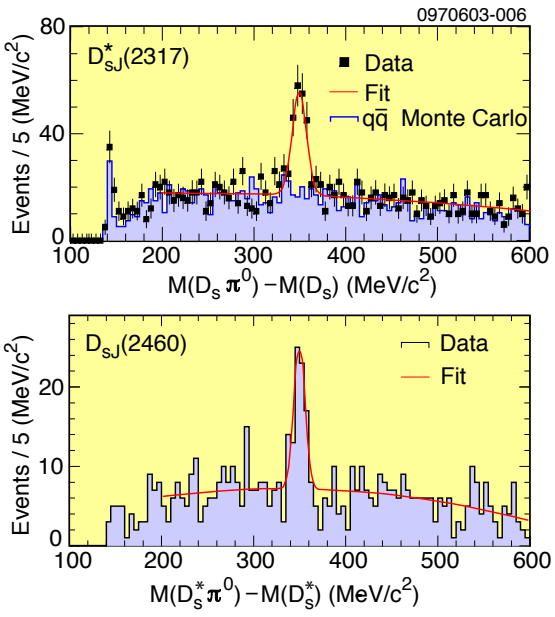
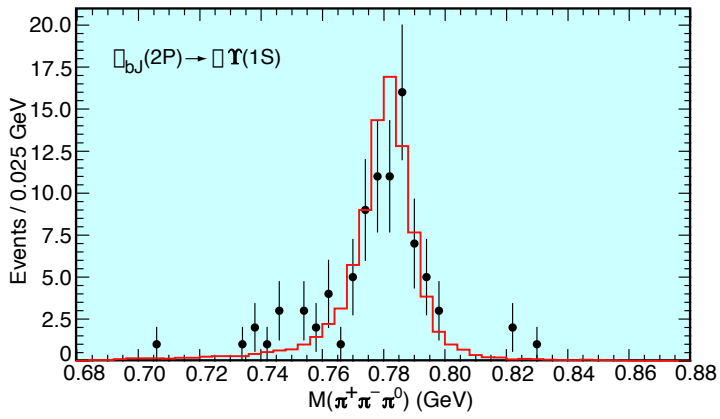
2230703-001

Heavy Quark Spectroscopy

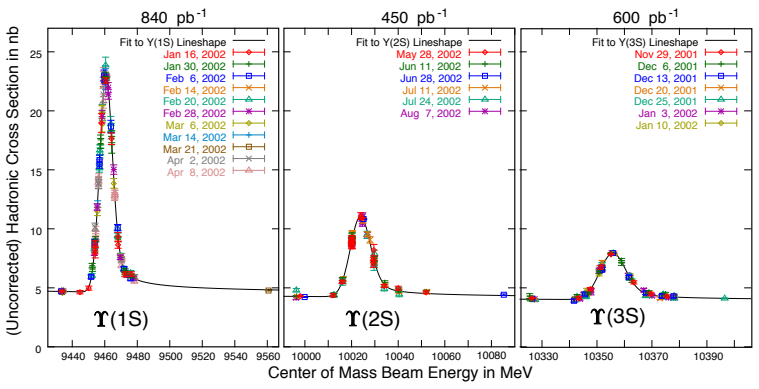
CLEO Collaboration

Two New Charmed Mesons. Based upon the initial observation by BaBar of a narrow state decaying into $D_s\pi^0$, CLEO quickly confirmed the existence of this new resonance, denoted $D^*_{sJ}(2317)$ and tentatively assigned spin-parity of 0^+. Our plot of the mass difference between the $D^*_{sJ}(2317)$ candidates and the D_s is shown in the upper plot. CLEO also carefully evaluated the final state $D^*_s\pi^0$ to determine that another state, $D_{sJ}(2460)$, with tentative 1^+ assignment, also exists. As shown in the lower plot the mass difference for $D_{sJ}(2460)$ minus D^*_s is very close to that shown in the upper plot for the $D^*_{sJ}(2317)$. This work is the subject of a poster by Selina Li of the University of Minnesota in the student poster section. It has been accepted for publication by Physical Review (see hep-ex/0305100), contributed to this conference as LP-34, and featured in the CERN Courier, Vol. 43, No. 6, p.8.

