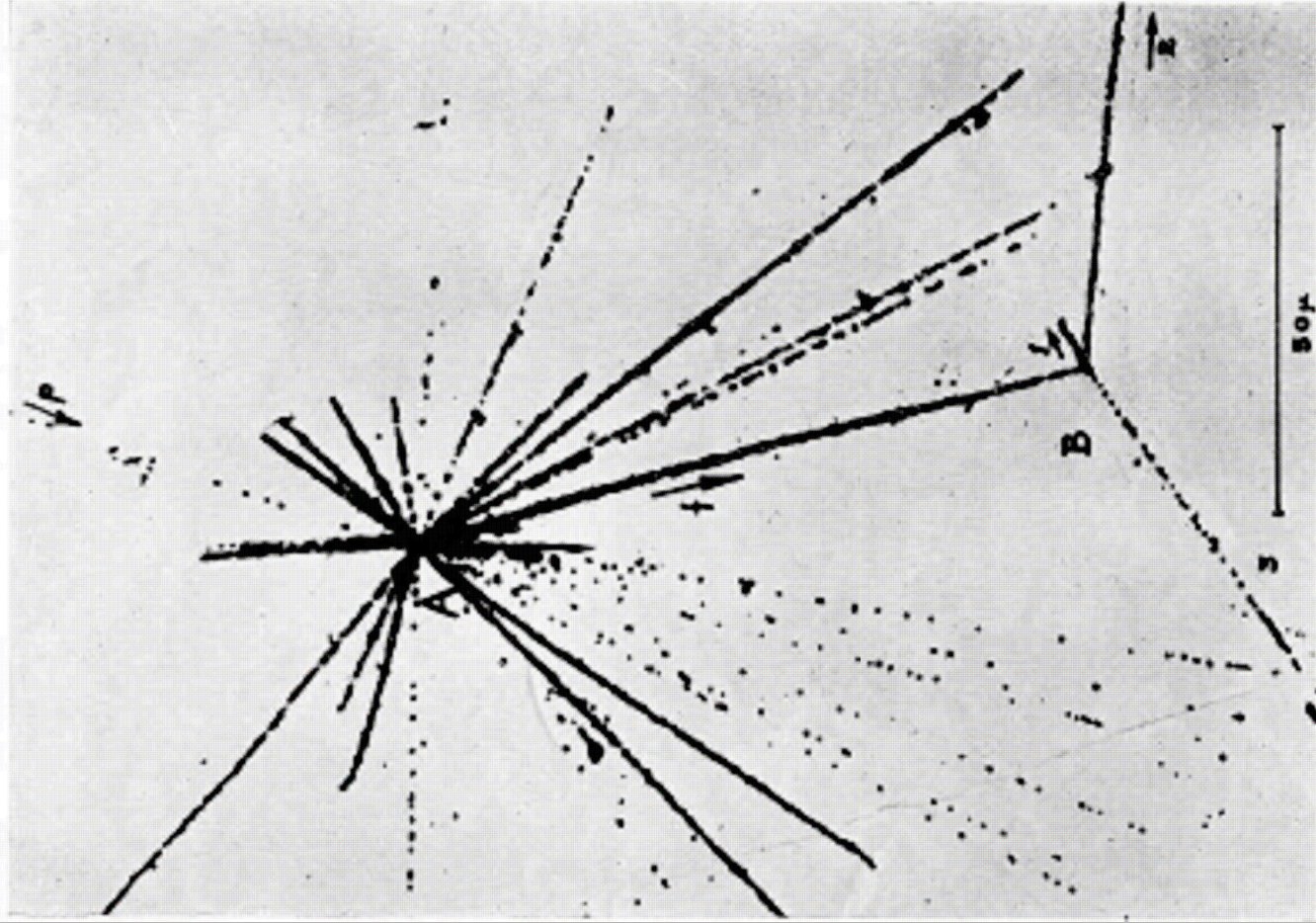


Fizyka jądrowa  
drugiego pokolenia  
czyli mezony ze zderzeń jądro-jądro

Tomasz Matulewicz  
Zakład Fizyki Jądra Atomowego  
IFD UW

26 stycznia 2007





1900

**1932**

**1953**

2000

prehistoria

$\alpha + {}^9\text{Be} \rightarrow X + n$  [uud] i [udd] I

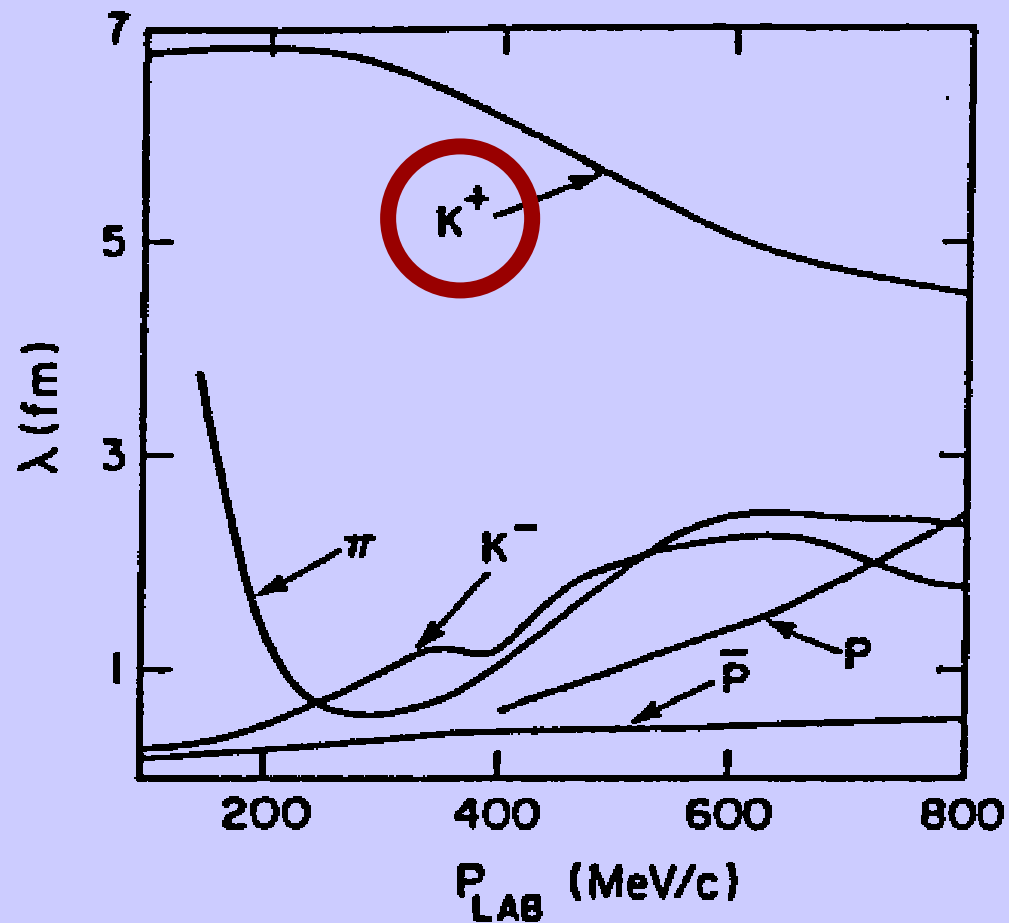
$NN \rightarrow N\Lambda K$   
[uds] oraz [ $u\bar{s}$ ][ $\bar{d}s$ ]... II

10 i 11 listopada 1988, Warszawa  
A. Gobbi, Z. Wilhelmi, B. Sikora,  
K. Siwek-Wilczyńska, TM  
**FOPI/Warszawa**

