Λ_c at STC

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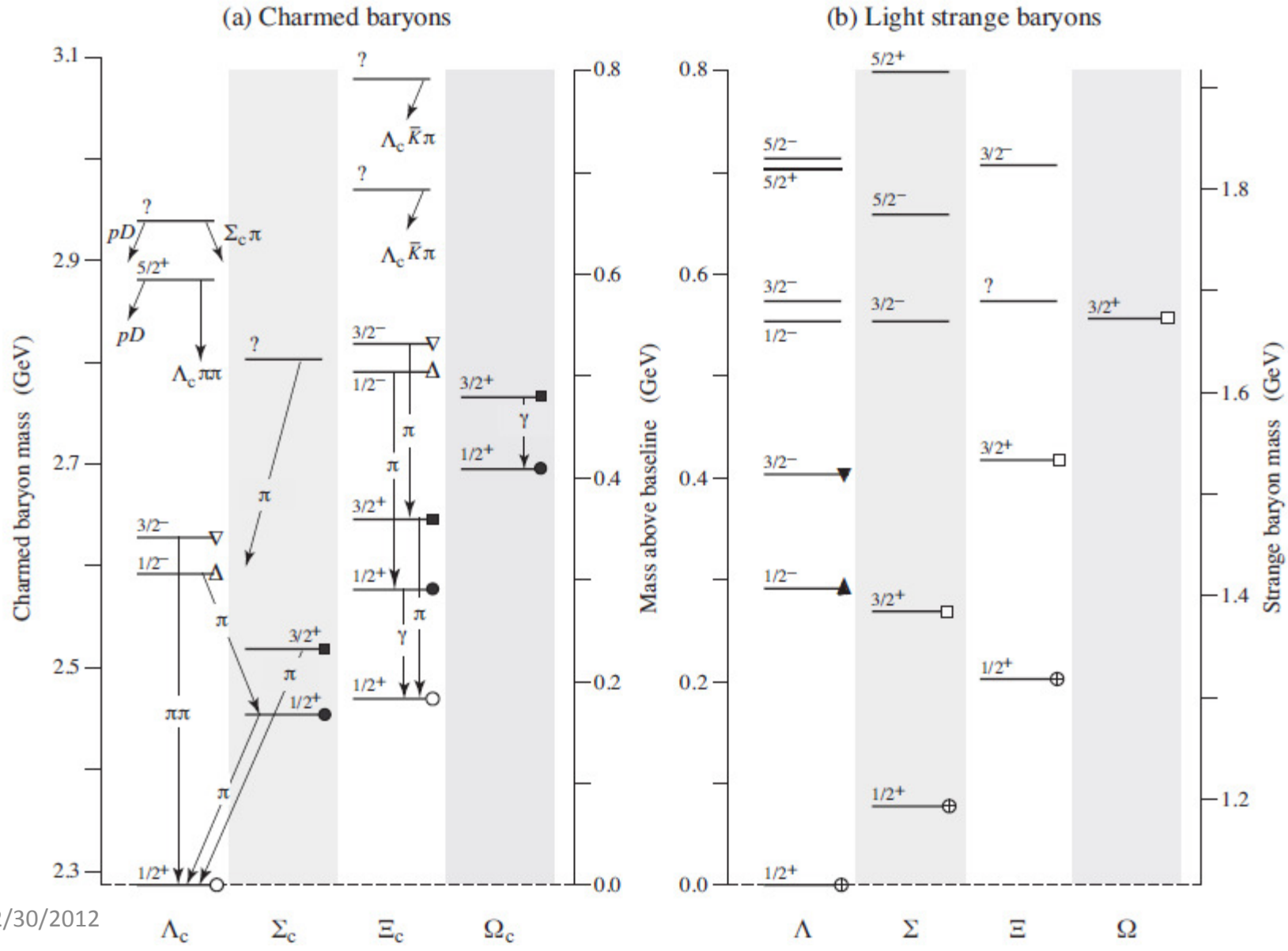
