

Asymmetry Measurement of the Polarized Σ p Elastic Scattering and the Hyperon-Nucleon Spin-Orbit Interaction (KEK-PS E452)

T. Kadowaki, J. Asai, W.Imoto, S. Iwata, M. Kurosawa, K. Nakai
A. Sato, K. Imai, H. Takahashi, C.J. Yoon, T. Maruta, M. Ieiri
T. Nagae, H. Noumi, T. Fukuda, P.K. Saha, B. Bassalleck

Department of Physics, Tokyo University of Science
Department of Physics, Osaka University
Department of Physics, Kyoto University
Department of Physics, University of Tokyo
High Energy Accelerator Research Organization (KEK)
Laboratory of Physics, Osaka Electro-Communication University
Department of Physics, University of New Mexico

E452 Publications

Physics papers published in refereed journals

Hyperon Scattering Experiments with a new Tracking Detector 'SCITIC'.

J. Asai, T. Fukuda, M. Ieiri, K. Imai, W. Imoto, S. Iwata, T. Kadowaki, M. Kurosawa, T. Maruta, T. Nagae, H. Noumi, P.K. Saha, A. Sato, H. Takahashi, C.J. Yoon, K. Nakai : Jpn. J. Appl. Phys. vol.43, pp.1586-1592 (2004)

Spin –Dependent Interactions in Hyperon Nucleon Scattering

K. Nakai : Nucl.. Phys. vol.A721, pp.673-678 (2003)

Asymmetry Measurement of the Polarized $\Sigma + P$ Elastic Scattering and the Hyperon Nucleon Spin-Orbit Interaction.

T. Kadowaki, J. Asai, W. Imoto, S. Iwata, M. Kurosawa, K. Nakai, A. Sato, K. Imai, H. Takahashi, C.J. Yoon, T. Maruta, M.Ieiri, T. Nagae, H. Noumi, T. Fukuda, P.K. Saha, B. Bassalleck, : Eur. Phys. J. vol.A15, pp.295-298 (2002)

Scintillating Track Image - SCITIC.

By A. Sato, J. Asai, M. Ieiri, S. Iwata, T. Kadowaki, M. Kurosawa, T. Nagae, K. Nakai. : Jpn. J. Appl. Phys. vol.43, pp.1593-1601 (2004)

Doctor theses

Akira Sato (2001) : Development of a New Tracking Detector for Hyperon-Nucleon Scattering Experiments (in Japanese)

Tetsuto Kadowaki (2002) : Asymmetry Measurement of the Polarized Hyperon-Nucleon Elastic Scattering

Jyunkichi Asai (2004) : Measurements of asymmetry and depolarization parameters in the polarized $\Sigma + p$ elastic scattering

Motivatio

n

Povh & Pirner

$$V_c^{\Lambda N} = (2/3)V_c^{NN}$$

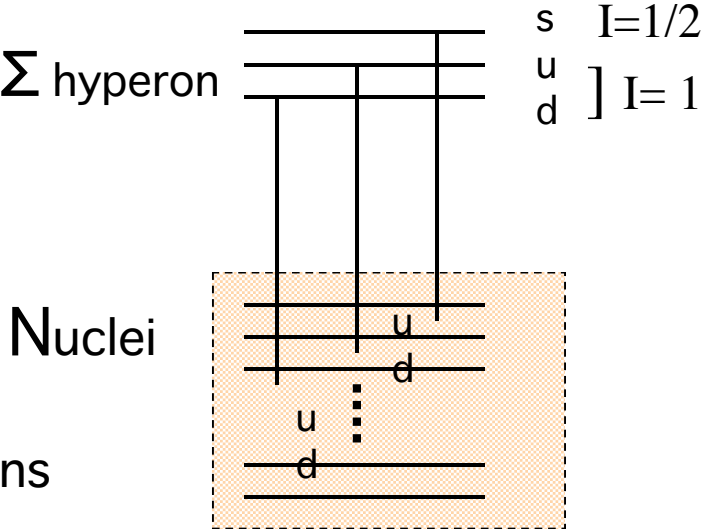
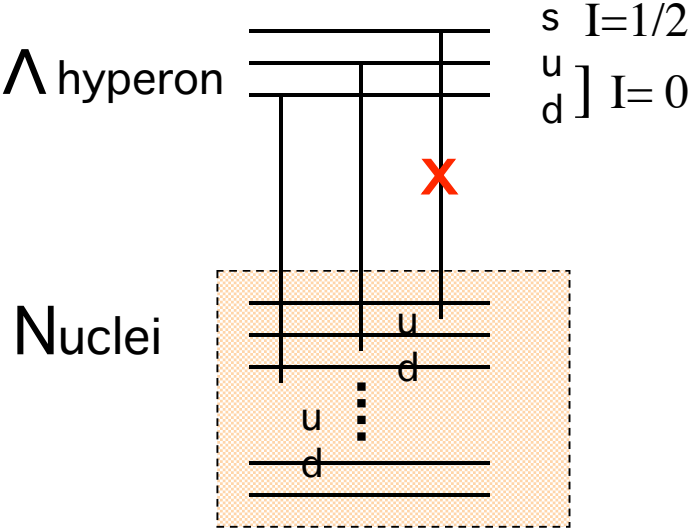
$$V_{LS}^{\Lambda N} \sim 0$$

Yazaki

$$V_{SLS}^{\Lambda N} \simeq -V_{ALS}^{\Lambda N}$$

$$V_{LS}^{\Sigma N} \text{ Large ??}$$

- X Σ hypernuclear experiments
- \Rightarrow Scattering exp. of polarized hyperons



Active Target Tracking Detectors

1950's M. Perl : Luminescent Chamber

1970's Bubble chambers for hyperon experiments

1990's SCIFI detectors by the Kyoto/Nagoya group

1992 Hazumi & Yamada at INS : use of a bulk scintillator

1995 D.Measday at KAON workshop : why not bulk scintillator ?

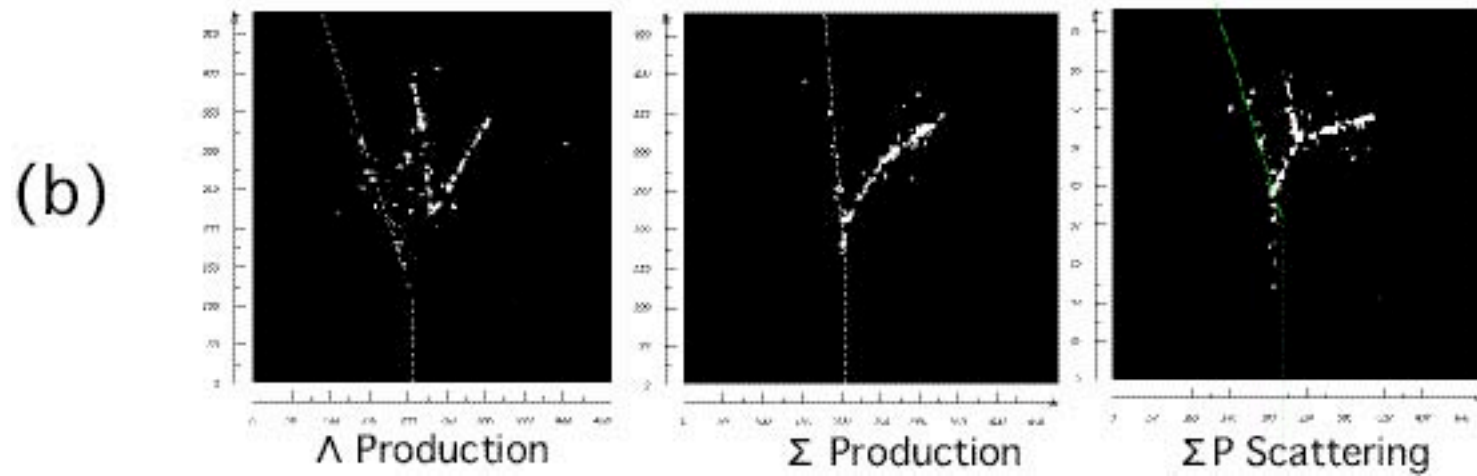
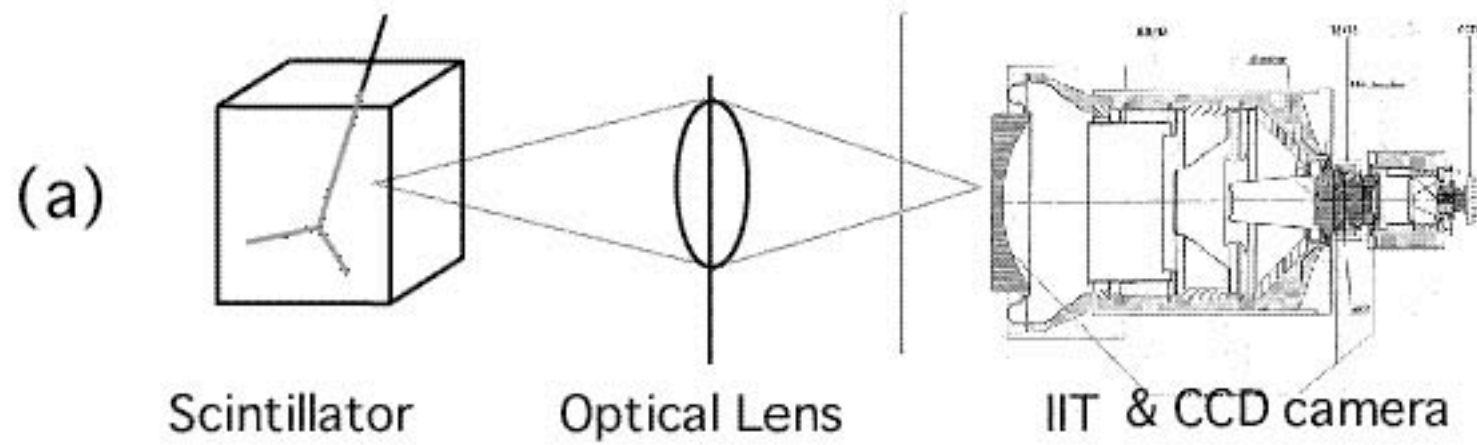
1995 Knoll exercise in his textbook: can you see a track of β -ray with your eye?

