Hadron 2005 review

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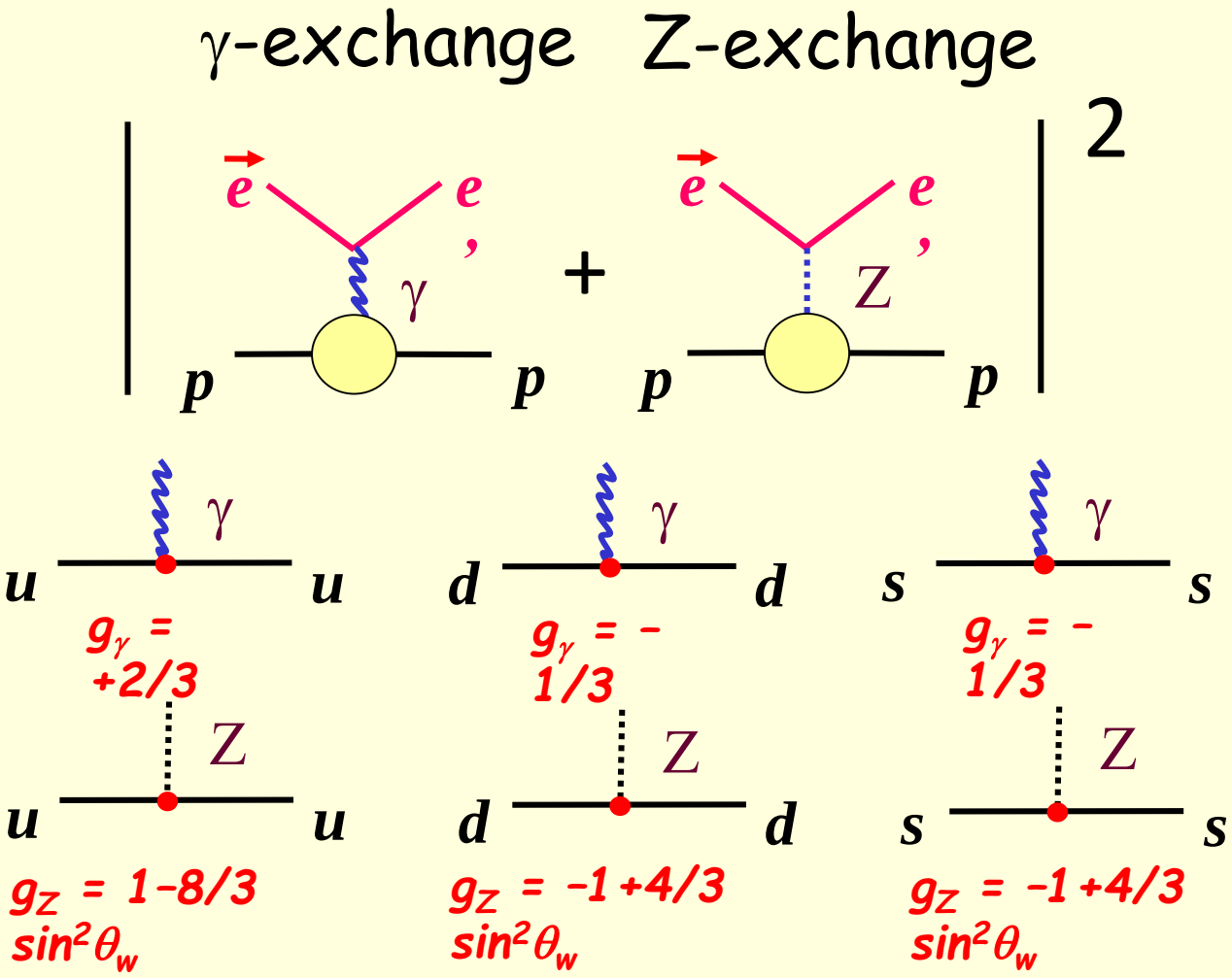
Rio De Janeiro Aug 05 21->26

