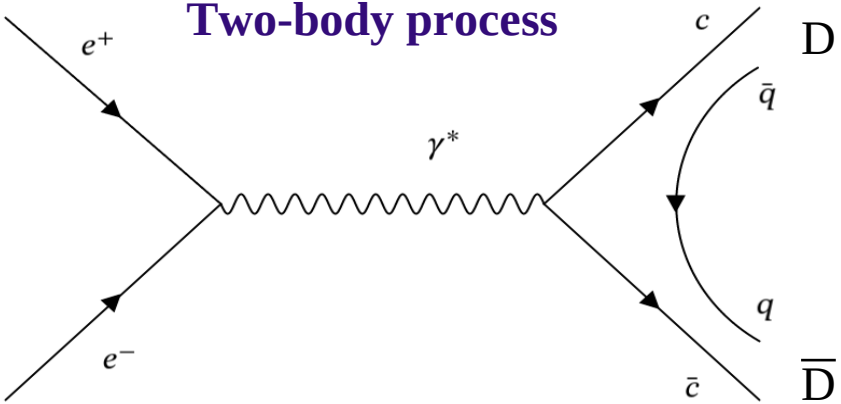
Open charm cross-section measurements at the Super tau charm factory

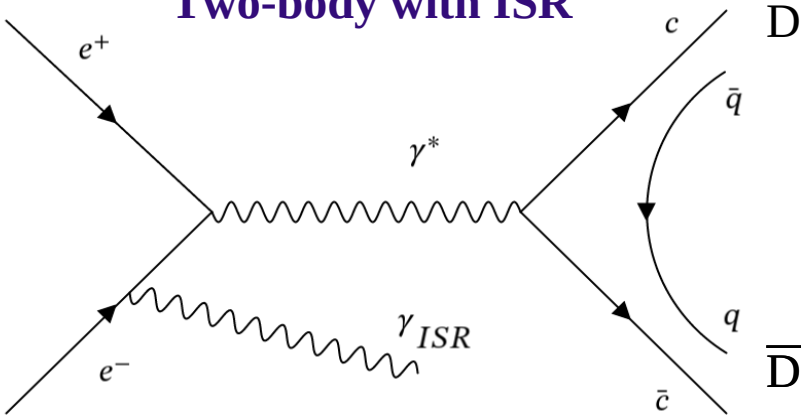
T. Uglov (HSE)

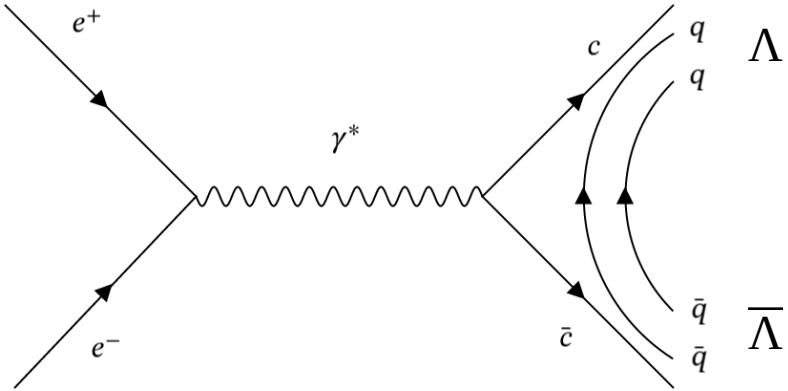
Open charm production mechanisms in e^+e^- collisions