1990 SCITIC (Scintillating track image camera)

1999 Proposal of E452 with SCIFI and SCITIC : cosmic muons, beams (T457, T467)

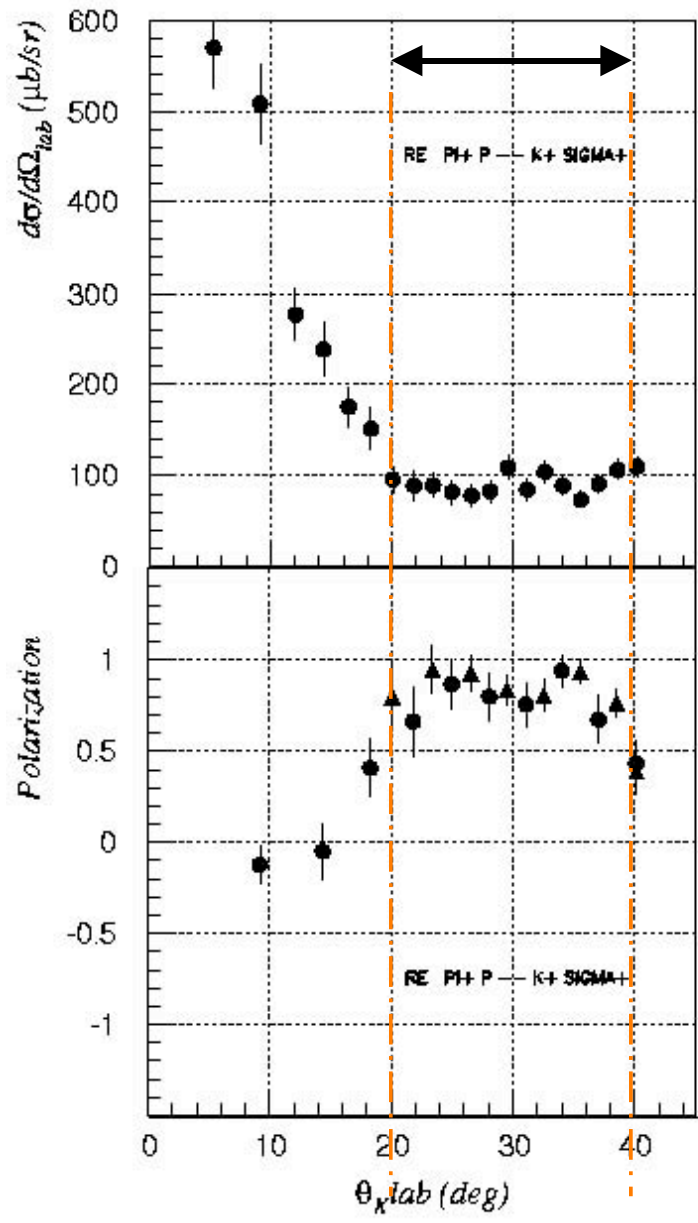
2000 E452A with SCITIC : the first use of SITIC for a physics experiment.

2001 E452B&C with new SCITIC : analysis of SCITIC data



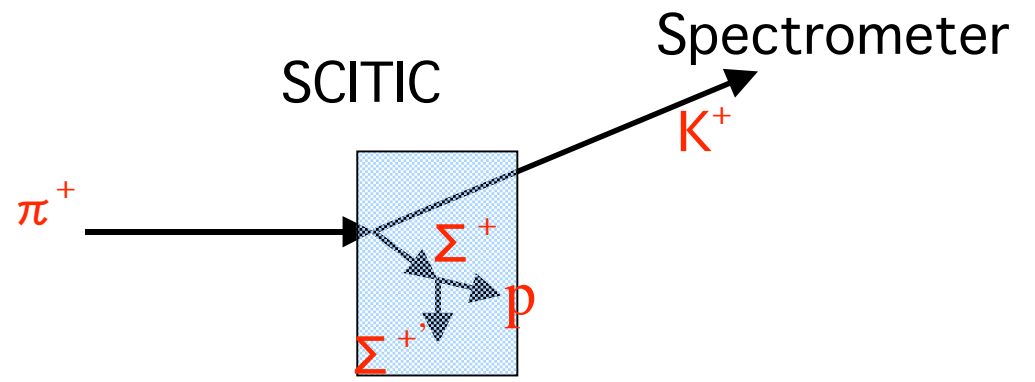
Production of Polarized Σ^+

$$p(\pi^+, K^+) \Sigma^+, \text{ at } E_\pi = 1.67 \text{ GeV}$$



Production Cross Section

From Candlin et al., Nucl. Phys. **B226** (1983) 1

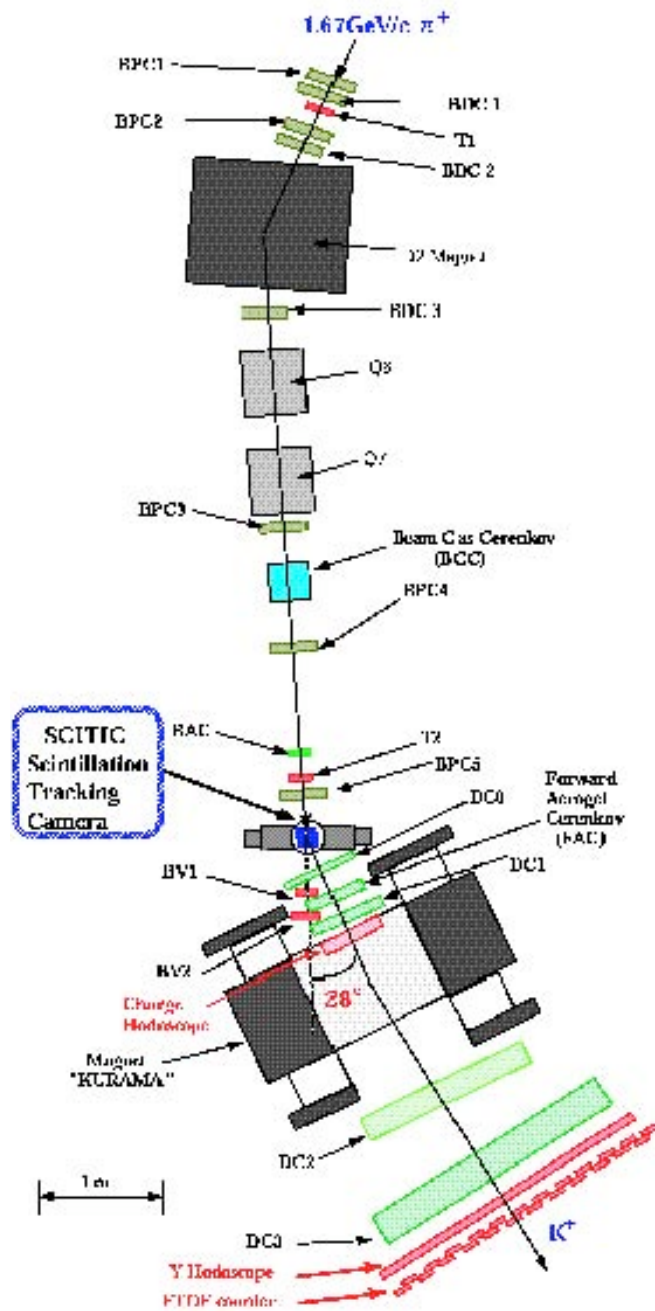


Polarization

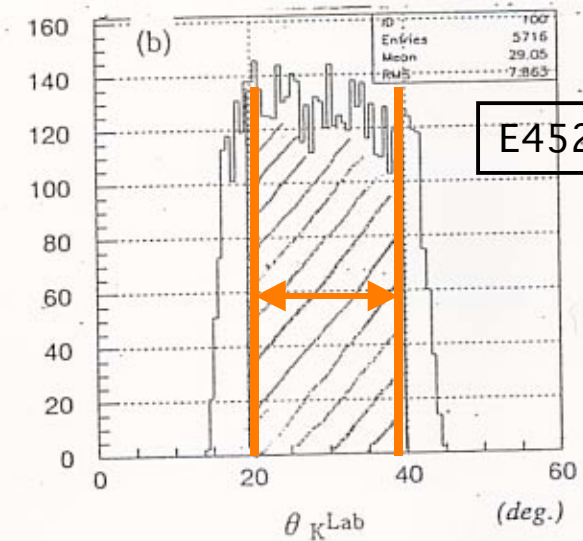
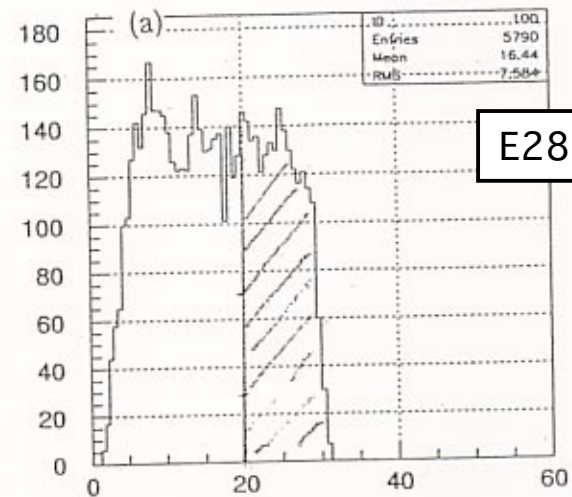
From Candlin et al., Nucl. Phys. **B226** (1983) 1,
Haba et al., Nucl. Phys. **B299** (1988) 627