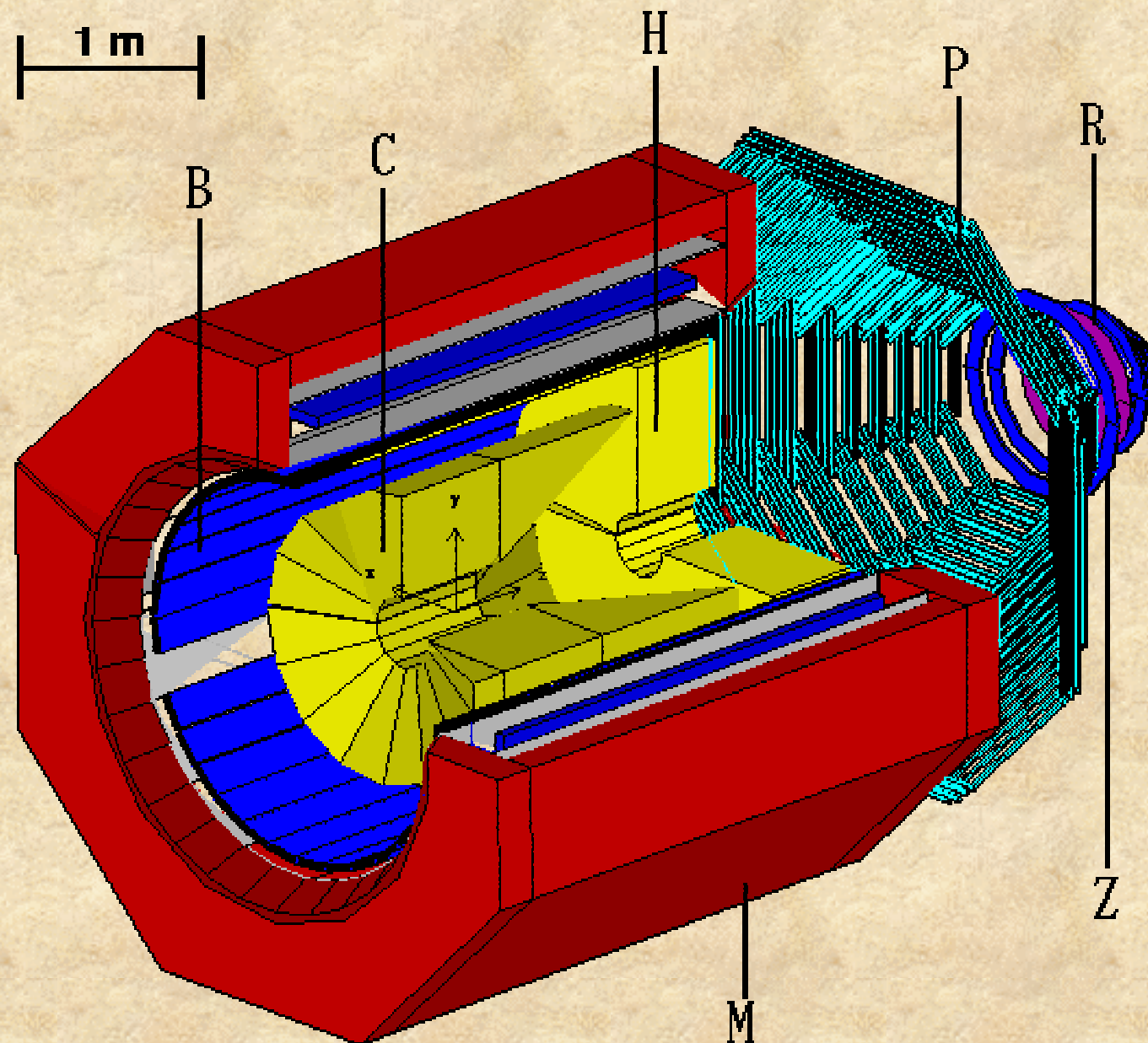
# DRUGIE POKOLENIE

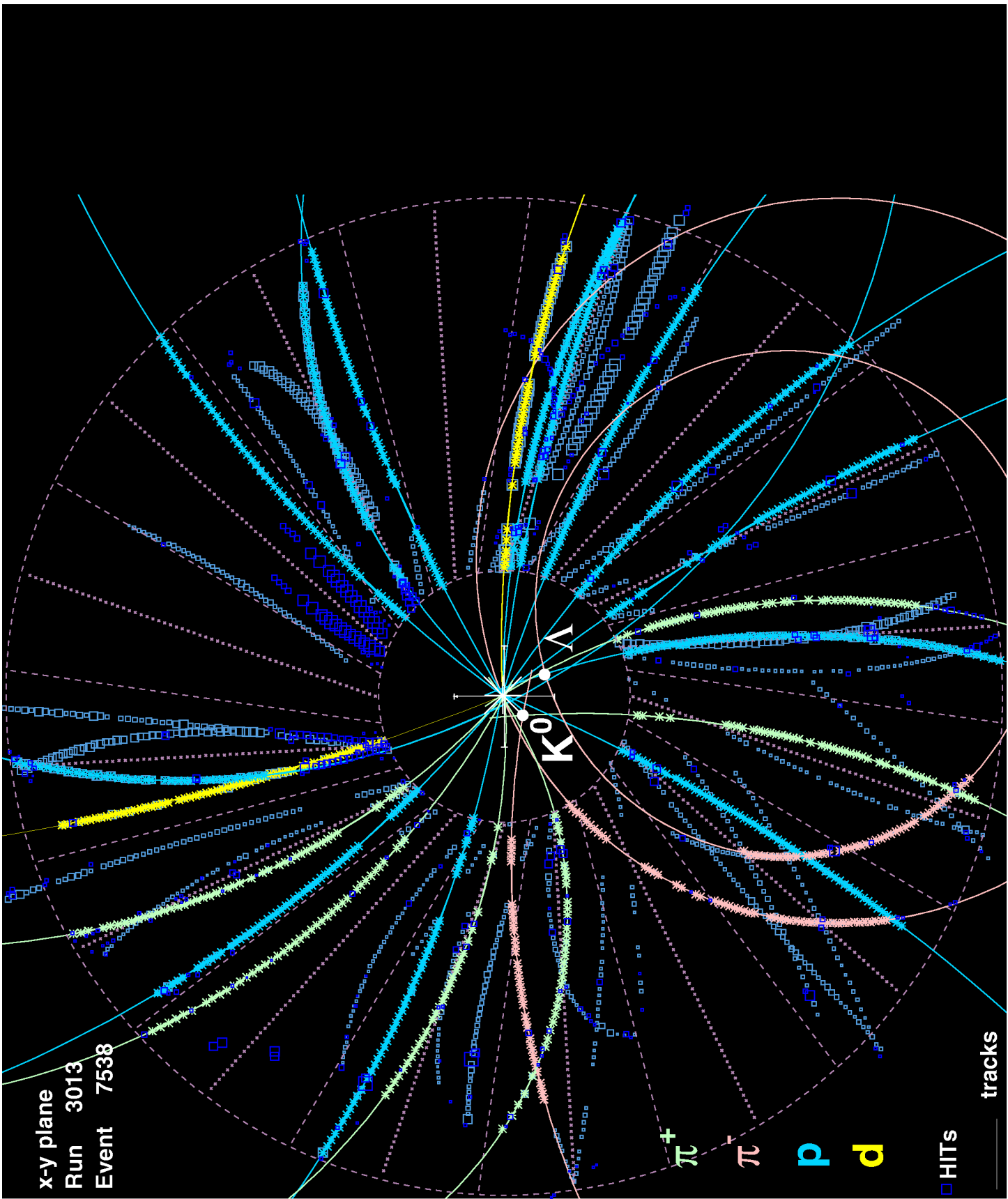
Kwarki	$u$ górný up	$c$ powabny charm	$t$ prawdziwy top
	$d$ dolny down	$s$ dziwny strange	$b$ piękny bottom
	$V_e$ neutrino elektronowe	$V_\mu$ neutrino mionowe	$V_\tau$ neutrino tau
Leptony	$e$ elektron	$\mu$ mion	$\tau$ tau
	I	II	III