Two-body process

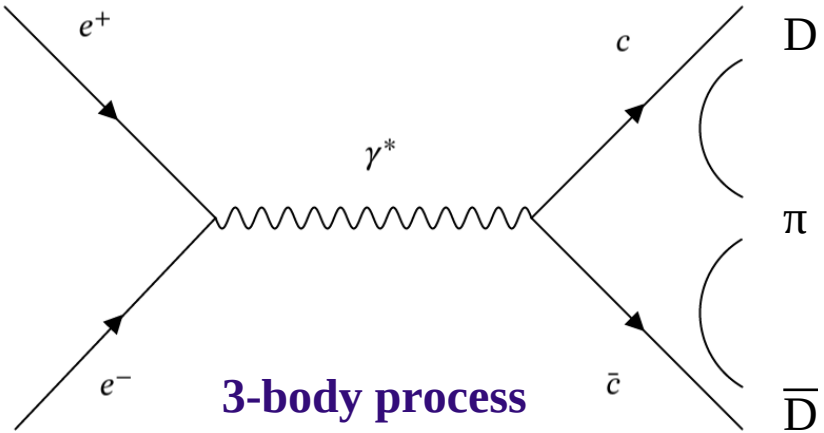


Two-body with ISR



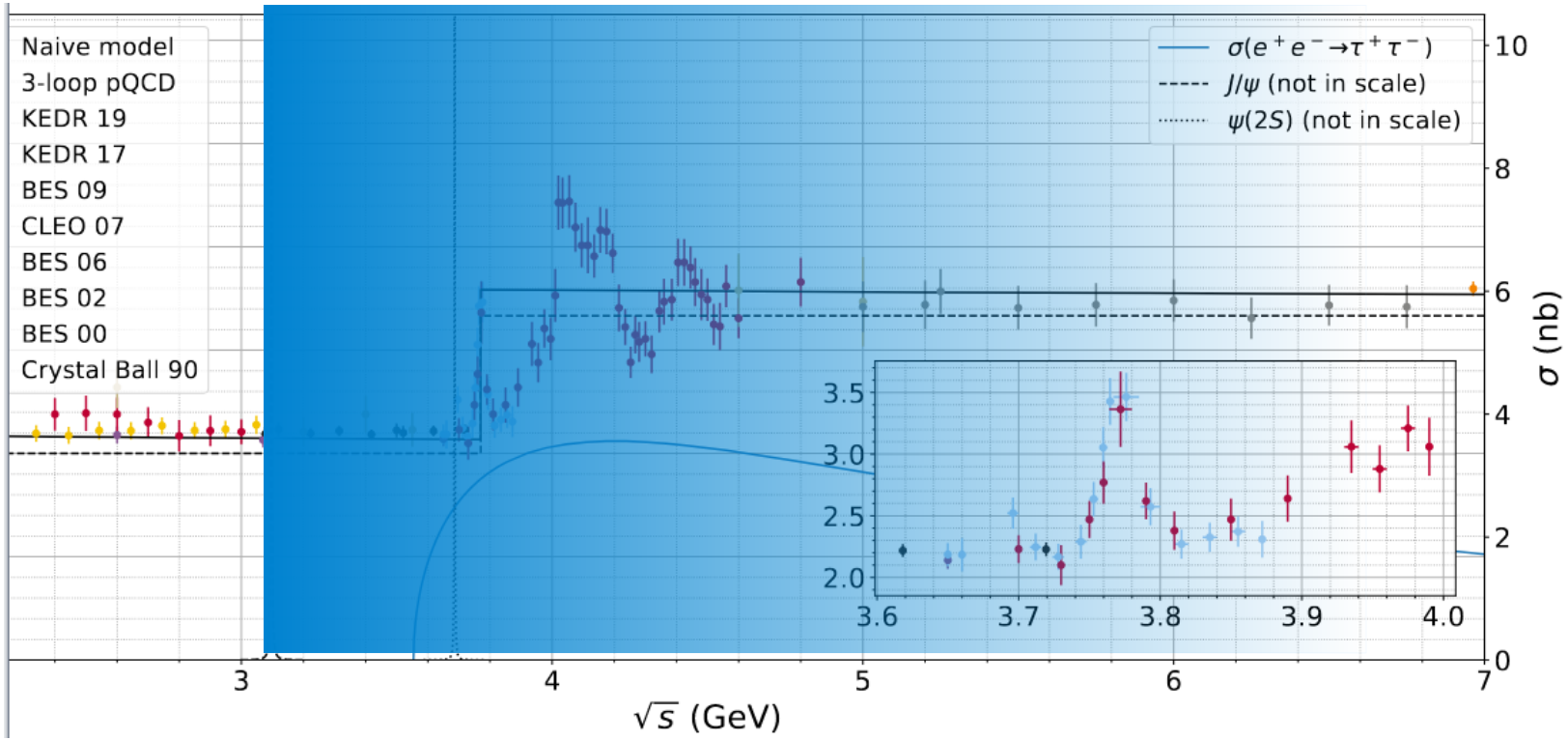


Baryon production

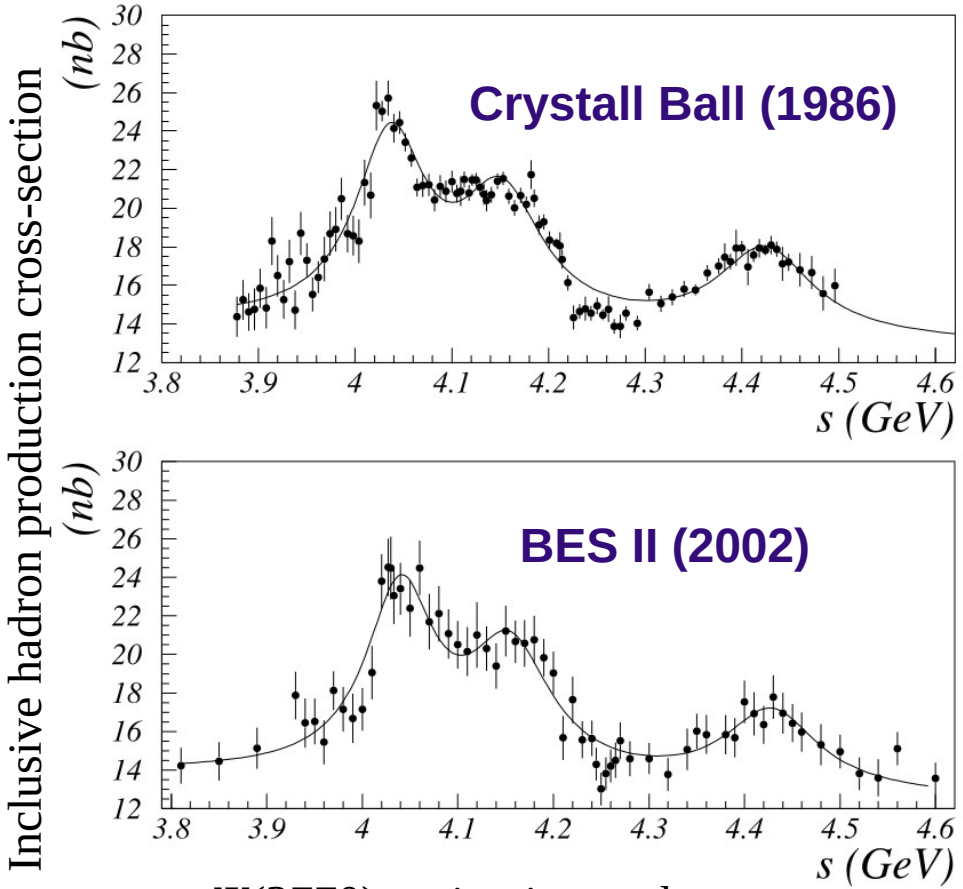


3-body process

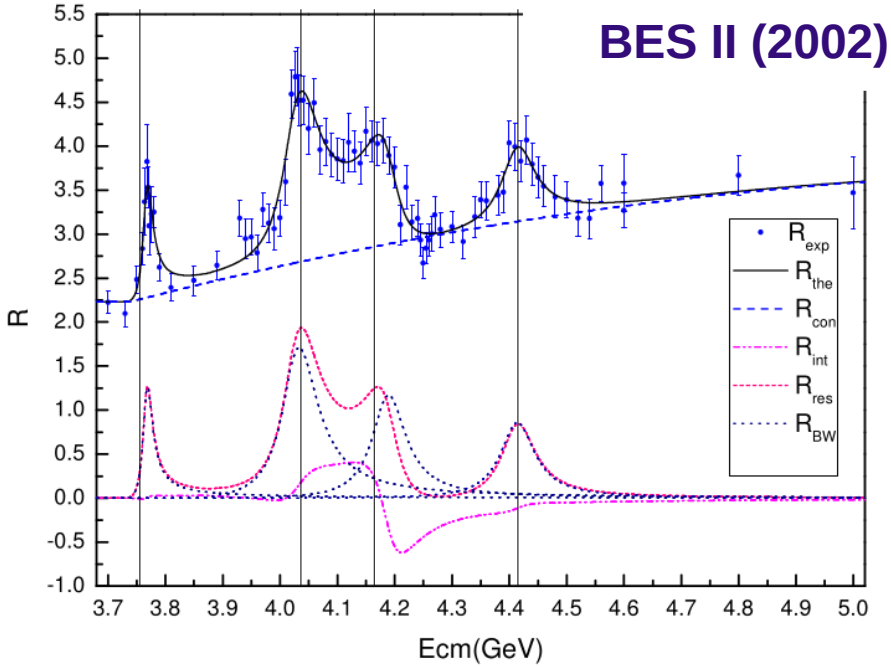