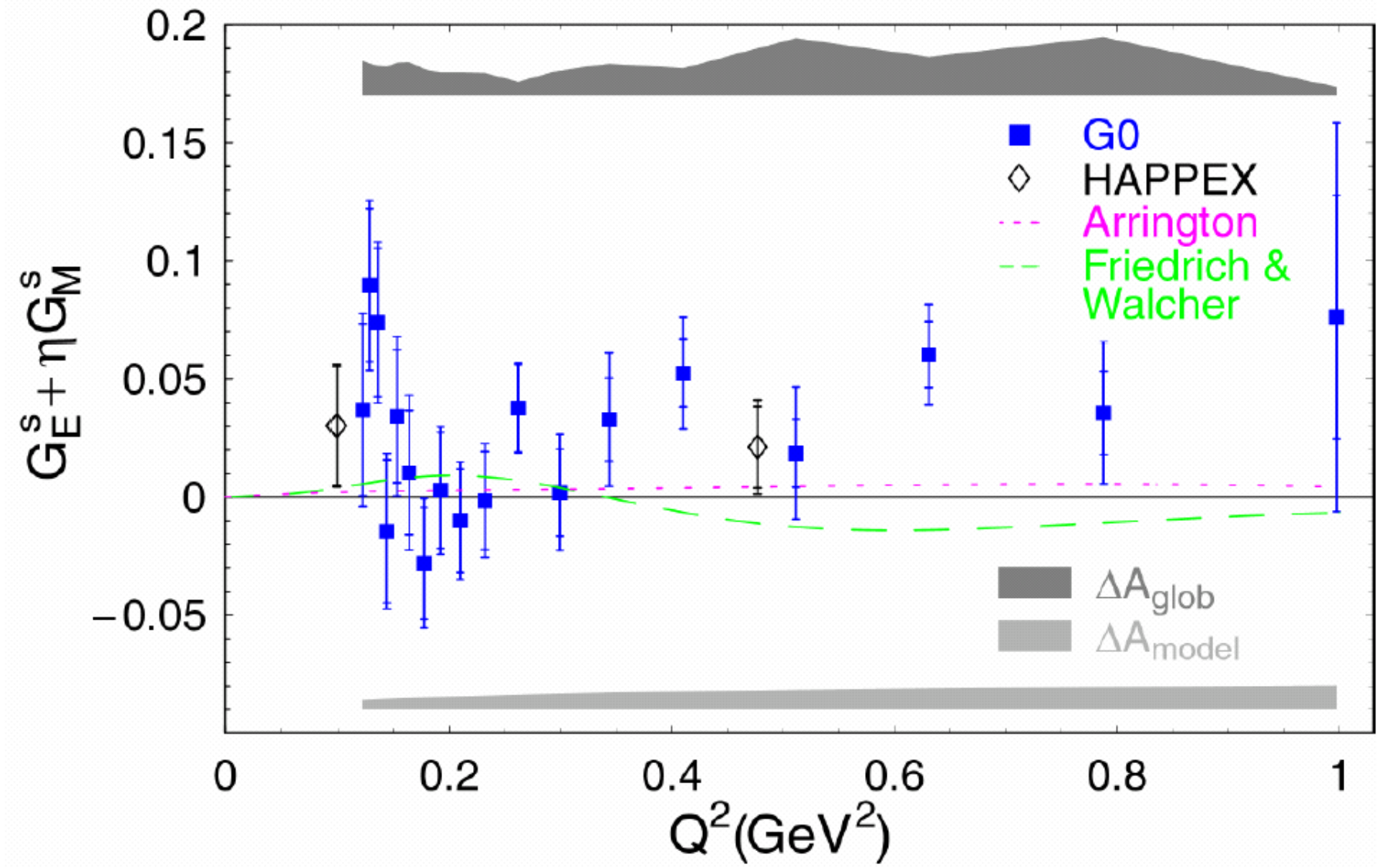
http://www.cbpf.br/~hadron05/index.htm

Recent results from Jefferson Lab

1. Strange quarks in Nucleon: Happex



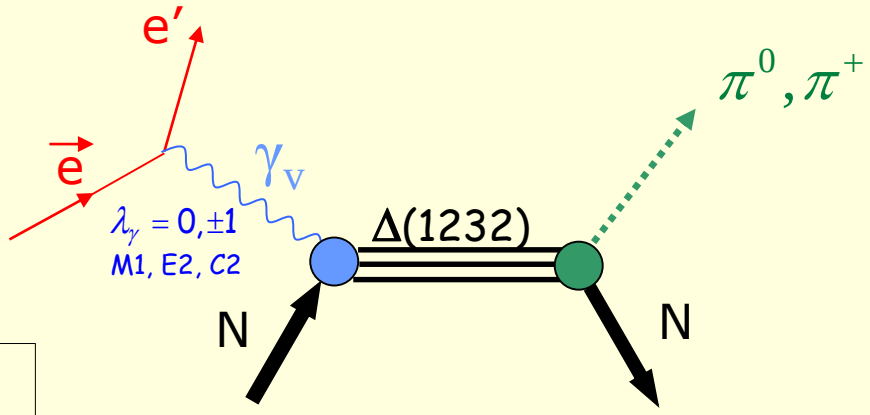
Strange quark contribution to the proton

