BROOKHAVEN NATIONAL LABORATORY

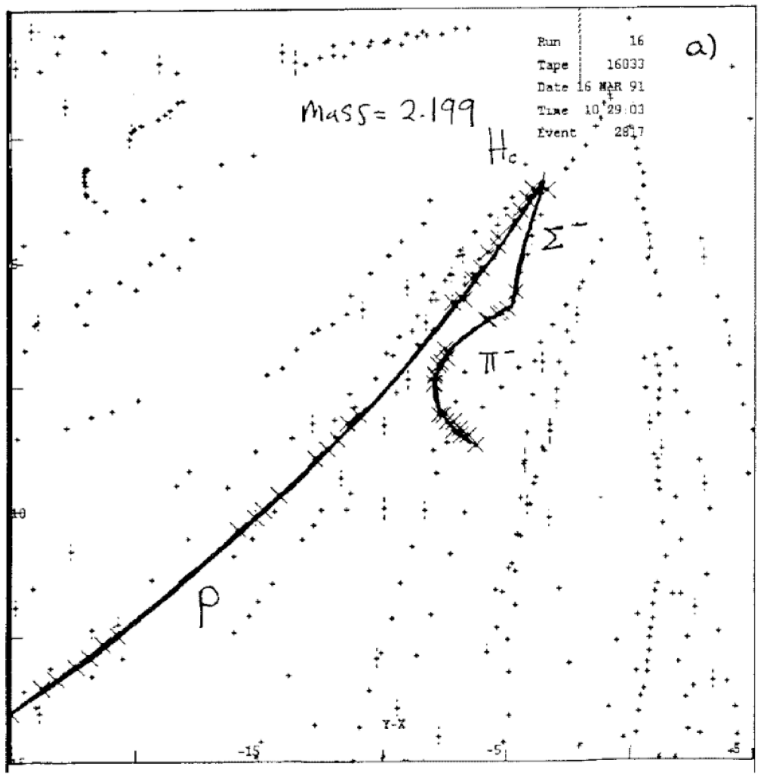
U.S. DEPARTMENT OF ENERGY

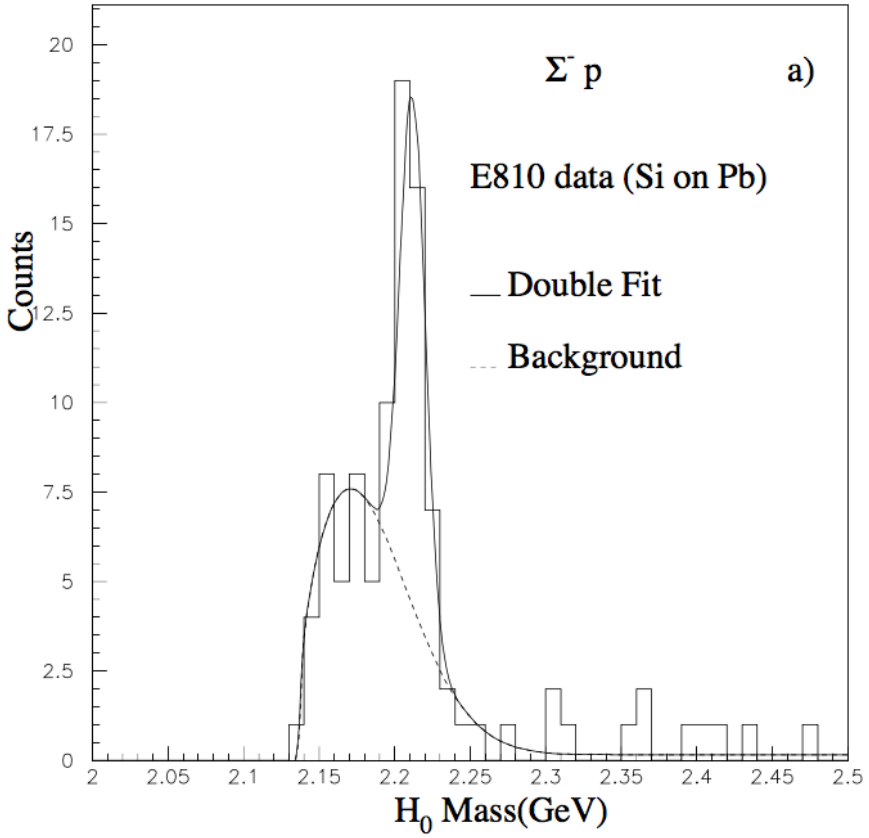
Thoughts on Exotic Searches at STAR

(with HLT + HFT + KFParticle on Phi card)

Aihong Tang

Six-quark state : Strangelet (udsuds)





$$H^0 \rightarrow p + \Sigma^- \left(\rightarrow \pi^- + n \right)$$

Six-quark state : Strangelet (udsuds)

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cτ for H^0 ~ 4 cm (theoretical prediction)
cτ for Σ^- 4.4 cm

It is challenging
(without SSD) For Σ^- to be measured, it has to live long enough so it has hits in two pixel l and IST. The prob. For that is ~7%. The Prob. For H^0 to decay before it reaches the inner layer of pixels is ~46%. Combining both, the efficiency due to acceptance is on the order of a few percent.
(with SSD)

However, we have billions of events.
Taking the estimated yield ~x10^{-2} [PRC 84, 064910 (2011)], we can see 10^{-4} per event. With billions of events, we have a chance to see H0 if it exits.

