# CESR and CLEO Results and Plans

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# CESR Performance

- $\Upsilon$(4S) running ended June 26 '01
- Peak luminosity 1.2 x $10^{33}$ $cm^{-1}$ $s^{-1}$
- Integrated luminosity

| | |
|---|---|
| CLEO III | 9.3 $fb^{-1}$ |
| CLEO II & III | 23 $fb^{-1}$ |

# CLEO Result Highlights

- CLEO II
  - $b \rightarrow s\gamma$
  - $V_{cb}$
  - $V_{ub}$
  - D intrinsic width
- CLEO III
  - Rare B decays

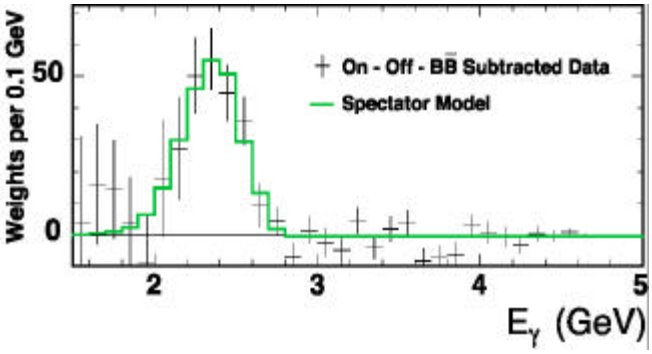
20 abstracts to EPS and Lepton-Photon

Preliminary

# b ® sg

- B(b → sγ) ( ± 0.40 ± 0.24 ) x $10^{-4}$
- CP Asymmetry: -0.27< $A_{CP}$ <0.40 (90% CL)
- γ spectrum

Agrees w/ SM value of ( 29 ± 0.33 ) x $10^{-4}$




Mean γ energy reveals b quark mass
Important to $V_{cb}$, $V_{ub}$

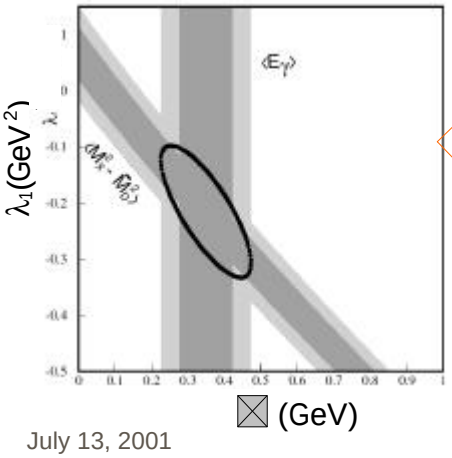
# $|V_{cb}|$ from b ® cln

Use…

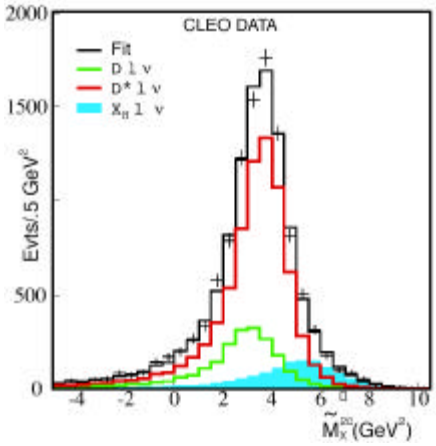
- Recoil mass spectrum and b s to constrain theory

Ligeti, Luke, Manohar & Wise; Bauer; Falk & Ligeti

- CLEO measurement of B(b → clν)




Preliminary



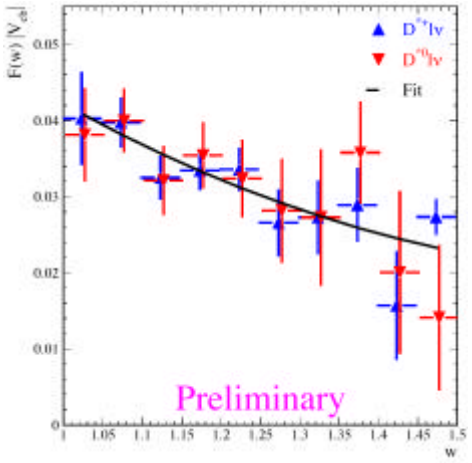

Find…

$|V_{cb}| = 0.0405 \pm 0.0009 \pm 0.0009 \pm 0.0008$

($\Gamma_{sl}$) ( & $\lambda_1$) ($1/M_B^3$ & $\alpha_s$)

