$D^0 \to K^- e^+ \nu$ analysis

- **$D \to K \ell \nu$ form factor q^2 dependence**
- **BR($D \to K \ell \nu$) measurement**

- BAD 1369 (updated), 1705 -

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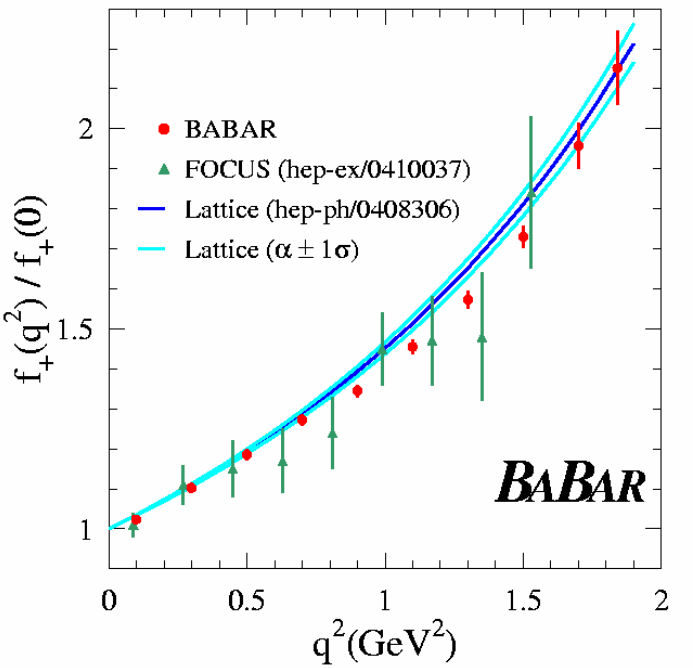
$F(q^2)$ results(1)

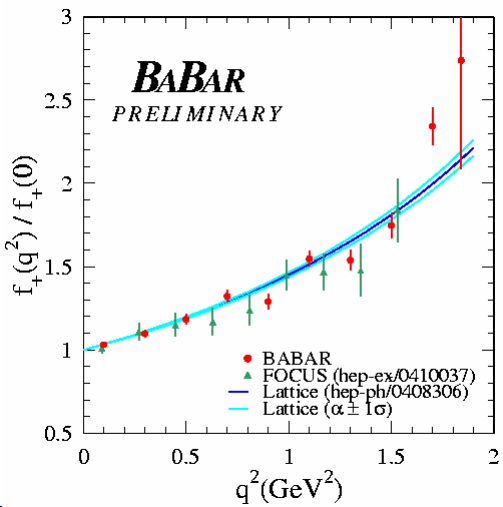
Fitted values of the parameters corresponding to different parametrizations of $f_+(^2)$.

Theoretical approach	parameters
Taylor expansion in z	$r_1 = -2.58 \pm 0.20 \pm 0.17$ $r_2 = 0.8 \pm 5.5 \pm 3.2$
modified pole	$\alpha_{pole} = 0.359 \pm 0.023 \pm 0.027$
simple pole	$m_{pole} = 1.893 \pm 0.012 \pm 0.015$ GeV/c^2
ISGW2	$\alpha_I = 0.2271 \pm 0.0046 \pm 0.0052$ GeV^{-2}

