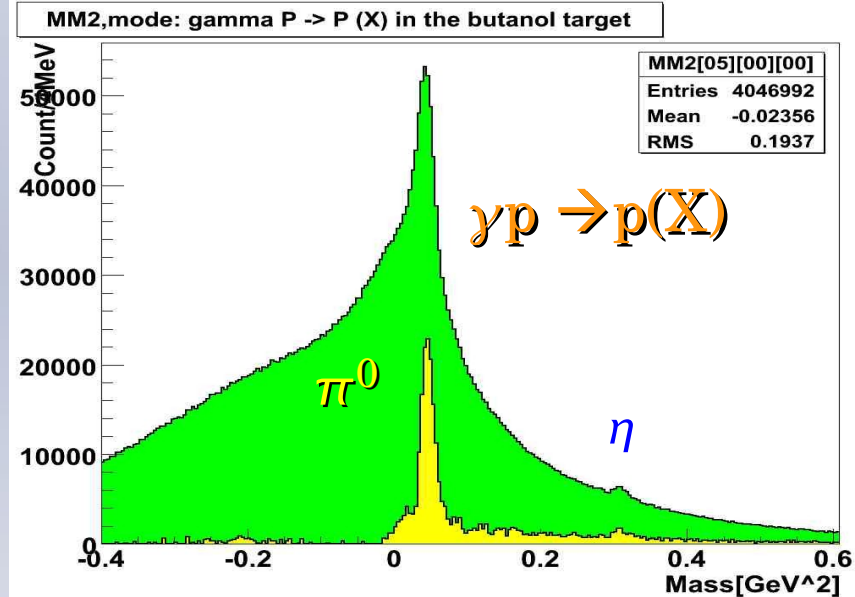
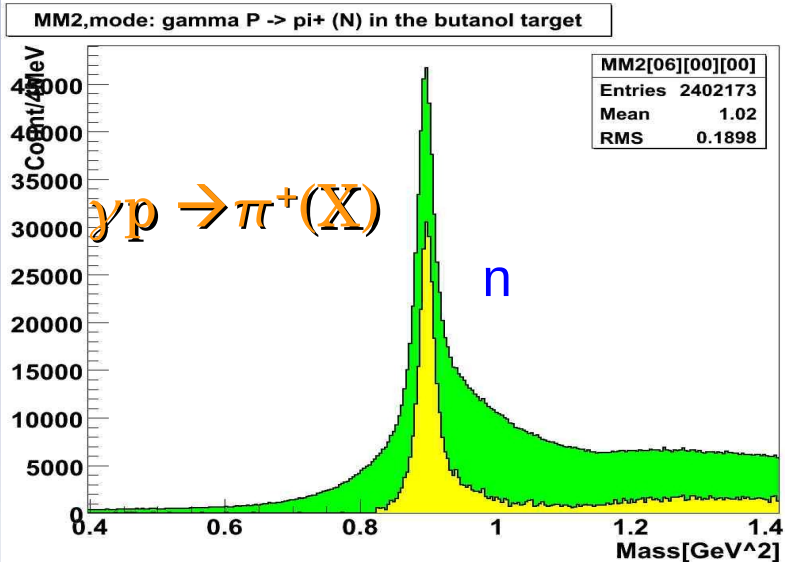
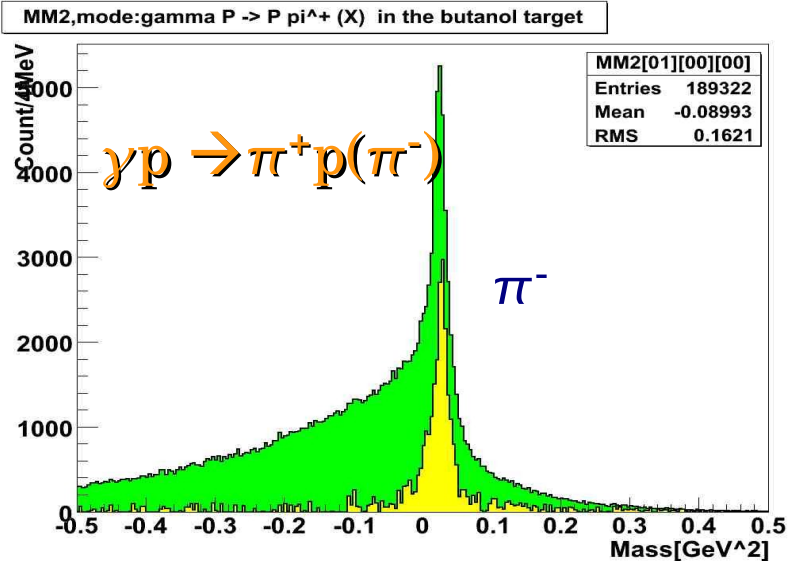
Missing mass square before and after
remove bound protons