STCF energy range



Inclusive cross-section measurements



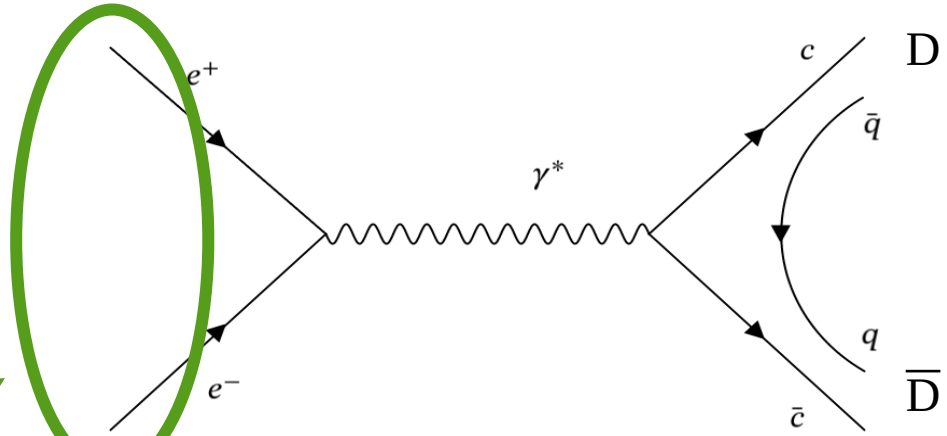
Ψ(3770) region is not shown



Information to be extracted from the fit:
4 resosnaces: mass, width, relative phase