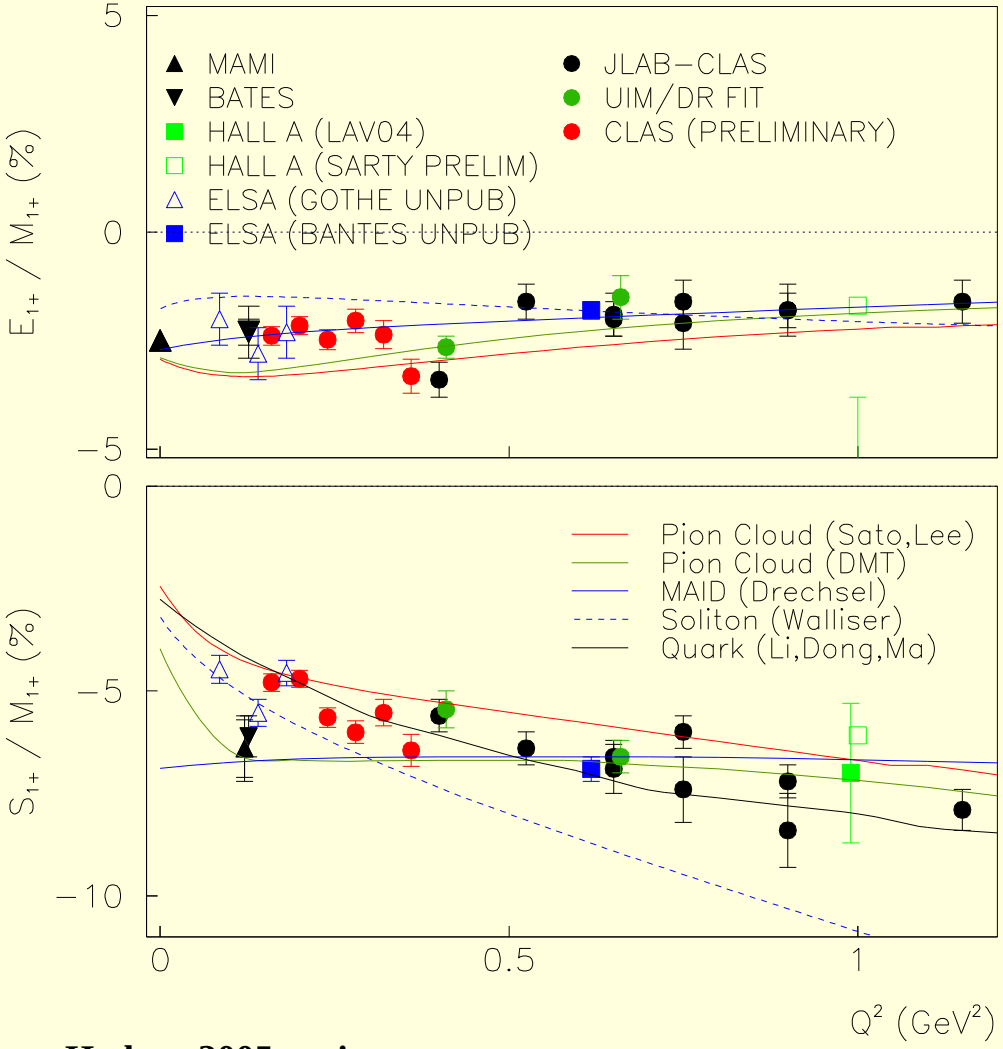


http://www.npl.uiuc.edu/exp/G0/Forward

DHB, 17 June 2005

2. N-Δ transition form factors