Rodziny materii

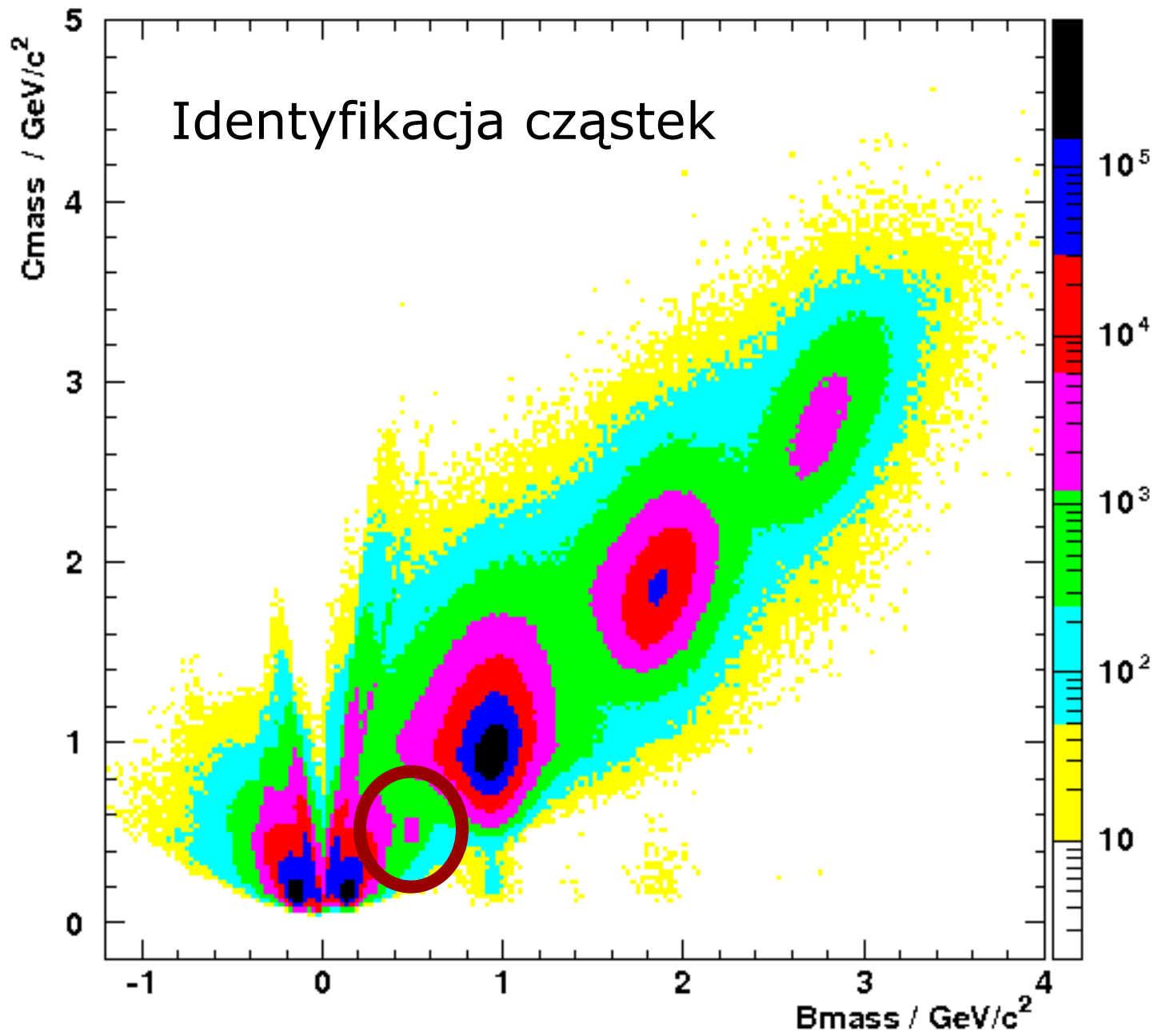


# Spektrometr FOPI



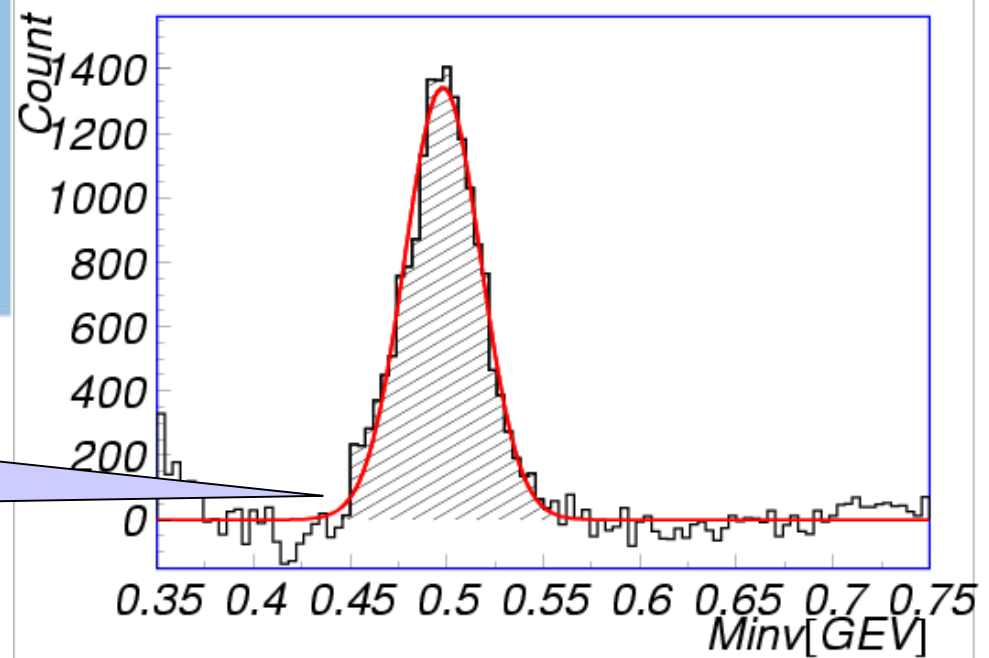
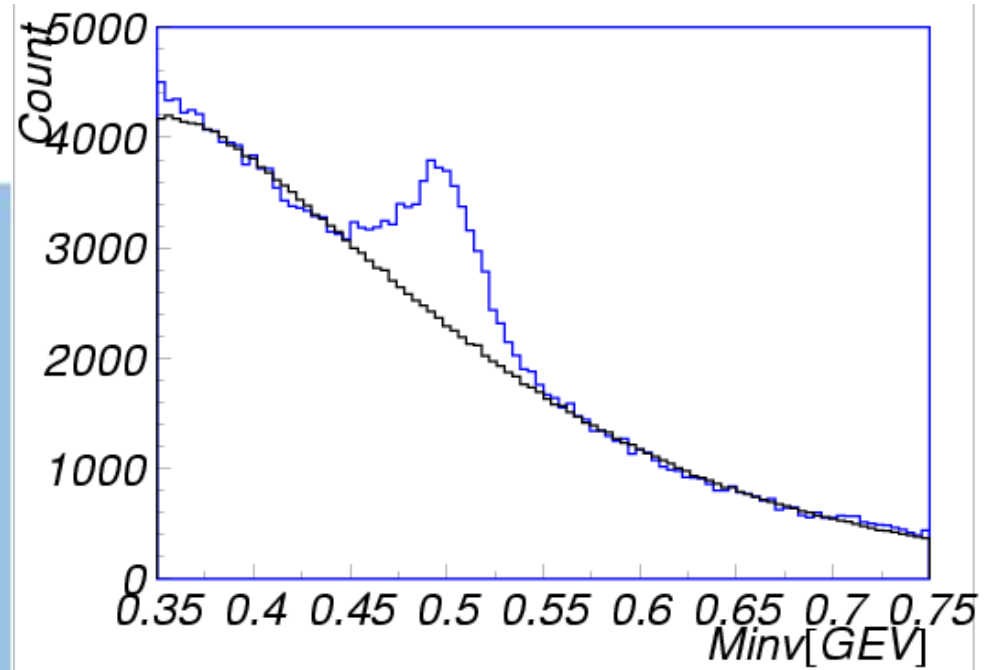
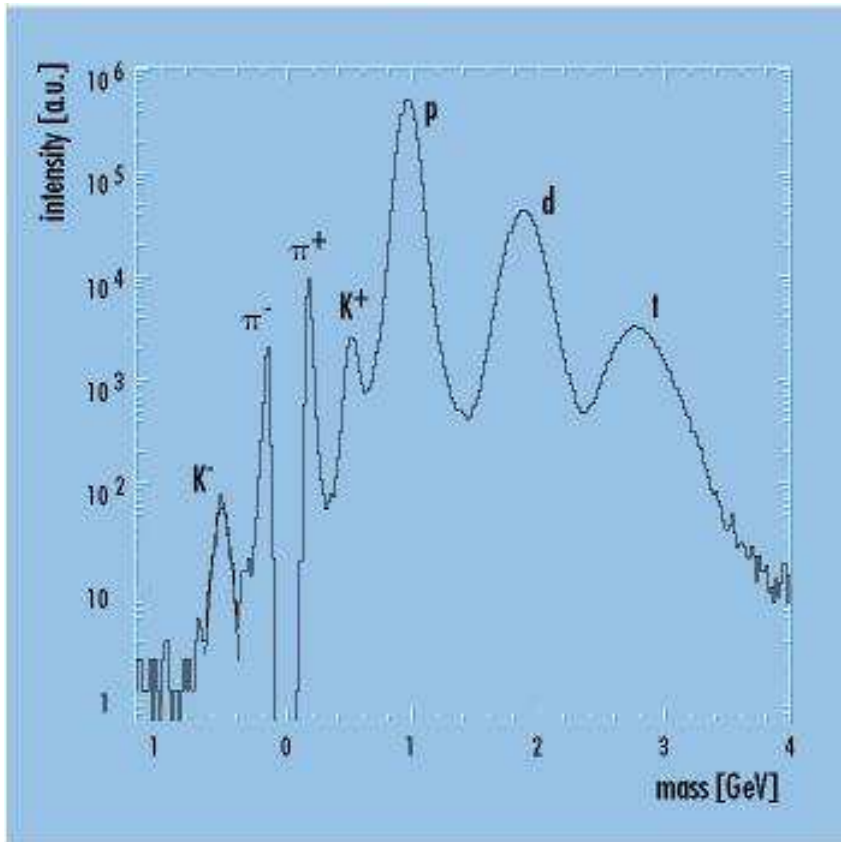


