Testing Lattice-QCD results with Charm Semileptonic Decays at BaBar

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Outline:

- **Purpose**
- **BaBar results (preliminary)**
- **Perspectives**

LABORATOIRE DE L'ACCÉLÉRATEUR LINÉAIRE

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Purpose

- New and improved techniques allow Lattice-QCD to provide very accurate values on hadron masses, decay constants, form factors, etc... but they still need approximations

- Experimentalists HAVE to check and validate these results and predictions ➔

Tests in the charm sector
(leptonic and semileptonic decays)
are a good place to validate Lattice-QCD evaluations

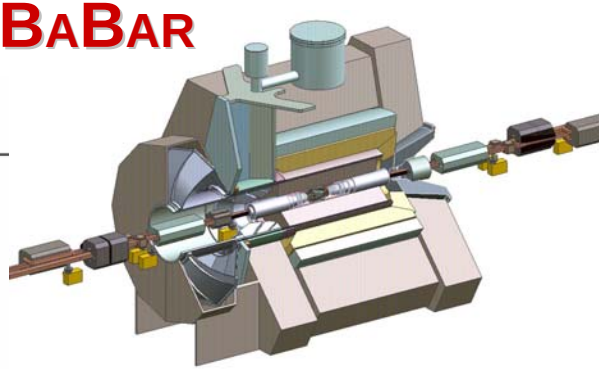
- We aim to perform very accurate measurements on charm semileptonic decays

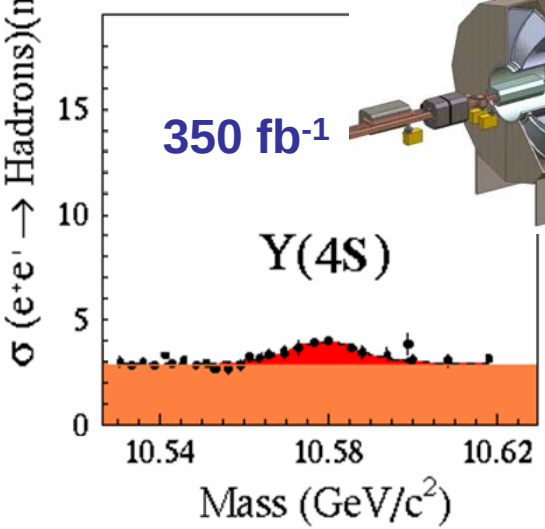
BaBar results

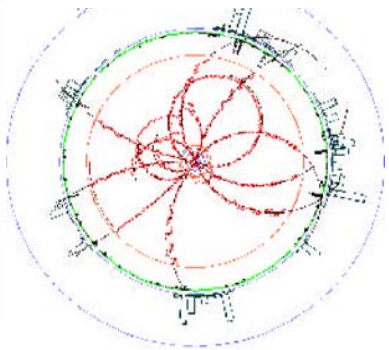
- **Charm is NOT only matter of CLEO-c**