left/right asymmetry

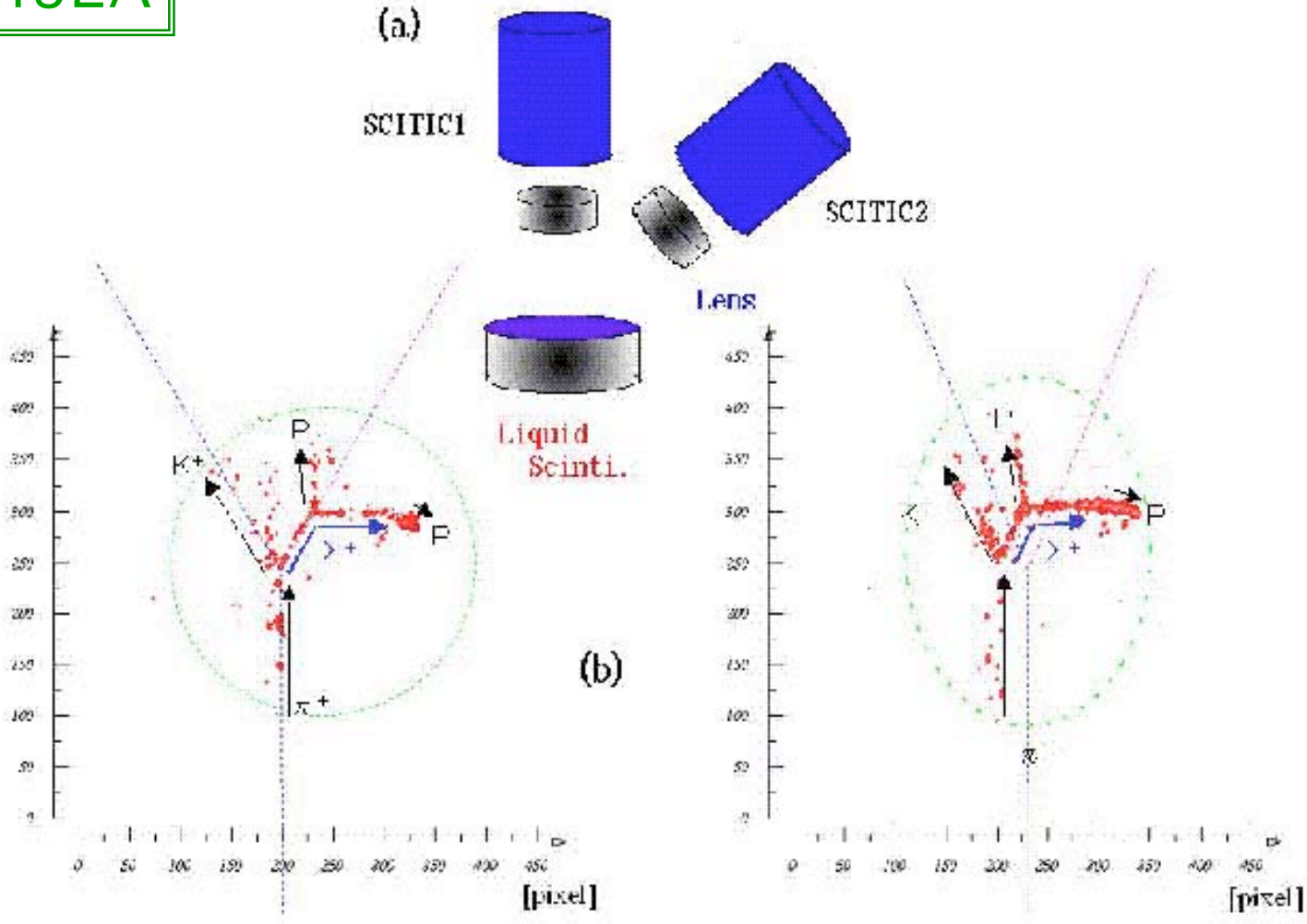
$$A = \frac{N_L - N_R}{N_L + N_R}$$



Spectrometer acceptance



E452A



Event-selection statistics

Triggered events 600,000

invariant -mass cut, vertex cut

(π, K) events 60,000

Eye scanning

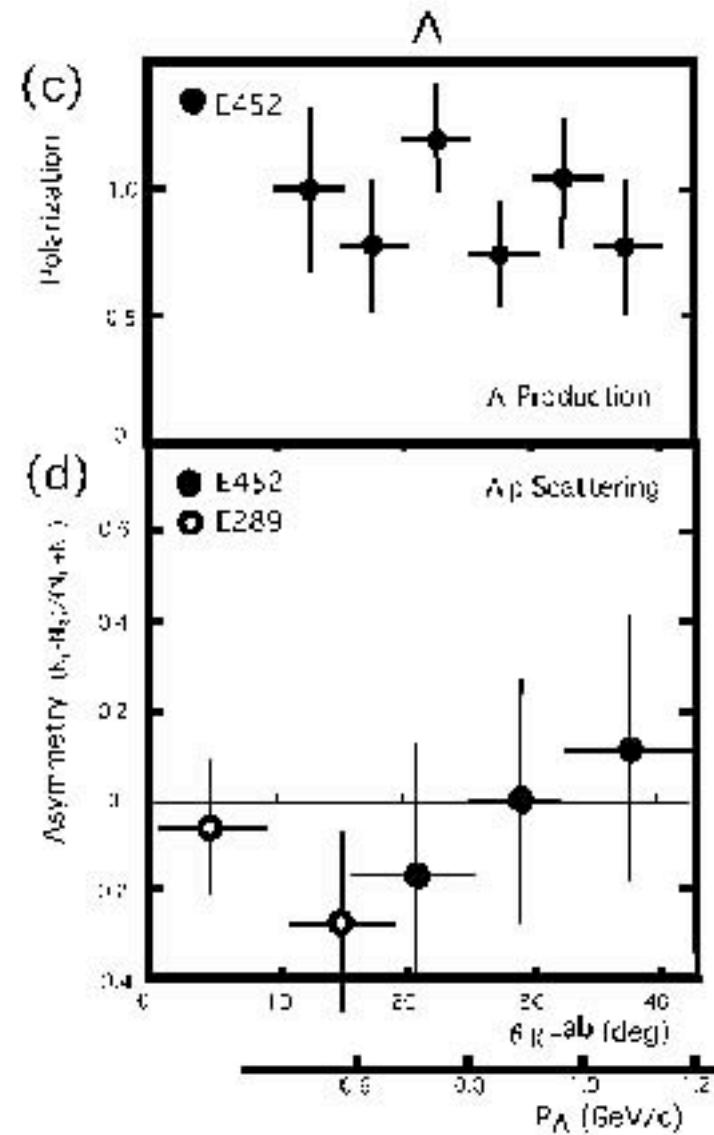
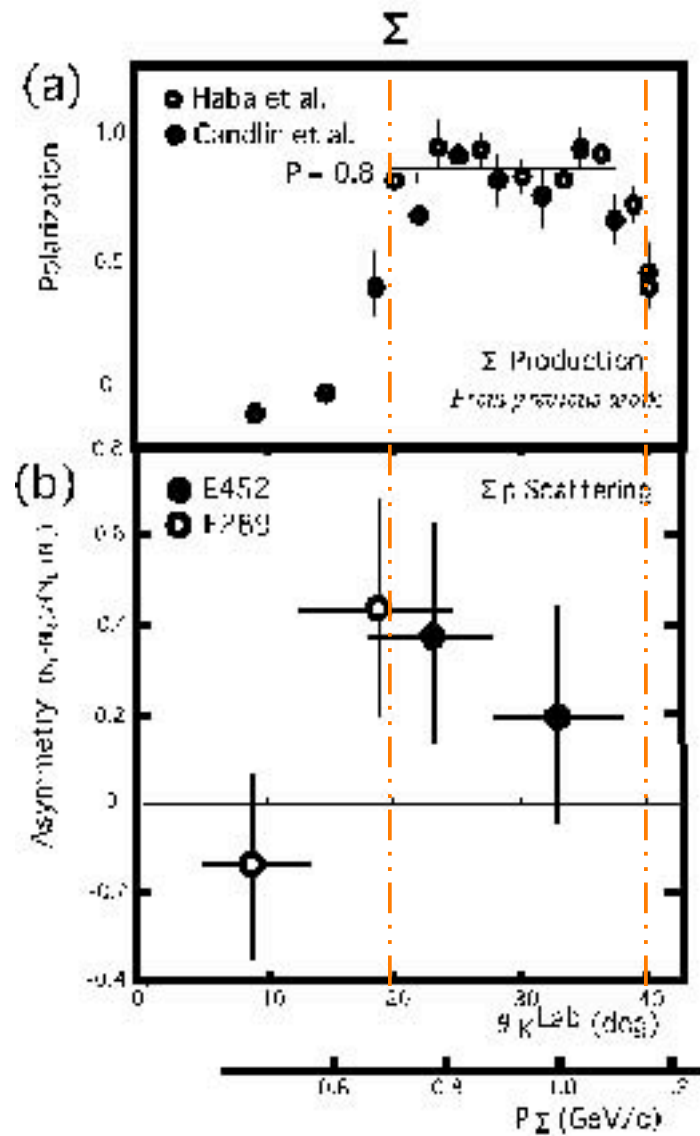
Σ^+ p candidates 500