# Identyfikacja cząstek





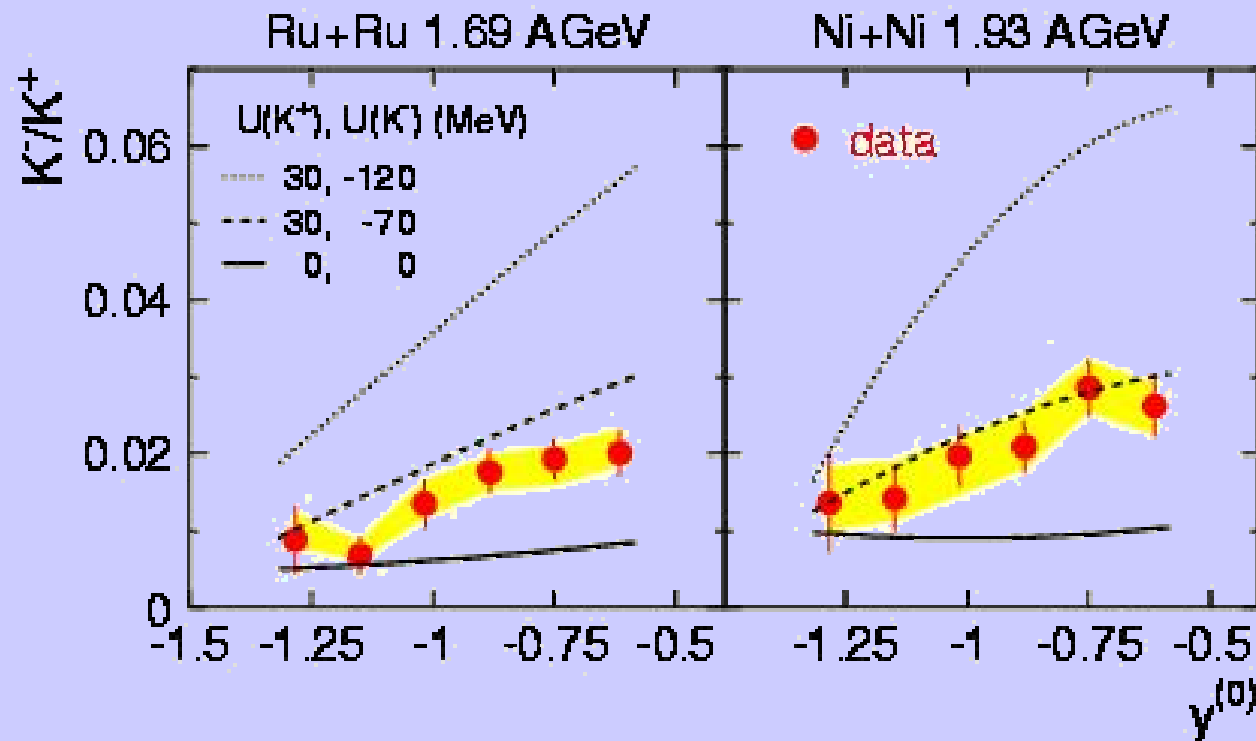
# Rozdzielczość



Identyfikacja mezonów  $K^0$   
poprzez rozpad  $K^0 \rightarrow \pi^+ \pi^-$



# Jeden z wyników: zmiana masy mezonów w materii

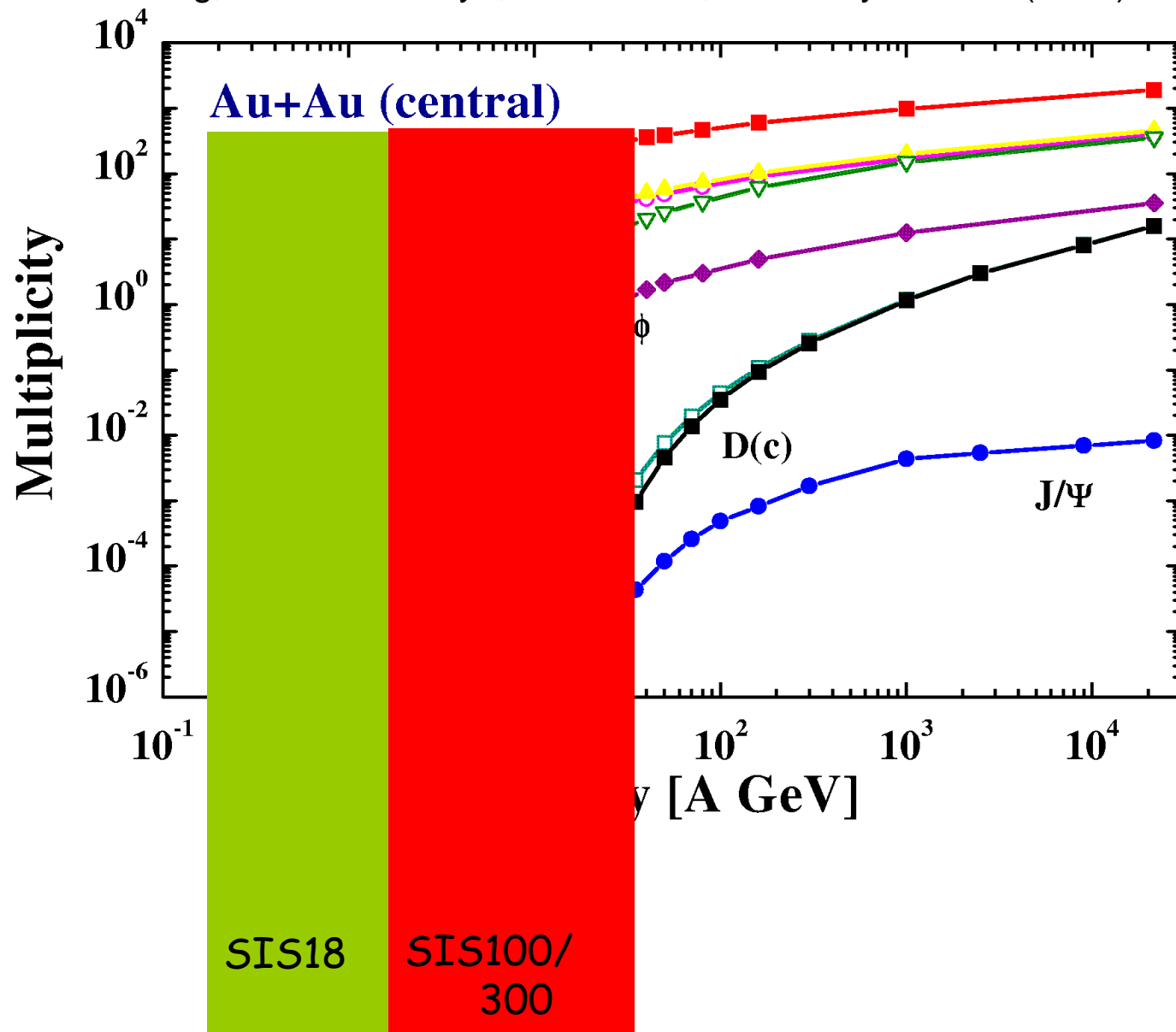


# DRUGIE POKOLENIE

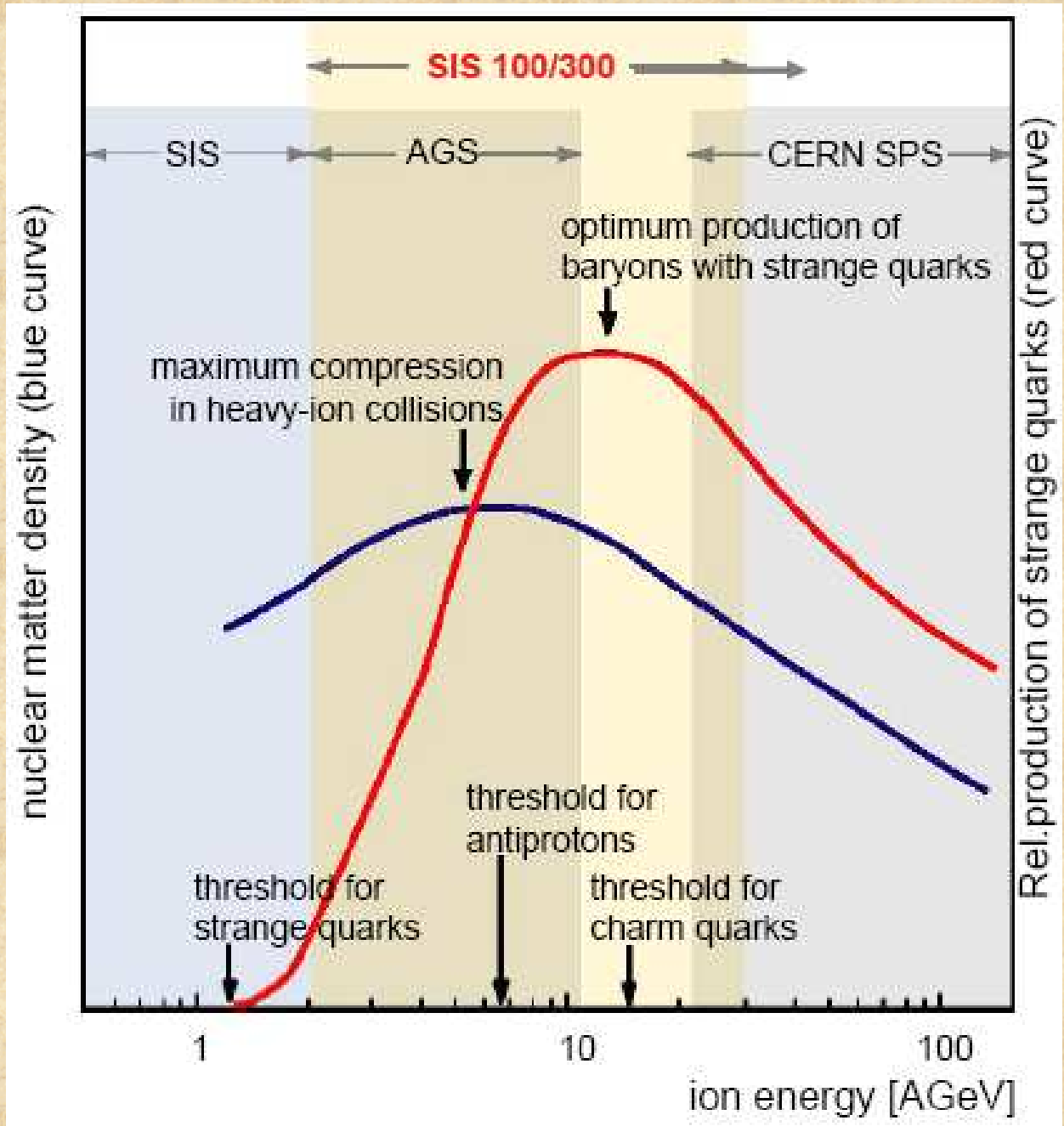
Kwarki	$u$ górnym up	$c$ powabnym charm	$t$ prawdziwym top
	$d$ dolnym down	$s$ dziwnym strange	$b$ pięknym bottom
Leptony	$\nu_e$ neutrino elektronowe	$\nu_\mu$ neutrino mionowe	$\nu_\tau$ neutrino tau
	$e$ elektron	$\mu$ mion	$\tau$ tau
	I	II	III
	Rodziny materii		

