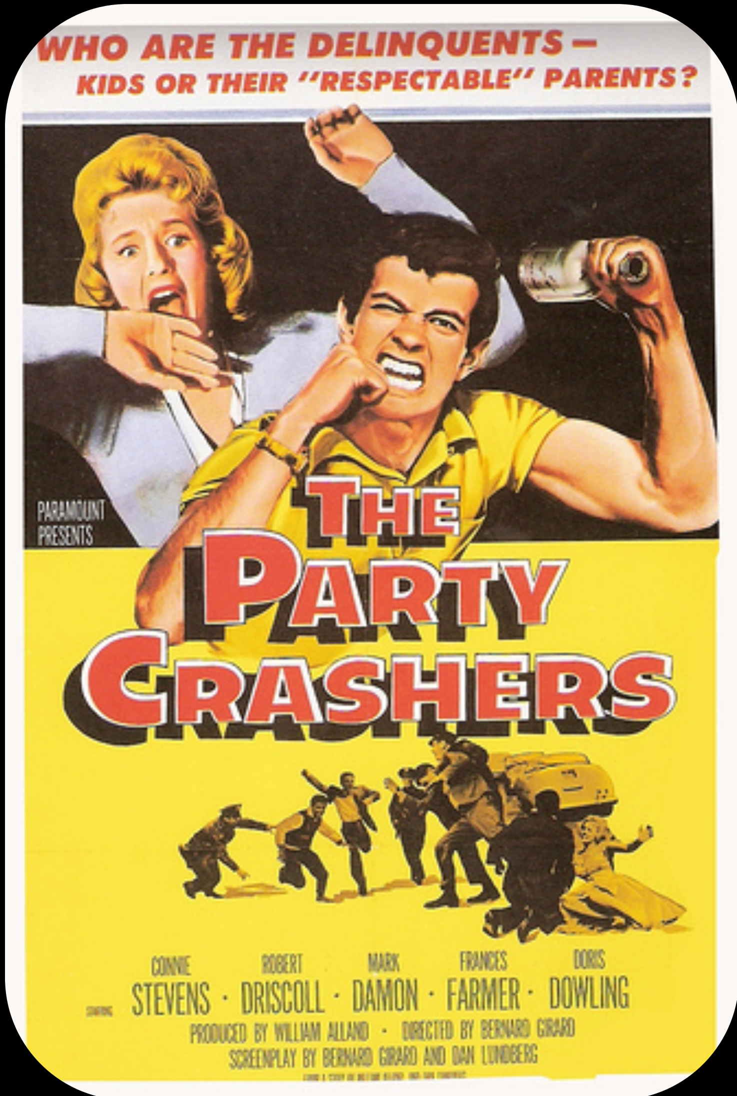
CDF – the party crashers



Capri 2010
July 5, 2010

Diego Tonelli
Fermilab
for the CDF Collaboration

Success!


VOLUME 89, NUMBER 20
PHYSICAL REVIEW LETTERS
11 NOVEMBER 2002
Measurement of the CP Asymmetry Amplitude sin2β with B⁰ Mesons
PHYSICAL REVIEW LETTERS
27 AUGUST 2001
Observation of CP Violation in the B⁰ Meson System
PRL 97, 251802 (2006)
PHYSICAL REVIEW LETTERS
week ending 22 DECEMBER 2006
Evidence of the Purely Leptonic Decay B⁻ → τ⁻ ν̄τ
PHYSICAL REVIEW LETTERS
Evidence for D⁰-D̄⁰ Mixing
VOLUME 93, NUMBER 13
PHYSICAL REVIEW LETTERS
Direct CP Violating Asymmetry in B⁰ → K⁺π⁻ Decays
Observation of Large CP Violation in the Neutral B Meson System

Or "flavor problem"?

Kaon physics and *B* factories: SM picture of CP violation satisfactory at least at tree level in B^0 and B^+ decays. NP amplitudes < 10%, if any.

Success of the CKM picture rules out NP with a generic, natural flavor structure.

To keep the NP-scale in the TeV range, physics beyond the SM should have a highly fine-tuned flavor structure

…the end of the story?

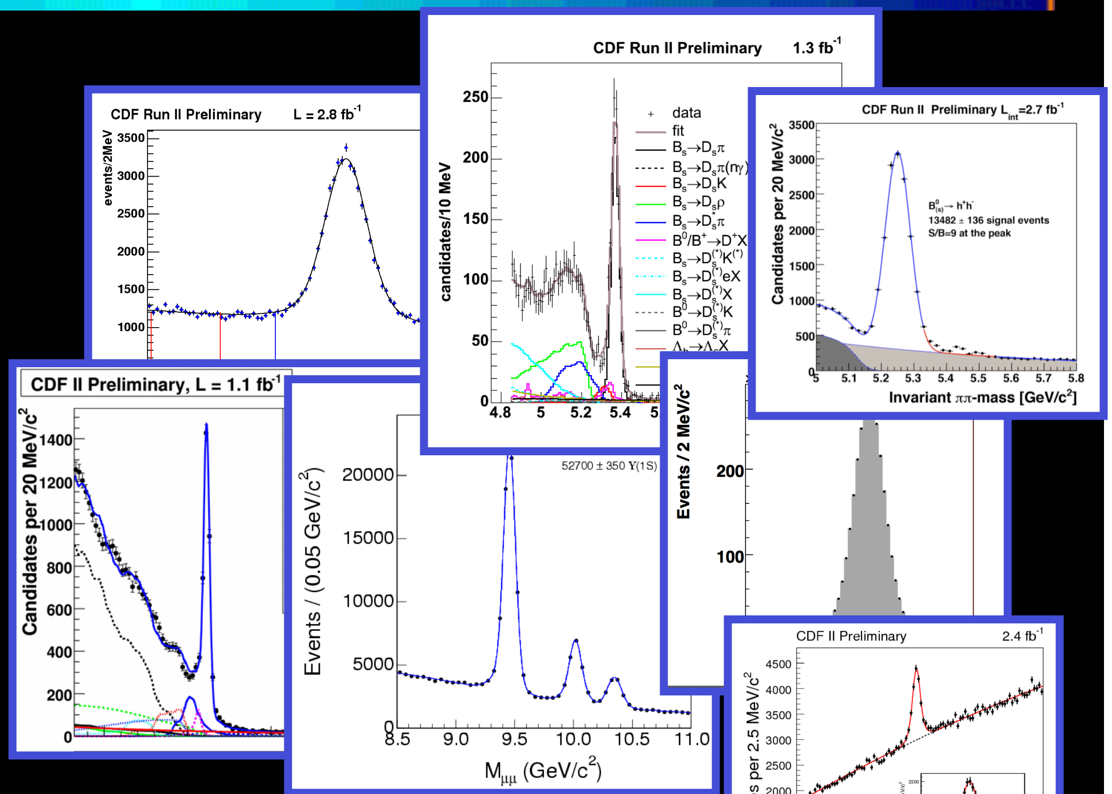
Why bother with CDF?

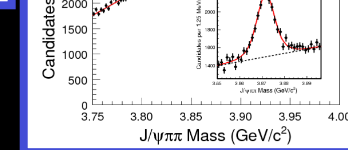
World's largest samples of B and charm.

Challenge *B* factories (on charged final states)

Access strange bottom: new, uncharted territory of independent dynamics.

Access *b*-baryons and B^+_c.





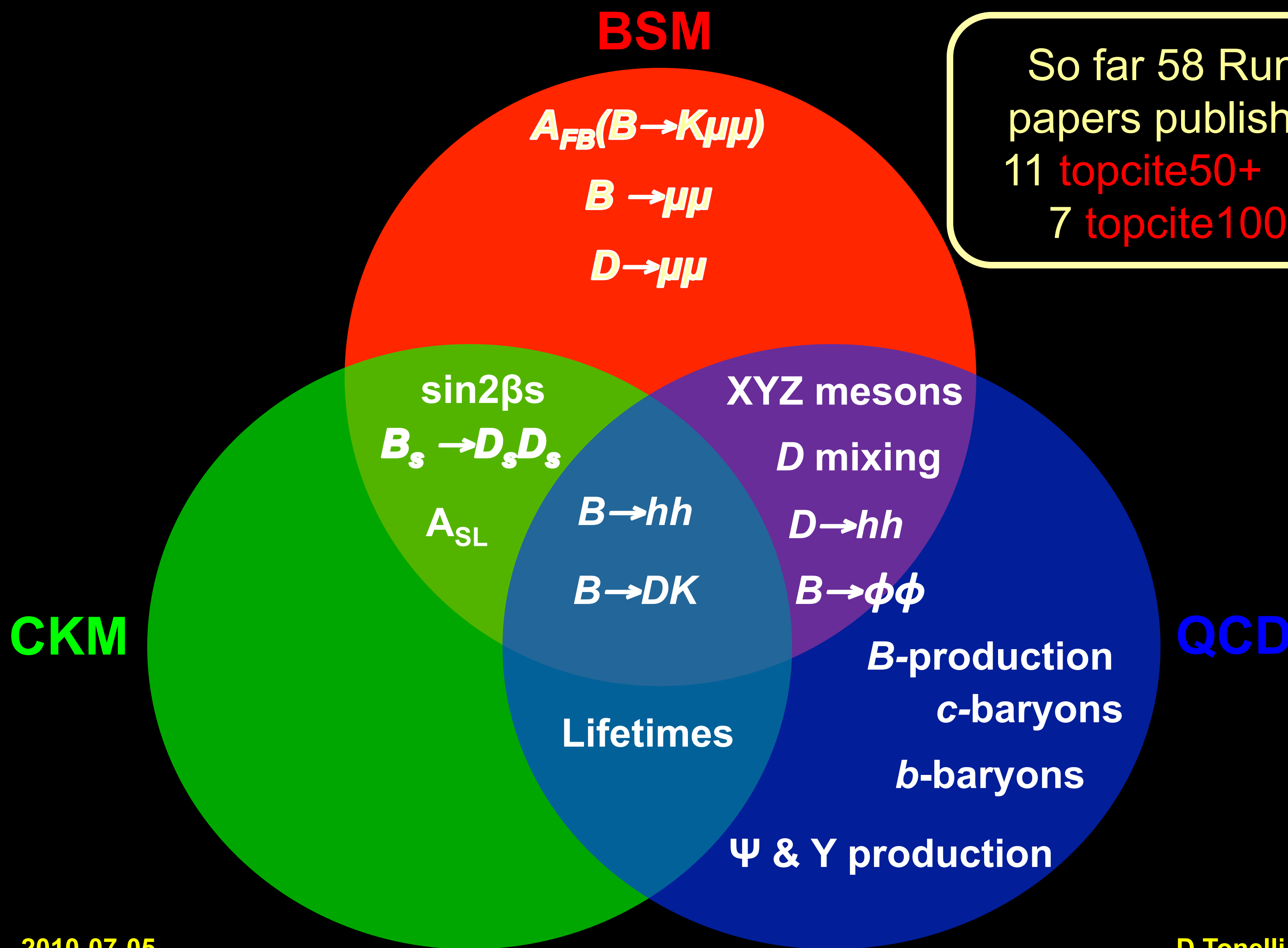
40M J/ψ (~20% from B)

6K $B^0_s \to J/\psi\phi$, 32K $B^0 \to J/\psi K^*$

50M $D^0 \to K^-\pi^+$, 12K $B^0 \to K^+\pi^-$….

The program

So far 58 Run II papers published: 11 topcite50+ and 7 topcite100+



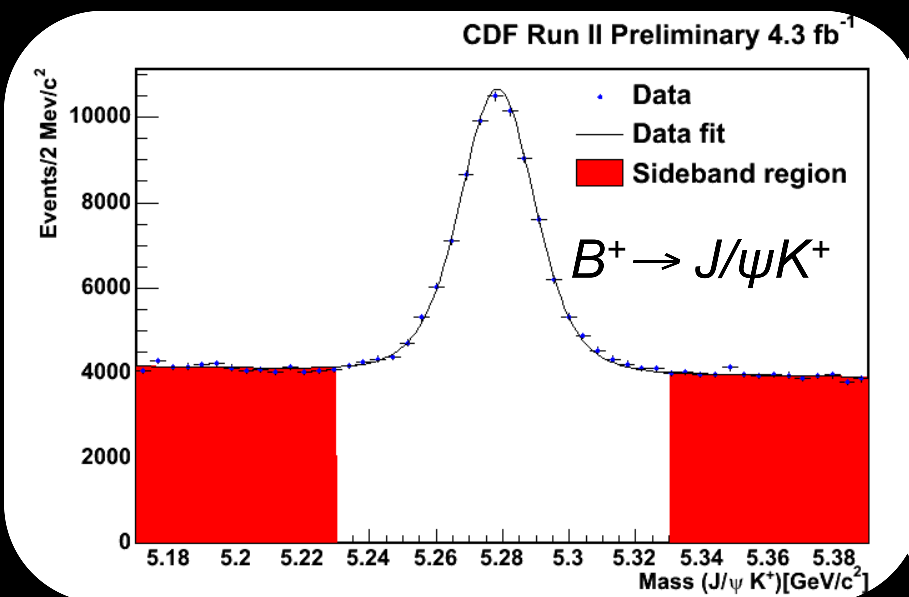
Gettin’ the basics straight

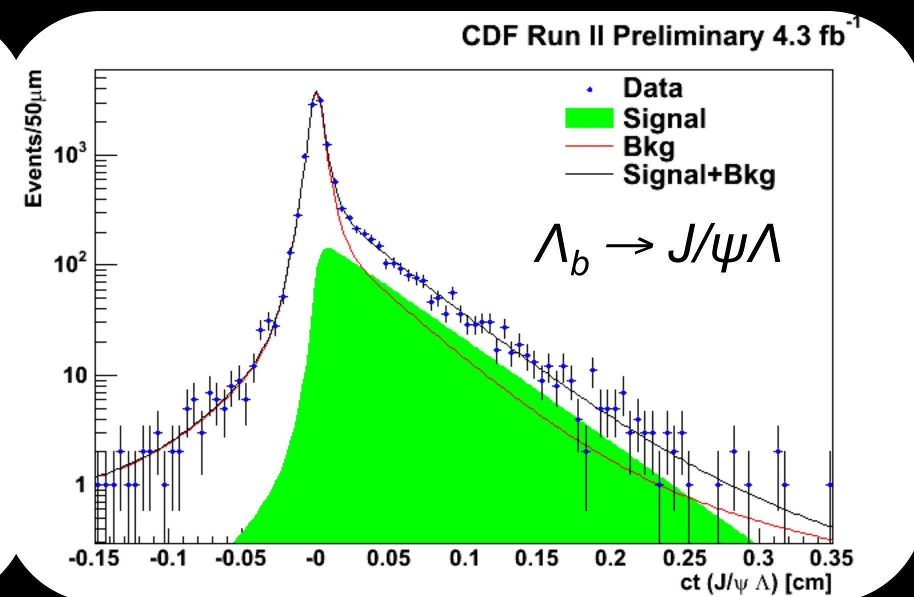
Vertexing - Lifetimes

45k $B^+ \to J/\psi K^+$, 17k $B^0 \to J/\psi K^*$, 12k $B^0 \to J/\psi K_s$, 1.7 $\Lambda_b \to J/\psi \Lambda$ in 4.3 fb^{-1}

Use J/ψ vertex to measure *ct*. Common to all modes, systematic uncertainties cancel in ratios – the ones HQE cares about.