Pointing, 3D-reconstruction,
Kinematical cut

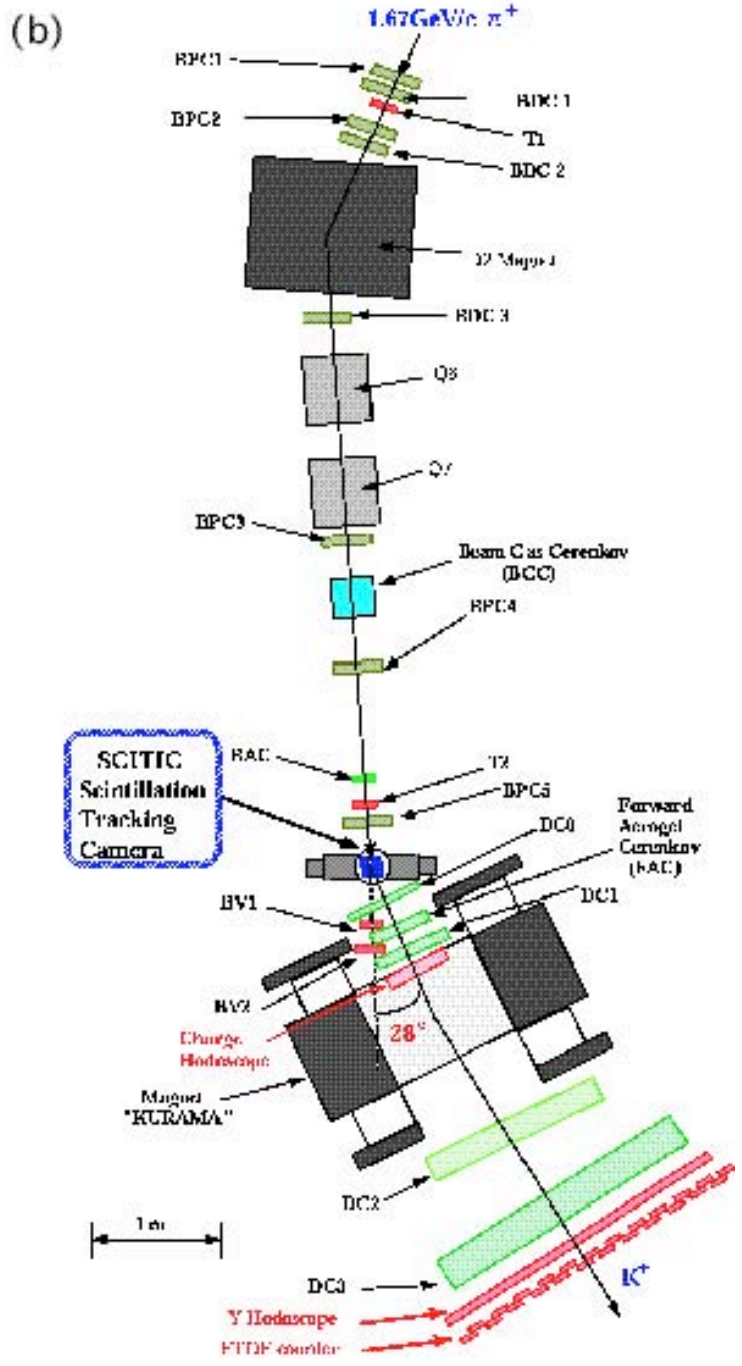
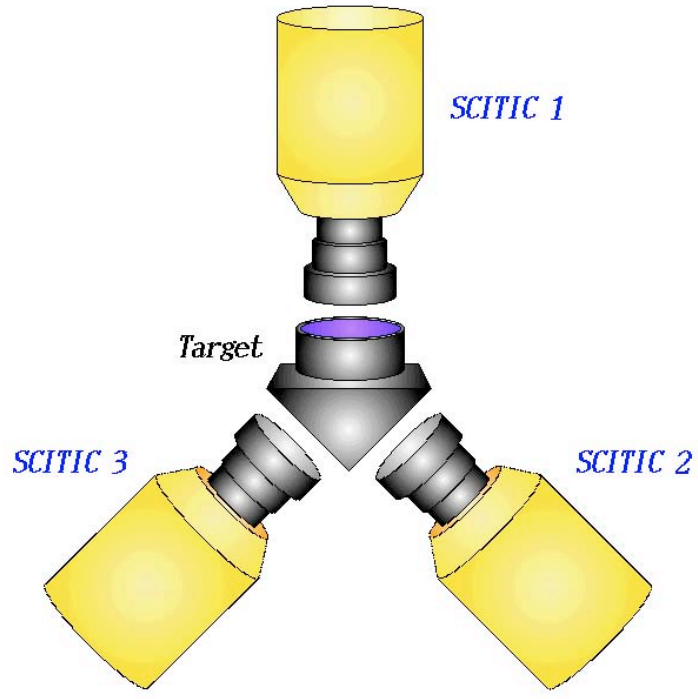
Pure Σ^+ p scattering 31

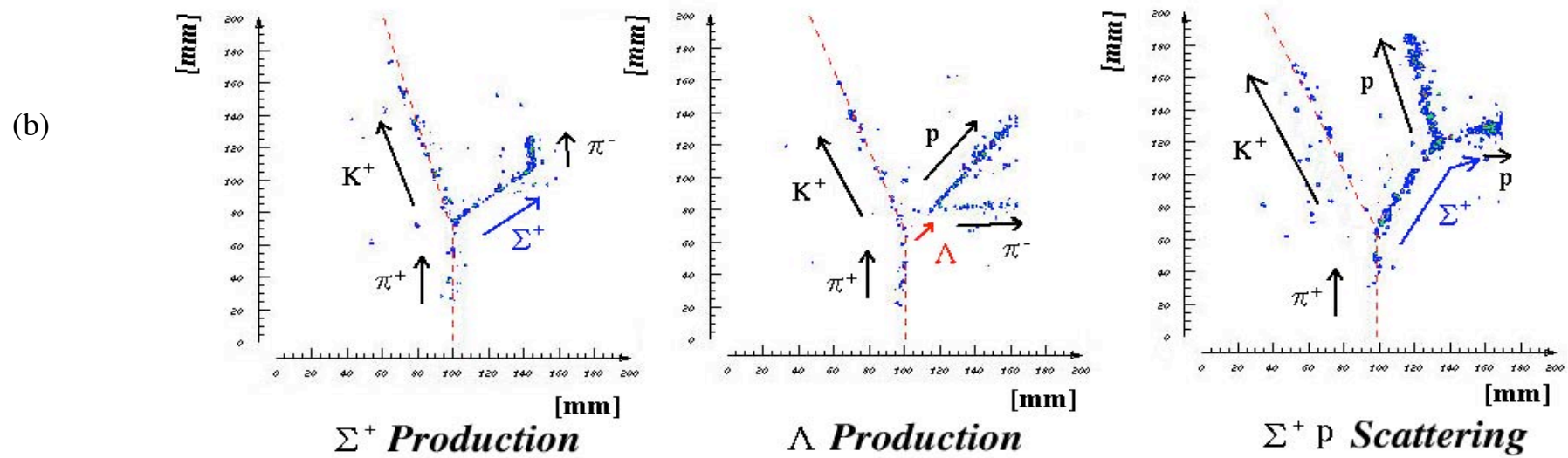
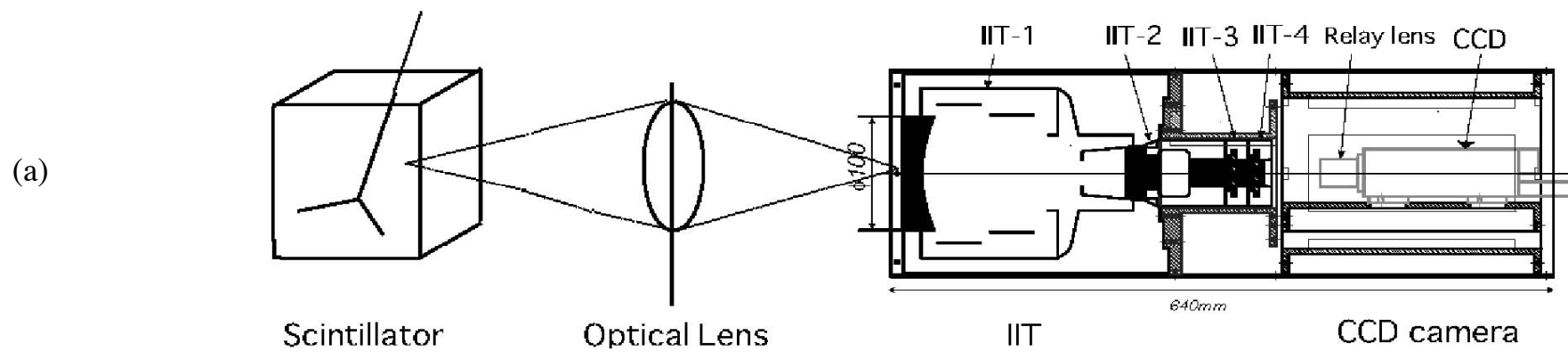
$$A = \frac{N_L - N_R}{N_L + N_R}$$

