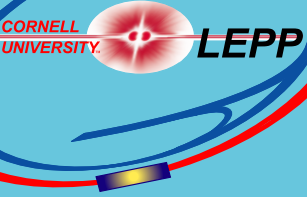




CESR

LEO



CLEO-c, CESR-c, and Accelerator Physics

The CLEO-c Program

Upsilon's ~1-2 fb⁻¹ each
Υ(1S) Υ(2S), Υ(3S)...
Spectroscopy, Matrix Elements, Γ_{ee}
10-20 times existing world's data

ψ(3770) -- 3 fb⁻¹
30M events, 6M *tagged* D decays
(310 times MARK III)

√s ~ 4100MeV -- 3 fb⁻¹
1.5M D_sD_s, 0.3M *tagged* D_s decays
(480 times MARK III, 130 times BES II)

ψ(3100) ? -- 1 fb⁻¹
1 G J/ψ decays
(170 times MARK III, 20 times BES II)

CLEO-c at the Frontiers of QCD

The CLEO Collaboration is embarking on CLEO-c, a focused program of precision measurements and searches for new physics in D decays, and searches for glue-rich exotic states in radiative J/ψ decays.

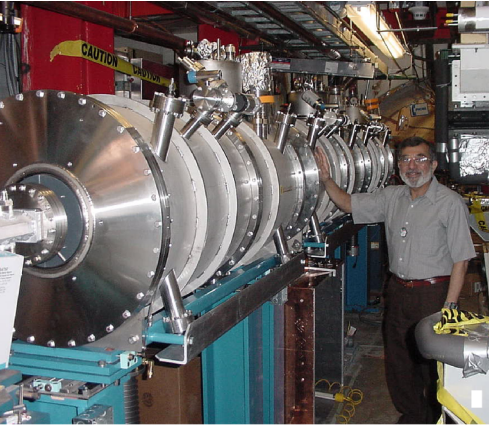
The CLEO-c program of precision measurements of D decays is already stimulating Lattice QCD (LQCD) theorists to develop techniques to improve calculations of D decay constants (f_D⁺ and f_D⁻) and semileptonic decay form factors in order to reach precisions of a few percent. Agreement with CLEO-c measurements would validate these LQCD calculations and provide the confidence required to apply them to the B meson sector where they are needed to derive CKM matrix elements from B decay measurements.

Radiative J/ψ decay is a "glue-rich" environment where glueballs should appear. With a data sample of 10⁹ J/ψ events CLEO-c will make definitive search for glueballs with masses in the 1-2 GeV/c² range.

Accelerator Physics for the Future

- LEPP continues its tradition of innovation and leadership in accelerator physics with R&D that addresses important elements required for linear colliders and neutrino factories/muon colliders:
- Wiggler magnets are required to achieve high luminosity in CESR-c. Six wigglers have been installed in CESR and efforts to understand the dynamics of wiggler-dominated storage rings are underway. This experience will be invaluable for the design of linear-collider damping rings.
 - LEPP is designing new superconducting RF (SRF) cavities for TESLA. These cavities will reach higher accelerating electric fields at a given maximum magnetic field.
 - LEPP is testing 200 MHz superconducting RF cavities prepared by CERN that are designed for use in neutrino factories and muon colliders.
 - LEPP is contributing undulators to the SLAC E-166 experiment to develop polarized e⁺ sources for linear colliders.

● CESR-c Wigglers



Tagging Technology

• Pure D \bar{D} or D \bar{D}_s production
✓ Many high branching ratios (~1-10%)
✓ High reconstruction eff
✓ Two chances

→ high net efficiency ~20% !

D → Kπ tag. S/B ~ 5000
D_s → KKπ tag. S/B ~ 100

6M D tags
300K D_s tags

Tagged BrFr Measurements

~ Zero background in hadronic modes

Set absolute scale for all heavy quark br fr

Decay Mode	PDG2000 (δB/B %)	CLEOc (δB/B %)
D ⁰ → Kπ	2.4	0.5
D ⁺ → Kππ	7.2	1.5
D _s → φπ	25	1.9

Semileptonic Decays |V_{CKM}|² |f(q²)|²

Low Bkg! form factors: 1% Check theory!