Joint fit: mass, mass-uncertainty, decay time, and decay-time uncertainty.





Similar S/B for all modes

Resolution model from data sidebands

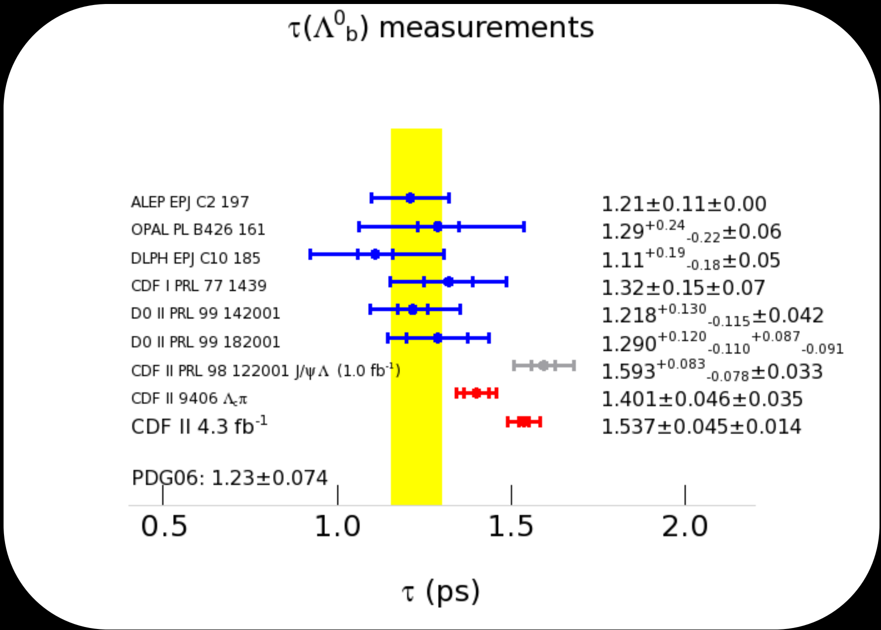
Vertexing - Lifetimes

World leading measurements

No surprises from B^0 and B^+ : *further* confidence in HQE.

Same expansion as for Γ_{12} - crucial for interpretation of CPV in B^0_s mixing

Λ_b higher than theory predictions.



Λ_b theory worse than for mesons: NLO not completed yet, non perturbative ME on lattice still at exploratory stage

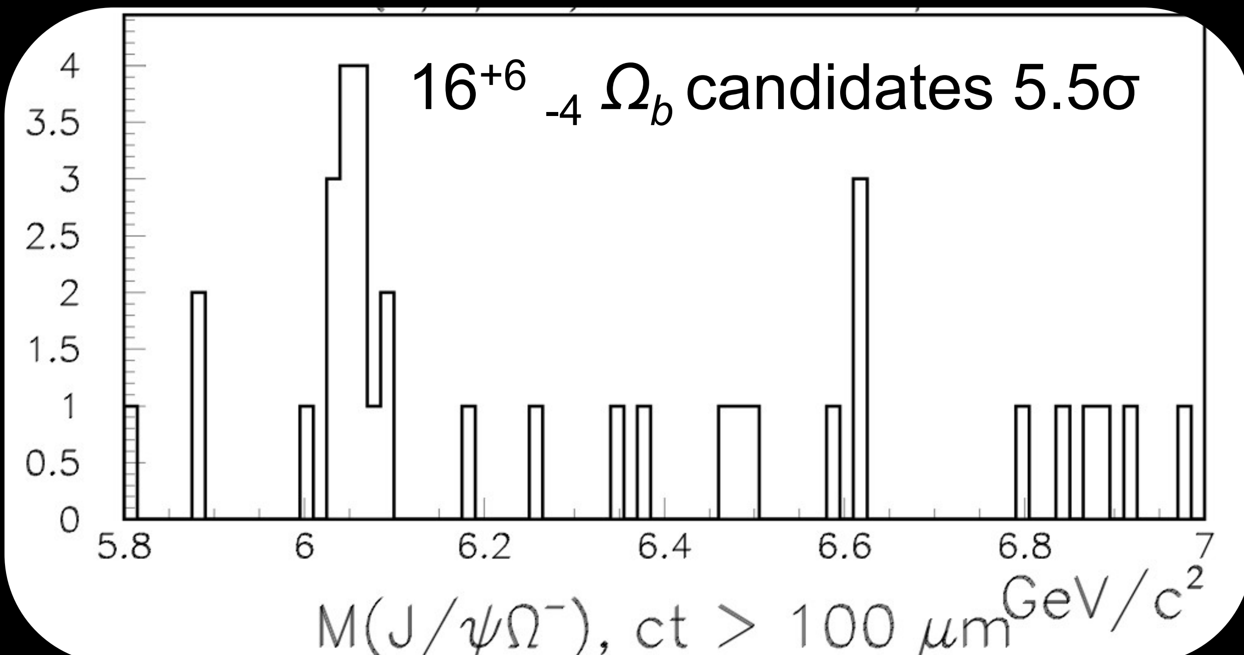
$$c\tau(B^+) = 491.4 \pm 2.6\ (stat.)\ \pm\ 2.6\ (syst.)\ \mu m,$$
$$c\tau(B^0) = 451.7 \pm 3.0\ (stat.)\ \pm\ 2.5\ (syst.)\ \mu m,$$
$$c\tau(\Lambda_b^0) = 460.8 \pm 13.4\ (stat.)\ \pm\ 4.1\ (syst.)\ \mu m.$$
$$\tau(B^+)/\tau(B^0) = 1.088 \pm 0.009\ (\mathrm{stat.}) \pm 0.004\ (\mathrm{syst.})$$
$$\tau(\Lambda_b^0)/\tau(B^0) = 1.020 \pm 0.030\ (\mathrm{stat.}) \pm 0.008\ (\mathrm{syst.})$$

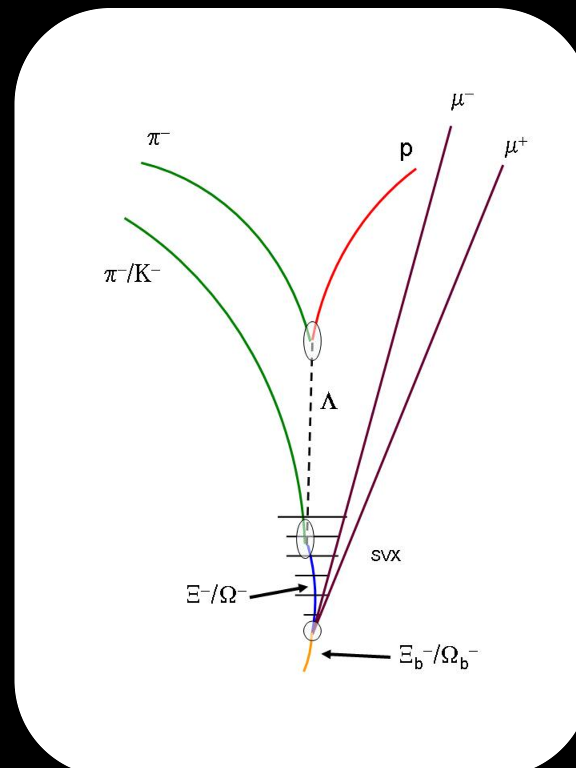
CDF Public Note 10071

Momentum – Ω_b mass

Reconstruct complex $\Omega_b \rightarrow J/\psi\Omega$ *(5 tracks, 3 vertices)* using known $B^0 \rightarrow J/\psi K^*$, $J/\psi Ks$ as reference.

Joint mass, mass uncertainty and lifetime fit





$M(\Omega_b) = 6054.4 \pm 6.8 \pm 0.9$ MeV/c^2 PRD 80, 072003 (2009)

Inconsistent with D0 measurement ($6105 \pm 10 \pm 13$ MeV/c^2).

New Physics in *Penguins*

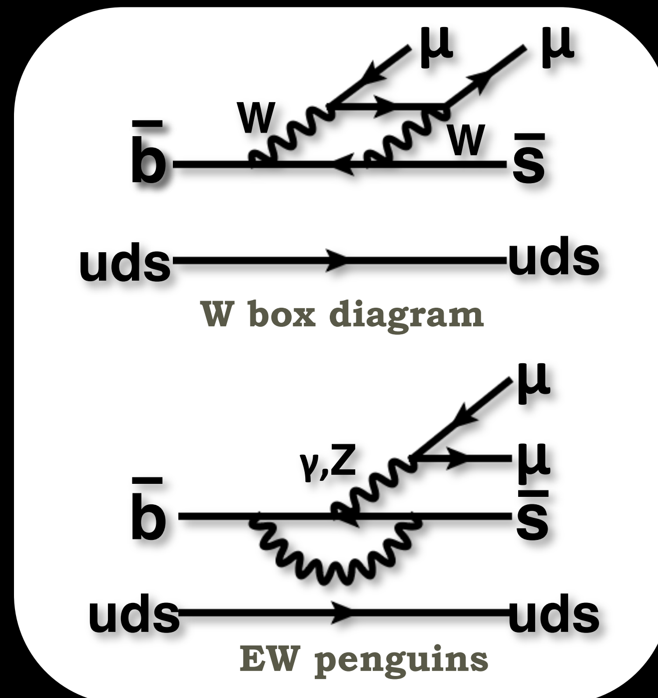
$b \rightarrow s\mu^+\mu^-$ - analysis

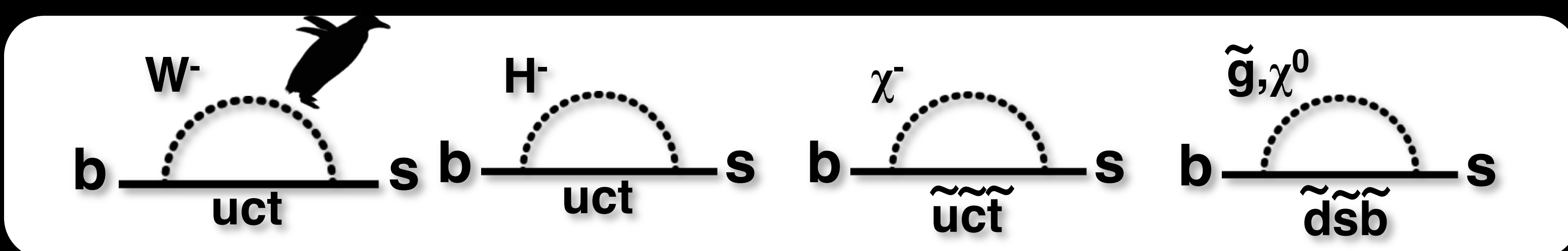
Suppressed in SM. Br ~ 10^{-6}

NP in penguin or box modifies decay-kinematics

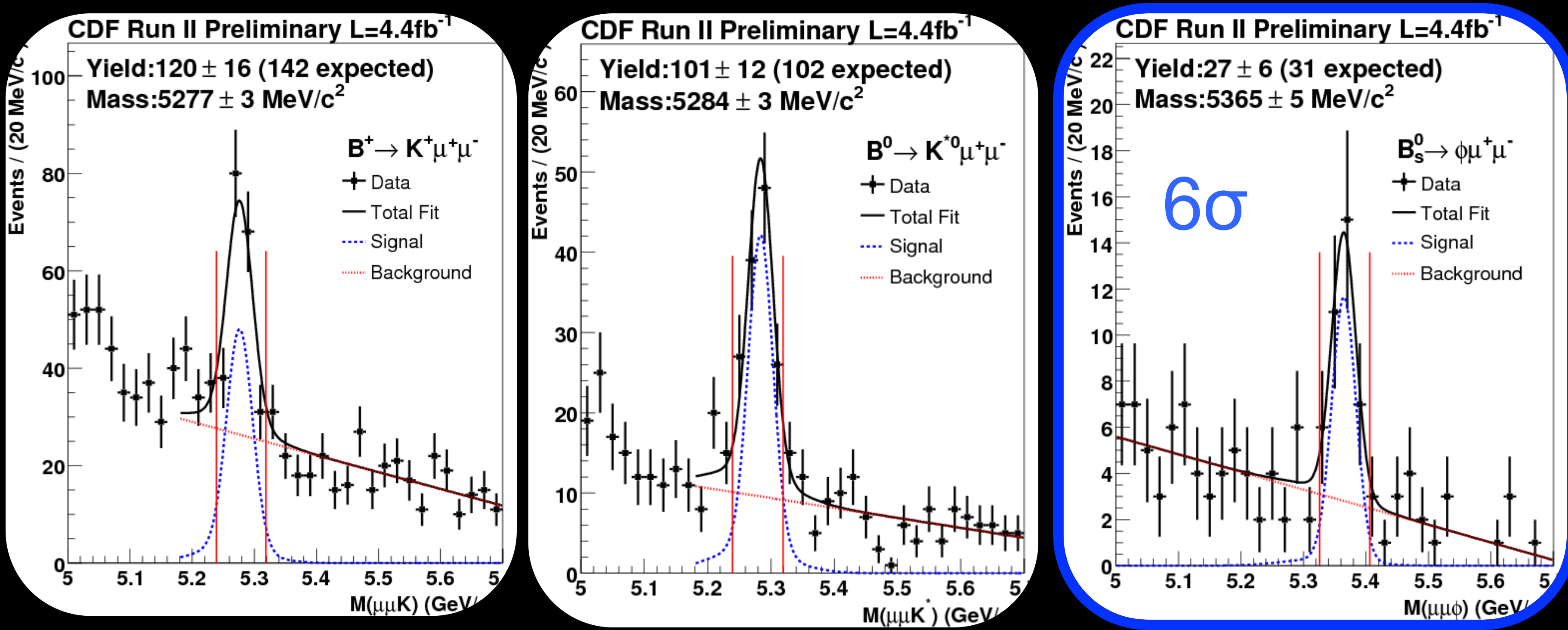
Pretty clean theoretically and experimentally.