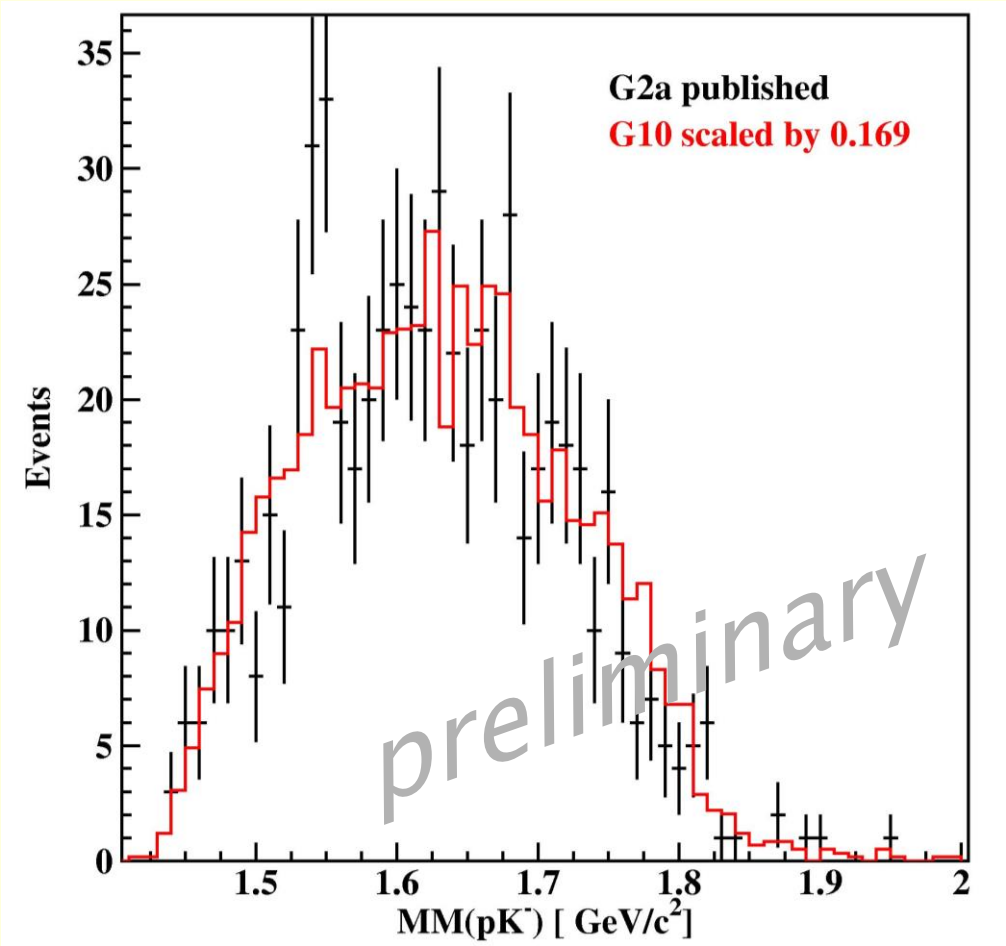
Preliminary E1+/M1+ is in good agreement with MAID, while S1+/M1+ continues to show strong Q2 dependence.