Caveat: Assumes quark-hadron duality

# $|V_{cb}|$ from B ® Dln



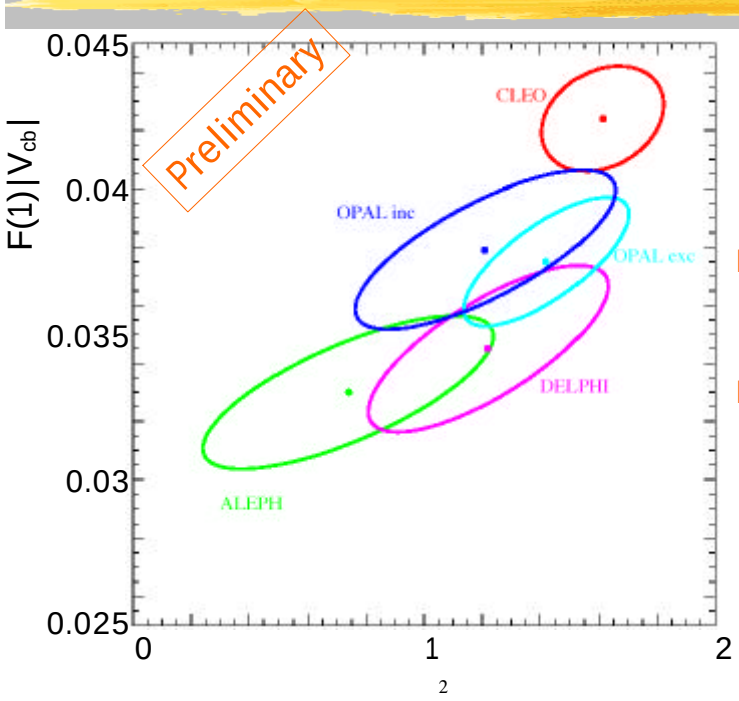

- Dlν is the most theoretically robust avenue to $V_{cb}$
- Extrapolate rate to w=1 to get $F(1)|V_{cb}|$.

$|V_{cb}| = 0.0462 \pm 0.0014 \pm 0.0020 \pm 0.0021$
(stat) (syst) (theory)

Preliminary

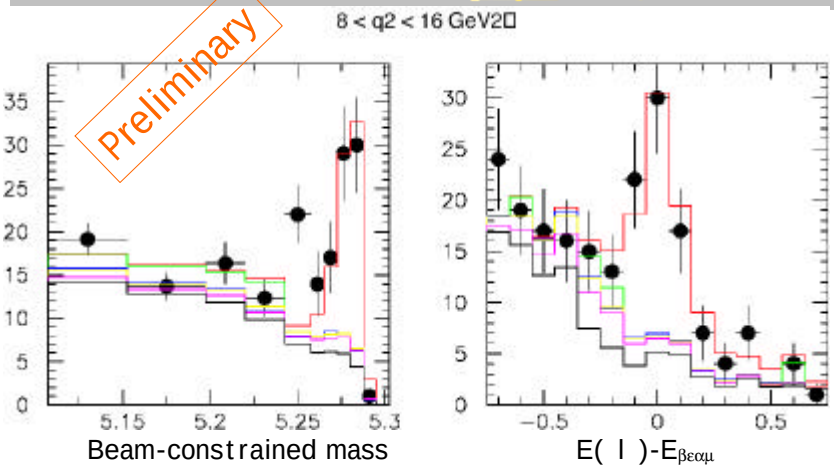
(Uses F(1)=0.913 ± 0.042)

# $|V_{cb}|$ from B ® Dln (con't)




- Result is the most precise to date.
- Central value is somewhat higher than past results.

# B ® Àln and $|V_{ub}|$

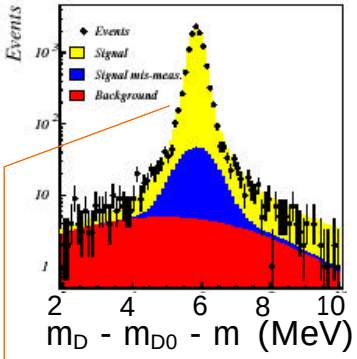



Exploits mature detector understanding

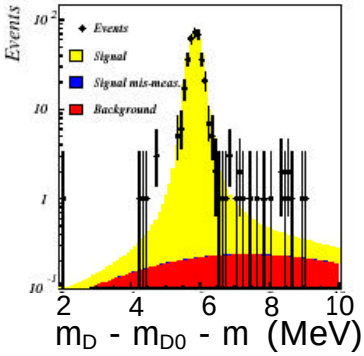
- Uses ν ρεχονστρυχτιον
- σ(|ς$_{ub}$|) ~ ± 5% (stat) ± 5% (syst) ± 15% (model)