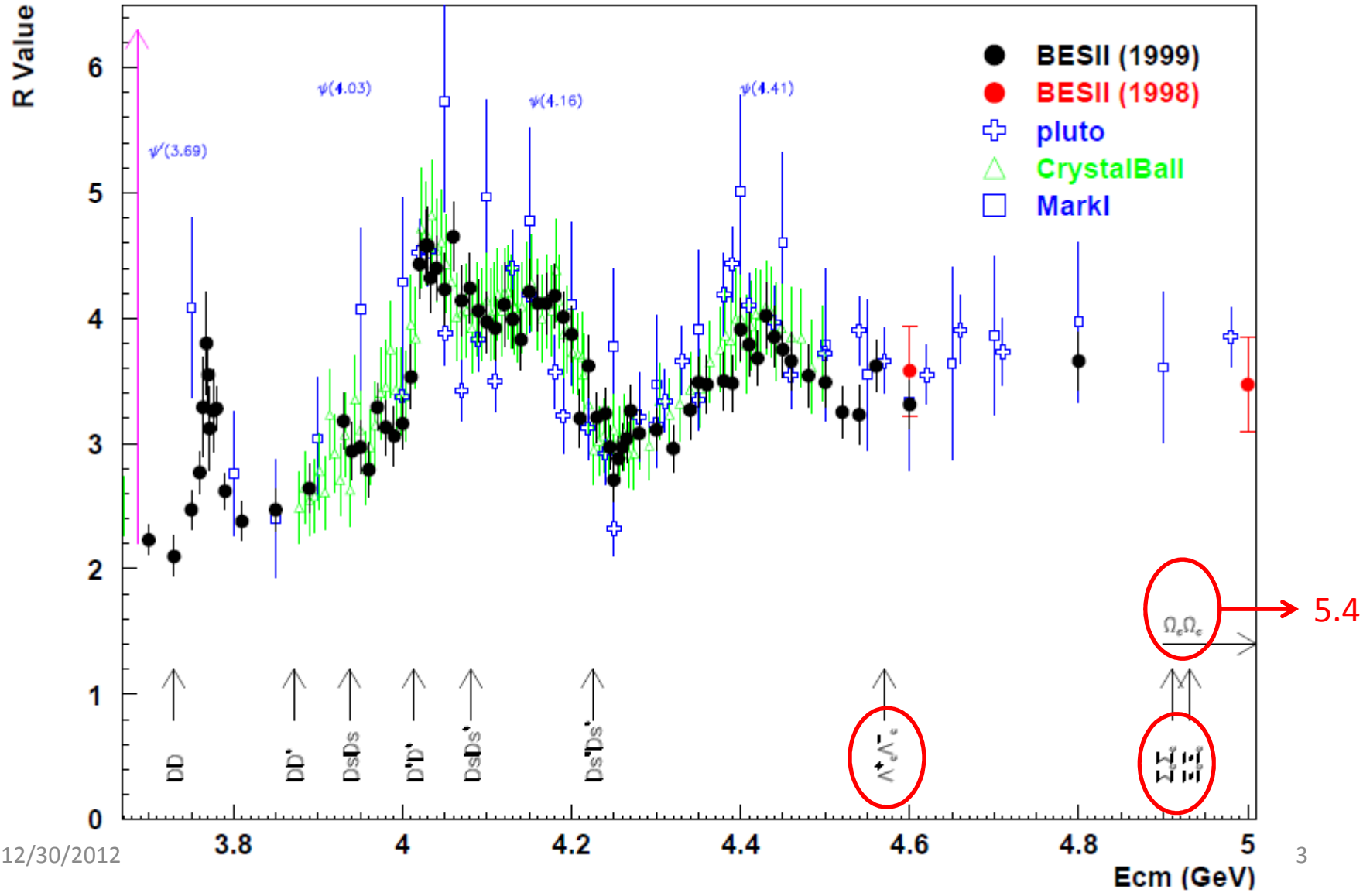
Charm baryon vs. strange baryon