Consistency between different data sets at low Q^2 needs to be understood. Reanalysis of ELSA low Q2 points in progress.

3. Latest on Pentaquarks

A comprehensive program to search for pentaquarks in photoproduction experiments at Jeffeson Lab were approved in 2003-2004 with the goal of confirming previous results and explore new kinematics with at least a factor 10 increase in statistics.

			Relevant Publication
g10	deuteron	E_γ ~ 1.0–3.5 GeV data taking completed in 2004	CLAS(d) g2 2003 Phys. Rev. Lett. 91, 252001-1
g11	proton	E_γ ~ 1.6–3.8 GeV data taking completed in 2004	SAPHIR 2003 Phys. Lett. B572, 127
eg3	deuteron	E_γ ~ 4.0–5.4 GeV data taking completed in 2005	NA49 2004 Phys. Rev. Lett. 92, 042003-1
Super-g	proton	E_γ ~ 3.8 – 5.7 GeV planned for 2006	CLAS(p) g6 2004 Phys. Rev. Lett. 92, 032001-1

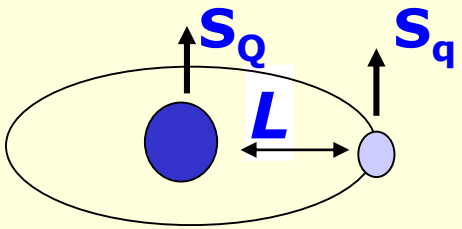


M(nK⁺)(GeV)

- Model-independent uppper limit 95% CL for Θ⁺ is < 20nb.
- With assumptions about the spectator, we can set a model-dependent upper limit to the cross section of < 4-5 nb.