BABAR

σ_{cc} ~1.3 nb

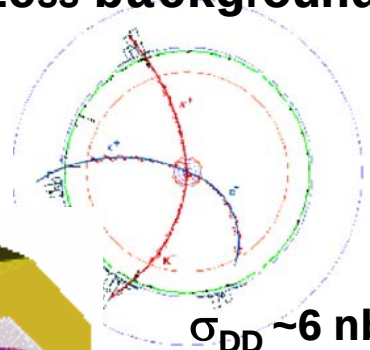




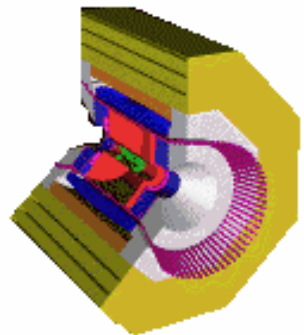


- **Much more statistics**

- **Better resolution**
- **Less background**

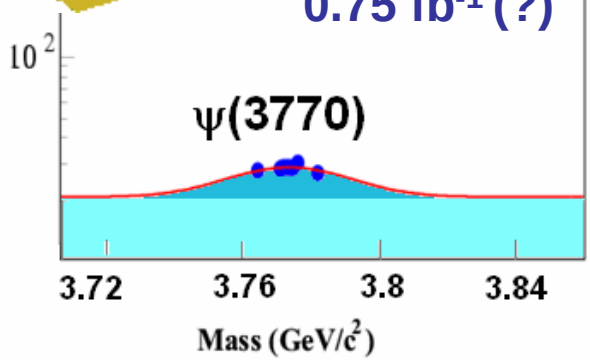


σ_{DD} ~6 nb



CLEO-c

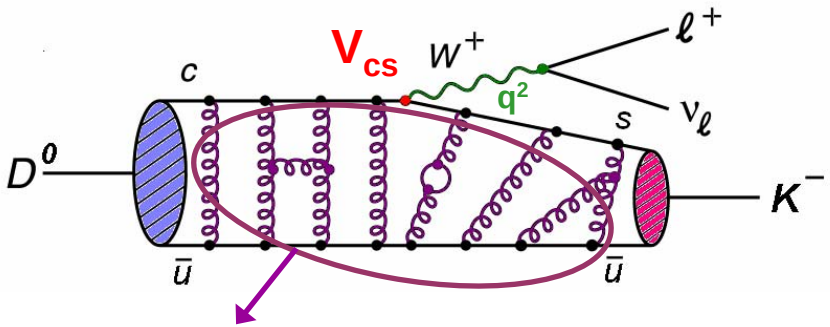
0.75 fb-1 (?)



Testing the BaBar potential to do this kind of physics ...

BaBar results

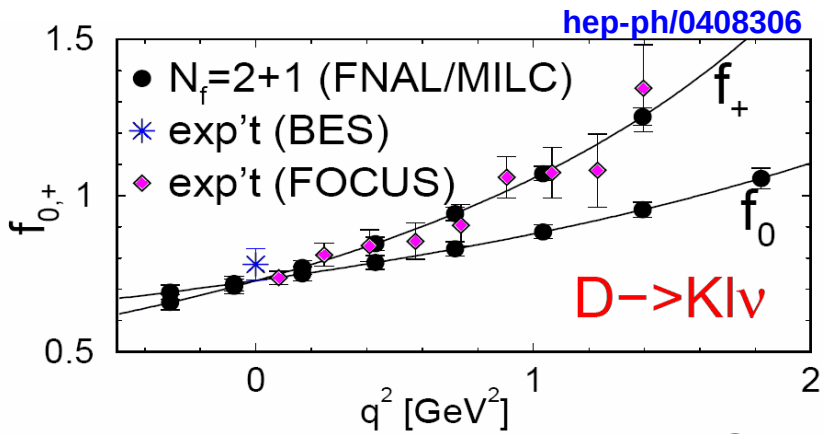
- **Measurement of the D → K ℓ ν form factor (simplest channel: Cabibbo-allowed, one ff)**



$$\frac{d\Gamma}{dq^2} = \frac{G_f^2 |V_{cs}|^2 \; p_K^3}{24\pi^3} |f_+(q^2)|^2$$

$q^2 = (p_\ell + p_\nu)^2 = (p_D - p_K)^2$

non-perturbative QCD → parameterized by form factors (easy quantities for Lattice)



Some parameterizations:

Pole form factor

KS, Z.Phys.C38 ('88) 511

$$|f_+(q^2)| = \frac{f_+(0)}{1 - \frac{q^2}{m^2_{pole}}}$$

Modified pole

BK, PLB 478 ('00) 417

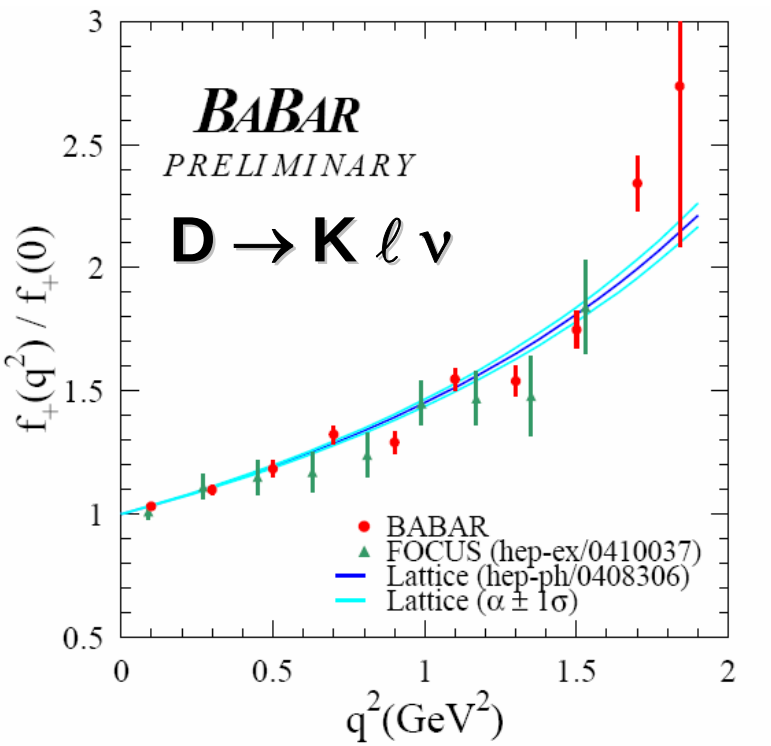
$$|f_+(q^2)| = \frac{f_+(0)}{\left(1 - \frac{q^2}{m^2_{D_s^*}}\right)\left(1 - \frac{\alpha_{pole} q^2}{m^2_{D_s^*}}\right)}$$

BaBar results

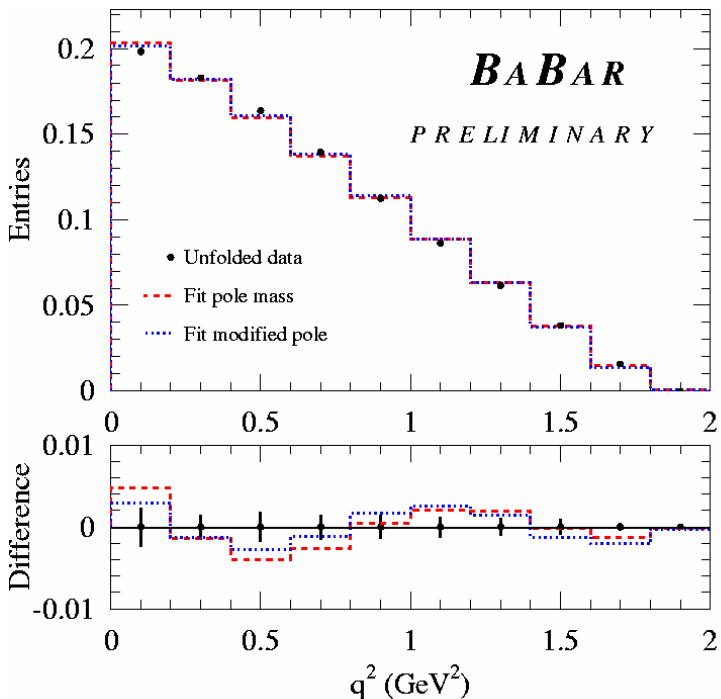
Experiment	m_{pole} (GeV/c)^2	α_{pole}	Statistics
CLEO III	$1.89 \pm 0.05 \pm^{0.04}_{0.08}$	$0.36 \pm 0.10 \pm^{0.08}_{0.07}$	7 fb^{-1}
FOCUS	$1.93 \pm 0.05 \pm 0.03$	$0.28 \pm 0.08 \pm 0.07$	13 k events
BELLE	$1.81 \pm 0.03 \pm 0.02$	$0.40 \pm 0.12 \pm 0.09$ (e^-) $0.66 \pm 0.11 \pm 0.09$ (μ^-)	282 fb^{-1}
CLEO-c	$1.98 \pm 0.03 \pm 0.02$	$0.19 \pm 0.05 \pm 0.03$	280 pb^{-1}
BaBar	$1.854 \pm 0.016 \pm 0.020$	$0.43 \pm 0.03 \pm 0.04$	75 fb^{-1}

(FPCP '06 Prel.)