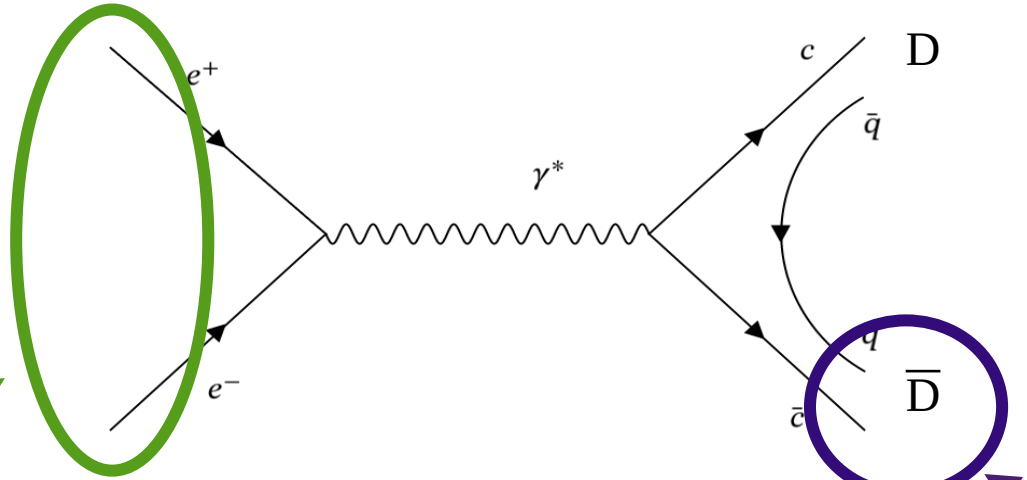
➡ Need more data

Exclusive analysis



4-momentum is known from the beam parameters

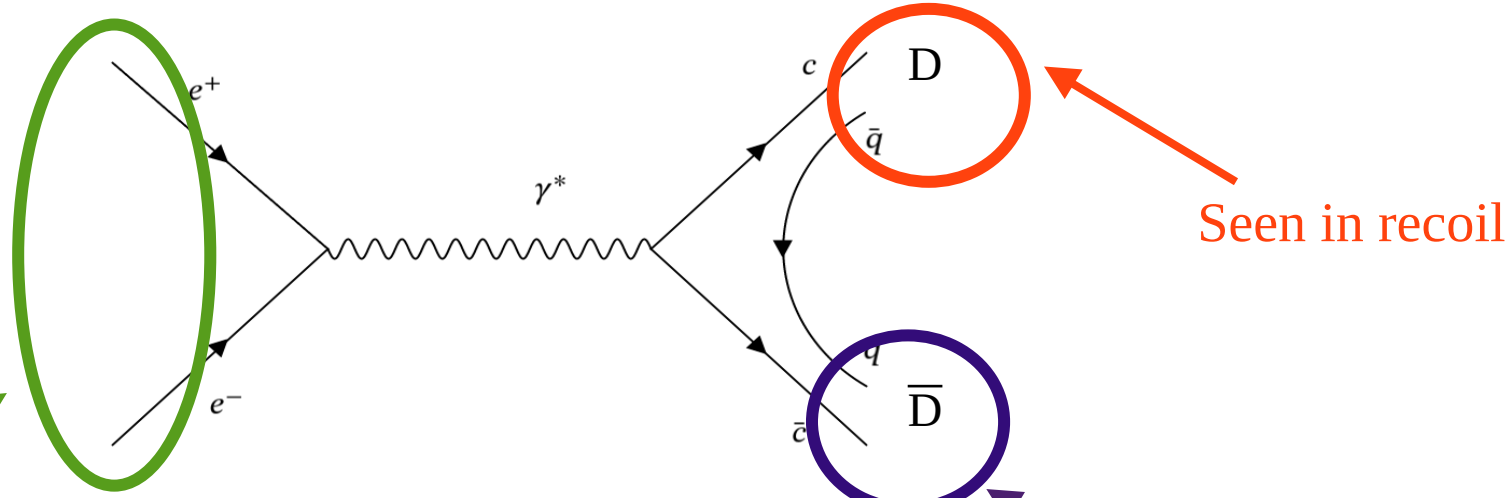
Exclusive analysis



4-momentum is known from the beam parameters

Reconstructed

Exclusive analysis

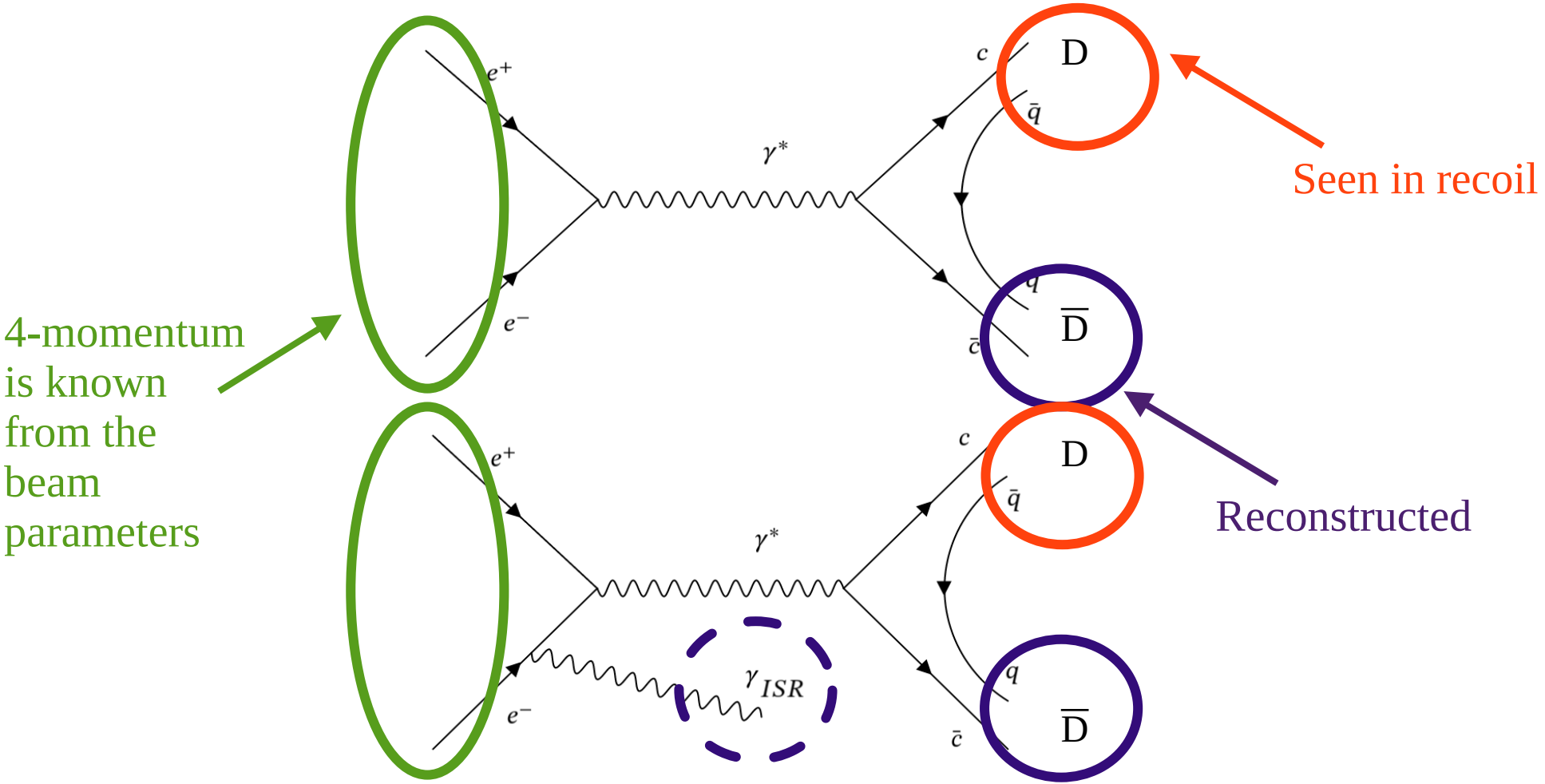


4-momentum is known from the beam parameters

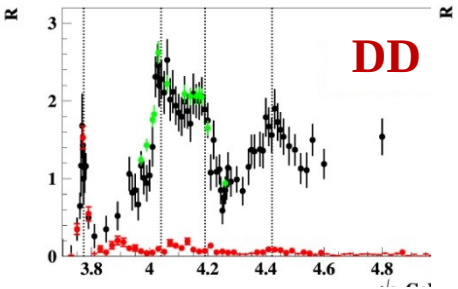
Seen in recoil

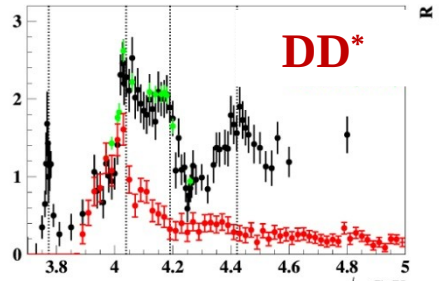
Reconstructed

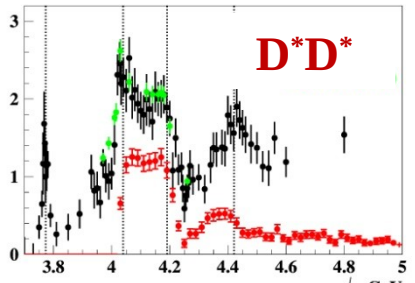
Exclusive analysis

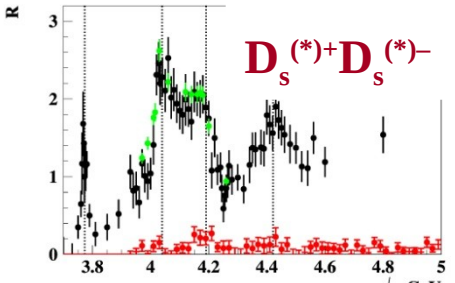


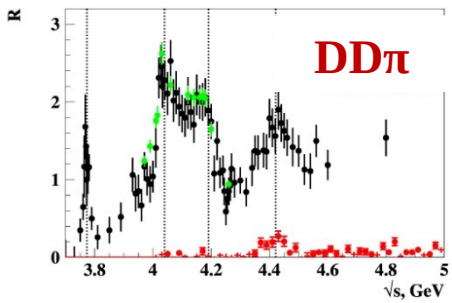
B-factories measurements with ISR

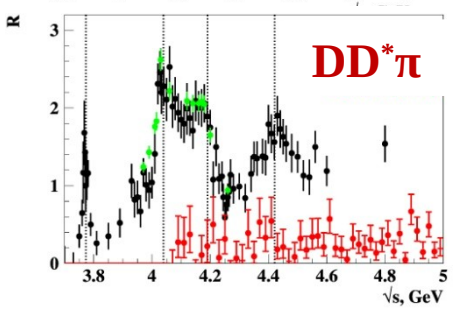


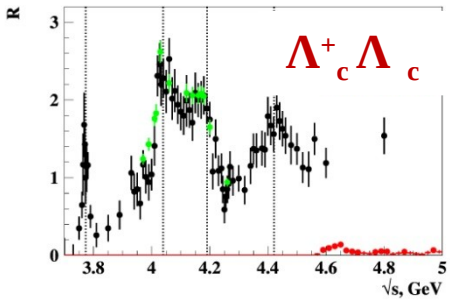






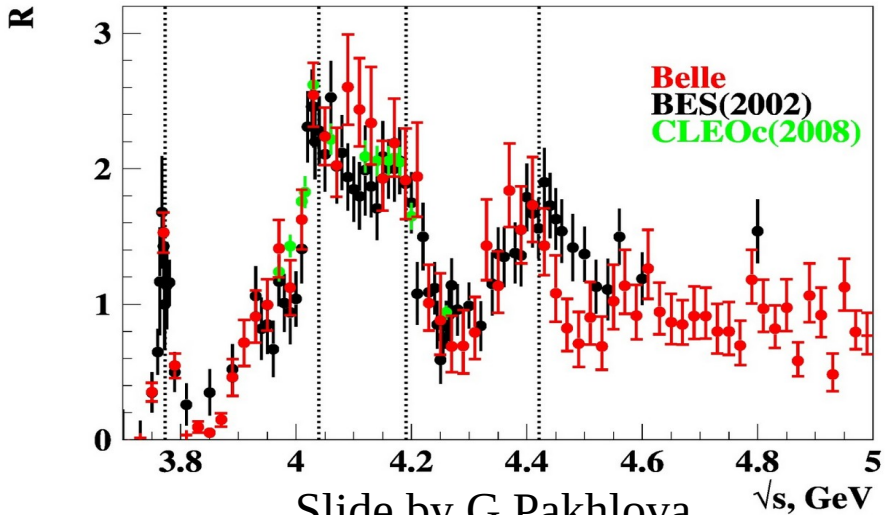