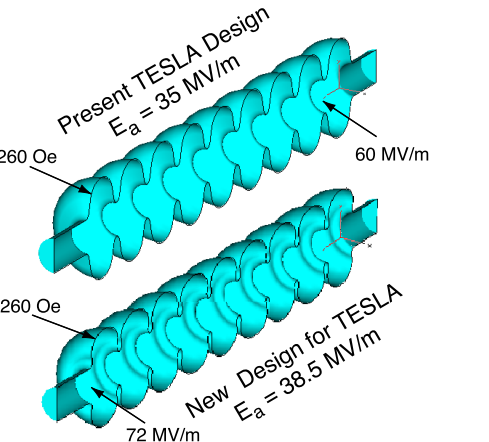
U = E_{miss} - P_{miss} q² (GeV²)

Decay Mode	PDG2000 (δB/B %)	CLEOc (δB/B %)
D ⁰ → Klν	5	1.6
D ⁰ → πlν	16	1.7
D ⁺ → πlν	48	1.8
D _s → φlν	25	2.8

Plus vector modes...

V_{cd}, V_{cs} to ~1.5%

● High Field SRF Cavity



Leptonic Decays: |f_D|² |V_{CKM}|²

δf_{D_s} / f_{D_s} ≈ 2.1% (Now: ±35%)

δf_D / f_D ≈ 2.6% (Now: ±100%)

What do we learn from these?

- Semileptonic decays: |V_{CKM}|² |f(q²)|²
 - Form factor *shapes* and *normalizations*
 - Calibrate theory!
 - Extract |V_{cd}|, |V_{cs}|
 - Theory → Extract |V_{ub}| from B
- Leptonic decays: |V_{CKM}|² |f_D|²
 - Decay constants
 - Calibrate theory!
 - Extract |V_{cd}|, |V_{cs}|
 - Theory → |V_{td}|, |V_{ts}| from B - mixing
- Hadronic decays:
 - Set scale of heavy quark decays
 - Enables precision tests in B decays
 - Strong phases: Extract γ from B → DK

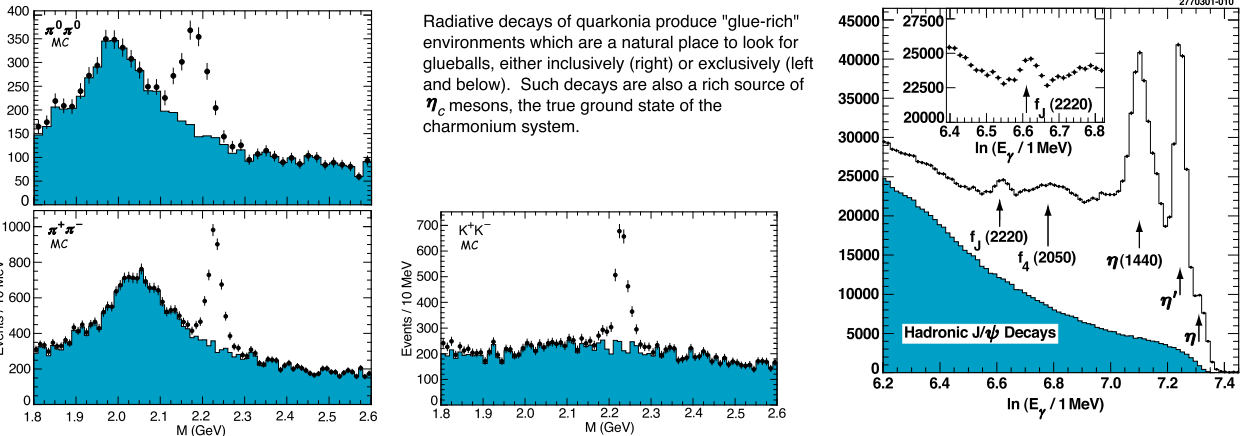
Probes of New Physics

- D \bar{D} mixing**
- Exploit coherence:
 - ψ(3770) → D \bar{D} (C = -1)
 - ψ(4140) → γD \bar{D} (C = +1)
 - For mixing: no DCSD; expect R_D = √(x² + y²) / 2 < 0.01 @ 95%CL
- CP violating asymmetries**
- Sensitivity: A < 0.01
 - Unique: CP = ±1 ← ψ(3770) → CP = ±1
- Rare Decays Br Fr Sensitivity: 10⁻⁶**
- CP eigenstate tags :**
- K⁺K⁻ → D_{CP} ← ψ(3770) → D_{CP} → K⁻π⁺
 - Measure strong phase difference
 - Needed for CKM angle γ from B → DK

● 200 MHz SRF Cavity



Glueball Searches in Exclusive and Inclusive Radiative J/ψ Decay



● Undulators for Polarized Positrons