Still difference between LEPS and J-Lab exits in forward direction

Charmed mesons spectroscopy chart

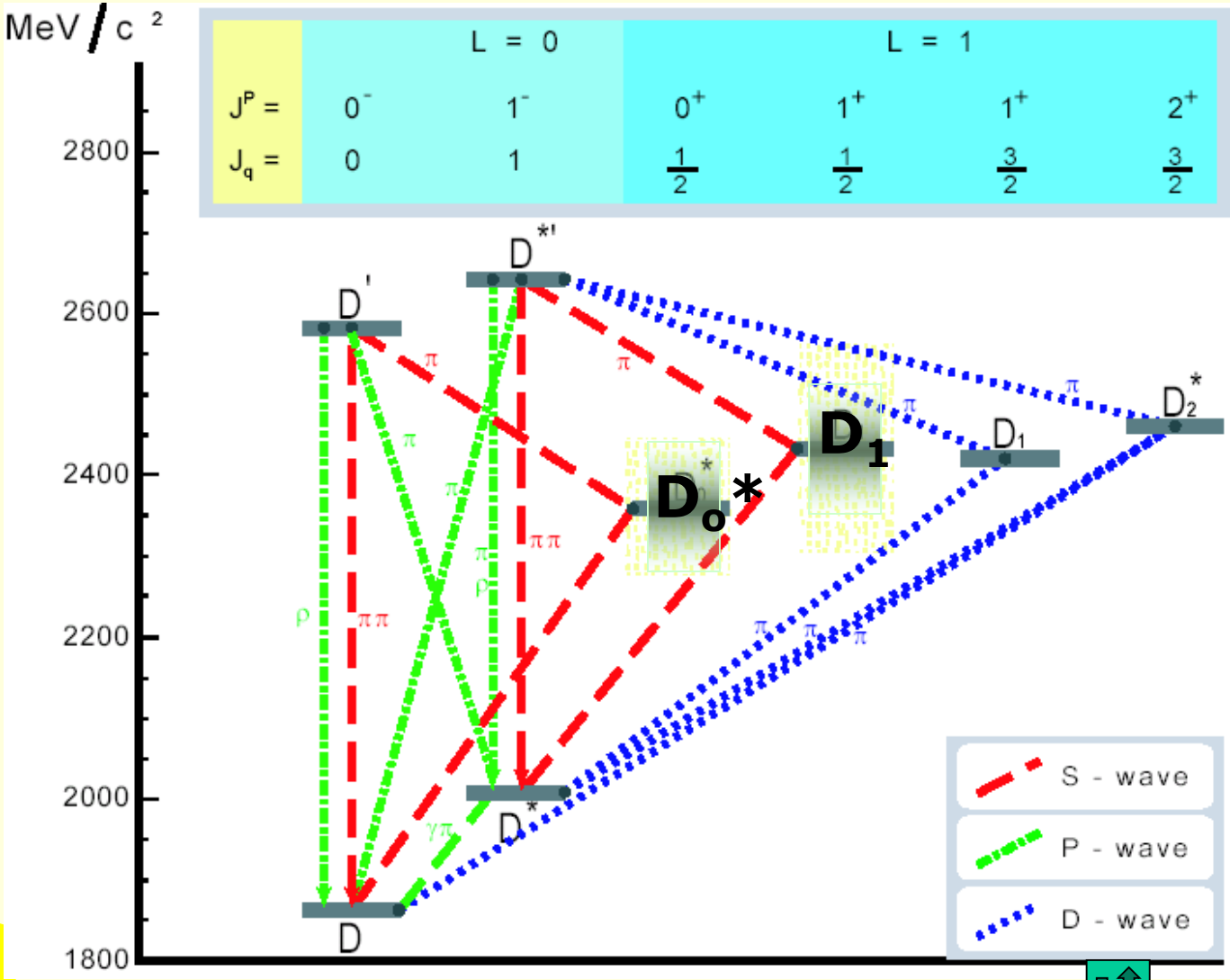


In the heavy-quark limit, the heavy-quark spin $\mathbf{S_Q}$ and the total angular momentum of the light-quark $\mathbf{j_q}=\mathbf{L}+\mathbf{S}$ are conserved

PREDICTION #1:
Each level is composed of a degenerate doublet of states with the same j_q and total angular momentum $J=j_q \pm ½$. $j_q=½$ states are predicted to be broad (100-200MeV width).

PREDICTION #2:
FLAVOUR SYMMETRY

THIS PARADIGMA FALSIFIED BY BABAR AND CLEO DISCOVERY OF Dsj STATES.