- ❑ Need huge statistics (low-p_T dimuon trigger collects1.5-2 GeV/c muons at $|\eta|<1$)
- ❑ NN selection that uses PID on K.
- ❑ Use "resonant" channels as reference





$b \rightarrow s\mu^+\mu^-$ - signals



Observation of ***$B^0_s \rightarrow \varphi\mu\mu$***, the rarest ***$B^0_s$*** decay observed.

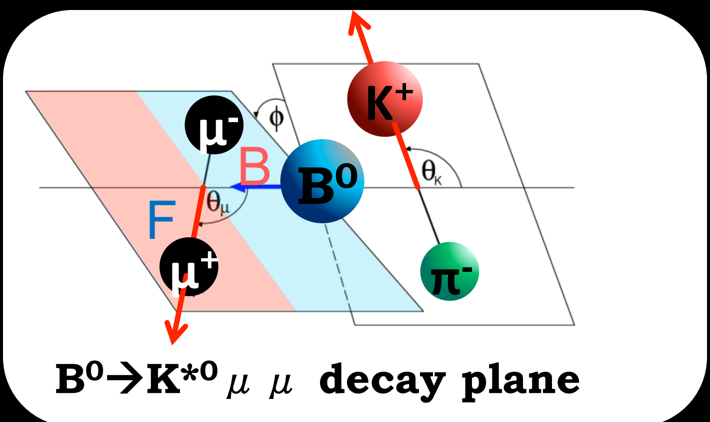
Br = [1.44 ± 0.33 (stat) ± 0.46 (syst)]$\times 10^{-6}$

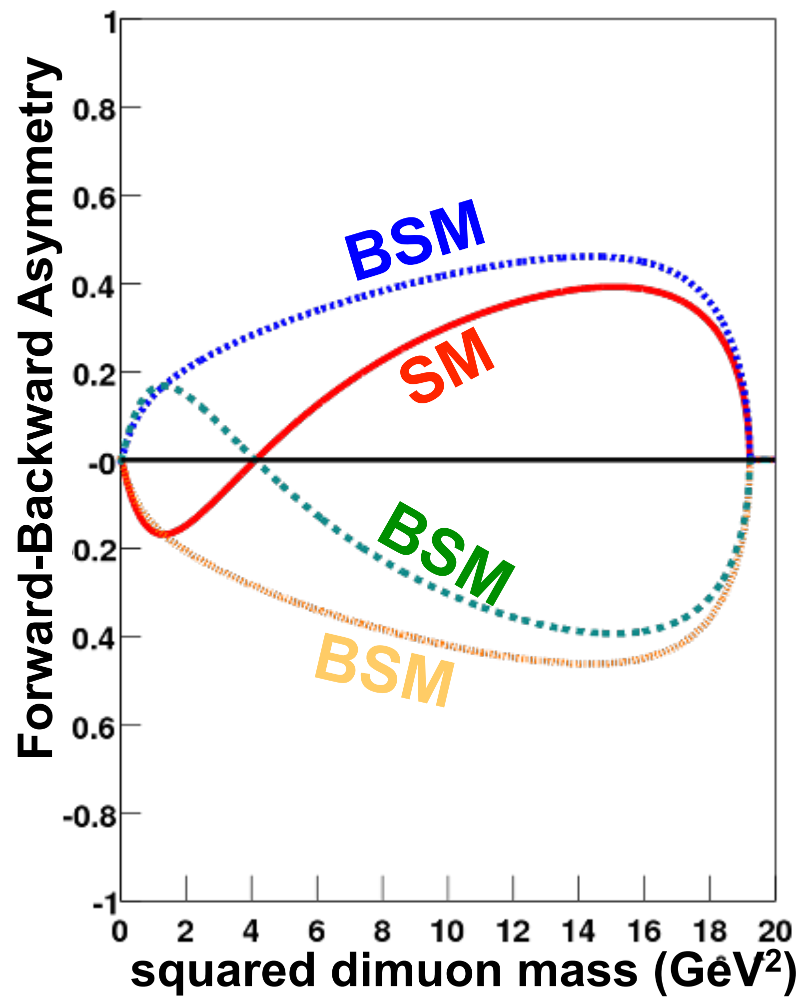
(consistent with predictions of 1.61×10^{-6})

$b \to s\mu^+\mu^-$ - A_{FB}

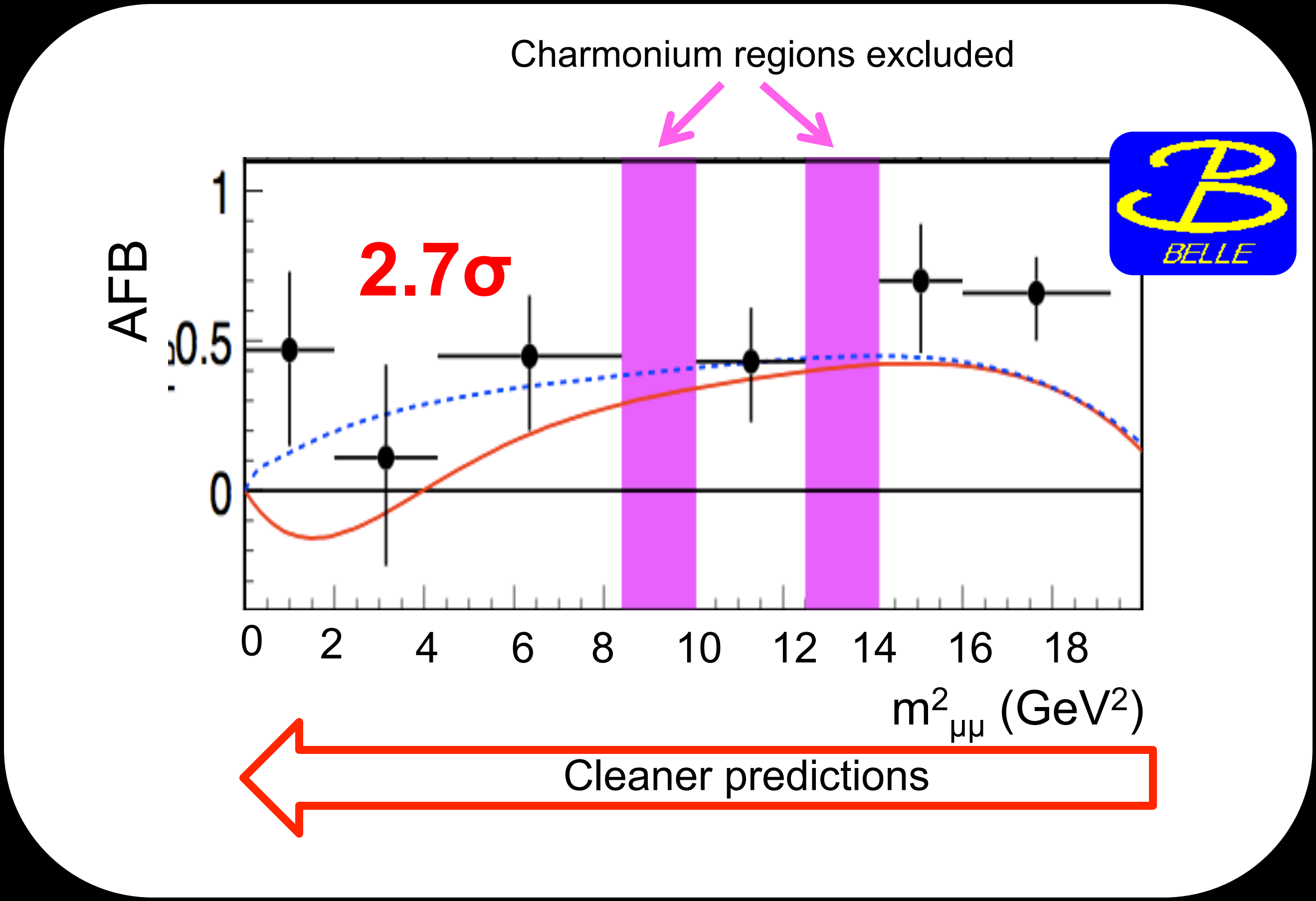
Final state hadrons.

Theory uncertainties limited using relative quantities (μ distribution asymmetries) very sensitive to NP.





$b \rightarrow s\mu^+\mu^-$ - status



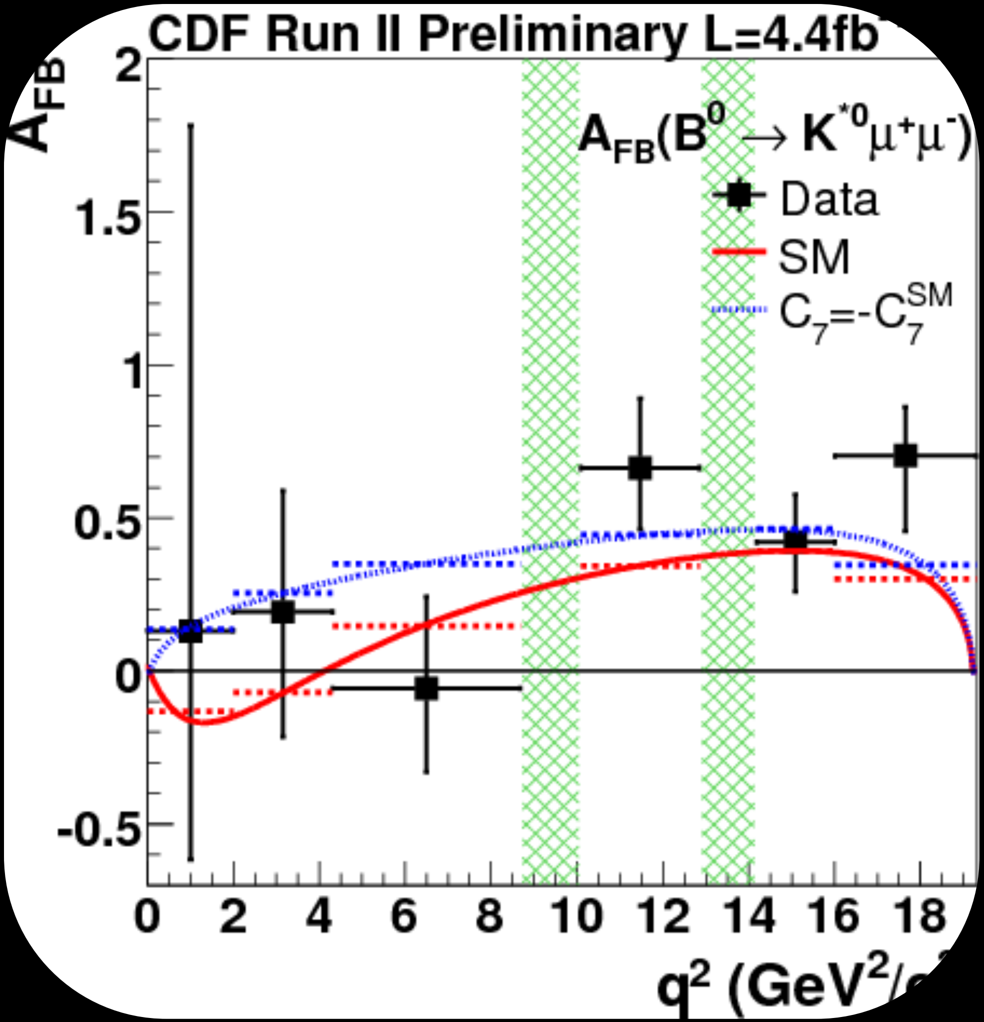
PRL103, 171801 (2009)

$b \rightarrow s\mu^+\mu^-$ - results

Not yet able to discriminate SM from non-SM

Consistent and competitive with best B-factories results.