# D Intrinsic Width

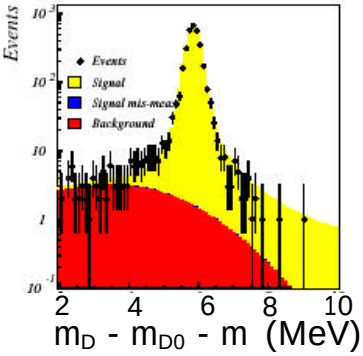
Nominal selection




Tracking selection




Kinematic selection



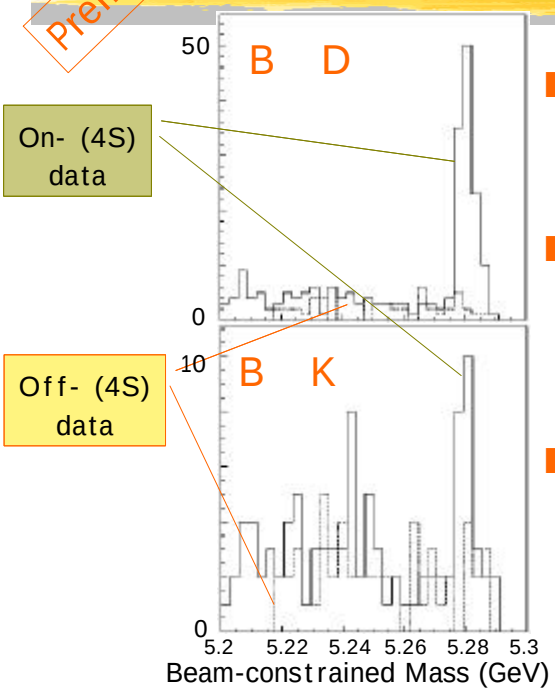

Measurement resolution is ~150 keV

Corresponds to a VP coupling of g = 0.59 ± 0.01 ± 0.07

- $\Gamma(D^+) = 96 \pm 4 \pm 22$ keV
- $m_{D+} - m_{D0} = 145.412 \pm 0.002 \pm 0.0012$ MeV/$c^2$

# Rare B Decays

Preliminary




- Plots are based on ~3.5 $fb^{-1}$ CLEO-III data
- 7-8 fb-1 aimed at Lepton Photon (along with 14 $fb^{-1}$ of CLEO-II data)
- "Box" remains unopened

# The Future: CESR-c & CLEO-c

30 M DD pairs

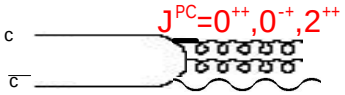
- $\psi(3770)$
  - $D \rightarrow K$ to ~1%
  - $f_D$ to ~2%
  - $D \rightarrow Kl\nu$ $\alpha\nu\delta$ $l\nu$ BR's to <1% and form factors to ~4%
  - $|V_{cd}|$ to ~2%
  - Rare D decays, mixing, CP violation

1.5 M $D_sD_s$ pairs

- $E_{cm}$ = 4140 MeV
  - $D_s \rightarrow \phi$ to ~2%
  - $f_{Ds}$ to ~2%
  - $D_s \rightarrow \phi l\nu$ BR to 3%
  - $|V_{cs}|$ to 1-2%

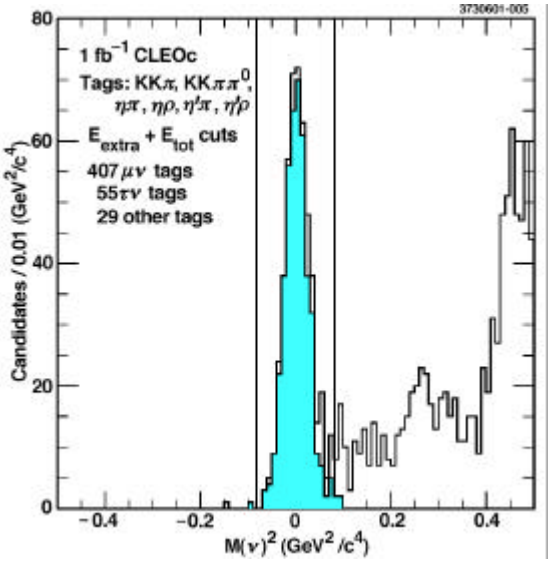
1 B J/

- $J/\psi(3100)$
  - Glueball studies via $J/\psi \rightarrow \gamma X$



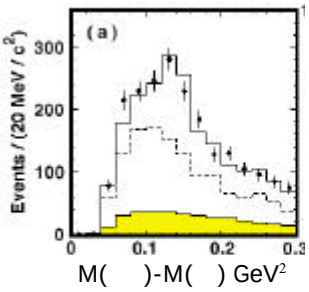

- Spot checks of R to ~2% each
- Other possibilities: $\psi(2S)$, $\tau\tau$ threshold, $\Lambda_c\Lambda_c$ threshold, above the $\Upsilon(4\Sigma)$