→ subtract the carbon histogram

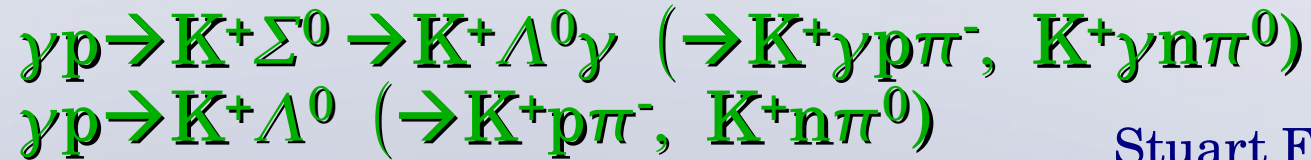


Sample analysis – Free hydrogen target -

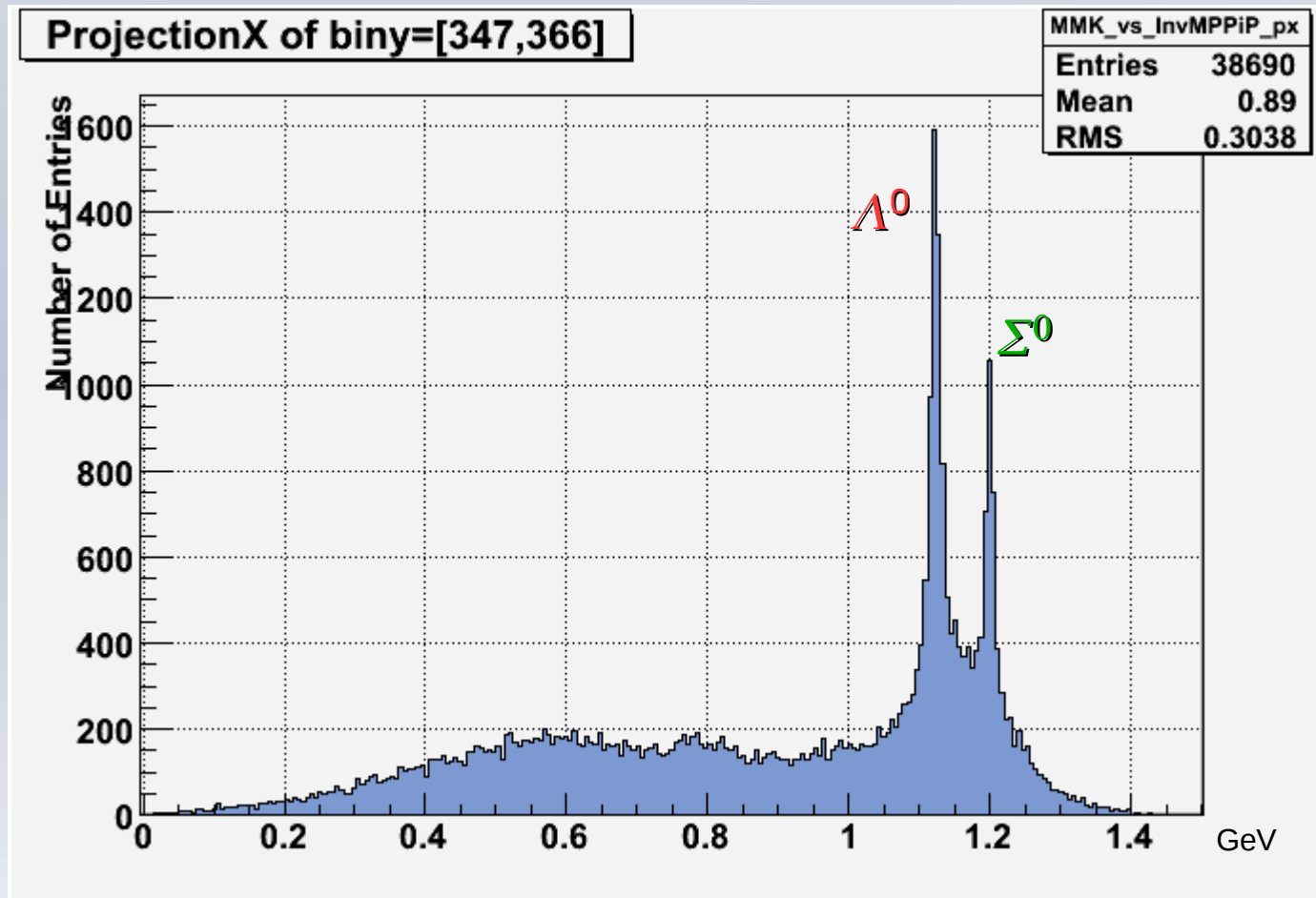
Sungkyun Park



Sample analysis - Hyperon -



Stuart Fegan

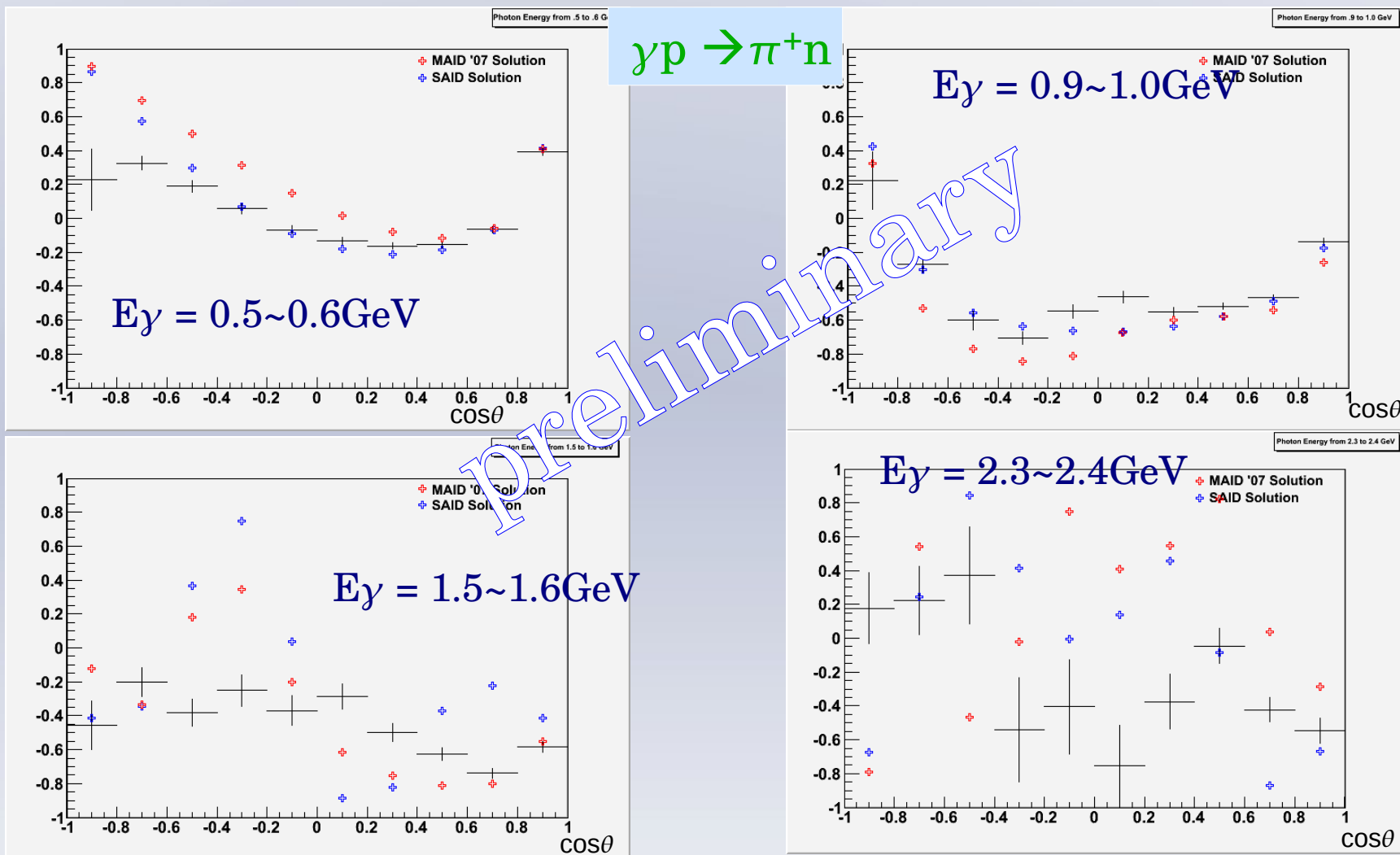