Contributions of D^+D^{*-}, $D^{*+}D^{*-}$, $D^0D^-\pi^+$ and $D^0D^{*-}\pi^+$ are scaled following isospin symmetry

Sum of all measured exclusive cross-sections to open charm



Slide by G.Pakhlova

Inclusive fit: coupled channels

EICHTEN, GOTTFRIED, KINOSHITA, LANE, AND YAN
PRD 21 203 (1980)

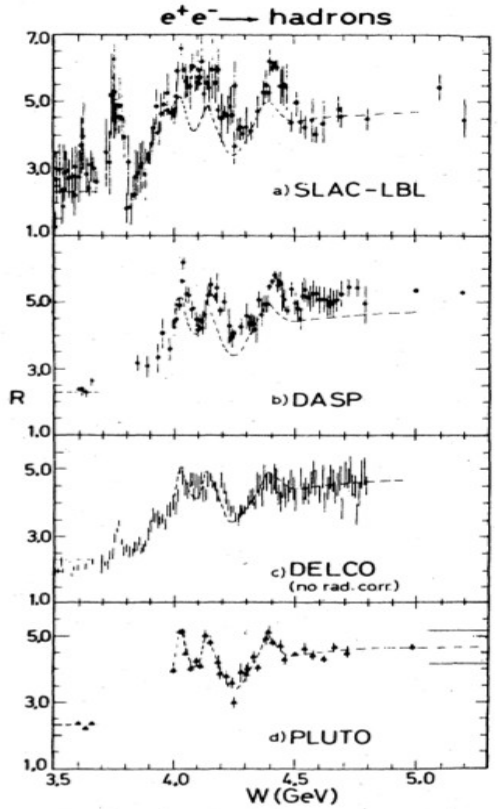


FIG. 15. Results of R (including $e^+e^- \to \tau^+\tau^-$) from four experiments: (a) SLAC-LBL (Ref. 44), (b) DASP (Ref. 46), (c) DELCO (Ref. 45), (d) PLUTO (Ref. 47). The curves represent a hand-drawn line through the PLUTO data. The band in Fig. 15(d) indicates the systematic errors of the PLUTO measurement. The plots shown were compiled by G. Feldman.

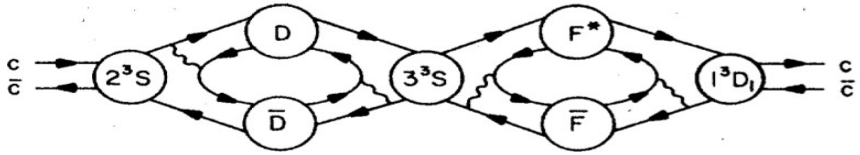


FIG. 8. The propagation of a $c\bar{c}$ pair in the presence of open and closed decay channels as described in the Green's function $\mathcal{G}$.