# $f_{Ds}$



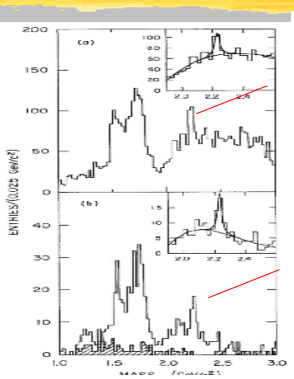

- $D_s \rightarrow \mu\nu$
- Fully reconstruct one $D_s$
- Look for lone remaining particle (no particle ID required)

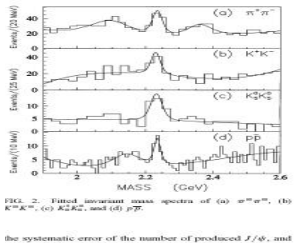
cf, CLEO-II Analysis



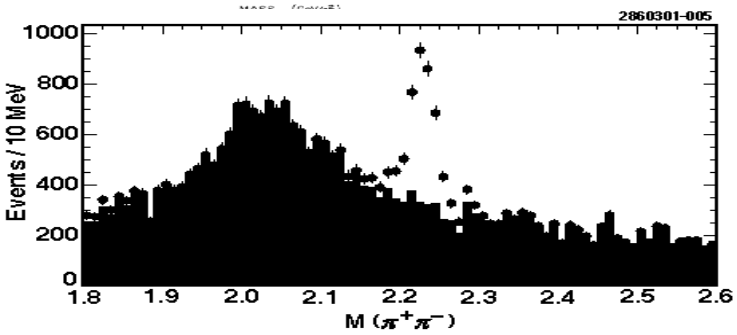
# Example: the x(2230)

MKIII
1986





BES
1996




**1/6 CLEO-C Assuming BES Branching Ratio**

# The Themes

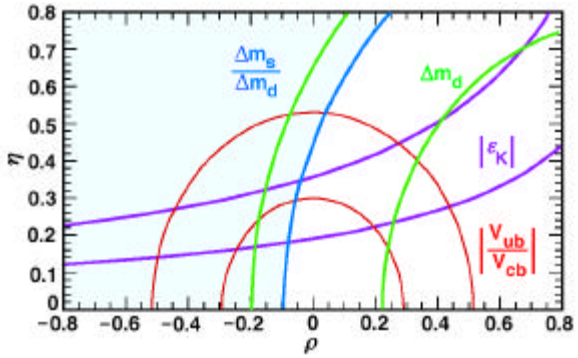
- Precision flavor physics
- Probes of non-perturbative QCD
  - Lattice QCD: Improved actions, advances in handling light quarks and possibility of unquenching have opened the door to 1-2% precision this decade

  Problem: There is little data to verify or drive these calculations

  - CLEO-c: decay constants, form factors, charmonia and bottomonia mass spectra and leptonic widths with percent precision.
  - Important for…
    - Reaping the benefits of B-factories
    - Handling strongly-coupled physics that may be discovered at the LHC or beyond
- Searches for physics beyond the Standard Model