Searches and measurements at

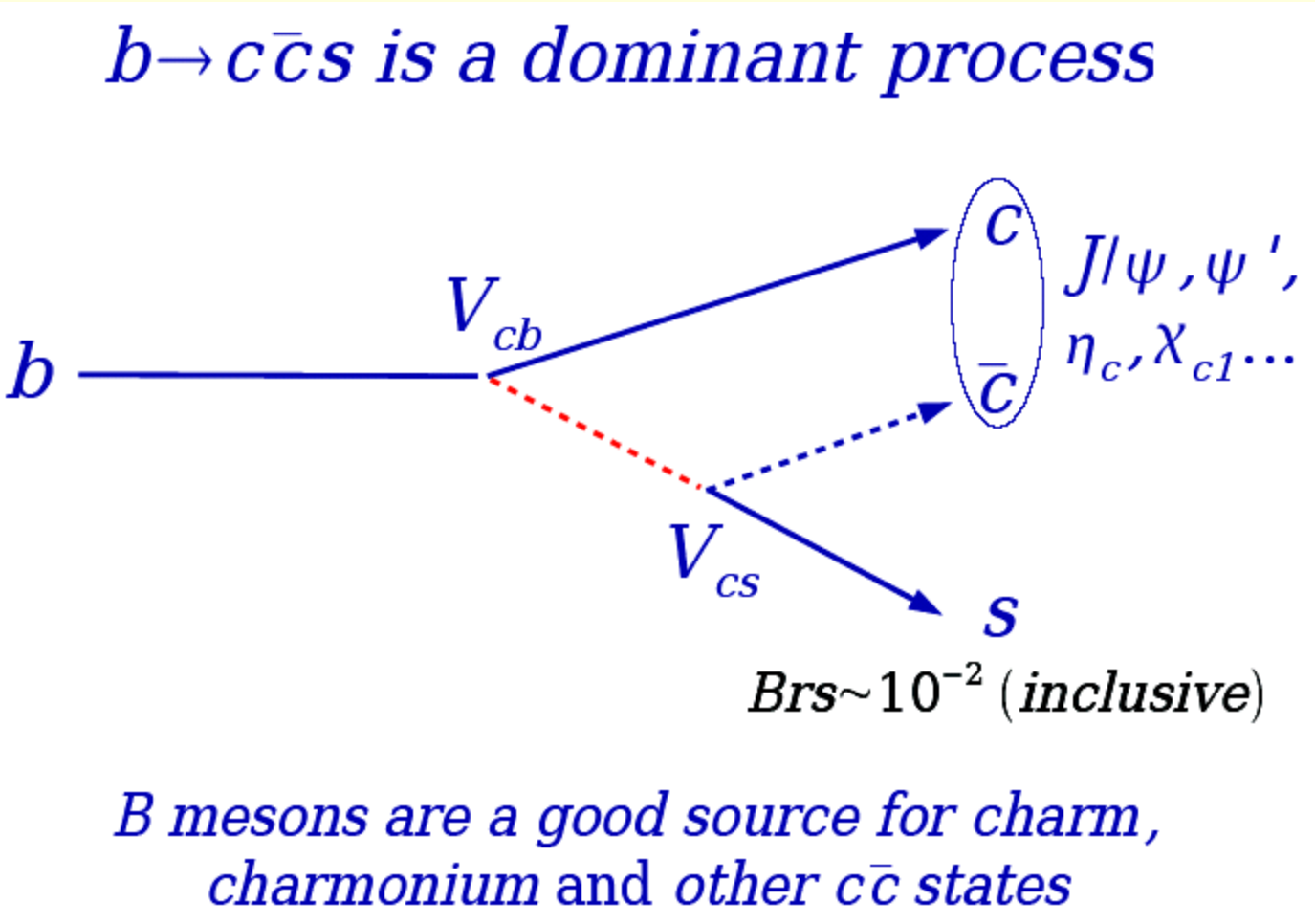
1. L=1 states at Focus (photoproduction at Tevatron) and Belle(B decay) and CDF

2. D_s states at BABAR and Belle

Table 1: Summer 2005 status of (L=1, n=1) $c\bar{s}$ mesons (MeV).
Statistical and systematical errors added in quadrature, unless noted.

j_q	1/2	1/2	3/2	3/2	1/2	1/2
J^P	0^+	1^+	1^+	2^+	0^-	1^-
L, n	1, 1	1, 1	1, 1	1, 1	0, 2	0, 2
	$D^*_{sJ}(2317)$	$D_{sJ}(2460)$	$D_{s1}(2536)$	$D^*_{s2}(2573)$	D'_s	$D^{*\prime}_s$
Decay Mode	$D^+_S\pi^0$	$D^+_S\gamma, D^{*+}_S\pi^0, D^+_S\pi^+\pi^-$	$D^*K, D\pi K$	DK		
			Mass (MeV)			
PDG $\pm$	2317 ± 0.6	2458.9 ± 0.9	2535.35 ± 0.6	2573.5 ± 1.7		
FOCUS prel. $\pm$	2323 ± 2		2535.1 ± 0.3	2567.3 ± 1.4		
			$BR(D\pi K)/BR(D^*K)$			
BELLE prel. $\pm$			$2.8 \pm 0.2 \pm 0.4\%$			
			Width (MeV)			
PDG $\pm$	<4.6	<5.5	<2.3 90 % cl	15 ± 5		
FOCUS $\pm$			1.6 ± 1.0	28 ± 5		