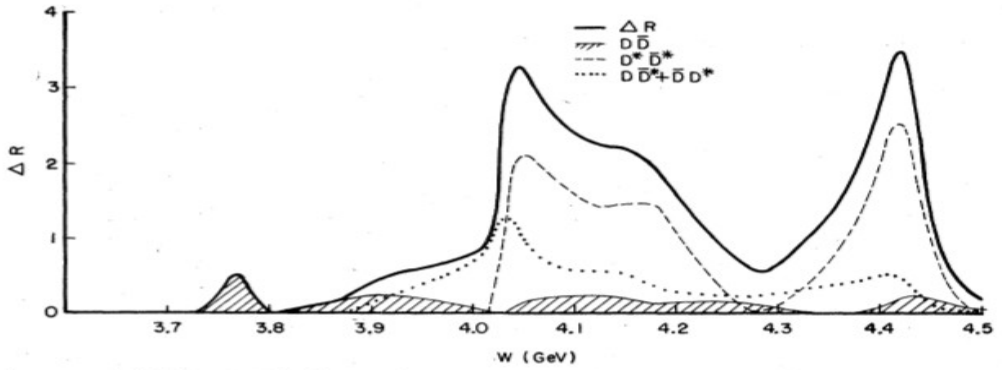
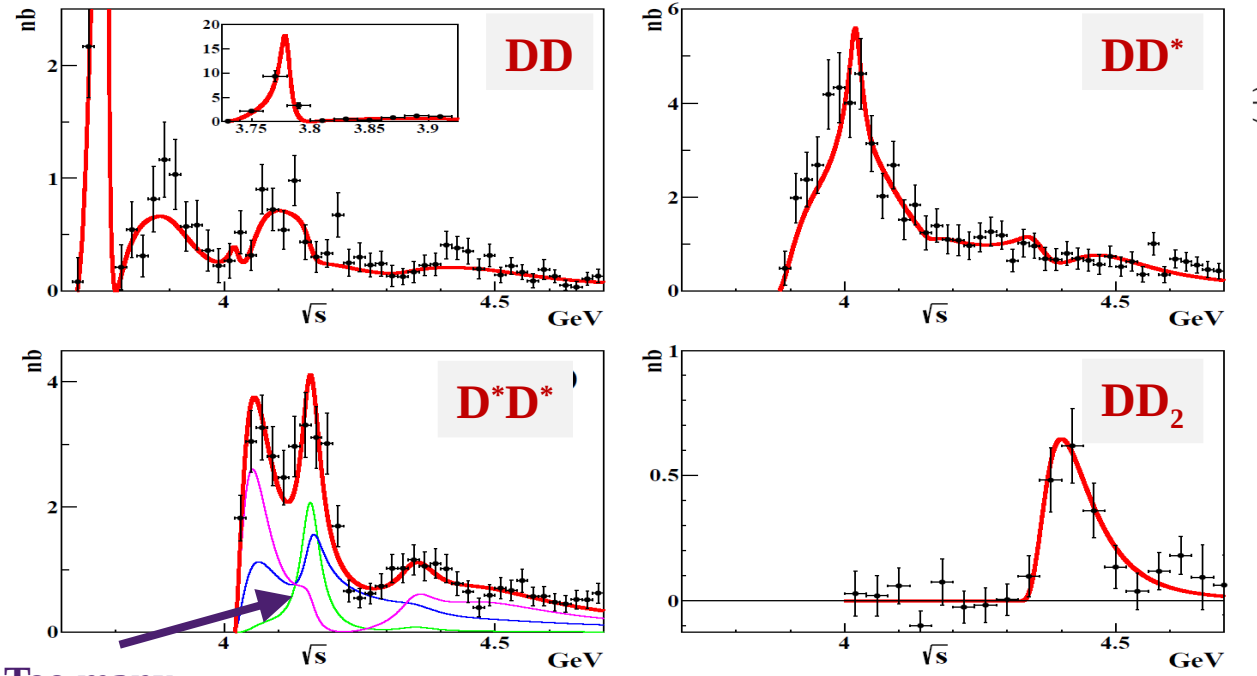
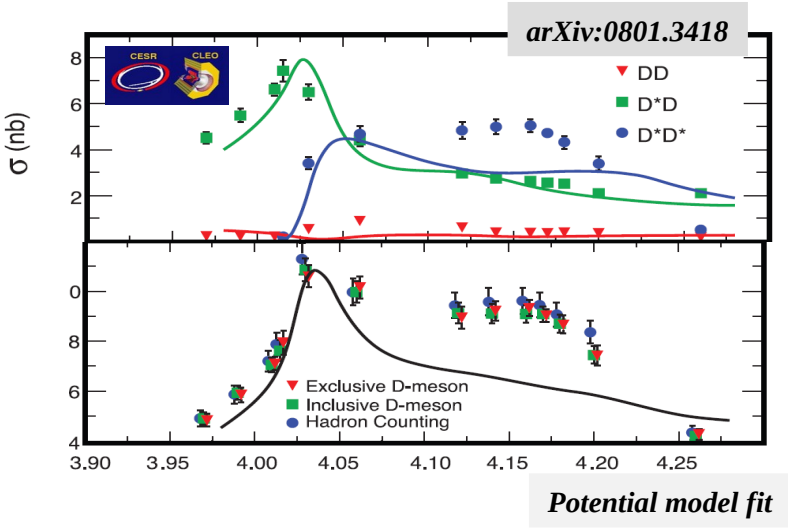


FIG. 13. The charm contribution to R in the region $3.7 < W < 4.5$ GeV as computed in the coupled-channel model. Contributions from $F_1\bar{F}_2$ channels are included but not indicated separately since they are too small; they are shown in Fig. 12.

Coupled channel fit with exclusive data





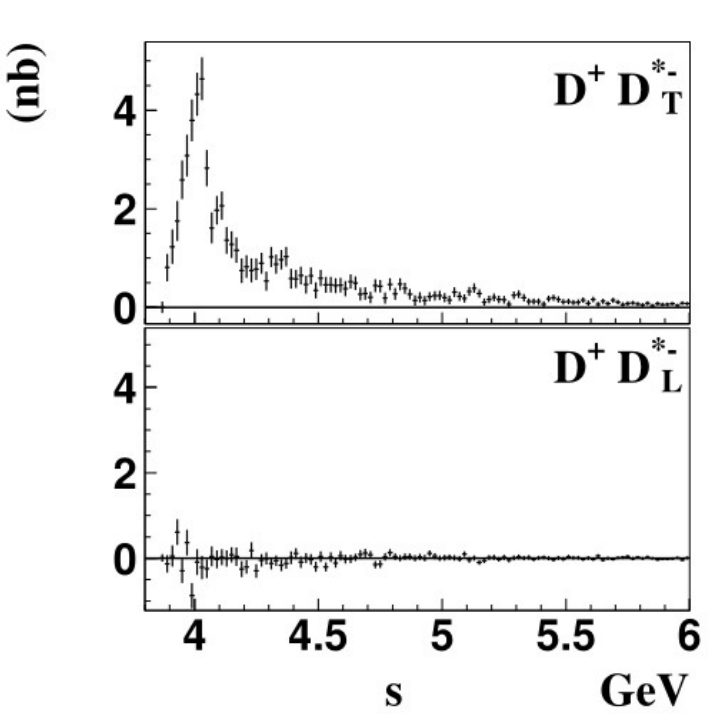
Too many interfering amplitudes… again!
(D* polarization)

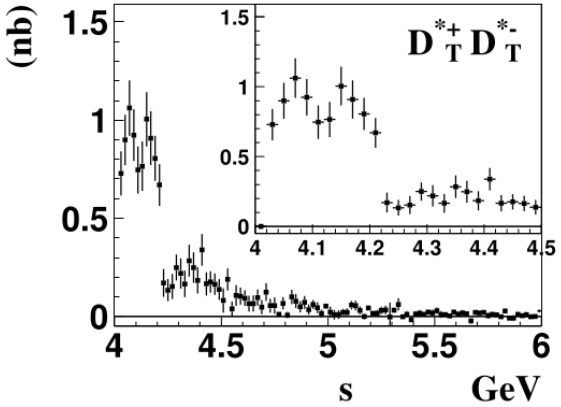
ψ(2S), ψ(3770), ψ(4040), ψ(4160), ψ(4415)