# Meson production in central Au+Au collisions

W. Cassing, E. Bratkovskaya, A. Sibirtsev, Nucl. Phys. A 691 (2001) 745



# SIS 100/300 energy range

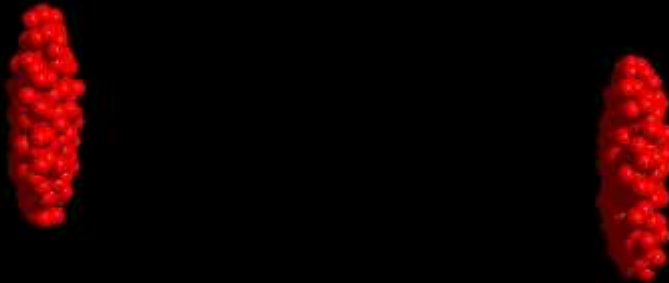




# U+U 23A GeV

U+U 23 GeV/A

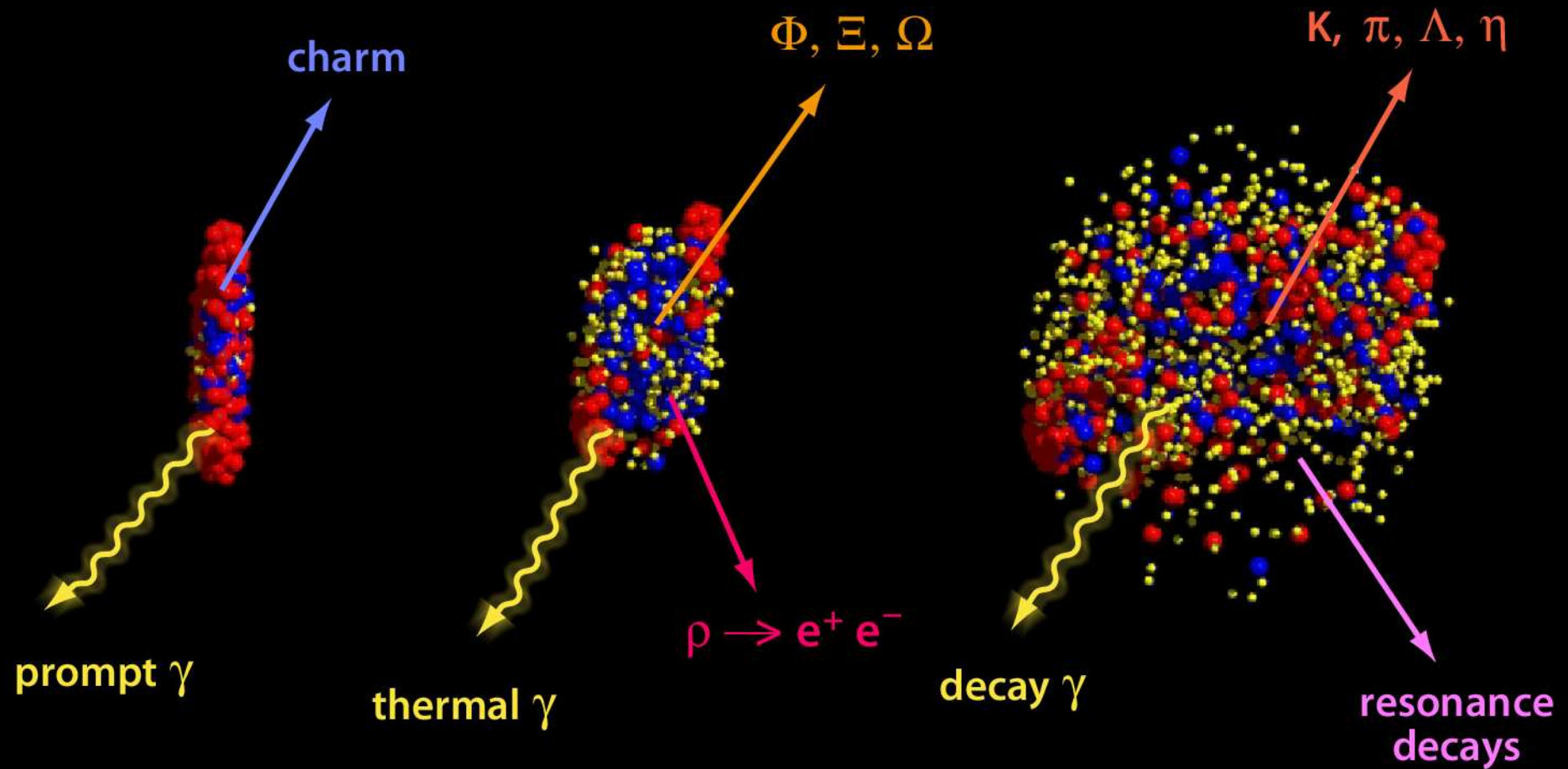
$t = -17.14$  fm/c



UrQMD Frankfurt/M

# Diagnostic probes

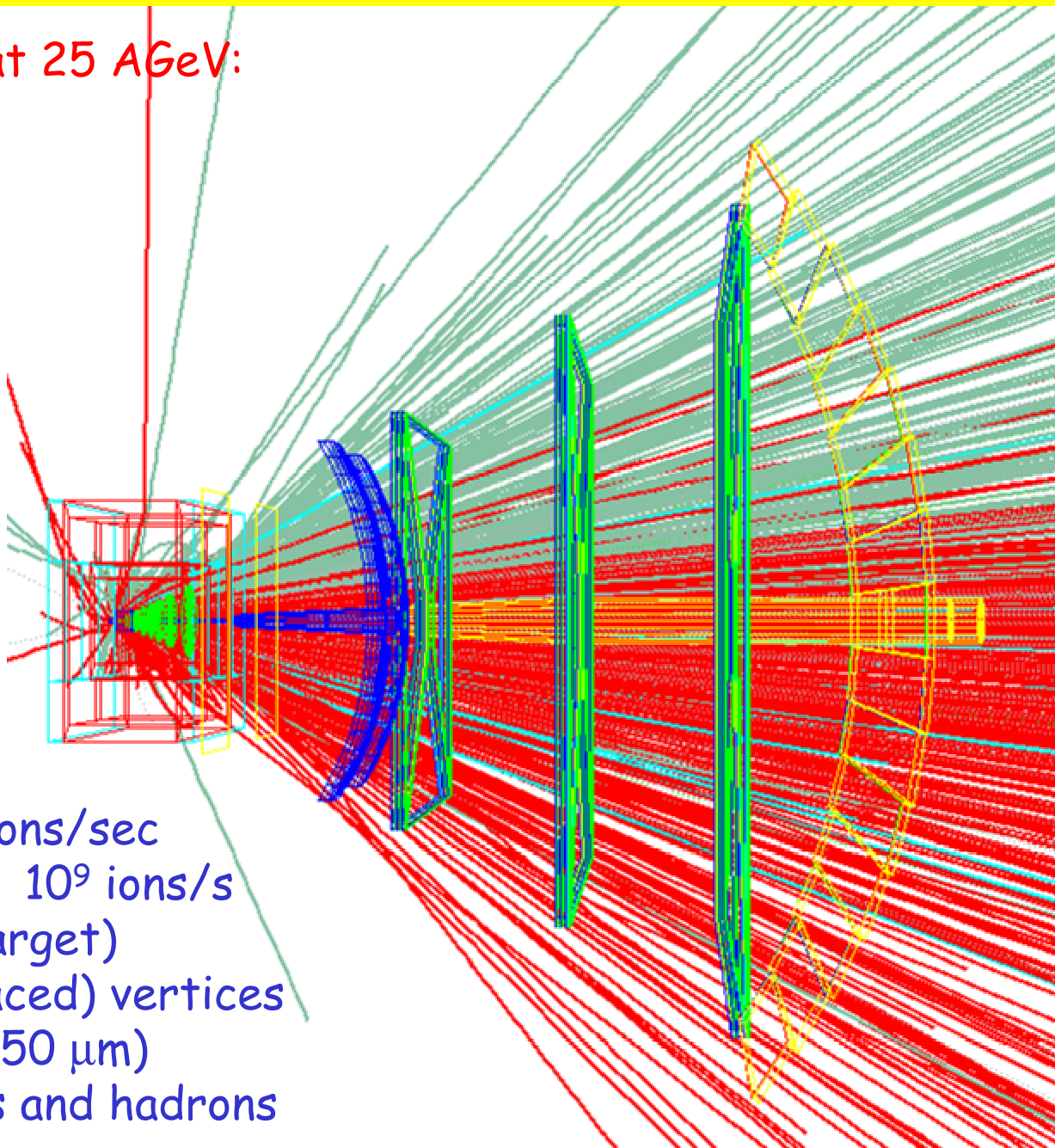
U+U 23 AGeV



# Experimental challenges

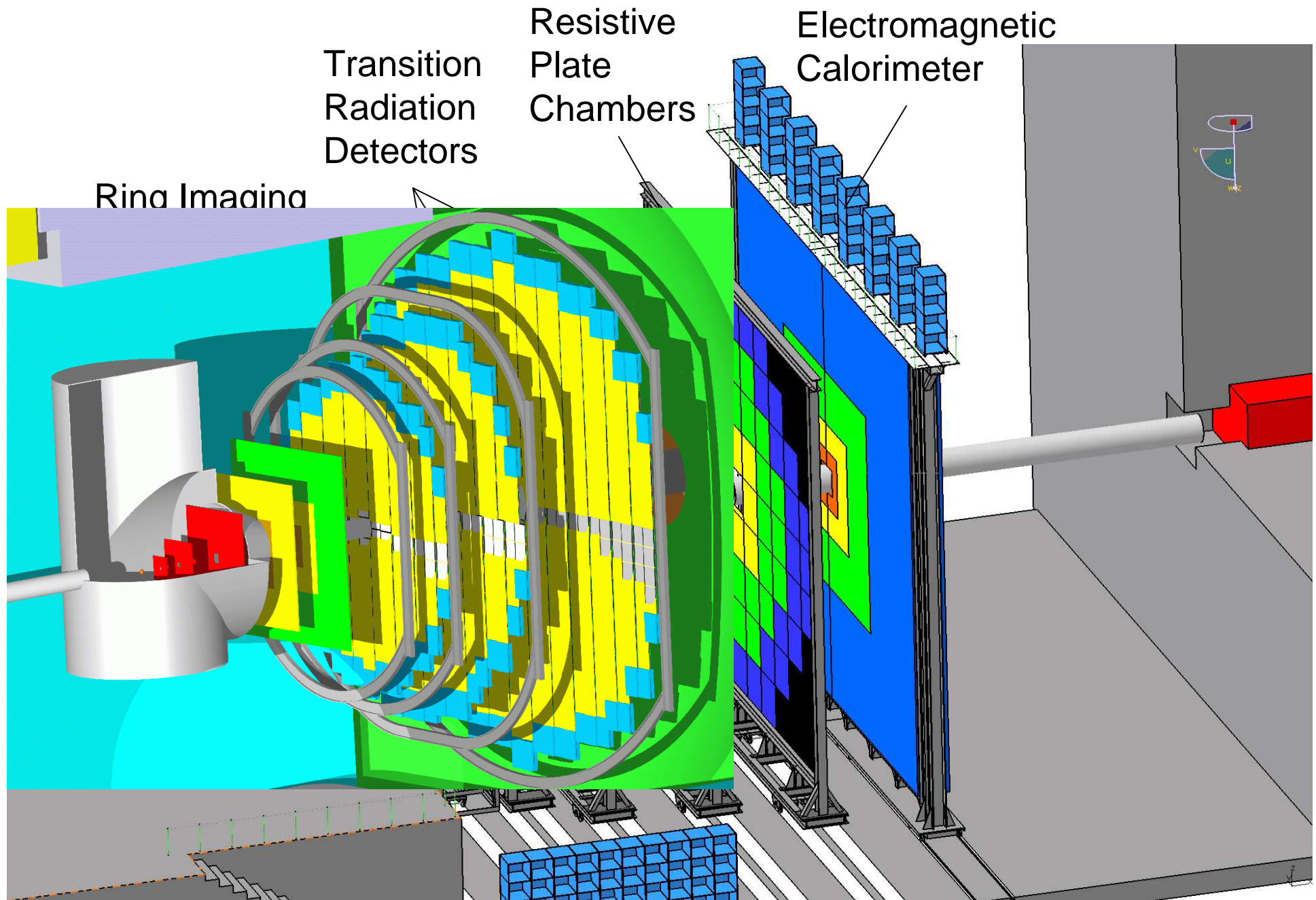
Central Au+Au collision at 25 AGeV:  
URQMD + GEANT4