CDF Public note 10047



Upcoming

Add 2-3x statistics (more data, triggers and final states). Improved analysis. World best in 2011.

Compare Br*10^{-6}

	BaBar (384M BB)	Belle (657M BB)	CDF (4.4fb^{-1})
$K^{*0}\mu\mu$	$1.35^{+0.40}_{-0.37} \pm 0.10$	$1.06^{+0.19}_{-0.14} \pm 0.07$	$1.06 \pm 0.14 \pm 0.09$
$K^{*}ll$	$1.11^{+0.19}_{-0.18} \pm 0.07$	$1.07^{+0.11}_{-0.10} \pm 0.09$	same as above
	PRL102,091803 (2009)	PRL103,171801 (2009)	Public note 10047

DØ weighing in (?)

LHCb: 1200 events expected with 1 fb^{-1} to exclude SM at 4σ and <1 GeV^2 precision on zero-crossing point.

$B^0_s \to \phi\phi$

Rich dynamics from three polarization amplitudes in PVV. First order SM hierarchy

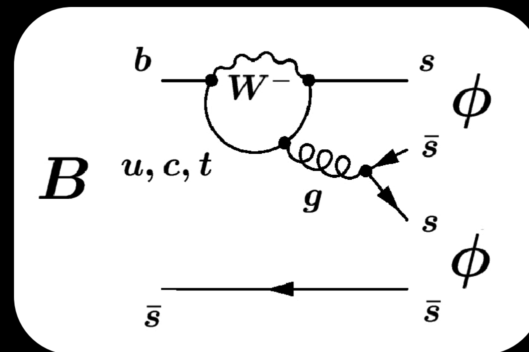
$$|A_0|^2 \gg |A_{\|}|^2 \simeq |A_\perp|^2$$

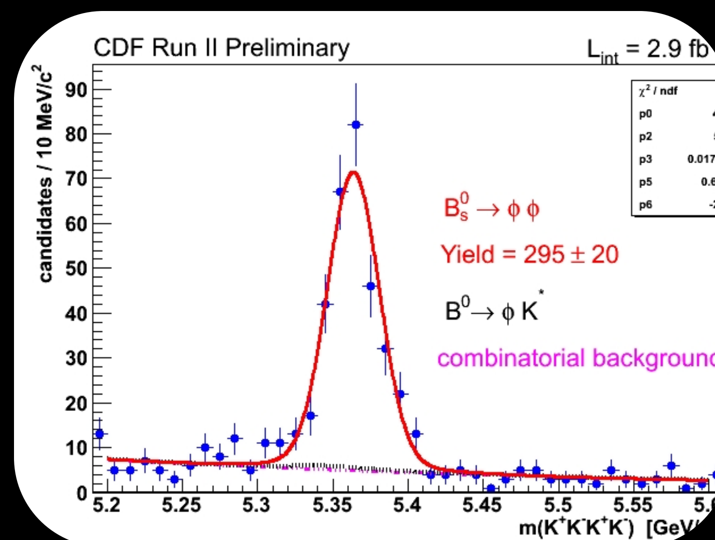
OK in $b \to d$ *and* $b \to u$. Violated in $b \to s$.

"Ad hoc" SM solutions are model dependent or inconclusive.

NP option still valid.

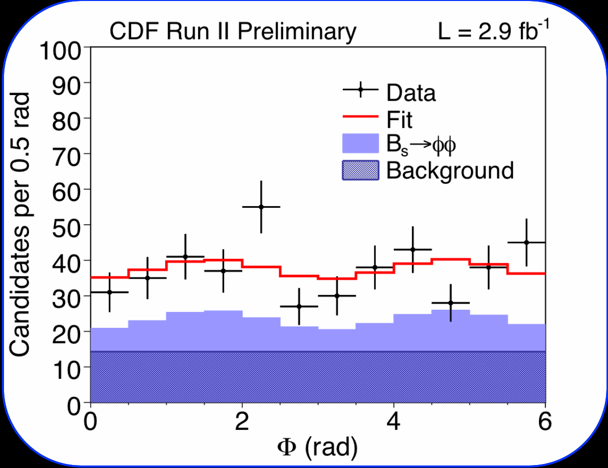
Further experimental info key to discriminate. $B^0_s \to \phi\,\phi$ + SU(3) checks for "penguin annihilation" **EPJ C60 (2009)**





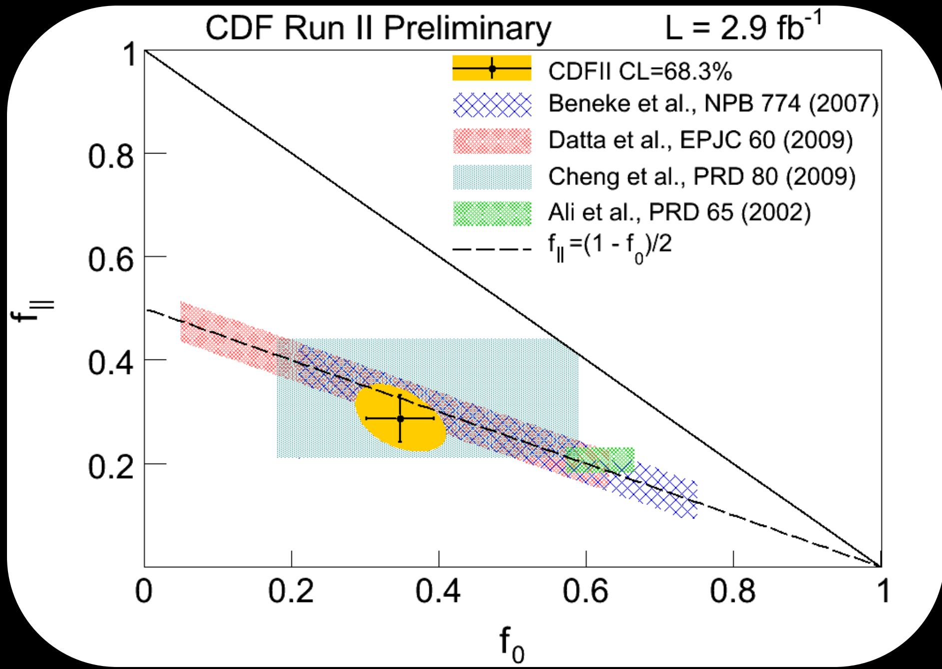
$$BR(B^0_s \to \phi\phi) = [2.40 \pm 0.21(stat) \pm 0.27(syst) \pm 0.82(BR)] \cdot 10^{-5}$$

$B^0_s \to \phi\phi$ – results



$$
\begin{aligned}
|A_0|^2 &= 0.348 \pm 0.041(\mathrm{stat}) \pm 0.021(\mathrm{syst}) \\
|A_{\|}|^2 &= 0.287 \pm 0.043(\mathrm{stat}) \pm 0.011(\mathrm{syst}) \\
|A_{\perp}|^2 &= 0.365 \pm 0.044(\mathrm{stat}) \pm 0.027(\mathrm{syst}) \\
\cos\delta_{\|} &= -0.91^{+0.15}_{-0.13}(\mathrm{stat}) \pm 0.09(\mathrm{syst})
\end{aligned}
$$

CDF Public Note 10120



First measurement of $b \to s$: penguin polarization in B^0_s sector.

Puzzling behavior confirmed

Measurement of CPV irrealistic at CDF. Statistics penalty from flavor tagging.

The deadliest NP killer around - $B^0_s \rightarrow \mu^+ \mu^-$

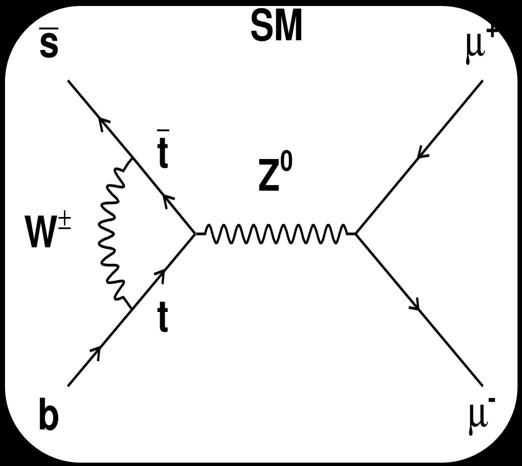
$B^0_s \to \mu^+\mu^-$ - *trivia*

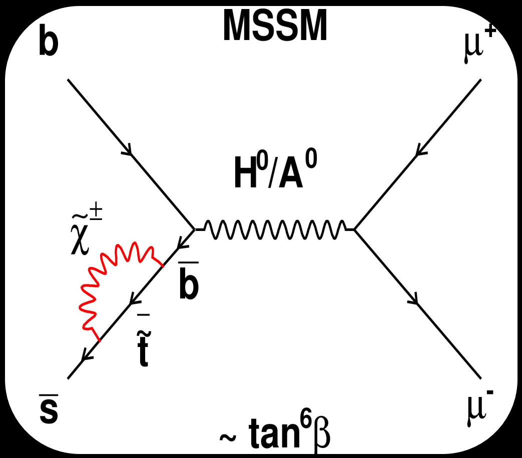
Gets all available suppressions in SM

All leptonic decay: robust SM prediction Br = $(3.6 \pm 0.3)\times10^{-9}$.

NP can enhance rate up to 100×.

Sensitive to a broad class of NP models, complementary to many TeV/LEP direct searches.





$B^0_s \rightarrow \mu^+\mu^-$ - the measurement

Latest result (summer 2009) uses 3.7 fb^{-1} (half of current sample)

Signal decays at 95%CL to be measured

Trigger acceptance ratio from MC approx. 0.2-0.3

Rec. efficiency ratio from MC/DATA approx 0.8

$$\mathcal{B}(B^0_s \rightarrow \mu^+\mu^-) = \frac{N_s}{N_+} \cdot \frac{\alpha_+}{\alpha_s} \cdot \frac{\epsilon_+}{\epsilon_s} \cdot \frac{1}{\epsilon_N} \cdot \frac{f_u}{f_s} \cdot \mathcal{B}(B^+),$$ PDG

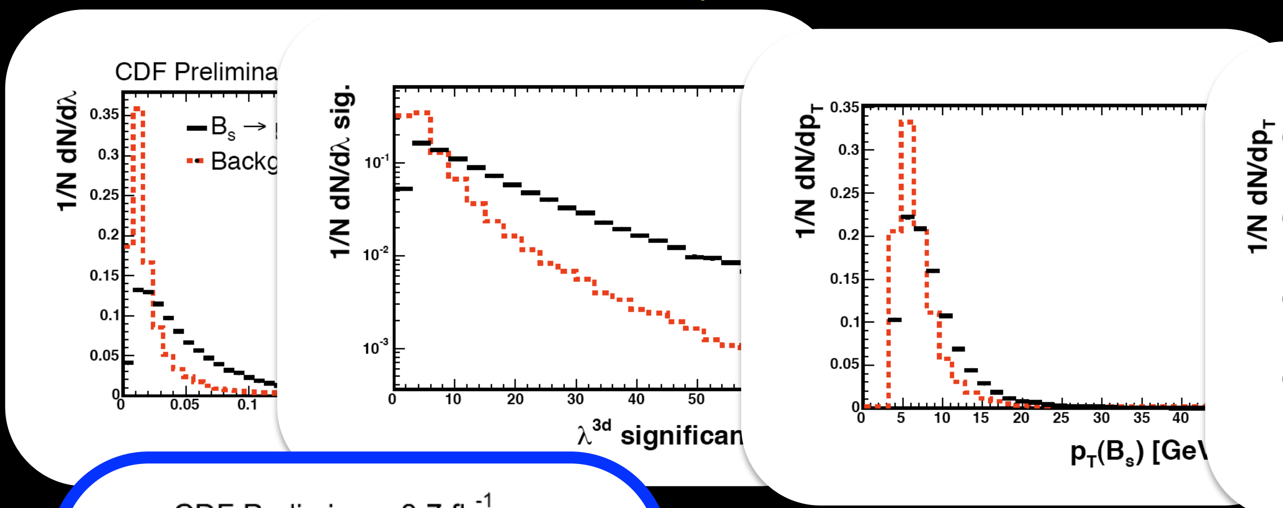
$B^+ \rightarrow J/\psi K+$ decays from data approx. 20K

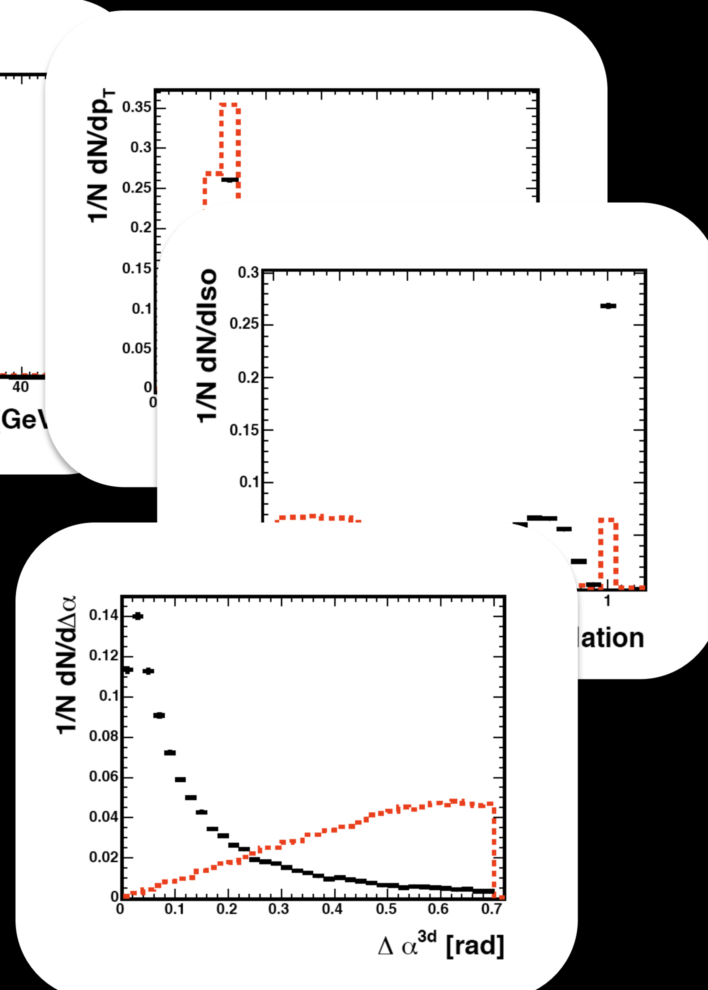
Efficiency of NN requirement from MC, approx 80-20% (cut-dependent)