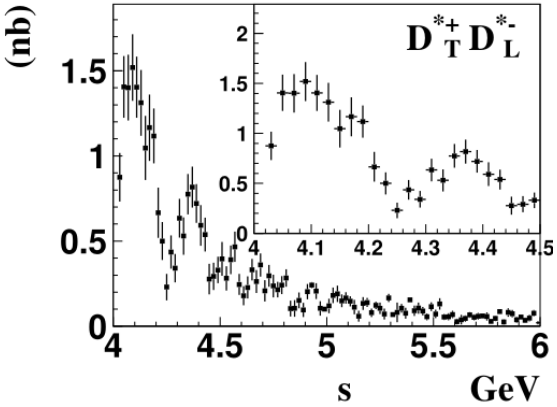
Uglov, Kalashnikova, Nefediev, Pakhlova, Pakhlov JETP Lett 105 (2017) 1

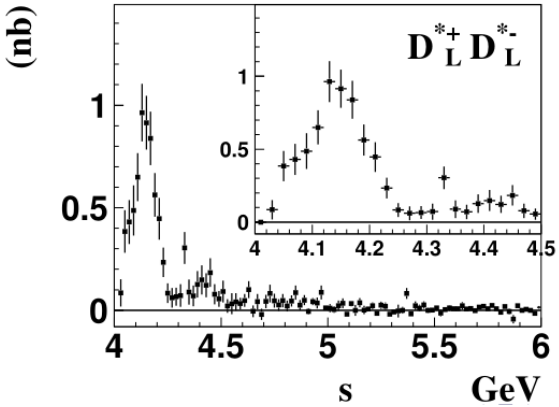
Simultaneous fit to all measured cross sections
Extracted parameters: masses, widths, electronic widths, couplings. Good description of the data.

Disentangle D* polarization







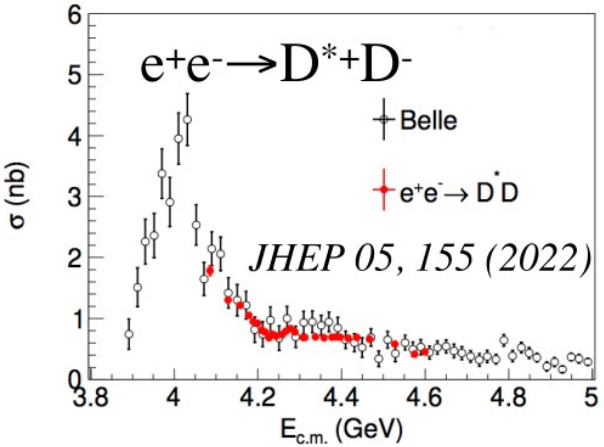


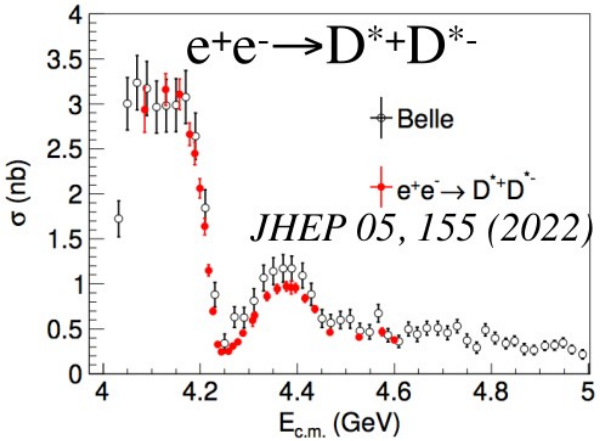
$D^*_{\mathrm{T}} \equiv$ transversely polarized D^* meson

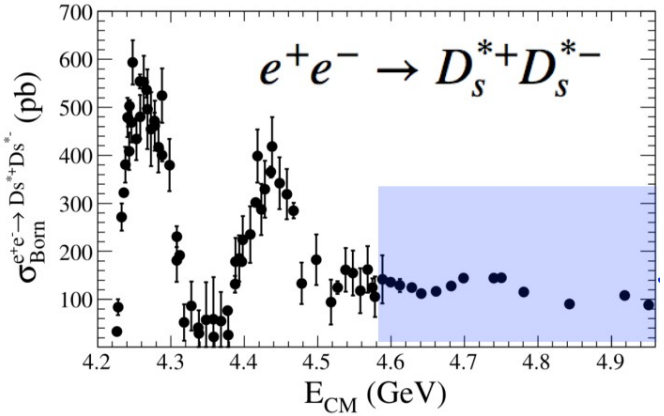
$D^*_{\mathrm{L}} \equiv$ longitudinally polarized D^* meson

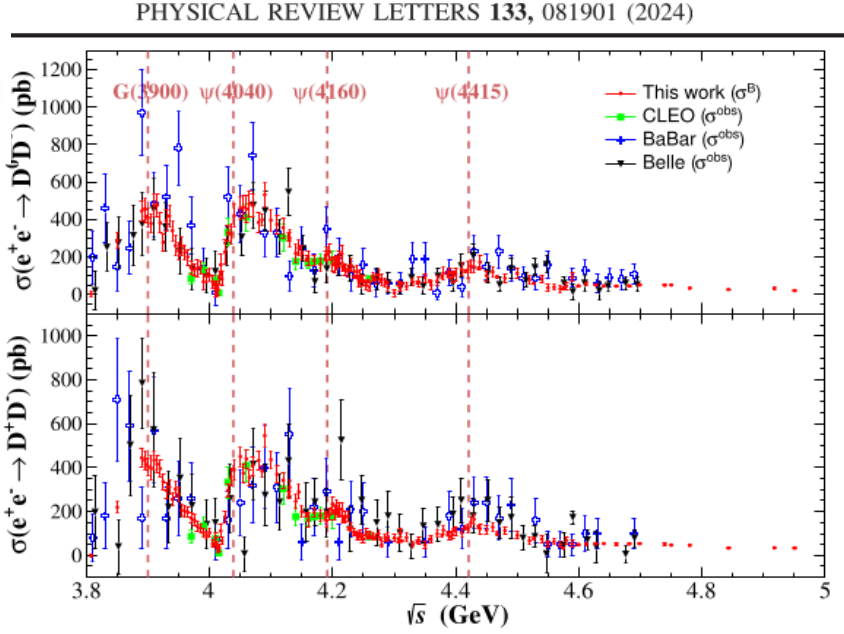
Phys. Rev. D 97, 012002 (2018)