E452A

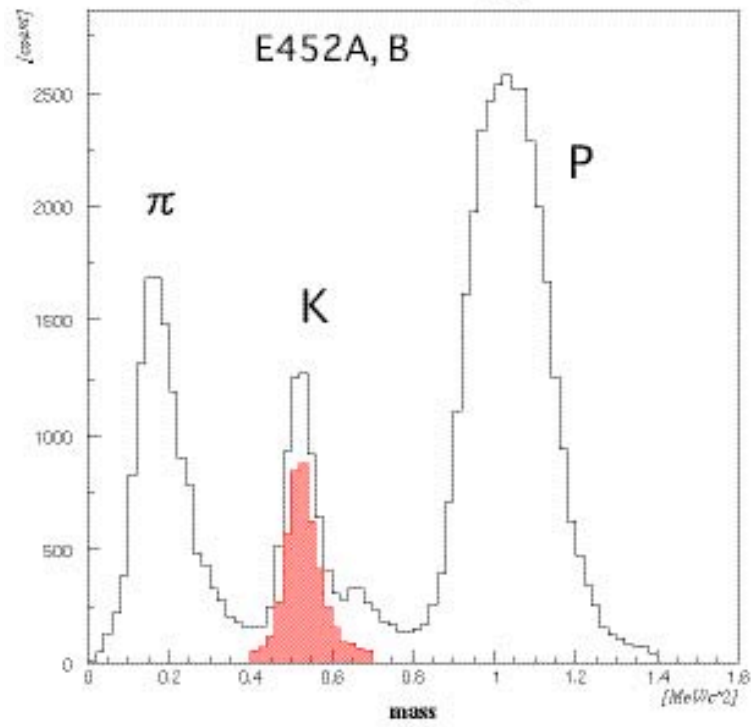


E452B & C

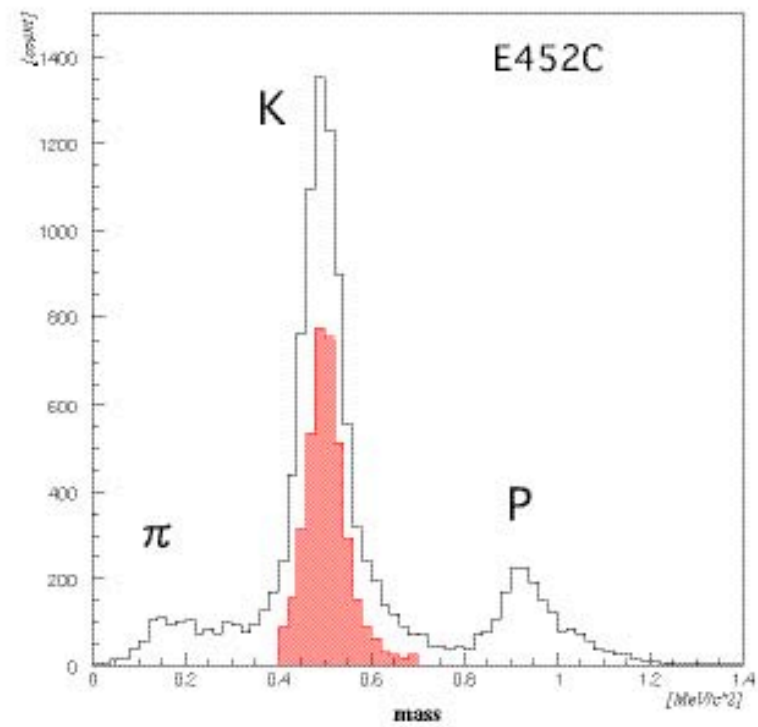




Standard Trigger



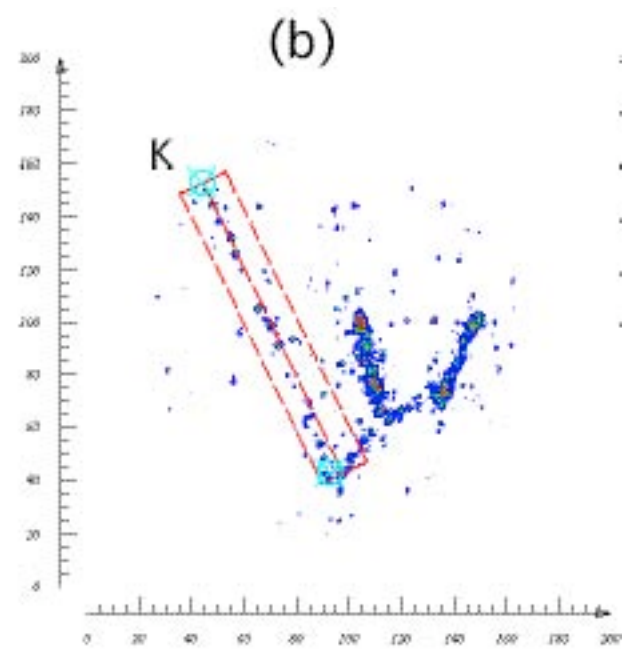
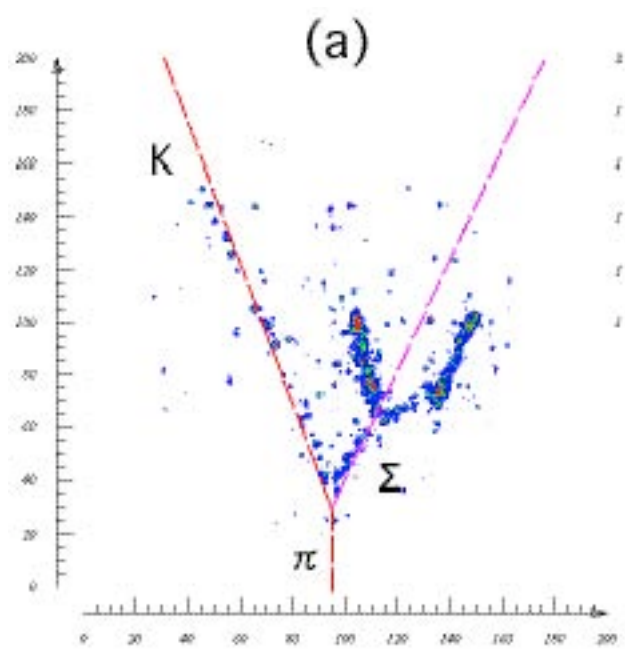
New Trigger

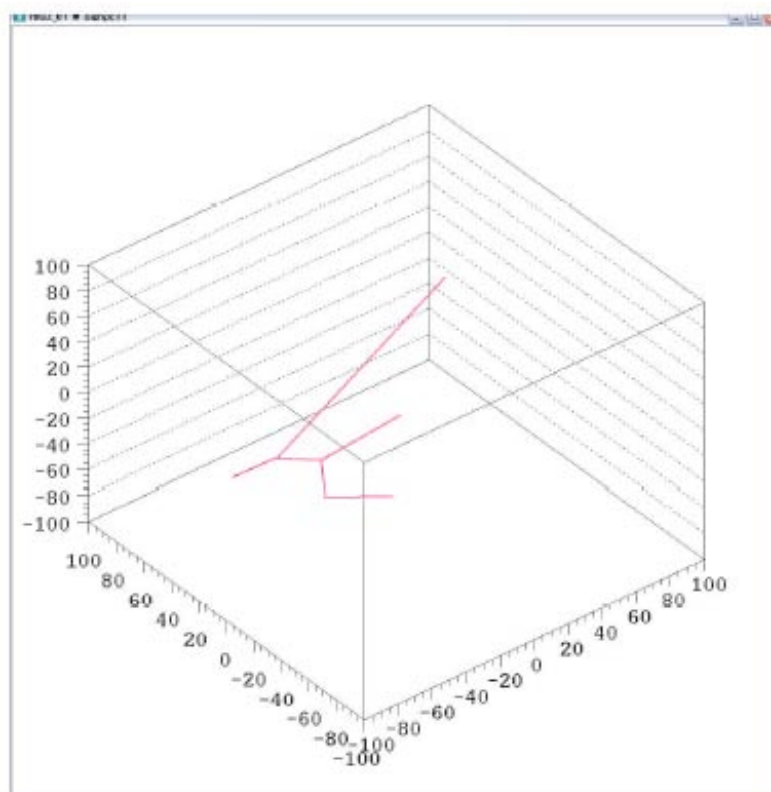
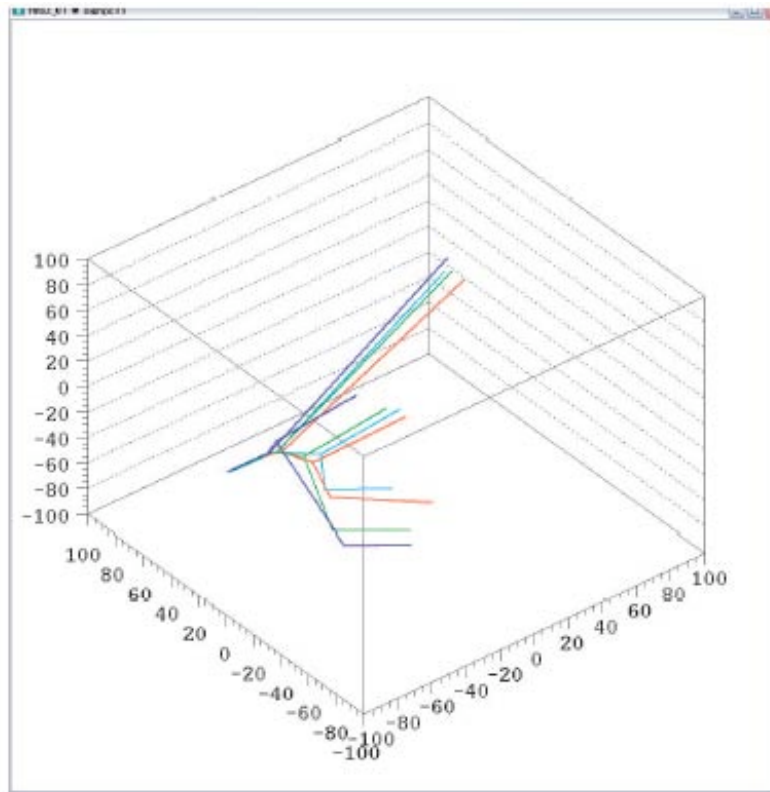