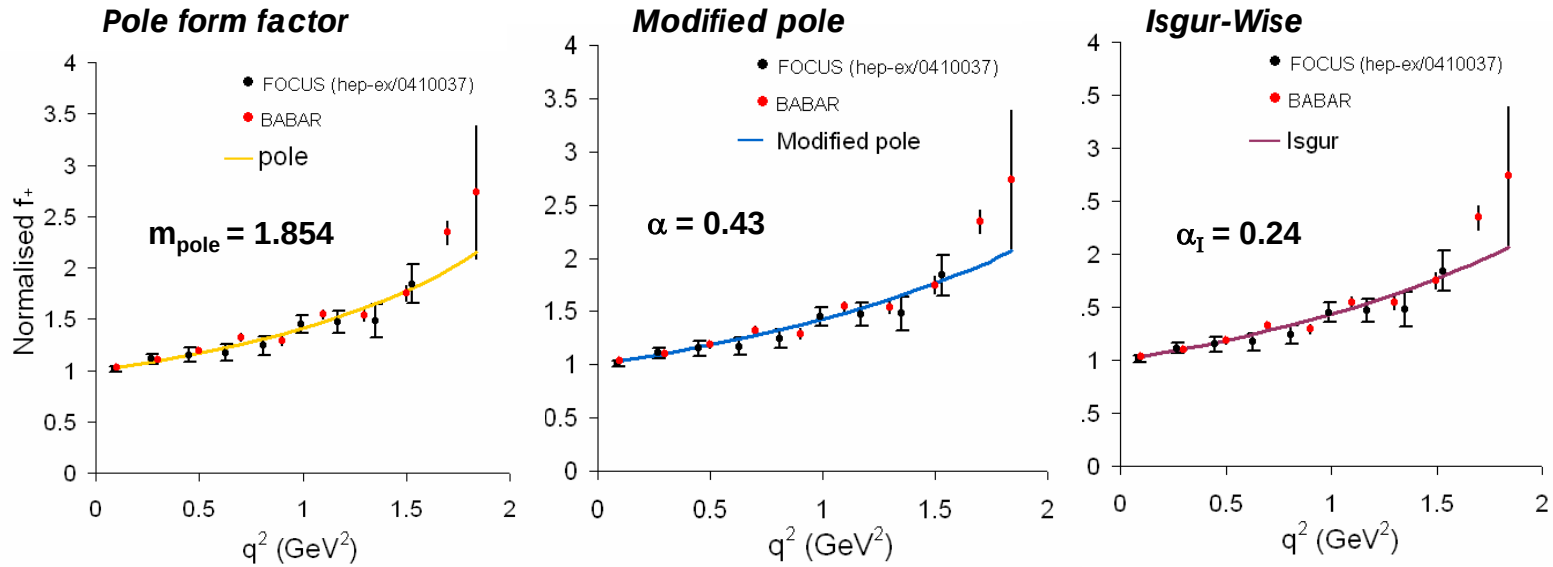
(Moriond '06 Prel.)