Updated exclusive data from BES





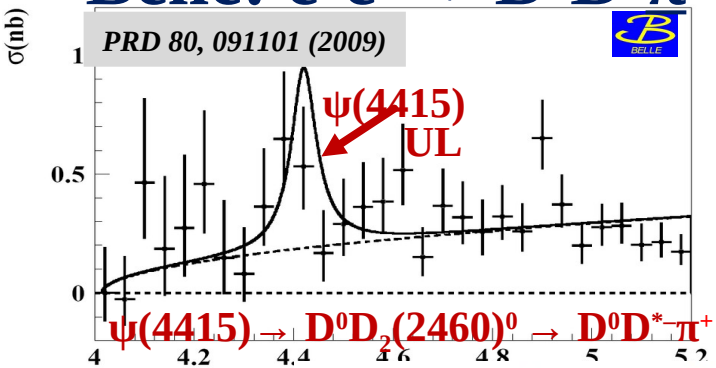


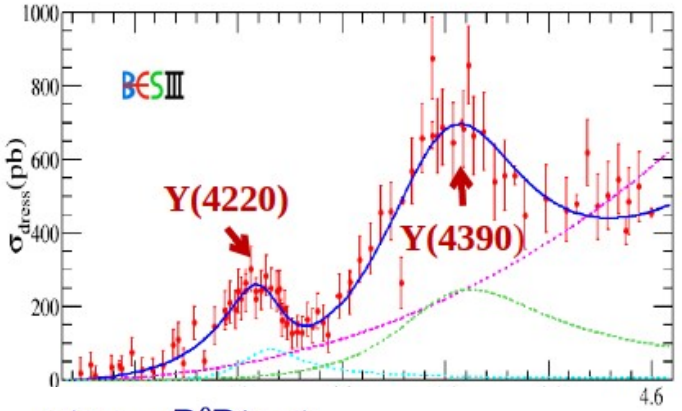


Multibody final states

Belle: $e^+e^- \to D^0\bar{D}^*\pi$

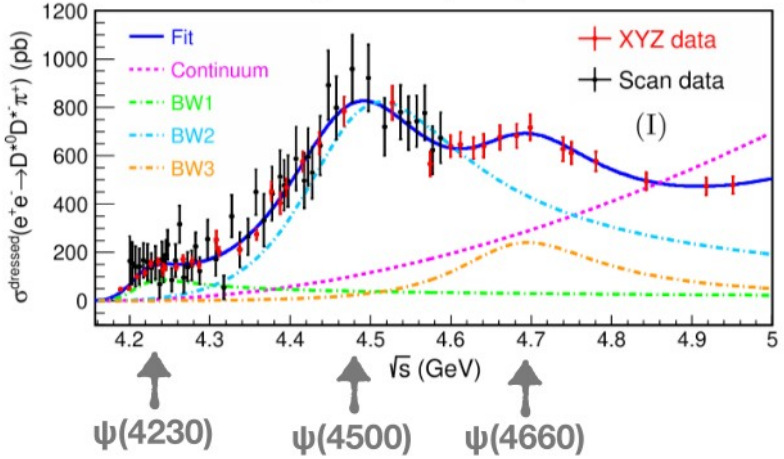
PRD 80, 091101 (2009)

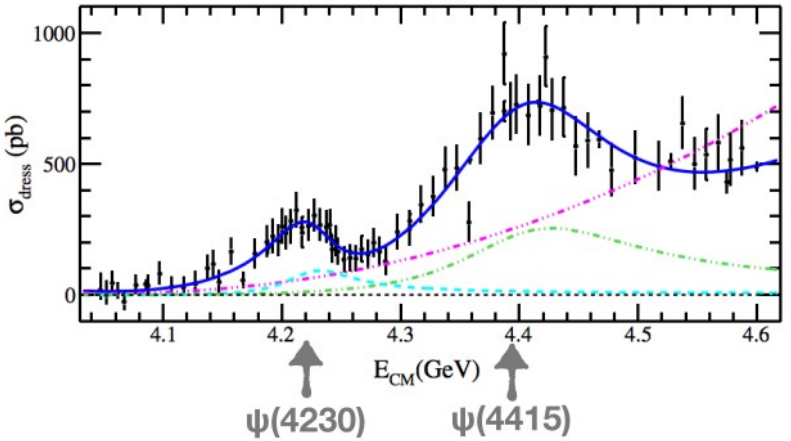




$e^+e^- \to D^{*0}D^{*-}\pi^+$

PRL 130, 121901 (2023)

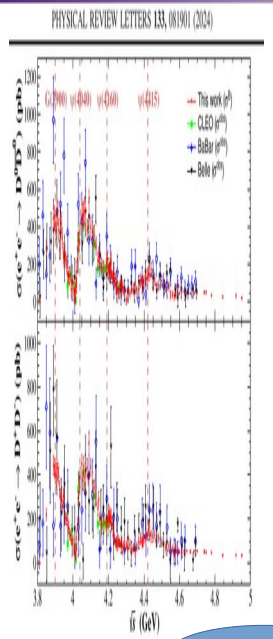




Far from the charm threshold

BES III

SCTF **Belle II**



Charmed hyperon thresholds

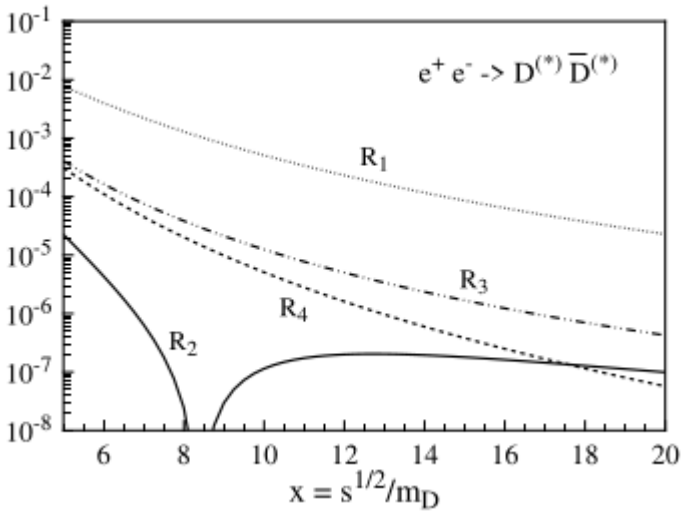
Phys.Rev.D70:071101,2004

σ (ee → DD)

σ (ee → DD*)

σ (ee → $D^*_L D^*_T$)

Phys.Rev. D55 (1997) 272-290



3 4 5 6 7 8 9 10 11 12 13 GeV

STCF capabilities in open charm cross-section

Unique laboratory for charm studies:

- Huge statistics allows to precise measure two-body open charm cross-section and disentangle contibutions from higher Ψ and Y
- Polarized beams simplifies helicity analysis
- Study three- and multibody final states with open charm – search for exotics
- Measure Ξ_c and Ω_c production cross-section
- Measure ee → open charm cross-section in wide energy range to test effective theories
- Many other studies