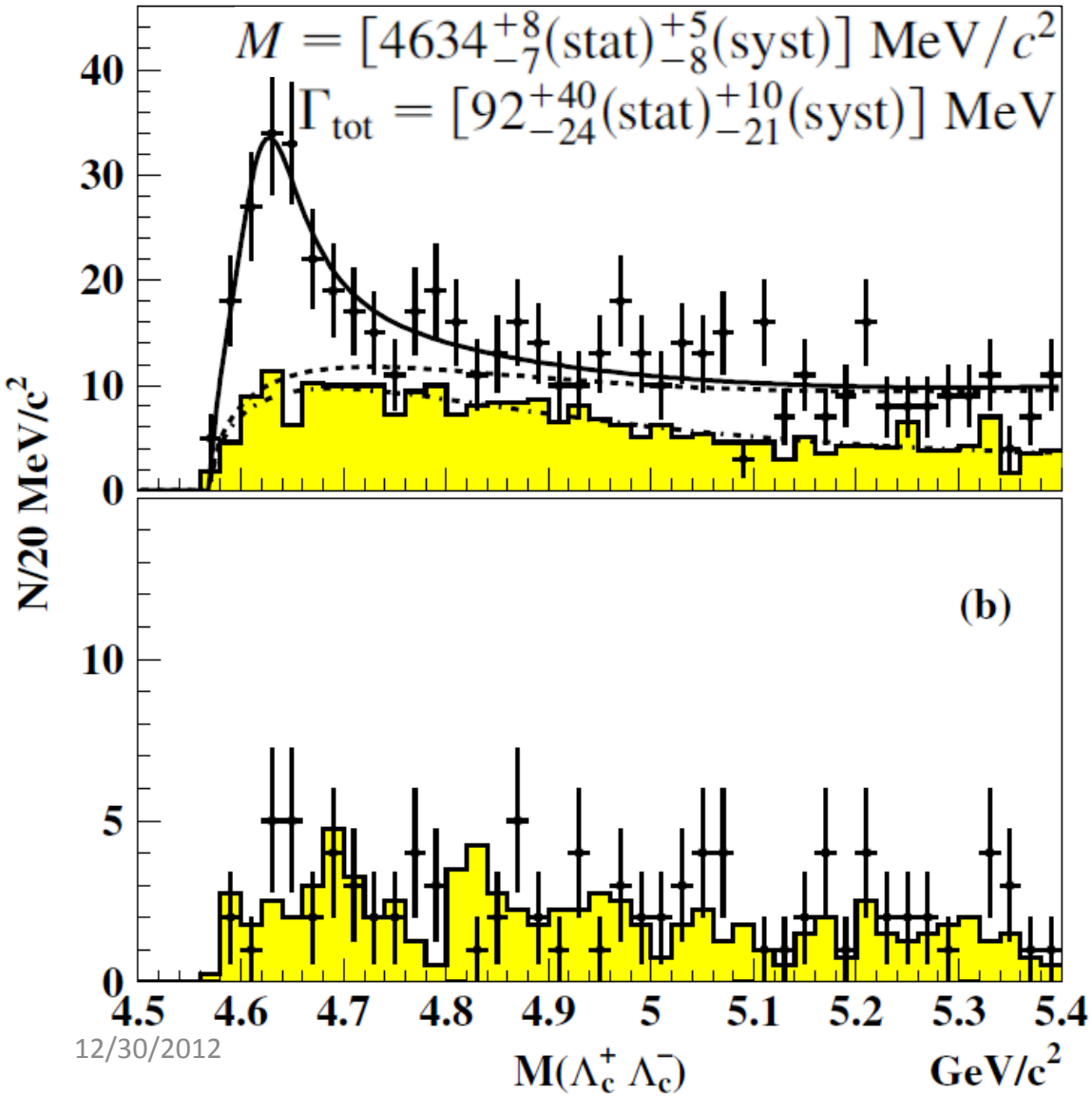
Charmed baryon thresholds around 4.6 – 5.5 GeV