Hadronic Physics at Belle



New Particles found by Belle

X(3872)

J^{PC} established as 1^{++}

$c\bar{c}$ charmonium component is small ($<$ few%)

properties consistent with a $D^0 \bar{D}^{*0}$ bound state

4−quark mesons : S.Ishida, M.Ishida, A.Polosa, J.Vijande

Y(3940)

No obvious $c\bar{c}$ assignment

4−quark state seems unlikely

$c\bar{c}$−gluon hybrid ?

X(3940)

new charmonium in $e^+ e^- \to J/\psi(c\bar{c}) : \eta_c(3S)$??

Z(3930)

χ'_{c2} candidate in $\gamma\gamma \to D\bar{D}$ production

$\Sigma_c(2800)$

Σ_{c2}, $J^P = 3/2^-$ isospin triplet

Hadronic Physics at BES

Summary

- Lots of progress in hadron spectroscopy study from BES and CLEOc in charmonia decay.
- X(1835) observed in $J/\psi \rightarrow \gamma + (\eta'\pi\pi)$ decays, could be the same state observed in $J/\psi \rightarrow \gamma p\bar{p}$, could be a baryonium. Need more information (J^{PC} etc.).
- Scalars are studied in J/ψ, ψ' and χ_{c0} decay. Parameters of σ and κ are given, other states are also measured in hadronic and radiative decays.
- Vector charmonia (J/ψ, ψ', and ψ'') hadronic decays are studied extensively and simultaneously to understand charmonium decay dynamics.
- "$\rho\pi$ puzzle" remains a puzzle, ψ'' charmless decays is observed and could be large.
- More data are needed (and expected) for further study (CLEOc and BESIII).

Recent results on Baryon Spectroscopy

- New Charm Baryon Masses this year
  - Λ_c^+ - Updated since 1991
  - Discovery of Isotriplet decaying to $\Lambda_c^+\pi$
  - Ξ_c^+ - Updated since 1998
  - Ξ_c^0 - Updated since 1998
- Update and Confirmation of Ξ_{cc}^+ -first report in 2002
- New Λ_b^0 Mass - updated since 1997
- Pentaquarks -what's their status?
- Summary

Babar, Belle

Selex

Summary of charm pentaquark results

Experiment	$Y(\Theta_c)$	$Y(D^{*-})$	$Y(D^-)$	$\frac{\sigma(\Theta_c \to D^{*-})}{\sigma(D^{*-})}$	$\frac{\sigma(\Theta_c \to D^-)}{\sigma(D^-)}$
H1 ep	50.6 ± 11.2	~ 3500		$\sim 1\ \%$	
FOCUS γN	< 15	105000	137000	$< 0.04\ \%$	$< 0.04\ \%$
ALEPH e^+e^-		~ 4300	~ 5400	$< 0.31\ \%$	$< 1.80\ \%$
CDF $p\bar{p}$	< 27	537000			
ZEUS ep		~ 60000		$< 0.23\ \%$	

- FOCUS result is in serious disagreement with H1 observation for $\Theta_c \to D^{(*)-}p$
- ZEUS has identical production and similar experiment; claims H1 signal excluded at $9\,\sigma$

Summary

1. Bound heavy pentaquark, unbound strange heavy pentaquarkCDF
2. Pentaquark search: forward direction
3. D states
4. Charomium states
5. Charmed baryon state