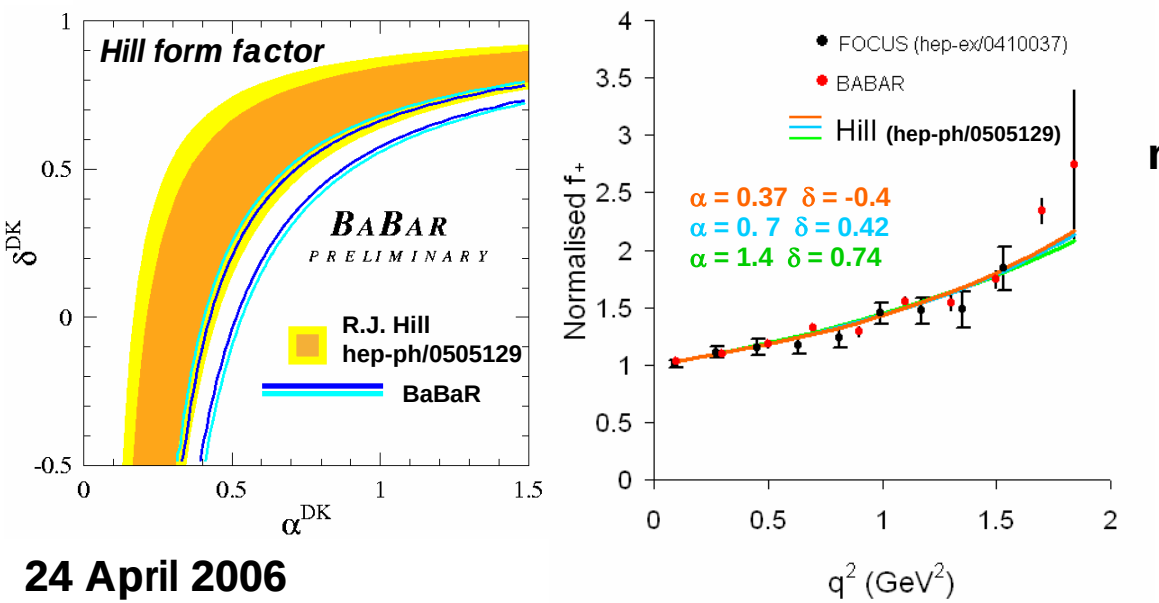


Lattice: $\alpha_{pole} = 0.50 \pm 0.04$



BaBar results





★ **Simple pole model with $m_{pole} = m_{D^*_s}$ excluded by all expts.**

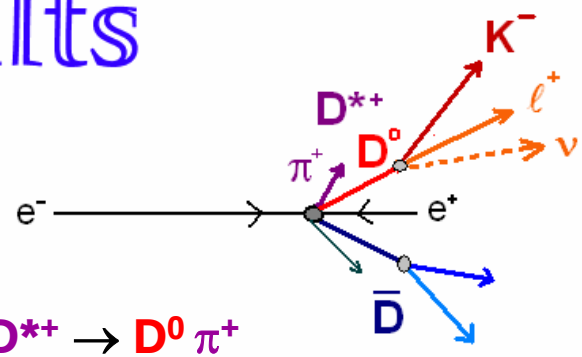
★**No particular model favoured by BaBar data**