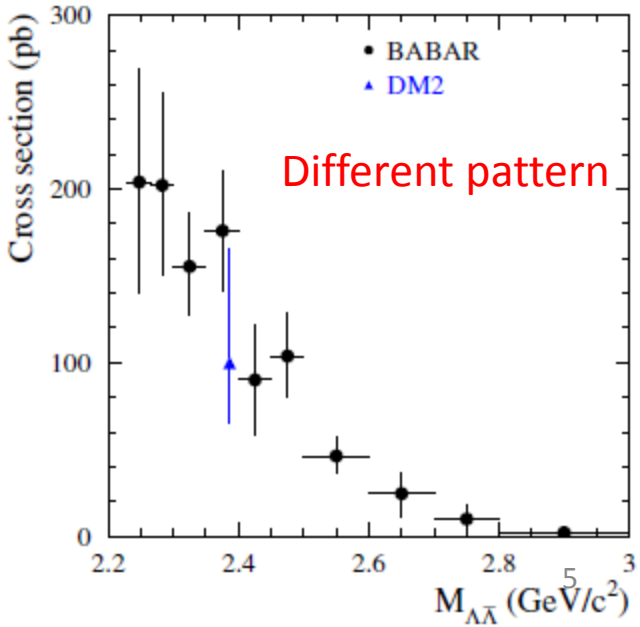
Λ_c^+ branching fractions

- Most Λ_c^+ branching fractions are measured relative to $B(\Lambda_c^+ \to pK^-\pi^+)$, which itself is not a model-independent measurement:
  - $(4.14\pm0.91)\%$ from $B(B \to \Lambda_c^+ X)\cdot B(\Lambda_c^+ \to pK^-\pi^+)$;
  - $(7.3\pm1.4)\%\cdot fF$ from $B(\Lambda_c^+ \to pK^-\pi^+)/B(\Lambda_c^+ \to \Lambda l^+\nu_l)$;
  - PDG average $(5.0\pm1.3)\%$;
  - Same result from CLEO $e^+e^- \to DpX$, $X = \Lambda_c^+ + \ldots$;
- Any change in $B(\Lambda_c^+ \to pK^-\pi^+)$ will affect most of the Λ_c^+ decay width;
- An absolute measurement is absolutely needed.

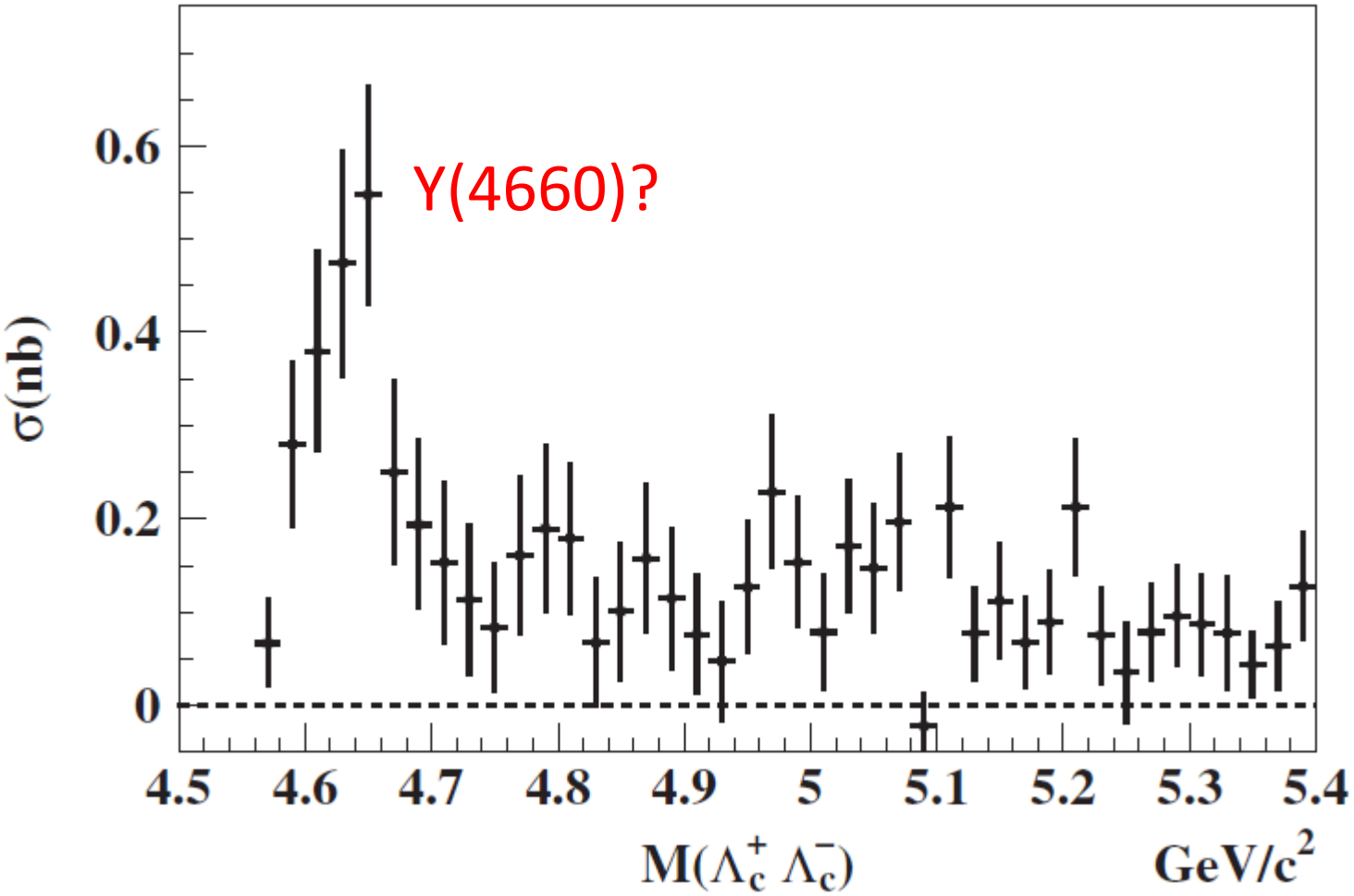
$e^+e^- \to \Lambda_c^+\Lambda_c^-$ from ISR (Belle)