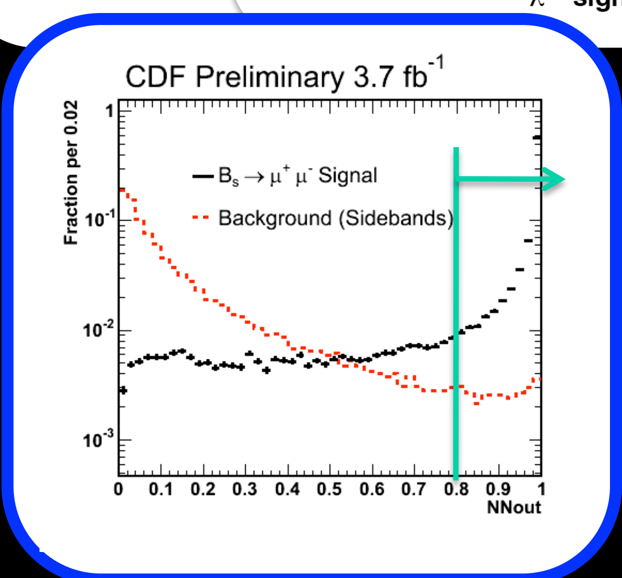
The challenge: reject 10^6 background while keeping signal efficiency high.

$B^0_s \rightarrow \mu^+\mu^-$ - selection

Discriminants: mass, life, p_T (obvious), B isolation and pointing to $p\bar{p}$ vertex



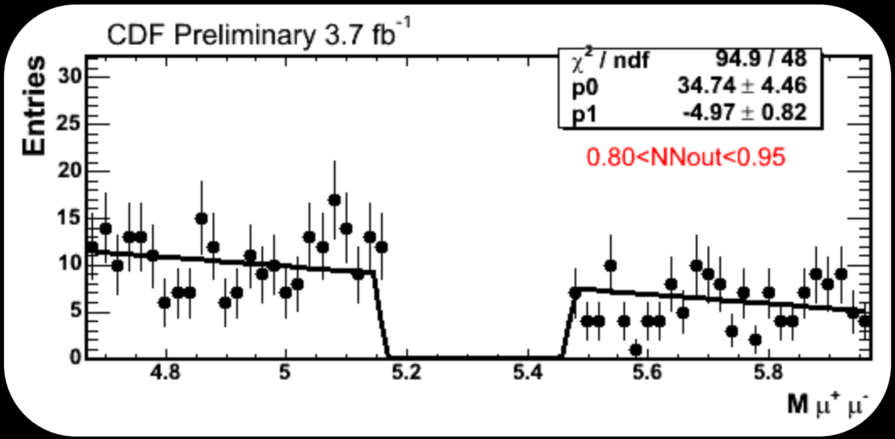




Combine discriminants into a NN. Validation of NN modeling and efficiency on B^+

$B^0_s \rightarrow \mu^+\mu^-$ - backgrounds

- ✓ continuum $\mu^+\mu^-$ from Drell-Yan
- ✓ sequential $b \rightarrow c\mu^- X \rightarrow \mu\mu s$ semilept.
- ✓ double semileptonic $b\bar{b} \rightarrow \mu^+\mu^- + X$
- ✓ $b/c \rightarrow \mu$ + fake
- ✓ fake + fake (peaking $B \rightarrow hh$)



Suppress fakes: calorimeter, dE/dx, muon-track matching.
All calibrated on $J/\psi \rightarrow \mu\mu$, $D^0 \rightarrow K\pi$, $\Lambda \rightarrow ph$ decays in data.

Combinatorial: extrapolate from sidebands into signal region

Extensive checks with background-enriched control samples: same-sign dimuons, dimuons with <0 decay-length, dimuons failing fake veto

Results

	$\mathcal{B}(B_s \to \mu^+\mu^-)$ 90%	95%	$\mathcal{B}(B_d \to \mu^+\mu^-)$ 90%	95%
Expected $\mathcal{B}$	2.7×10^{-8}	3.3×10^{-8}	7.2×10^{-9}	9.1×10^{-9}
Observed $\mathcal{B}$	3.6×10^{-8}	4.3×10^{-8}	6.0×10^{-9}	7.6×10^{-9}

World-leading.

$Br(B^0_s \to \mu\mu) < 4.3 \times 10^{-8}$ (95% CL)

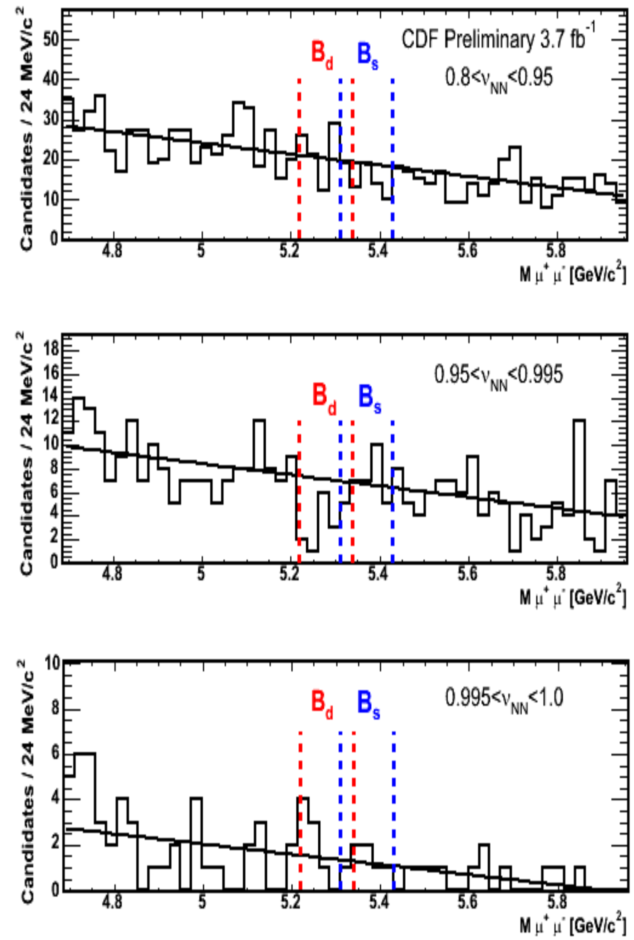
10*SM with 3.7 fb^{-1}.

This result CDF Public Note 9892,

2 fb^{-1} PRL100, 101802 (2008) topcite100+

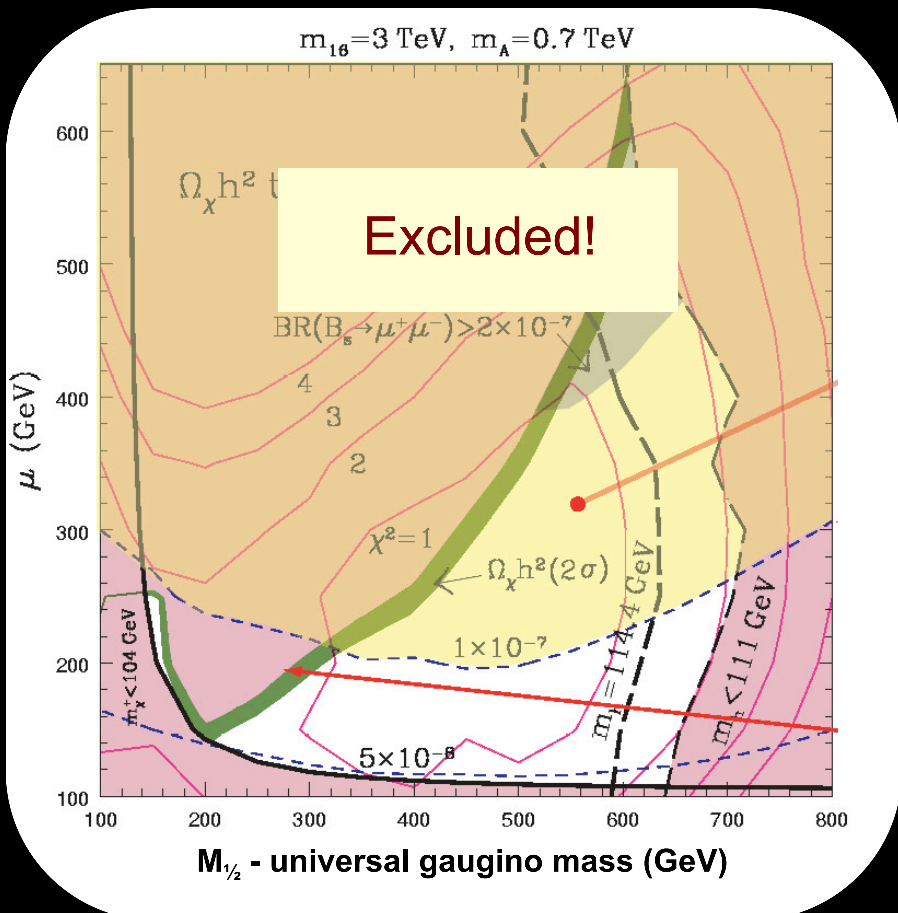
0.78 fb^{-1} PRL93, 032001 (2008) topcite50+

Three slices of NN output



6 bckg expected, 7 evts observed

$B^0_s \to \mu^+\mu^-$ - a broad impact



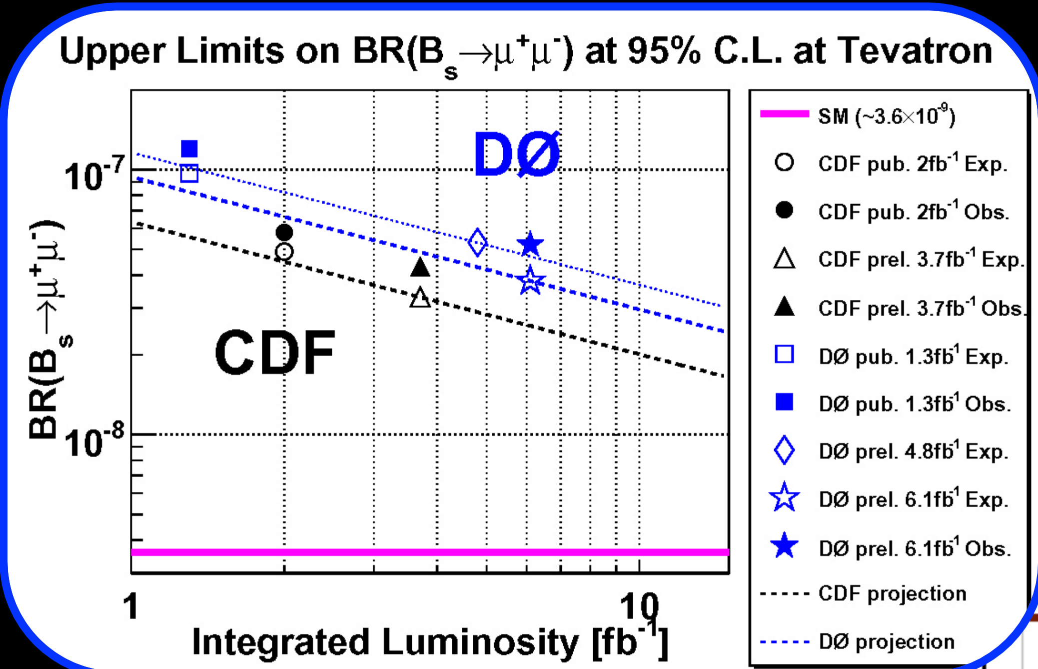
Lot of recent activity on implications for DM searches

$B^0_s \to \mu^+\mu$ rate and neutralino x-section depend on tan(β).