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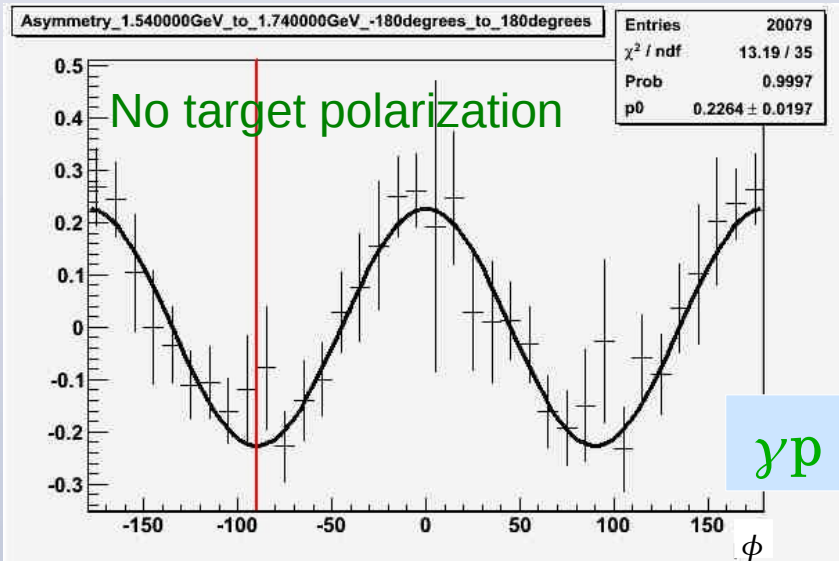
Sample analysis - Helicity asymmetry E -

$$\frac{d\sigma}{d\Omega} = \sigma_0 [1 - p_y p_z E] \quad E = \frac{(N_{1/2} - N_{3/2})}{(N_{3/2} + N_{3/2})}$$

Brian Morrison

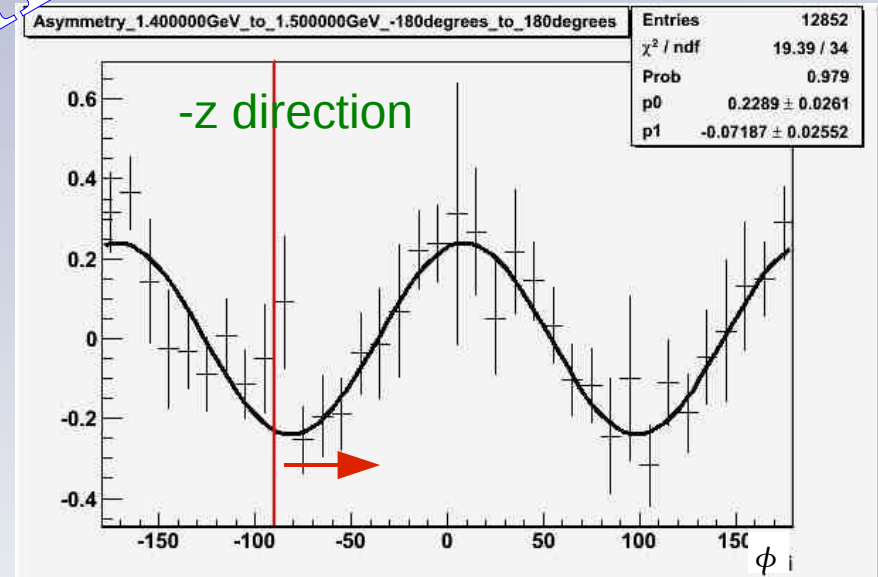