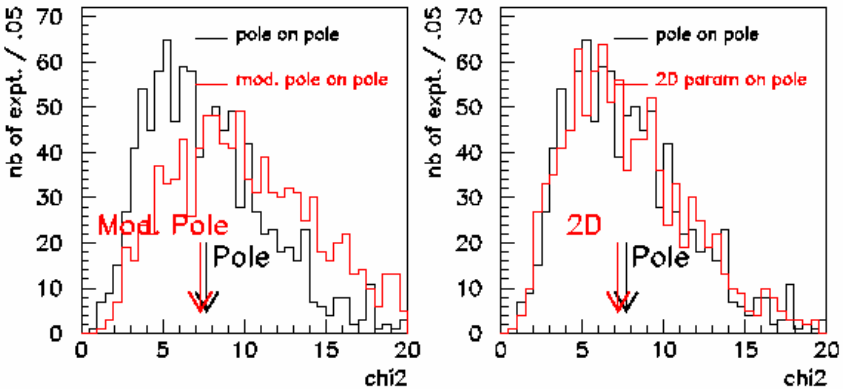


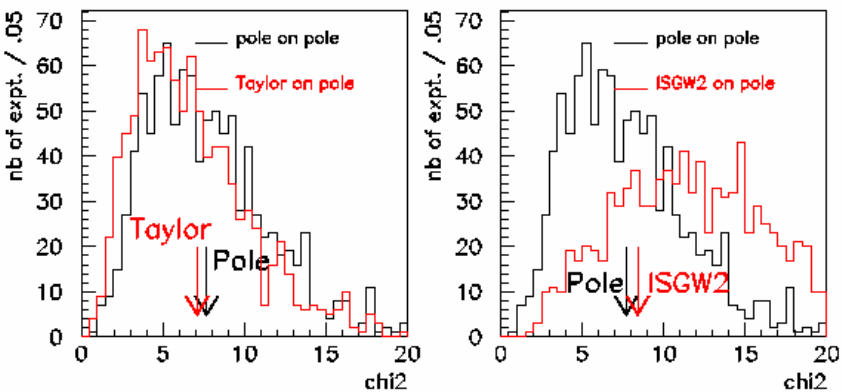
experiment	stat	m_{pole}(GeV/c^2)	α_{pole}
CLEO-c	281 pb^{-1}	1.98±0.03±0.02	0.19±0.05±0.03
FOCUS	13k evts	1.93±0.05±0.03	0.28±0.08±0.07
Belle	282 fb^{-1}	1.82±0.04±0.03	0.52±0.08±0.06
BaBar	75 fb^{-1}	1.854±0.016±0.020	0.43±0.03±0.04

unfolded



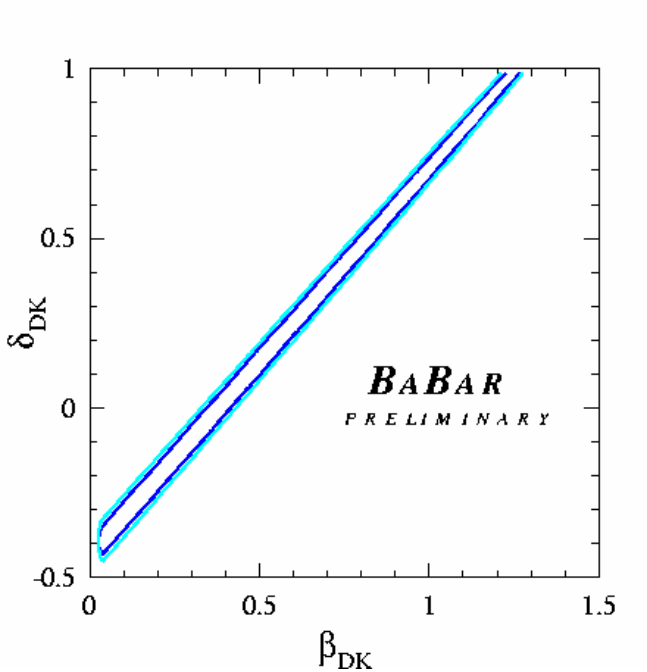
$F(q^2)$ results(2)

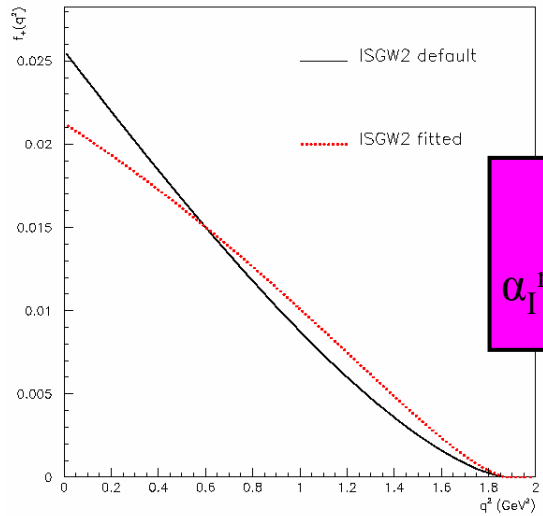




No favoured model
Good fits with 1 free parameter

$F(q^2)$ results(3)





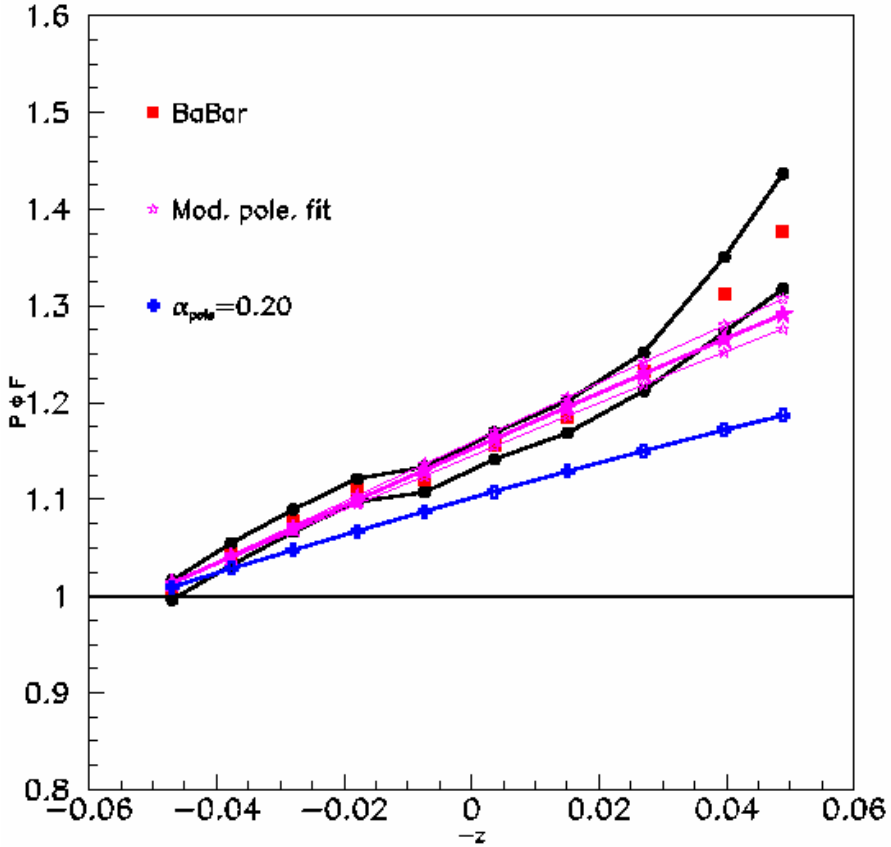
α_I^{th}=0.104 GeV^{-2}
α_I^{mes}=0.227±0.007 GeV^{-2}