Bounds on Br($B^0_s \to \mu^+\mu$) reduce allowed space of parameters for DM

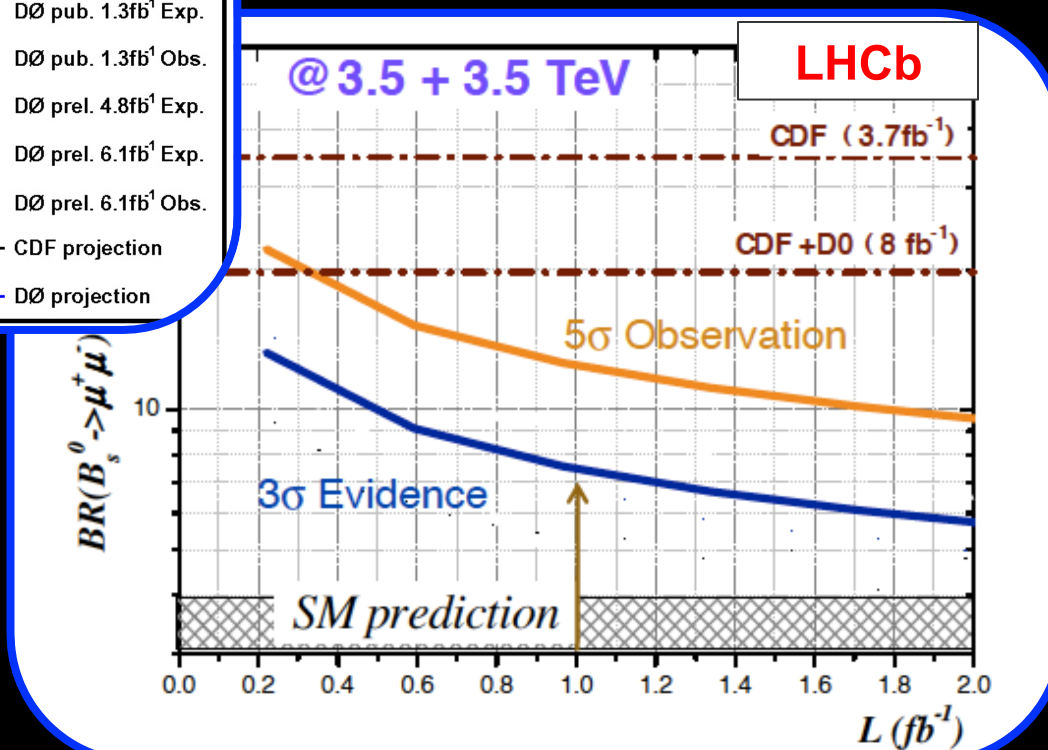
Strongly constrains specific SUSY models, e.g. SO(10) Dermisek et al. JHEP 0509, 029 (2005)

$B^0_s \rightarrow \mu^+\mu$ - year 2012



Competition may be tight. ATLAS and CMS may join

SM value won't be probed anytime soon, but eating-in last chunks of NP space.



New Physics in B^0_s mixing phase

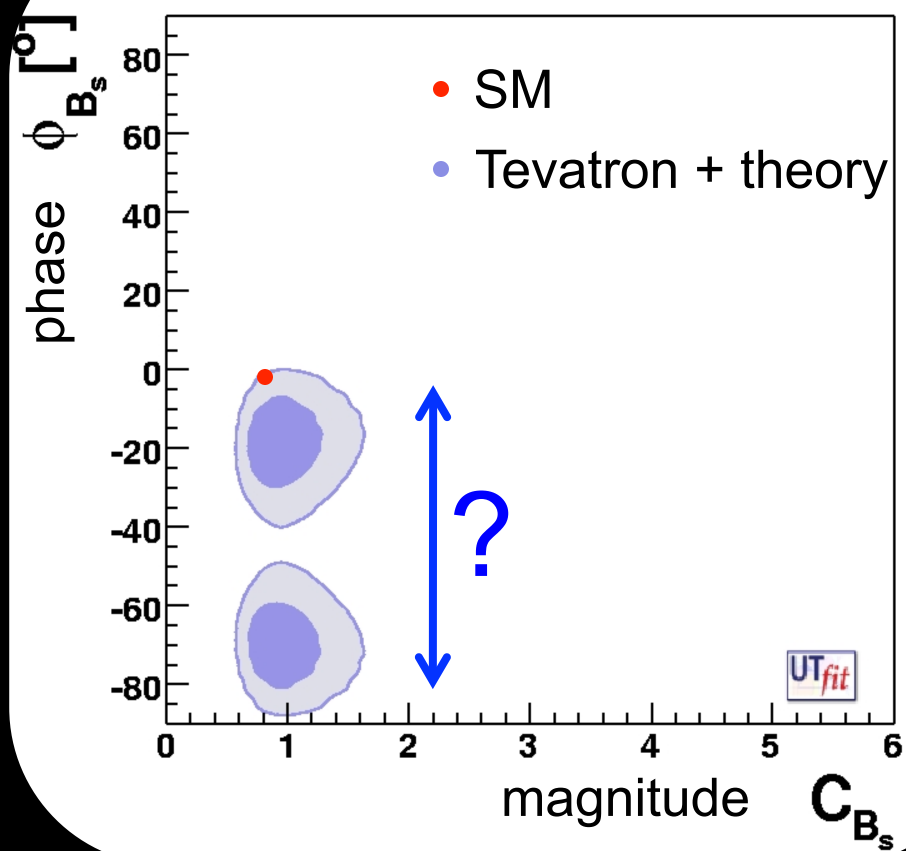
Why the phase?

$$\frac{\langle M|H_{\rm eff}^{\rm full}|\bar{M}\rangle}{\langle M|H_{\rm eff}^{\rm SM}|\bar{M}\rangle} = C_M e^{2i\phi_M}$$

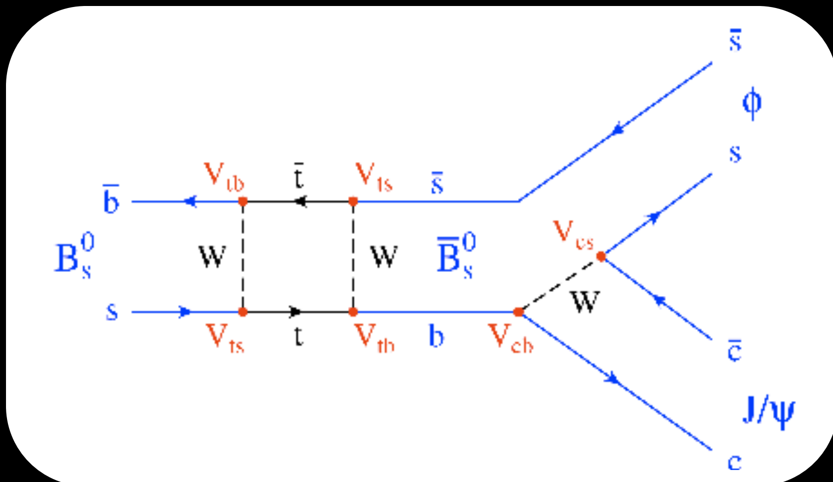
Magnitude measured in 2006. It is SM within uncertainty that is now theory dominated.

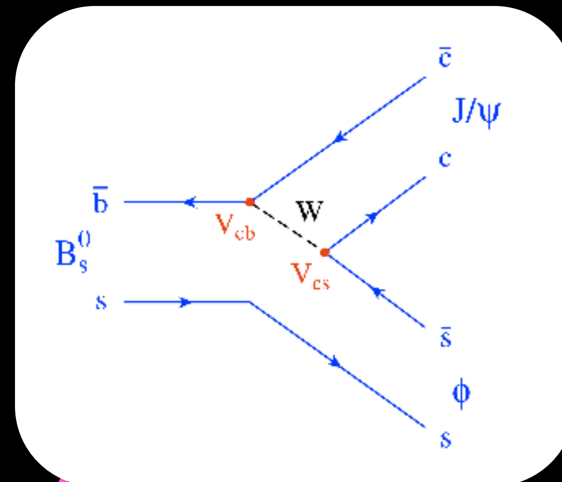
Phase still largely unconstrained.

Large room for NP left unexploredx



$B^0_s \to J/\psi\phi$ - the golden probe





Mixing phase sensitive to NP

Tree $b \to c\bar{c}s$ phase ≈ 0

Time-evolution:

$$2\beta_s = -\arg[(V_{tb}V^*_{ts})^2/(V_{cb}V^*_{cs})^2]$$

CKM hierarchy predicts 2βs tiny with error << current experimental sensitivity.

Any significant deviation is golden probe for new physics entering the box.

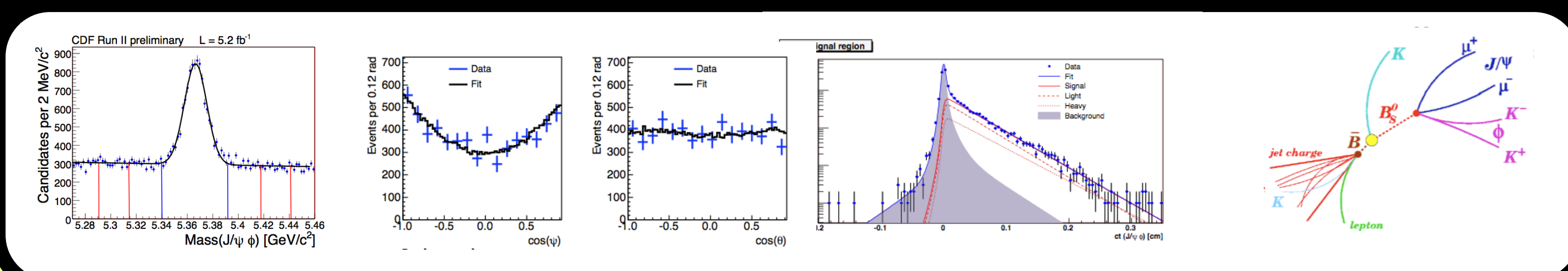
At a glance

Dimuon trigger

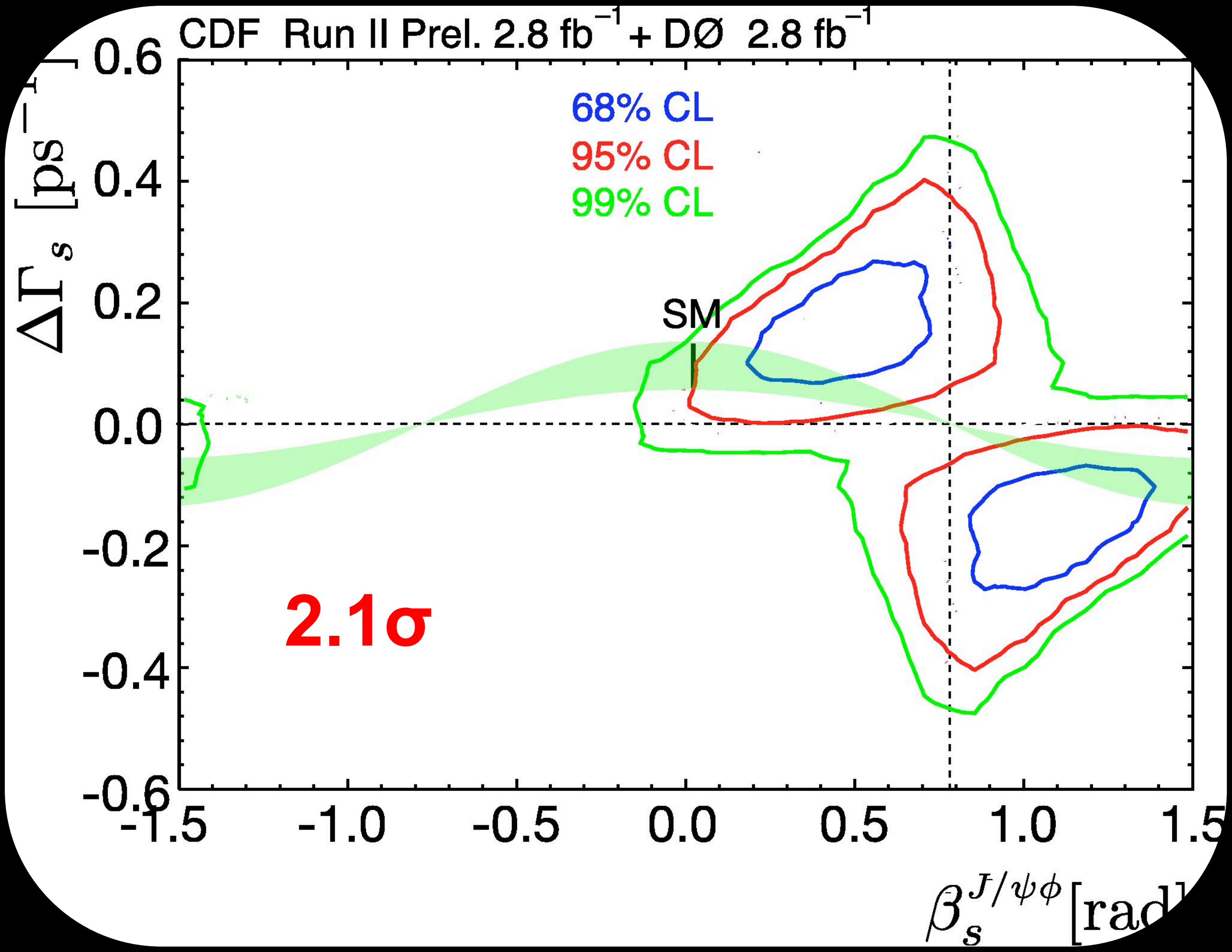
NN selection

Joint fit to mass, angles, decay-time and production flavor distributions

Mass to separate signal from bckg	Angles to separate CP-even/odd	Decay time to know time evolution	Flavor tagging to separate B from Bbar