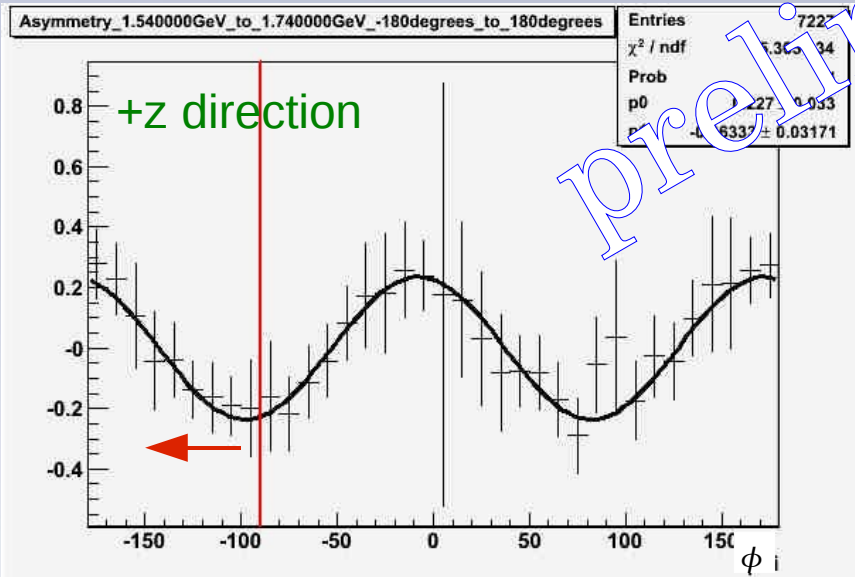


Sample analysis - asymmetry G -



$$\frac{d\sigma}{d\Omega} = \sigma_0 [1 - p_y \Sigma \cos(2\phi) + p_y p_z G \sin(2\phi)]$$

Jo McAndrew



Summary

Calibration: **complete**

Cooking : **complete**

Analysis : **in progress**