160 p  
400  $\pi^-$   
400  $\pi^+$   
44  $K^+$   
13  $K^-$



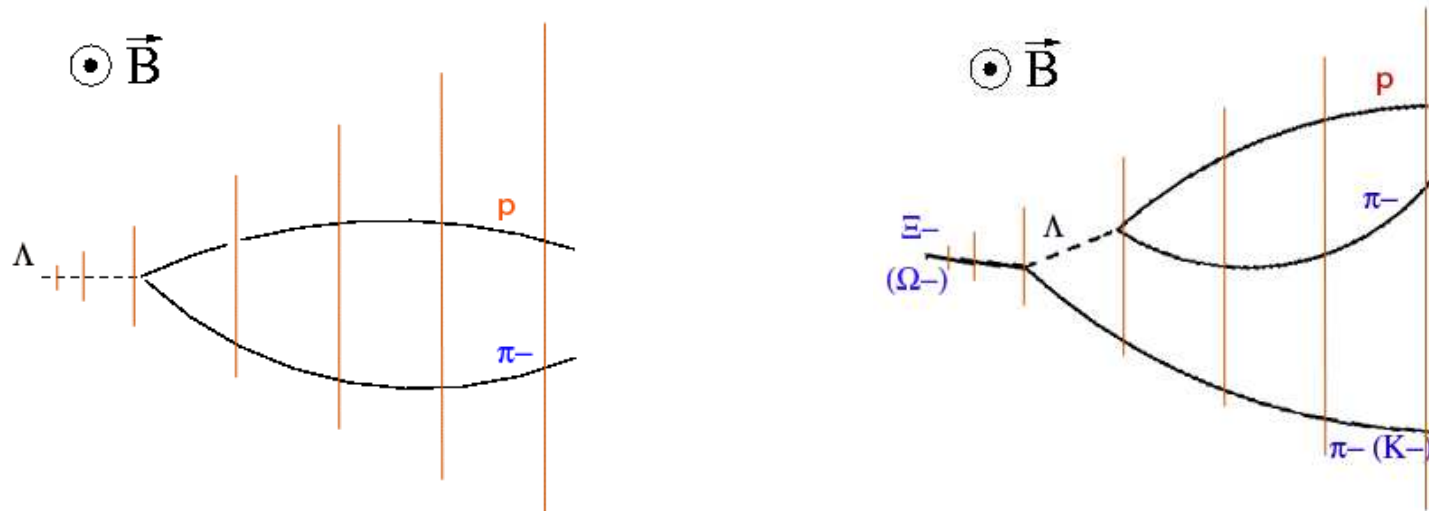
- up to  $10^7$  Au+Au reactions/sec (beam intensities up to  $10^9$  ions/s with 1 % interaction target)
- determination of (displaced) vertices with high resolution ( $\approx 50 \mu\text{m}$ )
- identification of leptons and hadrons

# The Compressed Baryonic Matter Experiment

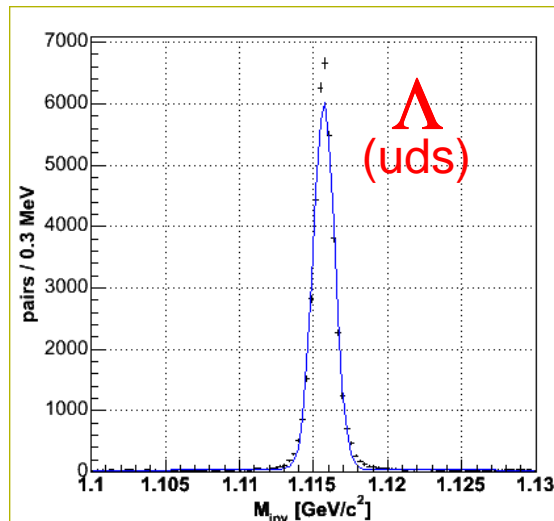




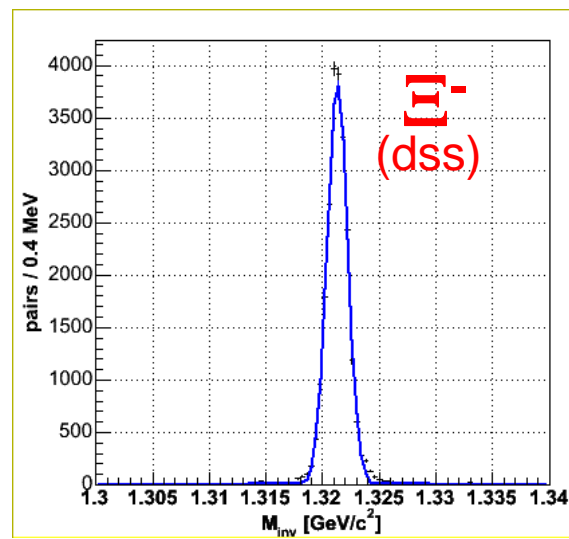
# Hyperon detection with STS without p, K, $\pi$ identification (realistic simulation using UrQMD, GEANT3/4, CBMroot)



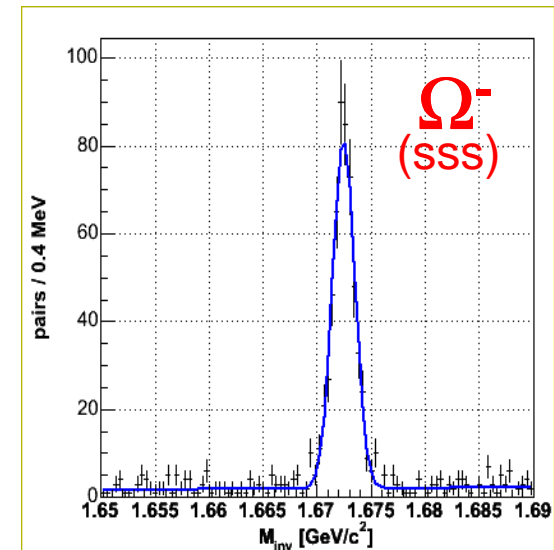
central Au+Au collisions at 25 AGeV:



efficiency 15.8%



6.7%



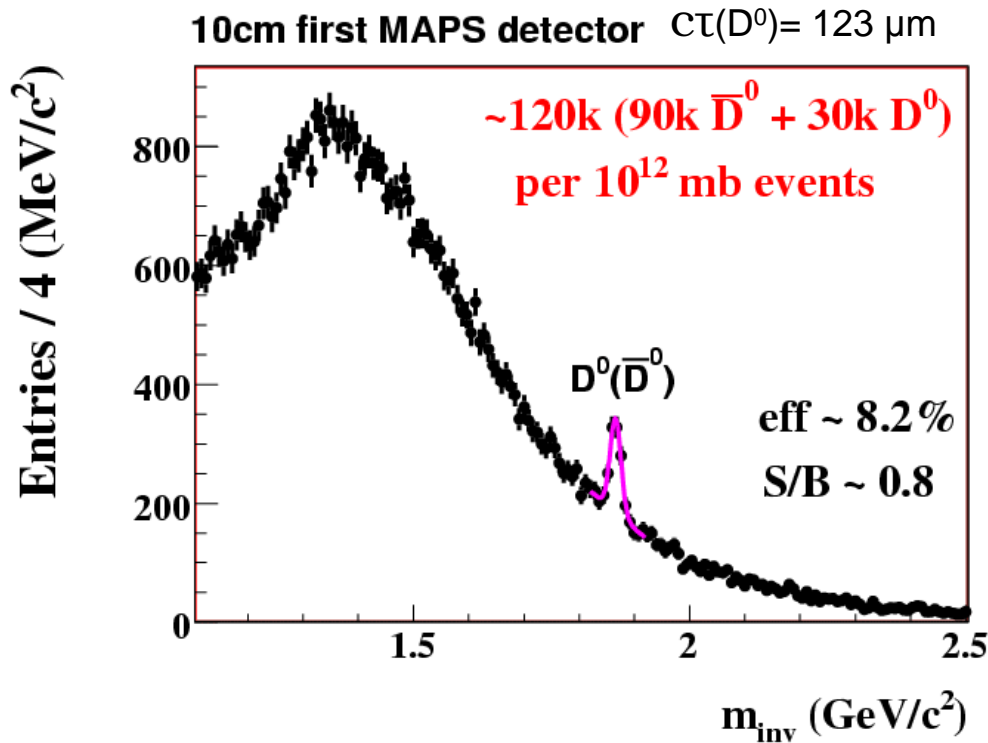
7.7%

# Benchmark for MVD and STS performance: D mesons from Au+Au collisions at 25 AGeV

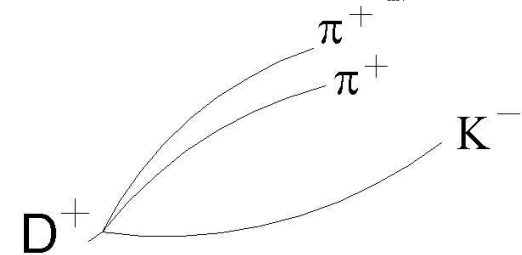
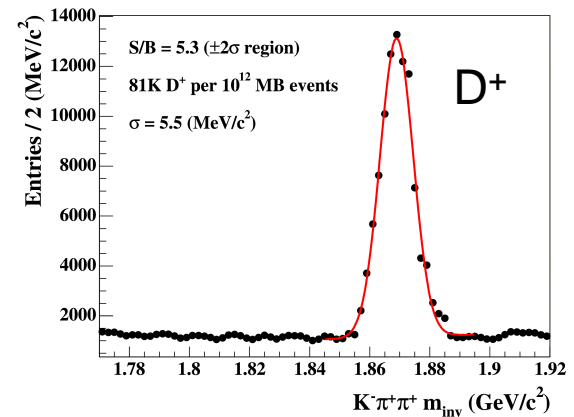
Track reconstruction:

- realistic magnetic field,
- 2 MAPS, 2 hybrid pixel, 4 strips
- proton identification required

D production cross sections from HSD  
25 AGeV Au+Au from UrQMD  
minimum bias collisions

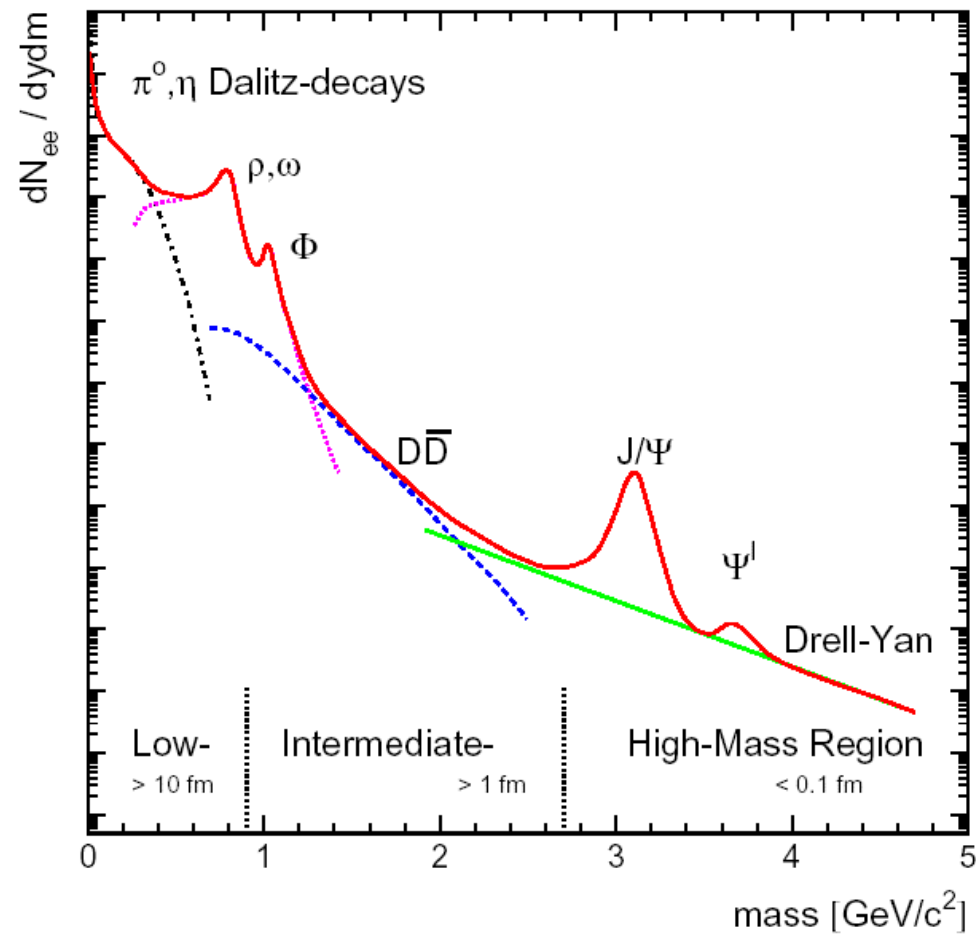


5 cm first MAPS,  $c\tau(D^+) = 317 \mu\text{m}$



120k  $D^0$  + 80k  $D^+$  + 160k  $D^-$  = 360k D-mesons in  $10^{12}$  min. bias Au+Au collisions with 0.2 MHz reaction rate  $\rightarrow$  60 days (limited by radiation hardness of Micro-Vertex Detectors)

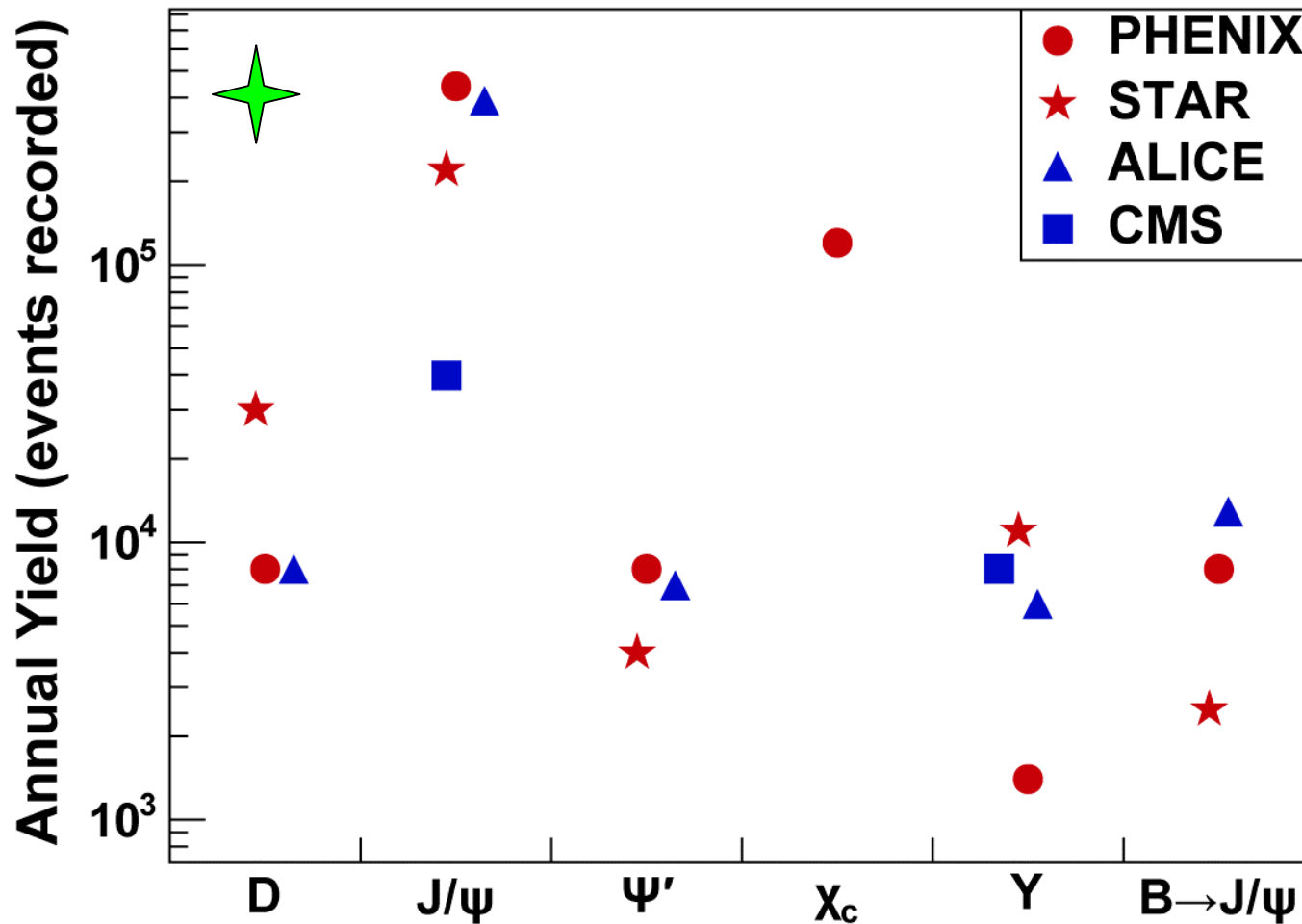
# Dilepton Sources in Heavy-Ion Collisions