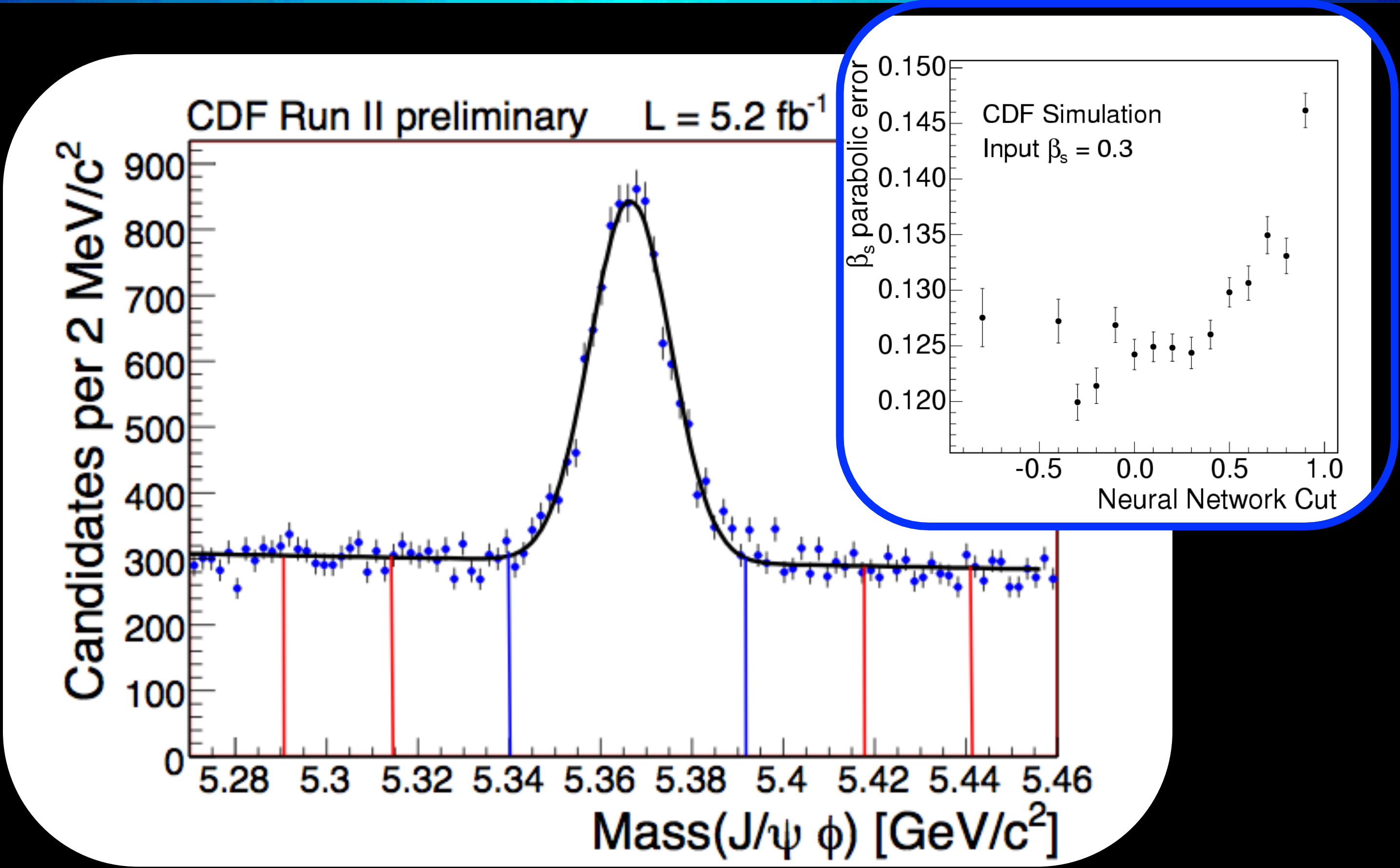
Status



PRL101 161802 (2008) topcite100+
PRL101, 241801 (2008) topcite100+
http://tevbwg.fnal.gov/results/Summer2009_betas/

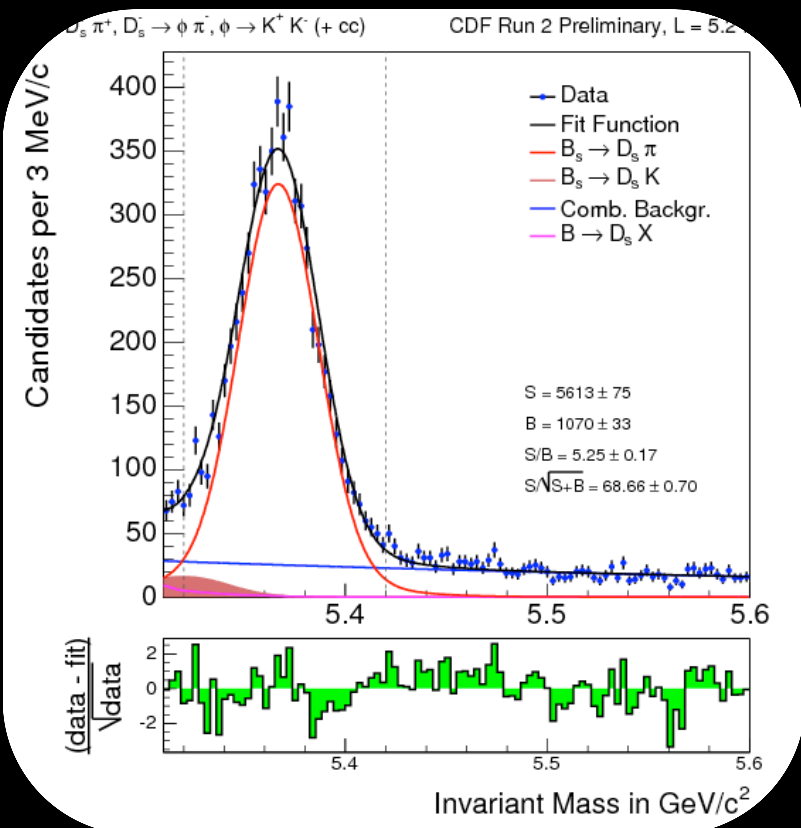
New update with 5.2 fb^{-1}

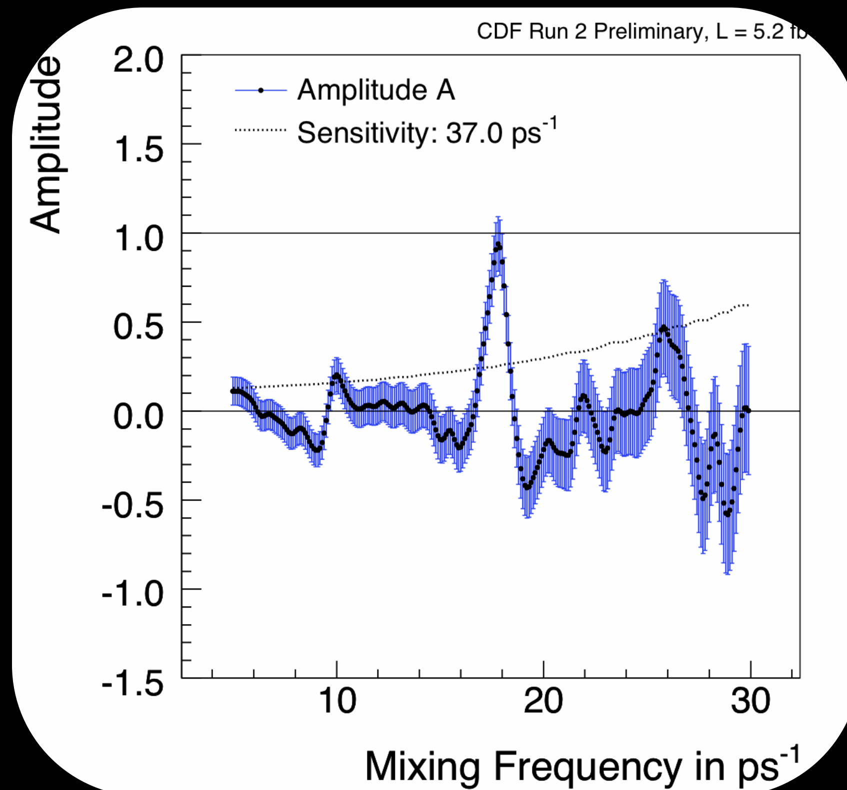
Signal



Selection optimized by minimizing the expected uncertainty on the phase as measured in pseudo-exp. 6500 signal decays. Compare with 3150 in 2.8 fb^{-1}. Improvement better than ~ L.

Calibrating production-flavor





SSKT fully recalibrated in data through new mixing analysis

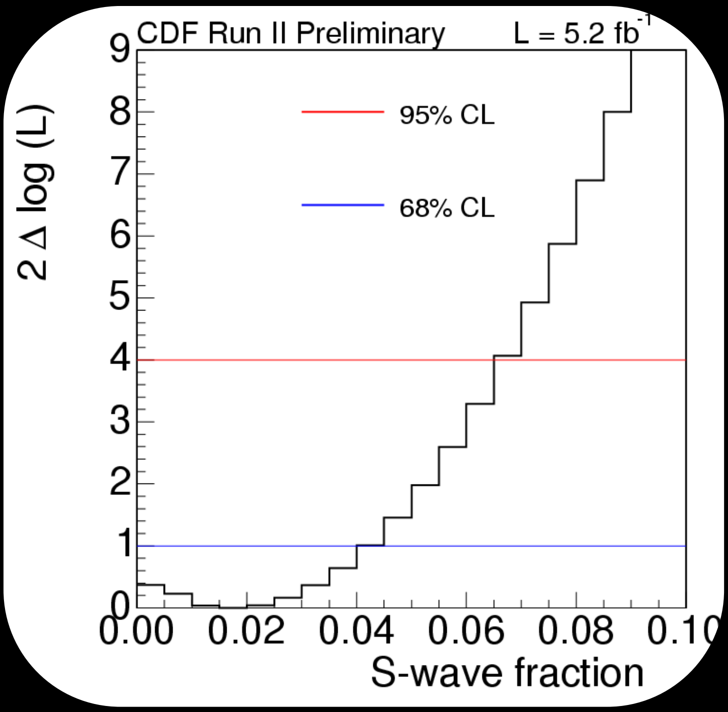
$\Delta m_s = 17.79 \pm 0.07\ ps^{-1}$ (stat. only)

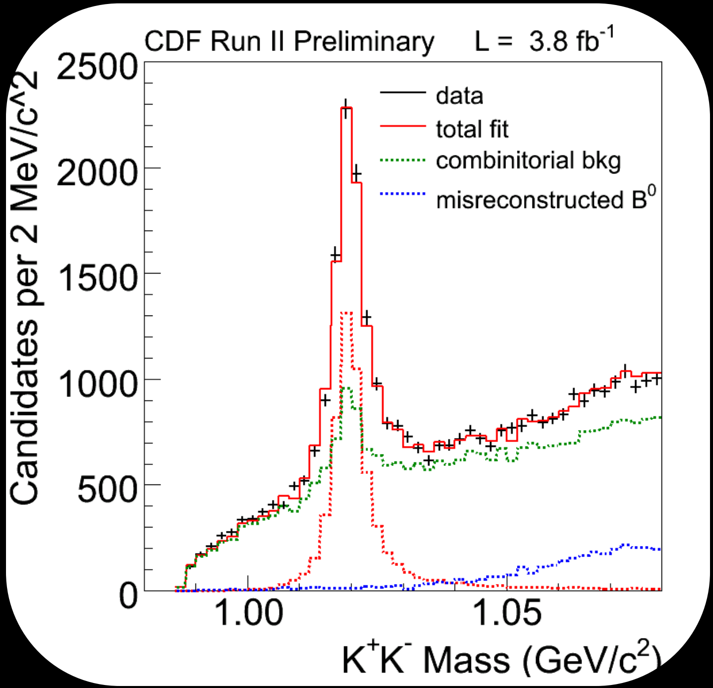
$\epsilon \mathcal{A}^2 D^2 \approx 3.2 \pm\ 1.4\ \%$

Non-ϕ KK contributions

$B^0_s \rightarrow J/\psi KK$ decays (non resonant or f^0) can bias the phase measurement. Included their contribution in full fit.

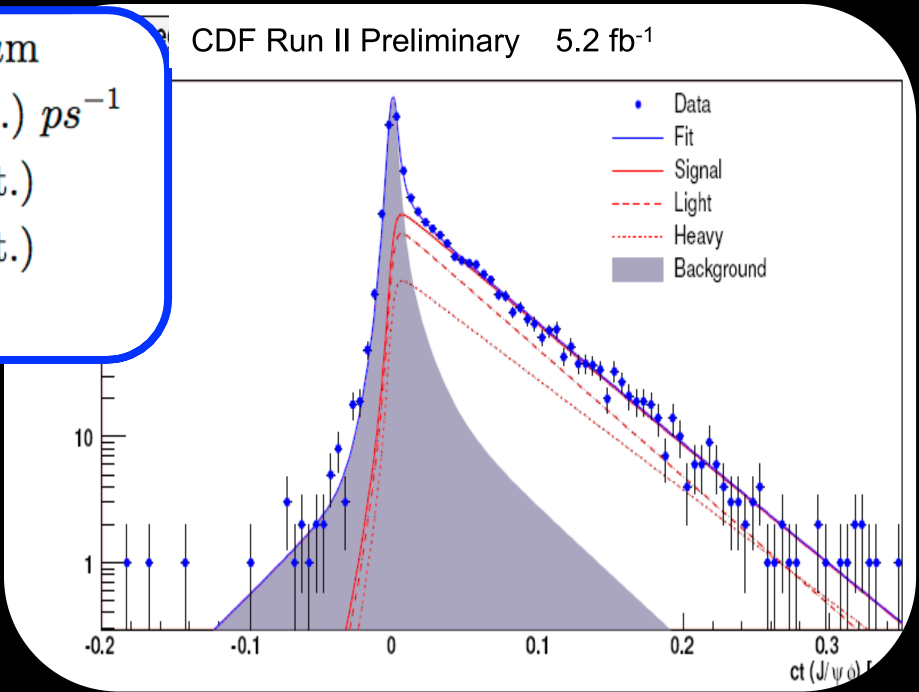
Non-ϕ component < 7% at 95%CL





Results – SM fit

$$c\tau_s = 458.6 \pm 7.5\ (\text{stat.}) \pm 3.6\ (\text{syst.})\ \mu m$$
$$\Delta\Gamma = 0.075 \pm 0.035\ (\text{stat.}) \pm 0.01\ (\text{syst.})\ ps^{-1}$$
$$|A_{\parallel}(0)|^2 = 0.231 \pm 0.014\ (\text{stat}) \pm 0.015\ (\text{syst.})$$
$$|A_0(0)|^2 = 0.524 \pm 0.013\ (\text{stat}) \pm 0.015\ (\text{syst.})$$
$$\phi_{\perp} = 2.95 \pm 0.64\ (\text{stat}) \pm 0.07\ (\text{syst.})$$