BaBar results

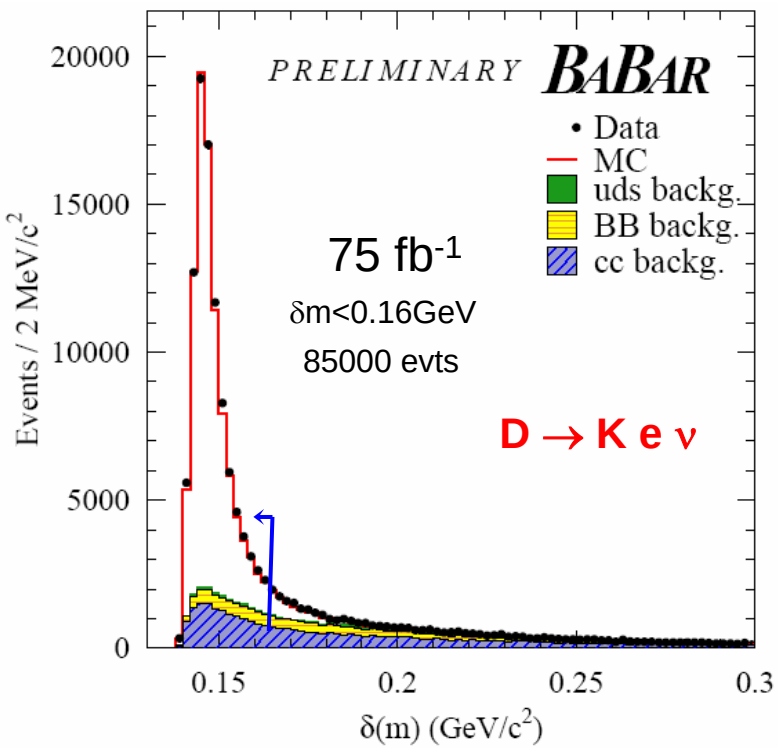
- **Results here use 75 fb^{-1}**

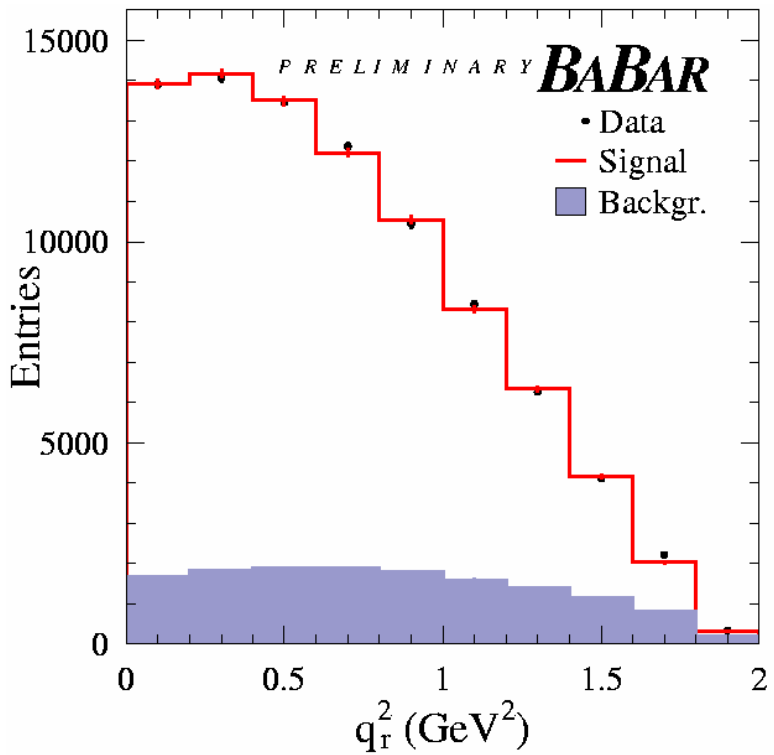
BaBar data are 350 fb^{-1}

(analysis with all stat. in progress, also determination of $f_+(0)$)



$D^{*+} \rightarrow D^0 \pi^+$

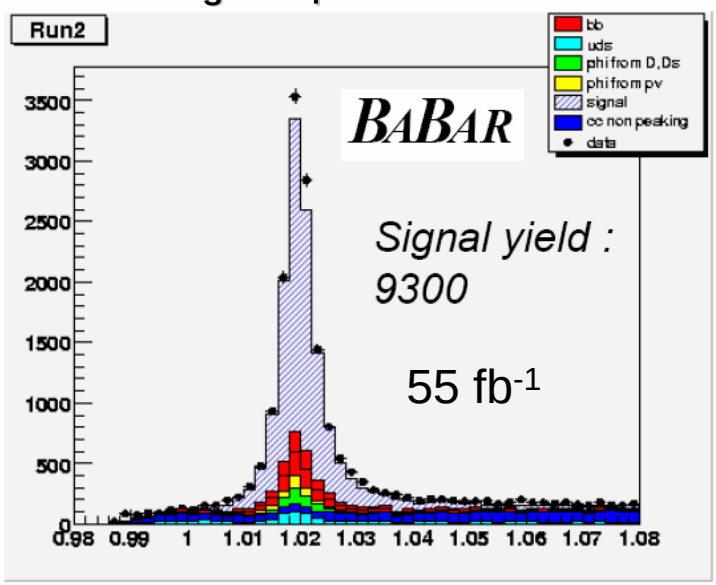




Perspectives

- **$D \to \pi \ell \nu$ form factor (challenge: the background)**
- **$D \to K \pi \ell \nu$ (form factors, mass distribution)**
- **D_s semileptonic decays (Ph.D. J. Serrano)**

$D_s \to \phi \ell \nu$



- **Best results from FOCUS (600 evts)**
- **CLEO-c @ present: 72 pb^{-1}** ($\sigma D_s D_s^* \sim$ 1nb)
  750 pb^{-1} expected in 2008

- **charm baryons (vast field basically unexplored)**