$$f_+^{ISGW2}(q^2) = \frac{F}{(1+\alpha_I(q^2_{max}-q^2))^2},\ \alpha_I = \frac{1}{12}r^2$$

$$f_+(q^2) = \frac{f_+(0)}{1-\alpha}\left(\frac{1}{1-\frac{q^2}{m^2_{D_s^*}}} - \frac{\alpha}{1-\frac{q^2}{\gamma m^2_{D_s^*}}}\right) = f_+(0)\frac{1-\delta\frac{q^2}{m^2_{D_s^*}}}{\left(1-\frac{q^2}{m^2_{D_s^*}}\right)\left(1-\beta\frac{q^2}{m^2_{D_s^*}}\right)}$$

$(1/\gamma-\alpha)/(1-\alpha)$ and $\beta = 1/\gamma$.

$F(q^2)$ results(4)



Taylor expansion

$$z(t,t_0) \equiv \frac{\sqrt{t_+ - t} - \sqrt{t_+ - t_0}}{\sqrt{t_+ - t} + \sqrt{t_+ - t_0}}$$

$$t = t_+ \; [t_\pm \equiv (m_H \pm m_L)^2]$$

$$t_0 = t_+(1 - \sqrt{1 - t_-/t_+})$$

$$F(t) = \frac{1}{P(t)\phi(t,t_0)} \sum_{k=0}^{\infty} a_k(t_0) z(t,t_0)^k$$

$$\sum_{k=0}^{\infty} a_k^2(t_0) \leq 1.$$

a0 ~ 0.03

a1/a0 ~ -2.58 ±0.20 ±0.17

a2/a0 ~ 0.8 ±5.5 ±3.2

Process	a_1/a_0
$D \to K$	$-2.7 \pm 0.5 \pm 0.4$
	$-2.2 \pm 0.4 \pm 0.4$
	$-3.2 \pm 0.5 \pm 0.2$

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

$$\frac{BR(Ke\nu,data)}{BR(K\pi,data)} = \frac{BR(Ke\nu,MC)}{BR(K\pi,MC)} \times \frac{N(Ke\nu,data)}{N(Ke\nu,MC)} \times \frac{N(K\pi,MC)}{N(K\pi,data)} \times \frac{N(Ke\nu,ccMC)}{N(K\pi,ccMC)} \times \frac{Lumi(K\pi,data)}{Lumi(Ke\nu,data)} \times \frac{\varepsilon(Ke\nu,MC)}{\varepsilon(Ke\nu,data)} \times \frac{\varepsilon(K\pi,data)}{\varepsilon(K\pi,MC)}$$

source	relative variation
cut on Fisher variable	$\pm 0.79\%$
background subtraction	$\pm 0.47\%$
lepton efficiency	$\pm 0.59\%$
total	$\pm 1.09\%$

Table 17: *Summary of systematic uncertainties on the relative decay rate measurement.*

7.6 Decay rate measurement and value of the hadronic form factor at $q^2 = 0$

The mesured relative decay rate is then:

$$R_D = \frac{BR(D^0 \to K^- e^+ \nu_e)}{BR(D^0 \to K^- \pi^+)} = 0.9329 \pm 0.0107 \pm 0.0102. \quad (11)$$

and using the world average value for the branching fraction $D^0 \to K^- \pi^+$, it gives:

$$BR(D^0 \to K^- e^+ \nu_e) = (3.545 \pm 0.040 \pm 0.039 \pm 0.065) \times 10^{-2} \quad (12)$$

where the last quoted uncertainty comes from the accuracy on $BR(D^0 \to K^- \pi^+)$.

This value corresponds to:

$$f_+(0) = 0.735 \pm 0.004 \pm 0.004 \pm 0.012. \quad (13)$$

For this last evaluation we have used the value $\tau_{D^0} = 4.101 \times 10^{-13} s$ for the D^0 lifetime and $V_{cs} = 0.9729$.

BR (D→Keν)= 3.55% (±1.1%) (±1.1%) (±1.8%)

BR (D→Keν)CLEO-c= 3.58% (±1.4%) (±1.4%)

BR (D→Keν)(PDG-06)= 3.51% (±3.1%)

() = relative error

Conclusions

- **Expect soon discussion with AWG**
- **Expect to finalize BAD for the publication**