Recent measurements of charmonium decay: $\psi(3686) \to \phi K_S^0 K_S^0$

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What is charmonium ?

The Nobel Prize in Physics 1976

Psi J

Photo from the Nobel Foundation archive.
Burton Richter
Prize share: 1/2

Photo from the Nobel Foundation archive.
Samuel Chao Chung Ting

"for their pioneering work in the discovery of a heavy elementary particle of a new kind"

first charmonium state: J/ψ

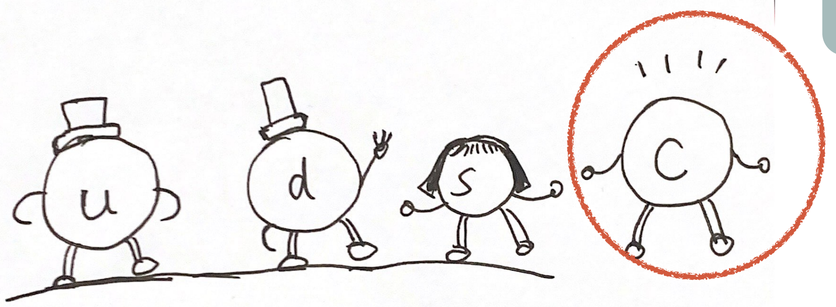
Charm Quark Exist!

❖**Gell-mann quark model**

☐ The u, d, s quark model failed to describe J/ψ

❖**GIM mechanism**

☑ The fourth quark ⇒ **Charm quark**



Hallo!

Study of the Charm onium

$c\ \bar{c}$

J/ψ

$\psi(3686)$

Why study this channel? $\psi(3686) \to \phi K_S^0 K_S^0$

❖**Charmonium decay**

✓Ideal place to

Validate models

Study the strong interactions

Test the quantum chromodynamics (QCD)

❖**12 % rule**

✓pQCD predict: The **relative ratio** of $J/\psi, \psi(3686)$ decays to the **same** final states is expected to be a **constant:**

$$\Rightarrow Q_h = \frac{\mathcal{B}(\psi(3686) \to h)}{\mathcal{B}(J/\psi \to h)} \approx \underline{12\,\%}$$

Consistent well with many experimental result…
But!

✓$\rho - \pi$ **puzzles**

$Q_{\rho\pi} < 0.6\,\%$ **Violation exists!**

(suppressed 1/20)

$\mathcal{B}(J/\psi \to \phi K_S^0 K_S^0) = (5.9 \pm 1.5) \times 10^{-4}$

$\mathcal{B}(\psi(3686) \to \phi K_S^0 K_S^0) =$?

How to solve it?

Large charmonium data set are collected!

Clean environment with low backgrounds!

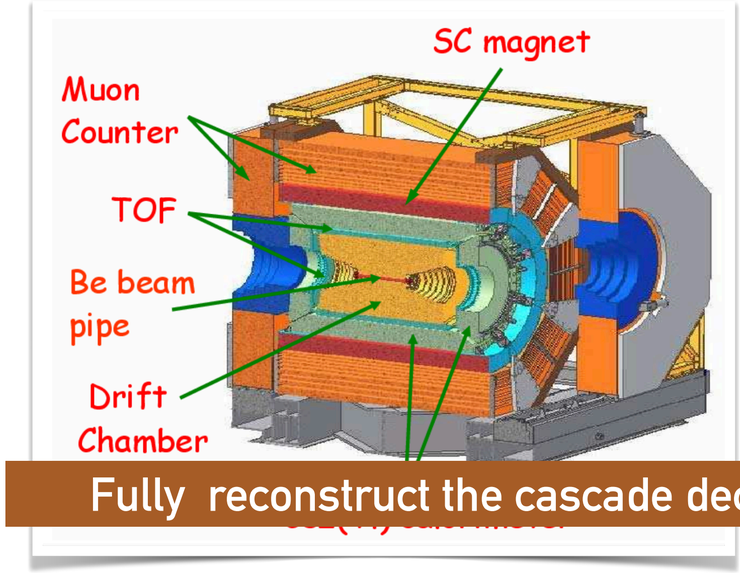
Fully reconstruct the cascade decay :

allows us to search for processes with very low Branching fraction

$$\psi(3686) \to \phi K_S^0 K_S^0, \ \ \phi \to K^+K^-, K_S^0 \to \pi^+\pi^-$$

≈ Half Billion $\psi(3686)$ events !

Large charmonium data set are collected!



Fully reconstruct the cascade decay

What's the result?

$\psi(3686) \to \phi K_S^0 K_S^0$ **First observation!**

The 12% rule is checked!

✓🥳Consistent? ✓🧐Violate?

Come to find the answer in the poster session!