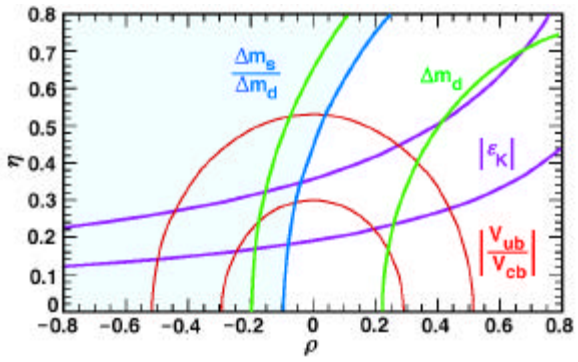
# CKM with CLEO-c

## Current status

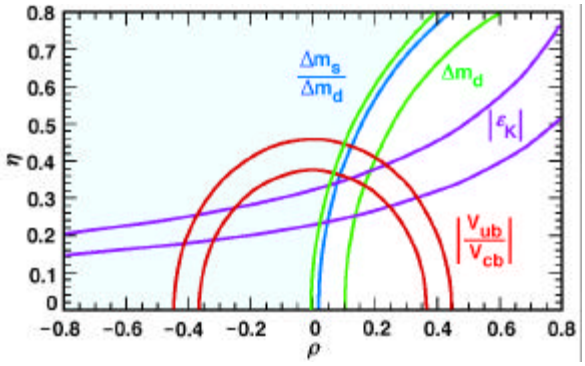


# CKM with CLEO-c

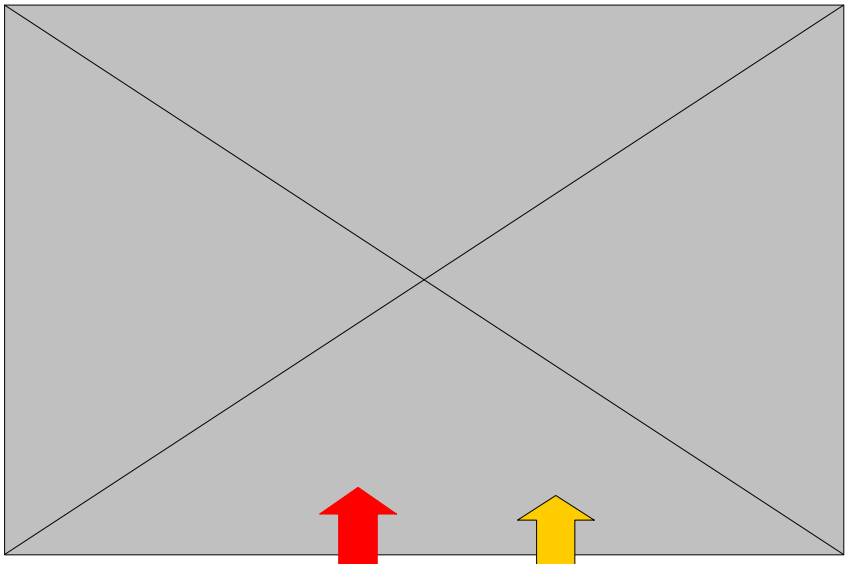
Current status




If lattice succeeds and is verified w/ CLEO-c



# Physics Targets & Sensitivity



Statistics limited.

Systematics & background limited.

# Plan

- Now - Jan 2002

  Install superconducting quads, tune-up CESR, do machine studies

- Jan - August 2002

  $\Upsilon(1S)$, $\Upsilon(2S)$, $\Upsilon(3S)$ $4\ fb^{-1}$

  10-20x existing samples

- Fall 2002

  Install wigglers

  Similar to those for LC damping rings

- 2003 - 2005

| $E_{cm}$ | Lum | Sample | Run Time |
|---|---|---|---|
| 4140 MeV | 3 $fb^{-1}$ | 1.5 M $D_sD_s$ | 1 year |
| 3770 MeV | 3 | 30 M DD | 1 year |
| 3100 MeV | 1 | 1 B $J/\psi$ | 1 year |

20x BES II goal

# Comparison with Other Experiments

**China:**

BES II is running now.

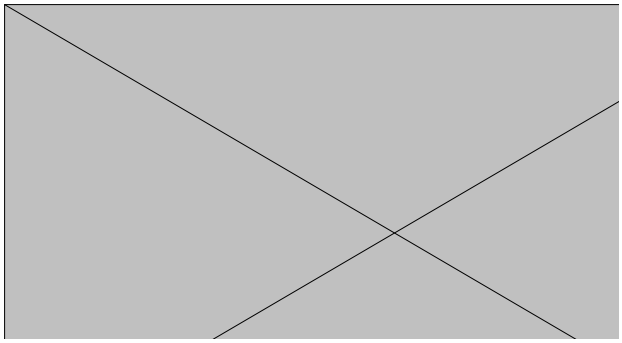
Proposed:

BES II --> BES III upgrade

BEPC I --> BEPC II upgrade,

~$10^{32}$ lumi.

Physics after 2005 if approval & construction go ahead.



**HALL-D at TJNAL**:

$\gamma p$ to produce states with exotic Quantum Numbers

Focus on light states with $J^{PC}$ = 0+-, 1+-, ...

Complementary to CLEO-C focus on heavy states with $J^{PC}$=0++, 2++, ...

Physics in 2007+ ?

# Next Steps

- Project Description — June, 2001
- PAC meeting — Sept 28, 29 2001
- NSF Review — January, 2002

# Summary

- Results
  - CLEO-II Capitalize on well-understood detector
  - CLEO-III 7-8 $fb^{-1}$ analyzed so far (of 9 fb-1 collected)

- CLEO-c & CESR-c
  - Precision flavor physics
  - Incisive tests of non-perturbative QCD
  - Searches for physics beyond the SM

- Collaboration is growing
  - New groups welcome