Event-selection statistics

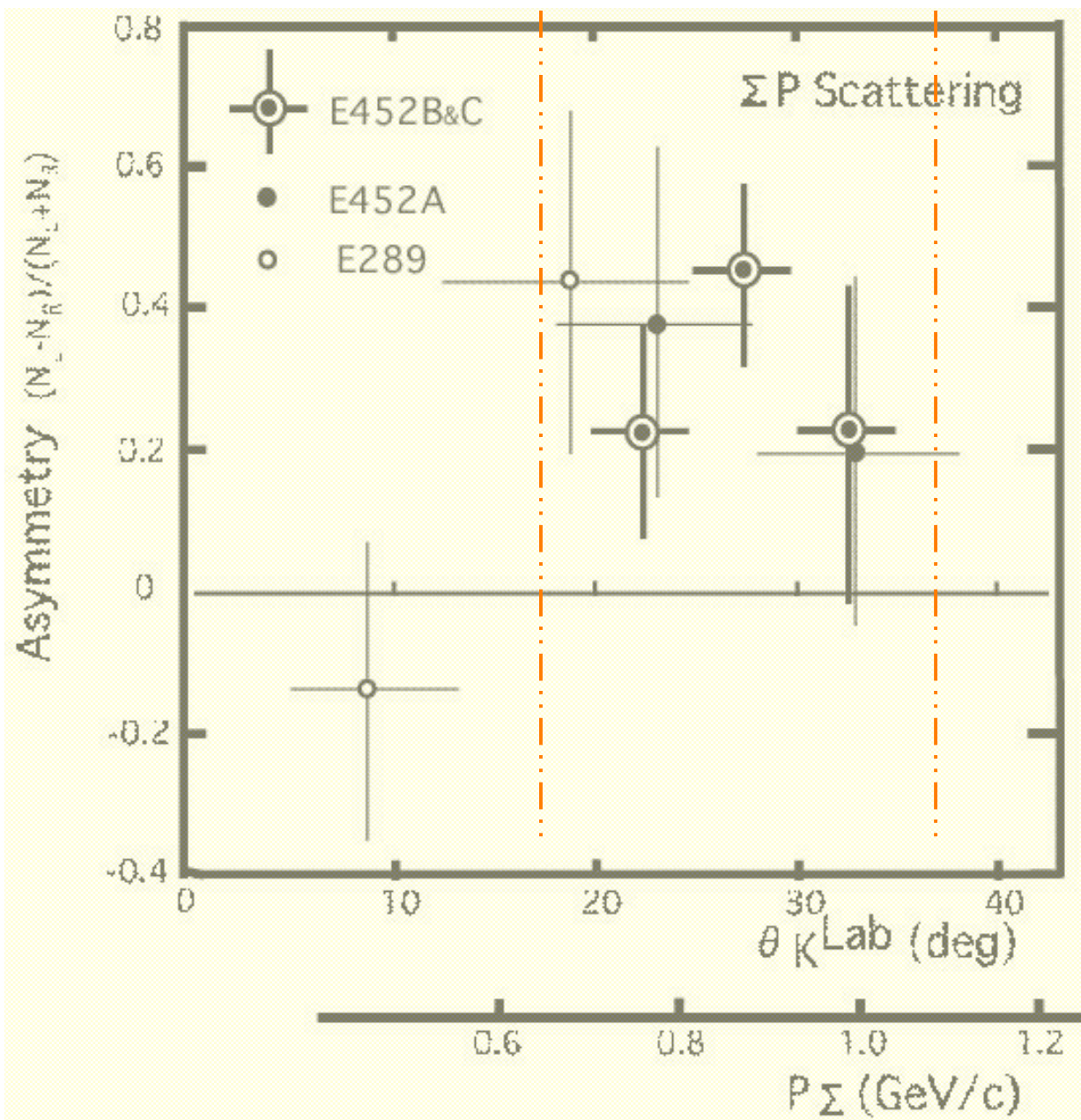
	452B&C	E452A
<u>Triggered events</u>	<u>7,000,000</u>	<u>600,000</u>
invariant -mass cut, vertex cut		
<u>(π,K) events</u>	<u>700,000</u>	<u>60,000</u>
Eye scanning		
<u>Σ^+ p candidates</u>	<u>2,400</u>	<u>500</u>
Pointing, 3D-reconstruction, Kinematical cut		
<u>Pure Σ^+ p scattering</u>	<u>111</u>	<u>31</u>