- 695 fb^{-1} data
- 8.2σ
- PRL 101, 172001 (2008)



Cross section for $e^+e^- \to \Lambda_c^+\Lambda_c^-$



$$\sigma(e^+e^- \to X(4630)) \times \mathcal{B}(X(4630) \to \Lambda_c^+\Lambda_c^-)$$

$$= [0.47^{+0.11}_{-0.10}(\text{stat})^{+0.05}_{-0.08}(\text{syst}) \pm 0.19(\text{syst})] \text{ nb}$$

Scan around 4.60GeV

1600 pb^{-1} @ 9 energy points ($3*10^{32}$ $cm^{-2}s^{-1}$)

4.55	4.60	4.61	4.62	4.63	4.64	4.65	4.70	4.75	GeV
50	270	350	420	470	420	360	180	100	pb
300,	200,	150,	100,	100,	100,	150,	200,	300	pb^{-1}

Λ^+_c can be fully reconstructed and antiproton are used As tag to suppress backgrounds.

First absolute measurements of Λc decays may be available at BES-III.

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(Haibo's slide in 2009)

But unfortunately BEPCII does not have the energy reach.

Summary

- There have been no improvements in the Λ_c^+ branching fraction measurements since 1998;
- If BEPCII can run slightly above 4.6 GeV, we will be able to study Λ_c^+, but it is unlikely;
- A super tau-charm factory will provide unique opportunity for charmed baryon study if it operates in 4.6 – 5.5 GeV;
- Especially for $\Lambda_c^+\Lambda_c^-$ pair, if peak cross section is 0.47 nb around 4.63 GeV, at a luminosity of 10^{35} $cm^{-2}s^{-1}$, the production rate would be 47 Hz, which is equivalently 4 M events per day. Assuming track selection efficiency is 80%, just for the $\Lambda_c^+ \rightarrow pK^-\pi^+$ mode, the single/double tagging efficiency would be ~50%/25%, and this gives 200k singly tagged $\Lambda_c^\pm$, or 2.5k doubly tagged $\Lambda_c^+\Lambda_c^-$.