# Annual yields at RHIC II & LHC

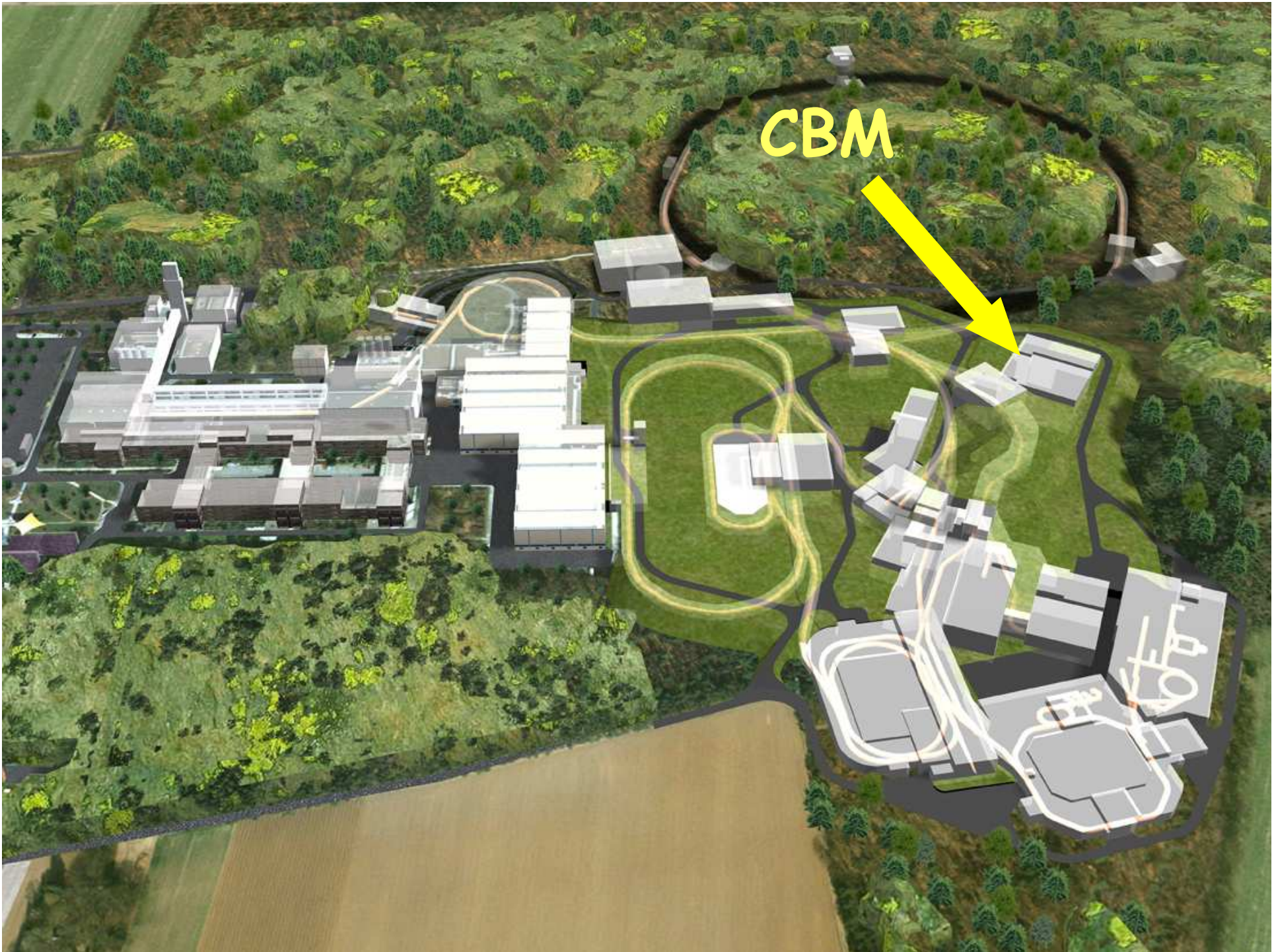
10 weeks CBM   
Au+Au 25 AGeV

from Tony Frawley  
RHIC Users mtg.



at LHC:  $(10-50) \times \sigma$      $\sim 10\%$  of  $\mathcal{L}$     25% running time

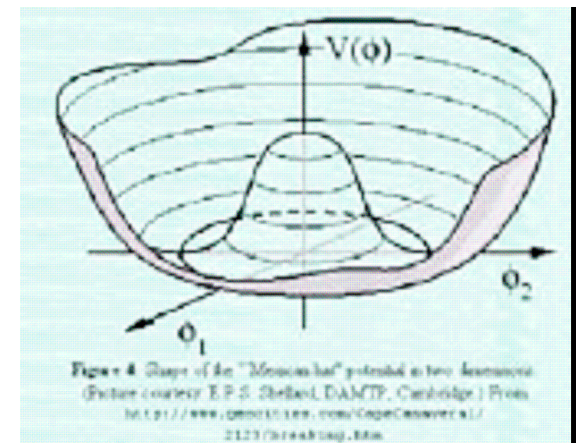
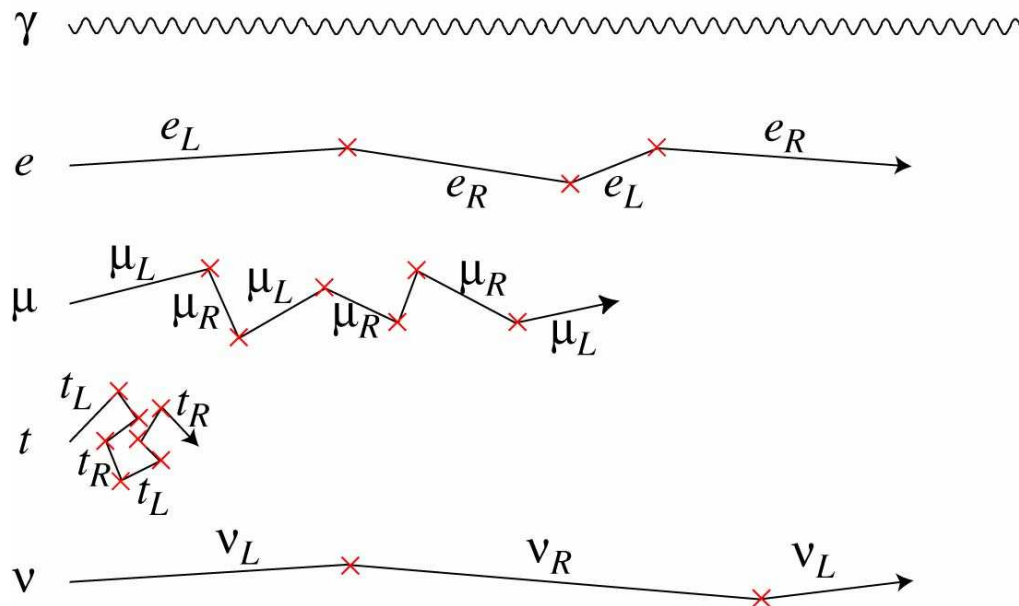
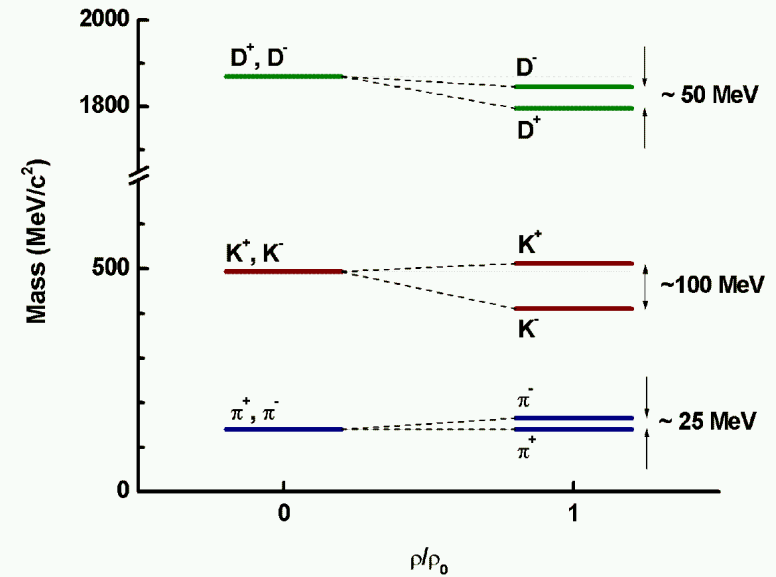
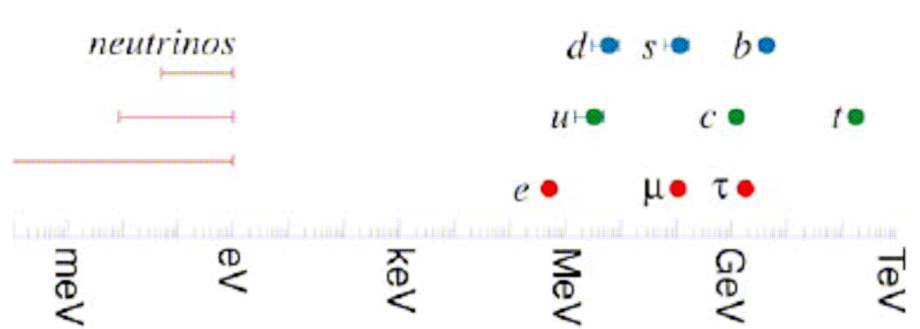




CBM



# Masa, Higgs, symetria chiralna





PAWEL KRZYZOSZCZYK, LEONARD  
KONKWISTY, KRZYSZTOF  
MICHAŁ RYGAŁ  
**DYPLOM**  
Teresa, Marianna  
1987  
1988  
1989  
1990  
1991  
1992  
1993  
1994  
1995  
1996  
1997  
1998  
1999  
2000  
2001  
2002  
2003  
2004  
2005  
2006  
2007  
2008  
2009  
2010  
2011  
2012  
2013  
2014  
2015  
2016  
2017  
2018  
2019  
2020  
2021  
2022  
2023  
2024  
2025





Occhi  
1907  
BORMIO

21 MAR 23 SETT Equinozio

L'uomo misura il tempo...  
e il tempo misura l'uomo.