$$A = \frac{N_L - N_R}{N_L + N_R}$$

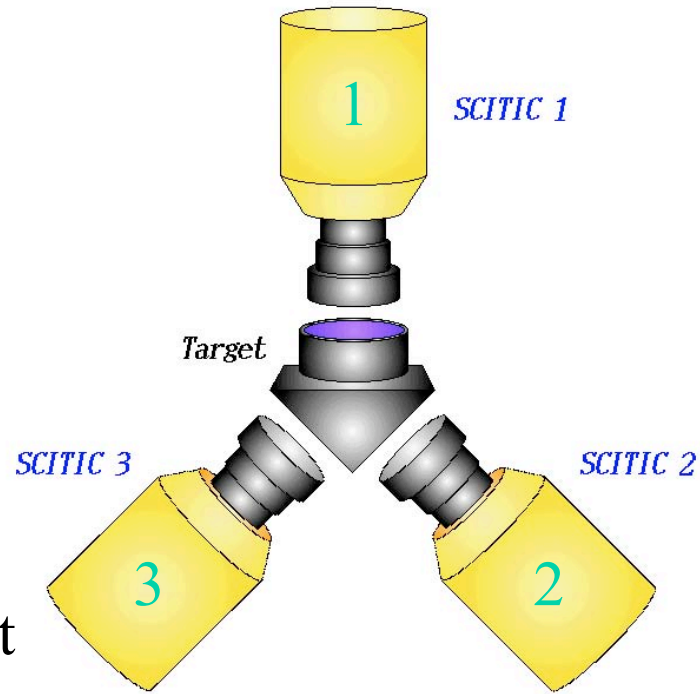




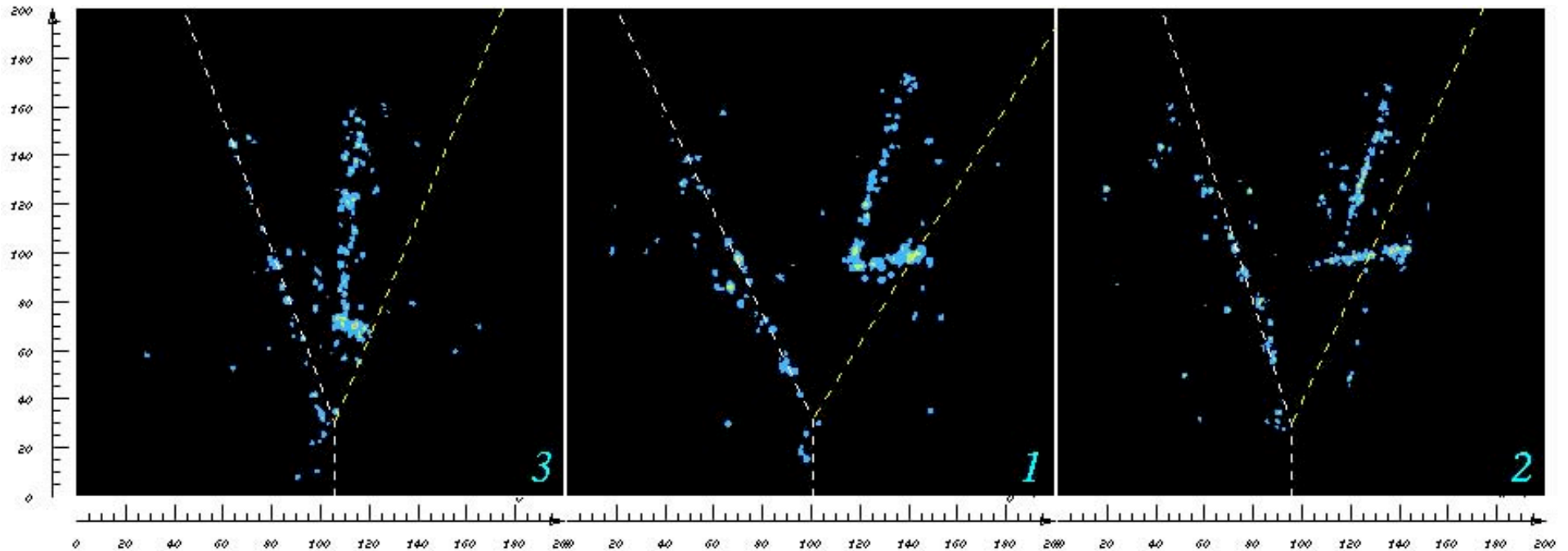
E452B & C

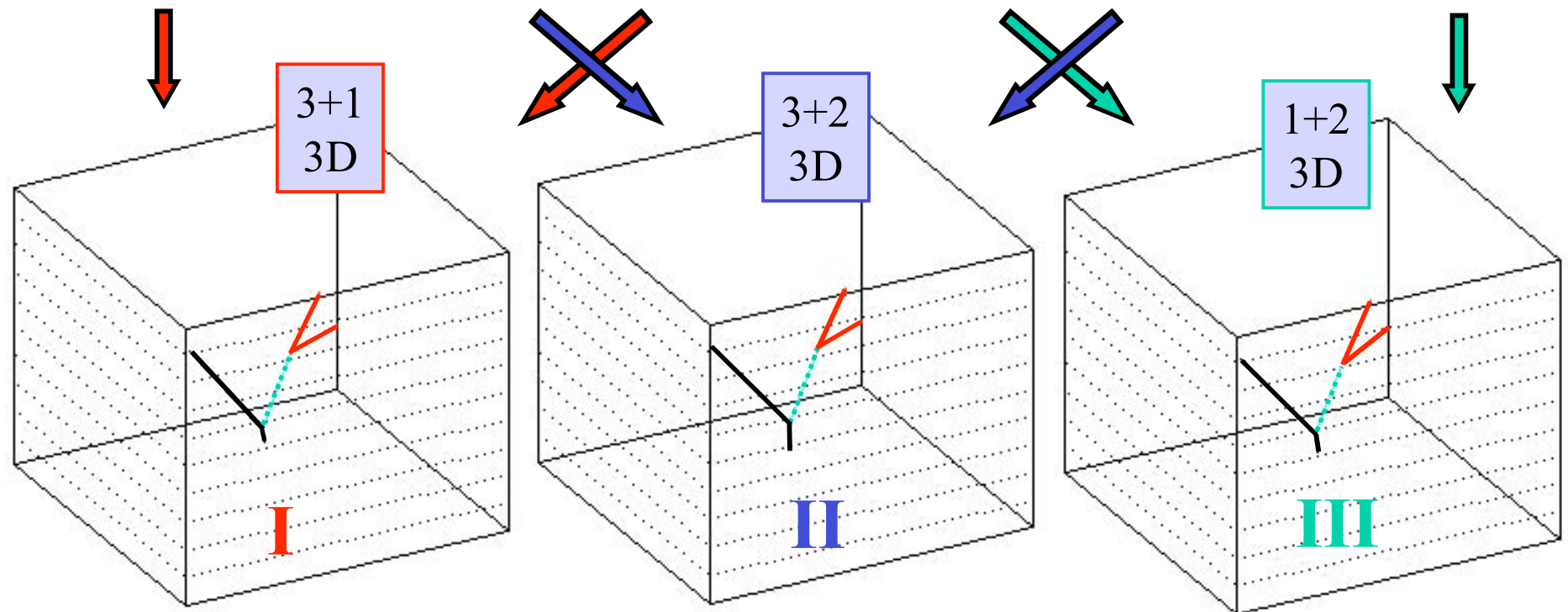
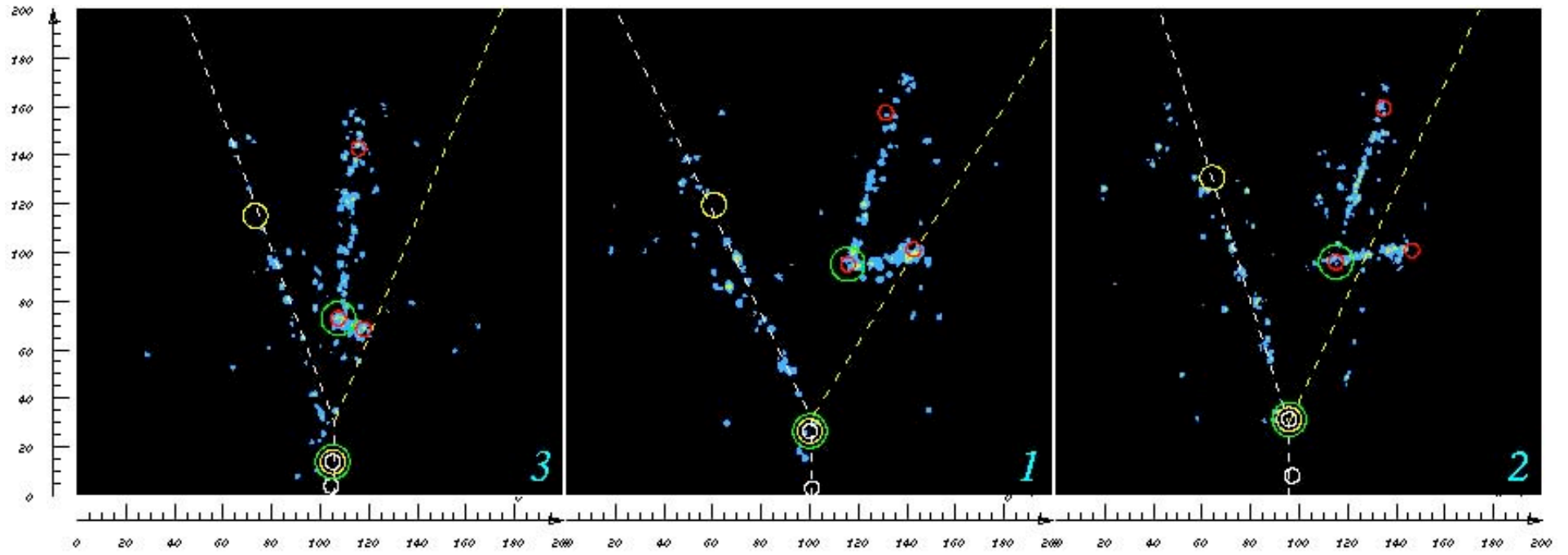


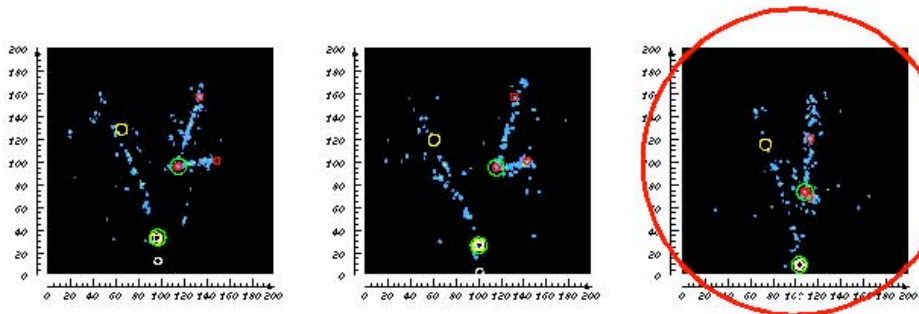
Check the Image



An example of a
 Δ production event







1 & 2

END **LAM**

1 & 3

SIG **SIG-P**

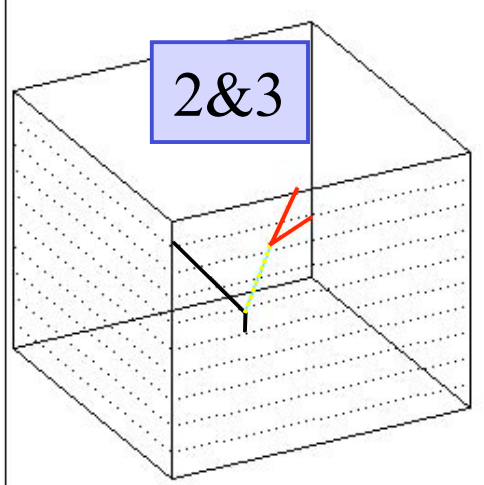
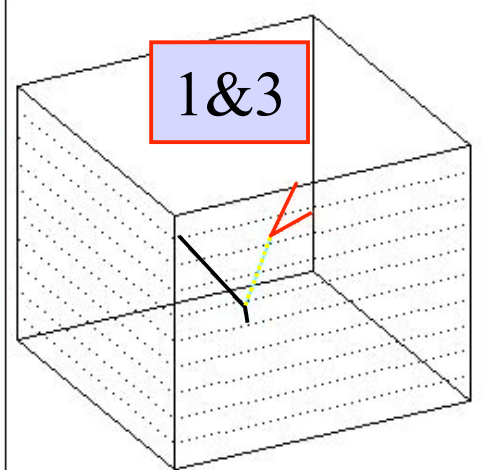
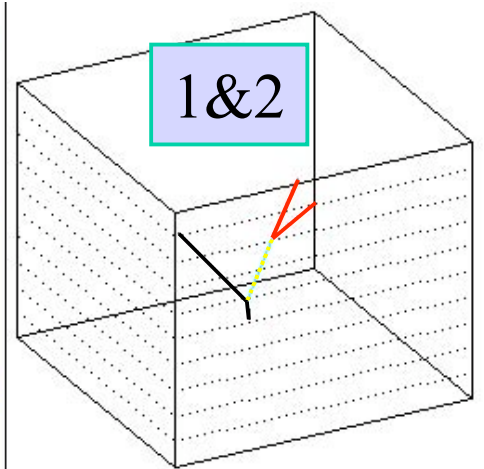
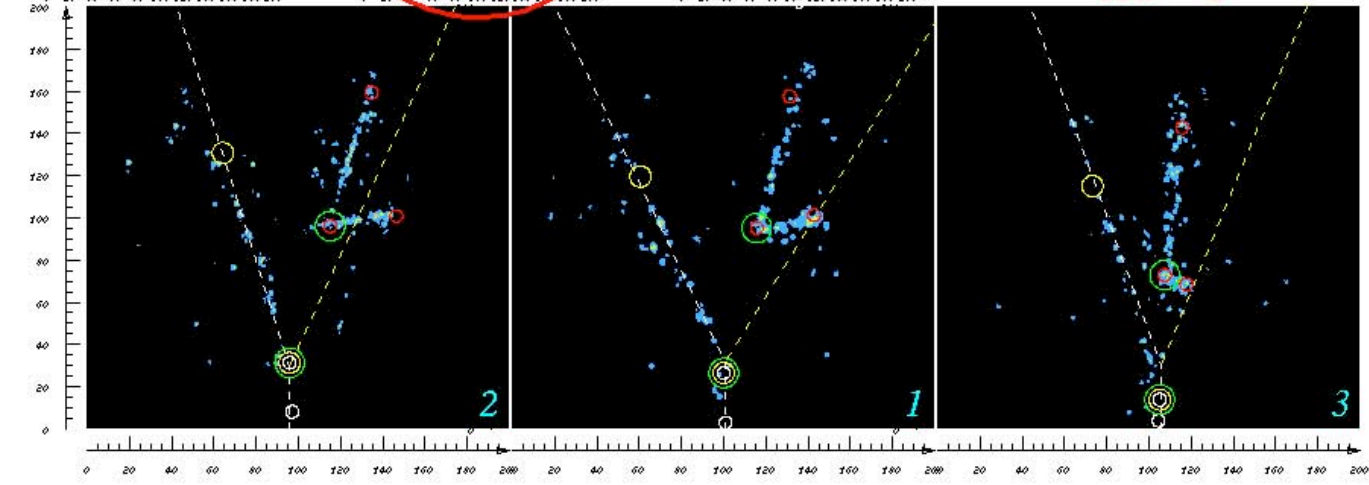
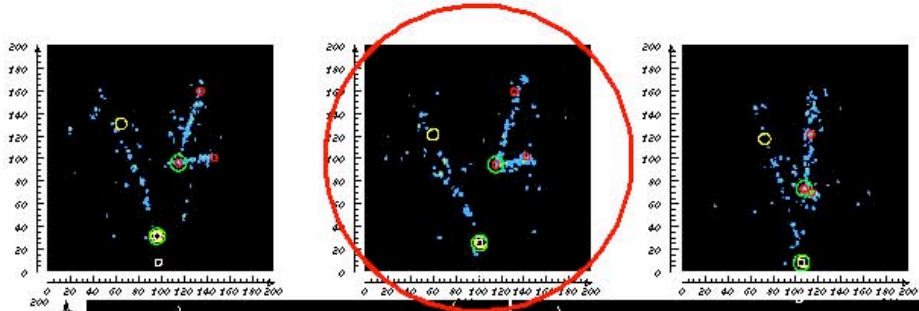
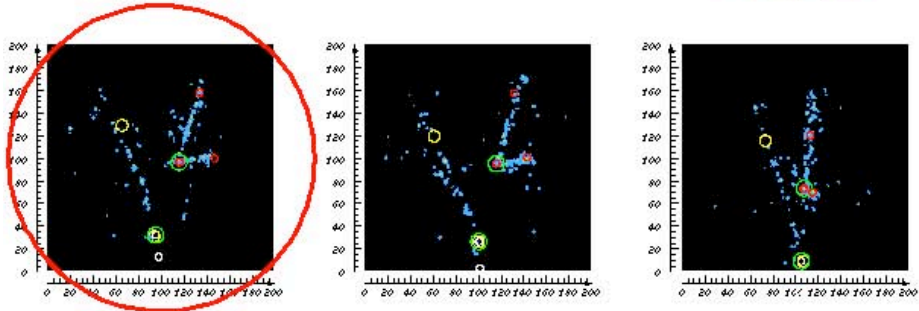
2 & 3