Six-quark state : H^{++}_c (qqqqsc dibaryon)

$$H_c^{++} \rightarrow p + \Xi_c^+ (\rightarrow \Lambda K^- \pi^+ \pi^+)$$

Weak Decay.
Mass ~ 3406 MeV.

Eur. Phys. J. C 64 283 (2009)

Five-quark state : Θ_{cs} (q q q s cbar)

$\Theta_{cs} \rightarrow p + \phi + \pi^-$ (checked by E791 experiment at Fermilab PRL 81 44 (1998))

$\Theta_{cs} \rightarrow K^{*0} + K^- + p$ (checked by E791 experiment at Fermilab PLB 448 303 (1999))

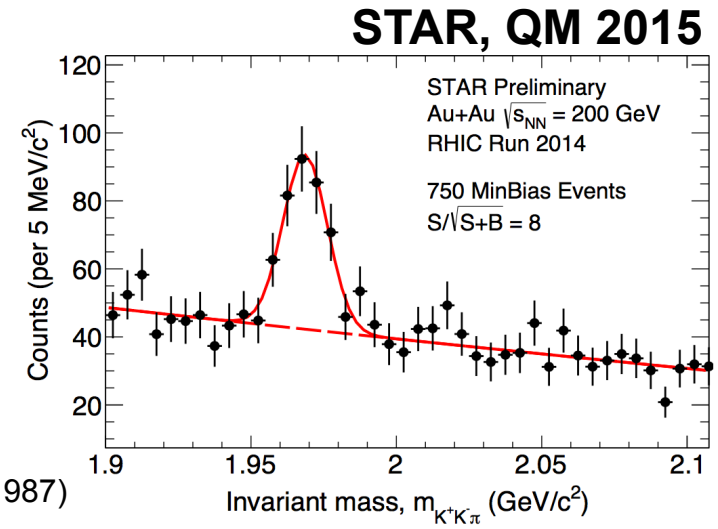
$\Theta_{cs} \rightarrow p + \eta + \pi^-$

$\Theta_{cs} \rightarrow \Lambda + K^+ + \pi^- + \pi^-$ (possible at STAR)

$\Theta_{cs} \rightarrow \Lambda + D^-$ (possible at STAR)

Mass 2920-2930 MeV
Strong decay

H.J. Lipkin, PLB 195 484 (1987)
C. Gignoux, B. Silvestre-Brac, and J.M. Richard, PLB 193 323 (1987)



- Decay Channel : $D_S^{\pm} \longrightarrow \phi (\rightarrow K^+ + K^-) + \pi^{\pm}$
- Branching Ratio: 2.32 ± 0.14 %
- Decay Length : 150 ± 2 μm
- Mass : 1968.47 ± 0.33 MeV/c^2

FYI, Θ+ (uuddsbar) disproved
Λ_b^0 (uudccbar) found by LHCb

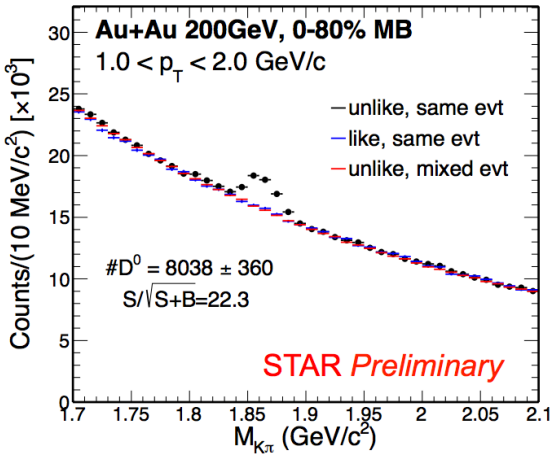
Four-quark state : T^1_{cc} (u d cbar cbar)

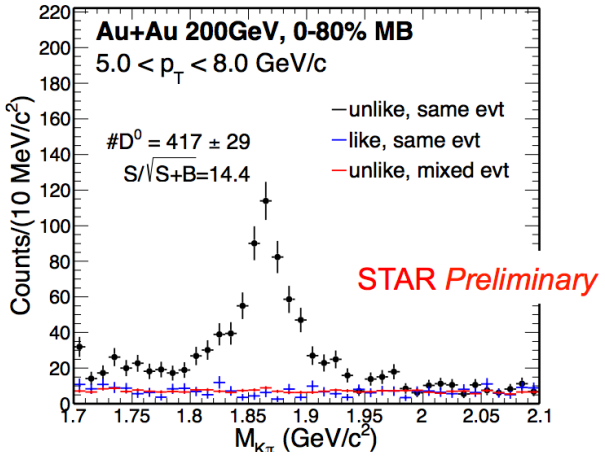
$$T^1_{cc} \to D^{*-}\,\bar{D}^0$$
$$T^1_{cc} \to D^0 \bar{D}^0 \pi^-$$

Mass 3796 MeV
Strong decay
Predicted yield at RHIC ~ 10^{-6} /evt

Eur. Phys. J. C 64 283 (2009)

STAR, QM 2015





$$D^0(\overline{D^0}) \to K^{\mp}\pi^{\pm}$$

B.R. 3.9% $c\tau \sim 120\ \mu m$