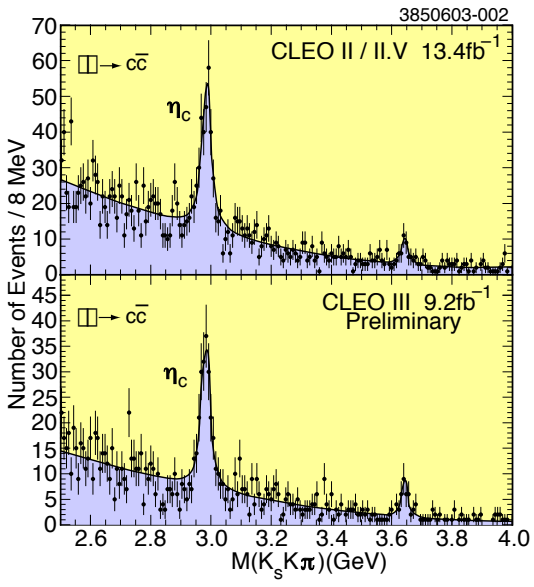




First Hadronic Transition Involving a χ_b State. From our sample of ~6 million $\Upsilon(3S)$ decays, CLEO has observed the decay $\chi_{bJ}(2P) \to \pi\pi\Upsilon(1S)$ in the decay chain starting with $\Upsilon(3S) \to \gamma\chi_{bJ}(2P)$ and ending with the $\Upsilon(1S)$ decaying to lepton pairs. Shown above is the three-pion invariant mass after simple kinematic and track quality requirements, clearly showing a peak in the data (points) at the η mass very consistent in shape with the Monte Carlo prediction (histogram). Our preliminary results, presented to this conference as LP-121, show the branching fraction for $\chi_{bJ}(2P) \to \pi\pi\Upsilon(1S)$ to be ~3%, roughly equally divided between J=1 and J=2. [hep-ex/0307034]



Di-lepton Widths of the Narrow Upsilon Resonances. CLEO carefully took many scans of the three narrow Υ states in order to accurately measure their areas, and thus their di-lepton widths. These widths and their ratios are stringent tests of lattice QCD predictions. The statistical uncertainty is below 0.4% for each. Systematic biases from beam energy calibration, acceptance and backgrounds seem under control at the 1-2% level each. Efforts to reduce the luminosity uncertainty are underway with the ultimate goal of total systematic uncertainties of ~2%.



New State of Charmonium. CLEO has observed the $\eta_c'(2\,^1S_0)$, the first radial excitation of the ground state of charmonium, produced in two-photon fusion and decaying into $K_sK\pi$. In the upper figure we plot the invariant mass of the $K_sK\pi$ system for events chosen to be consistent with two-photon fusion from 13.4 fb^{-1} of data taken with the CLEOII and CLEOII.V detector configurations. In addition to the η_c ground state there is a clear enhancement at ~3643 MeV with greater than 4σ significance. In the lower plot this observation is confirmed in 9.2 fb^{-1} of data taken with CLEOIII , showing the η_c' at the same mass with a significance of over 5σ. These results, still preliminary, are in LP-37, contributed to this conference. [hep-ex/0306060]

Branching fractions×10^{-6}

(Statistical sig.(#σ), 90% CL ULs)

Channel	Υ(1S)		Υ(2S)		Υ(3S)	
$\rho\pi$	-	4	-	11	$9^{+7}_{-8}\pm1/1.5$	22
$K^*\bar{K}$	$6^{+3}_{-2}\pm1/3.6$	11	-	8	-	14
ρa_2	$9\pm4\pm1/3.0$	19	-	24	$8^{+15}_{-6}\pm1/1.3$	30
ωf_2	$3^{+2}_{-1}\pm1/2.6$	7	-	11	-	8
$\phi f_2'$	$7^{+3}_{-2}\pm1/5.5$	12	$6^{+6}_{-3}\pm1/3.0$	17	-	14
$K^*\bar{K}_2^*$	$9^{+5}_{-4}\pm1/3.0$	19	$11\pm8\pm2/1.6$	32	-	28
$b_1\pi$	$3\pm2\pm1/2.9$	8	-	12	$5^{+9}_{-4}\pm1/1.4$	18
$K_1(1270)\,\bar{K}$	-	8	-	11	-	17
$K_1(1400)\,\bar{K}$	$14^{+4}_{-3}\pm2/5.6$	23	$16^{+10}_{-7}\pm2/2.9$	33	$7^{+10}_{-5}\pm1/1.5$	22

#σ ULs

First Two-body Hadronic Υ Transitions. In the $c\bar{c}$ system there are a number of two-body hadronic decays, such as $\rho\pi$, that are copious for the J/ψ but suppressed for the $\psi'(3686)$. CLEO has reported preliminary results, in LP-122, on such decays of the three narrow Υ resonances. To the left is a table showing the various modes with 68% CL intervals (red), significance of being non-zero (blue, only entered if $>1\sigma$), and 90% CL upper limits, all in units of 10^{-6}. Below are the total event energies (scaled to the c-o-m energy) and invariant submasses for the two channels having $> 5\sigma$ significance; points are data; green is scaled Υ(4S); red is Monte Carlo **shape**. [hep-ex/0307035]

Photon Transitions within Charmonium. In a short engineering run to prepare for CLEO-c, CLEO accumulated ~2.6 pb^{-1} of data at a center of mass energy of the $\psi'(3686)$. Even this small data sample allowed us to examine the E1 and M1 photon transitions with a sensitivity similar to that of the Crystal Ball. In the main plot we show the inclusive photon spectrum after suppression of π^0 backgrounds. In the high energy region we see the spectrum after subtraction of the smooth background; CLEO is clearly able to see the χ_c (statistical significance > 8σ) at a mass consistent with that in the PDG. In the lower energy region we also cleanly observe the three E1 transitions to χ_c states but no evidence of the η_c' near 91 MeV, as claimed by the Crystal Ball. Our preliminary upper limit, to be presented at this conference, is incompatible with their claimed rate for this M1 transition.