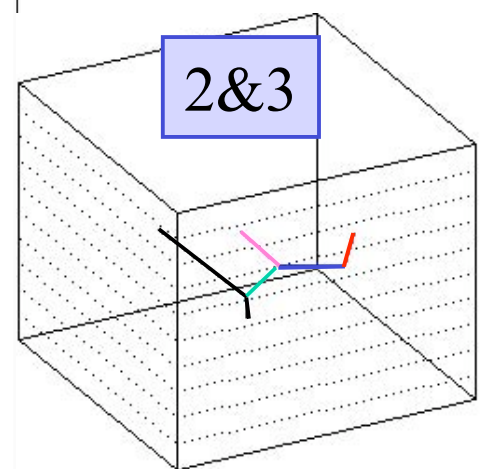
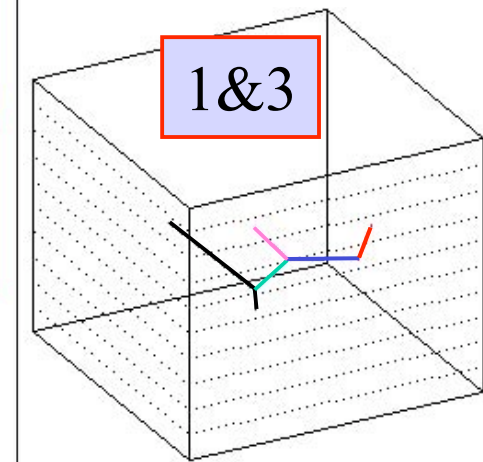
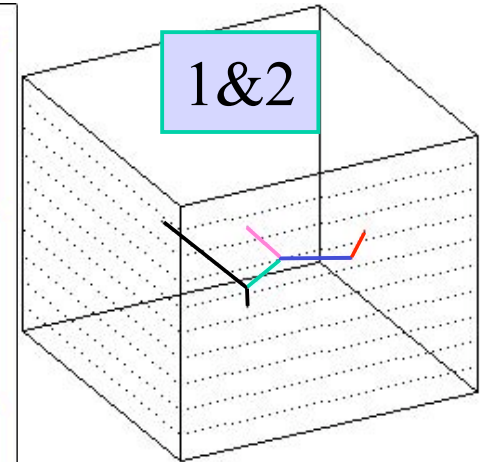
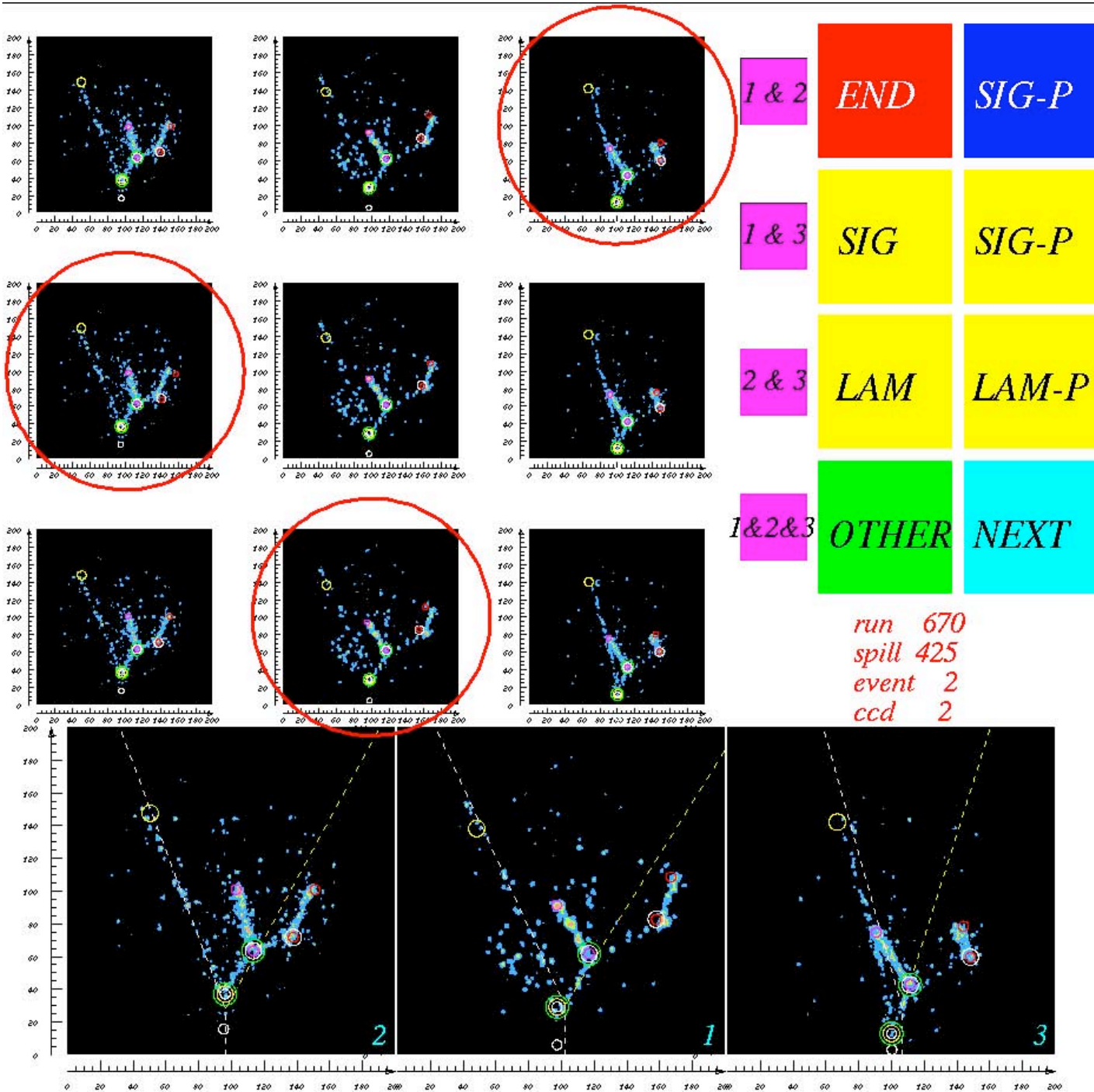
LAM **LAM-P**

1&2&3

OTHER **NEXT**

run 670
spill 152
event 1
ccd 1





SCITIC vs. SCIFI

Picture : SCIFI > SCITIC

Clear

Low noise

Versatility : SCITIC > SCIFI

Any target material

larger H/C,

gas scintillator

polarized active target

Adjustable magnification

charm, beauty particles

cosmic observation