PDG 2009: $\tau_s = 1.472^{+0.024}_{-0.026}$ *ps*

$\Delta\Gamma = 0.062^{+0.034}_{-0.037}\ ps^{-1}$

World-leading measurements of B^0_s lifetime, decay-width difference and decay polarization amplitudes

CDF Public Note 10206

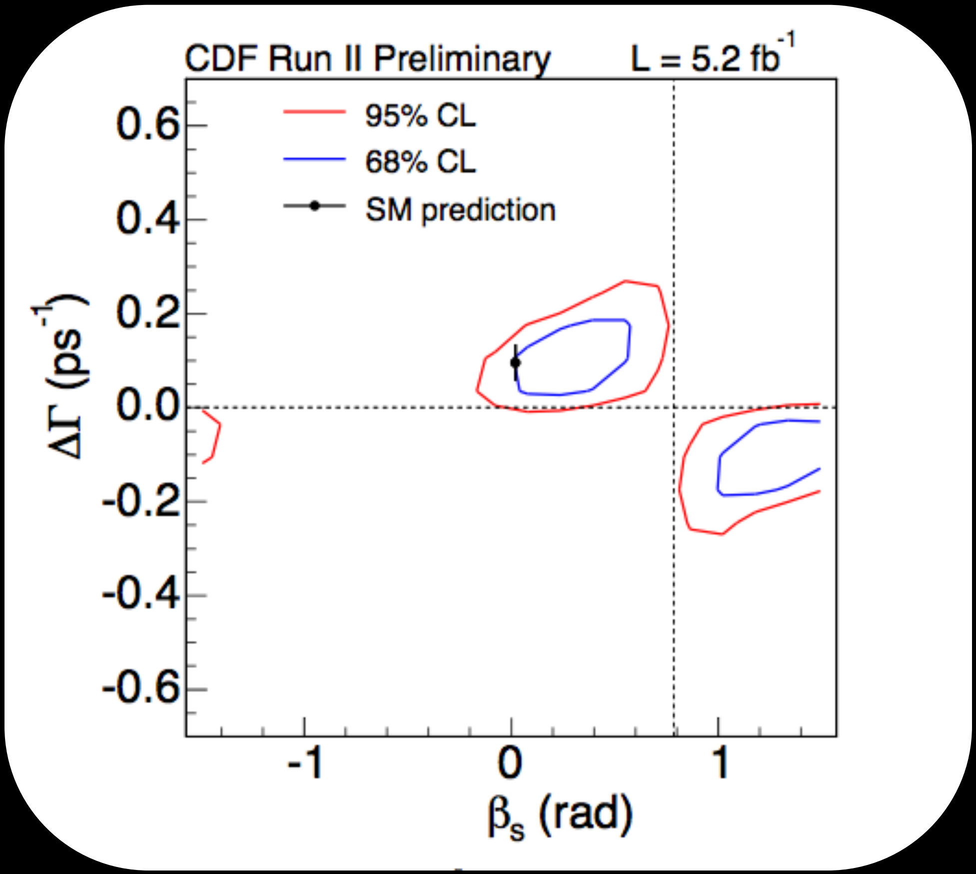
Results -- CPV fit

Allowed region for phase greatly reduced

Two solutions clearly separated.

Unfortunately the contour moved toward SM…

CDF Public Note 10206



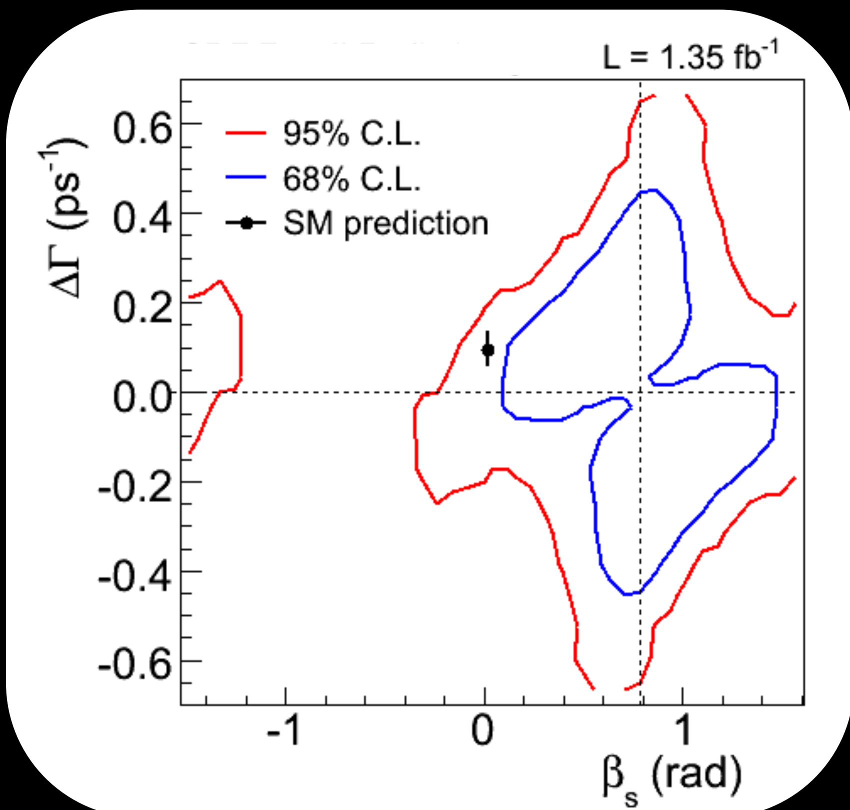
P-value = 44% wrt SM

βs in [0.0, 0.5] U [1.1, 1.5] at 68% CL (one-dimensional)

βs in [-0.1, 0.7] U [0.9, π/2] U [-π/2, -1.5] at 95% CL (one-dimensional)

Comparison

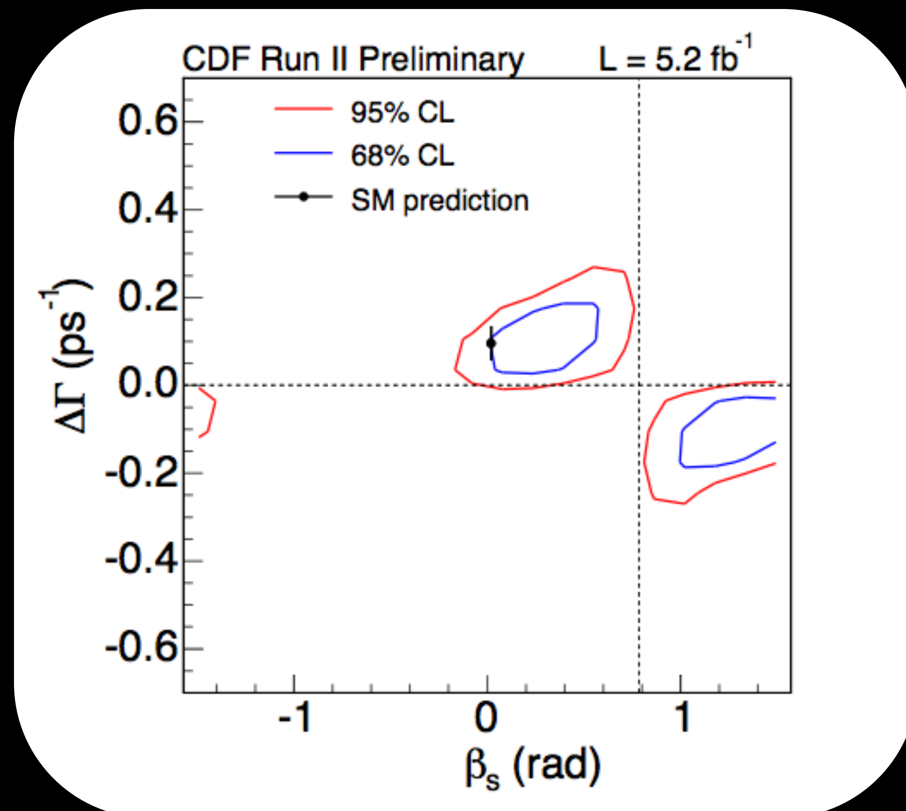
Something old…



P-value = 15% wrt SM

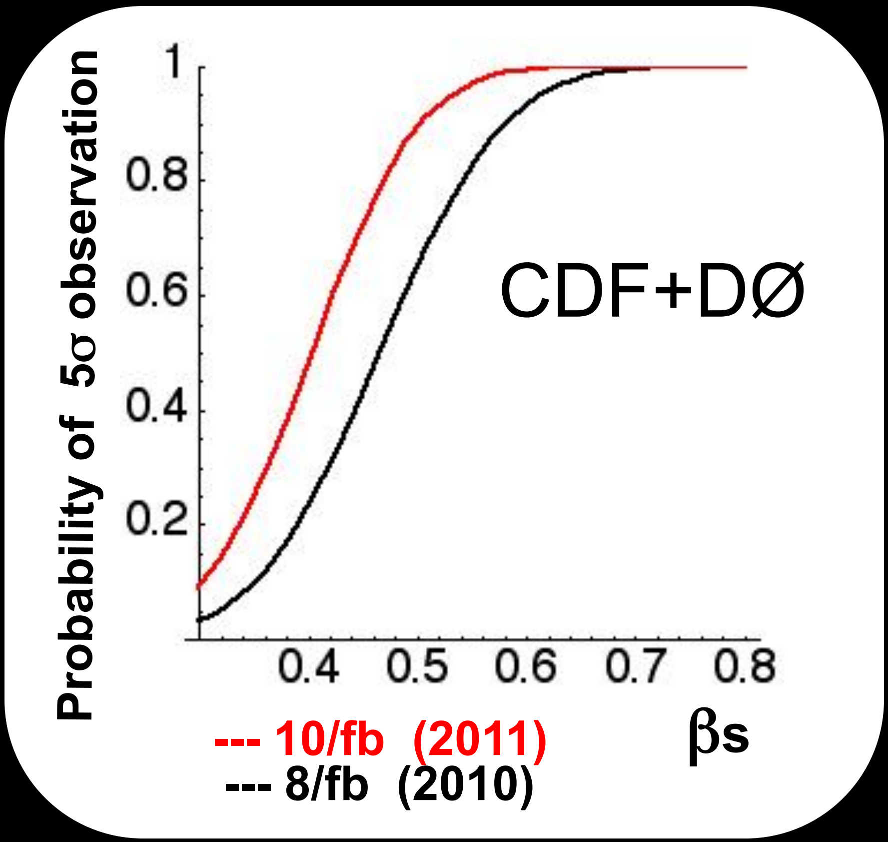
PRL101 161802 (2008) topcite100+

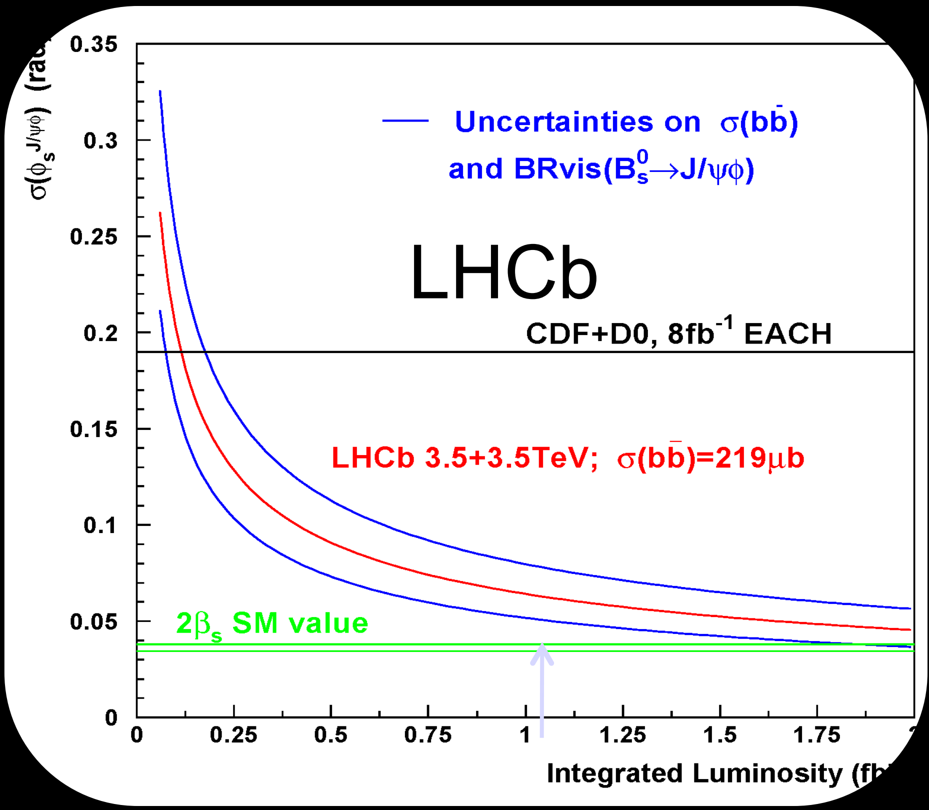
Something new…



P-value = 44% wrt SM

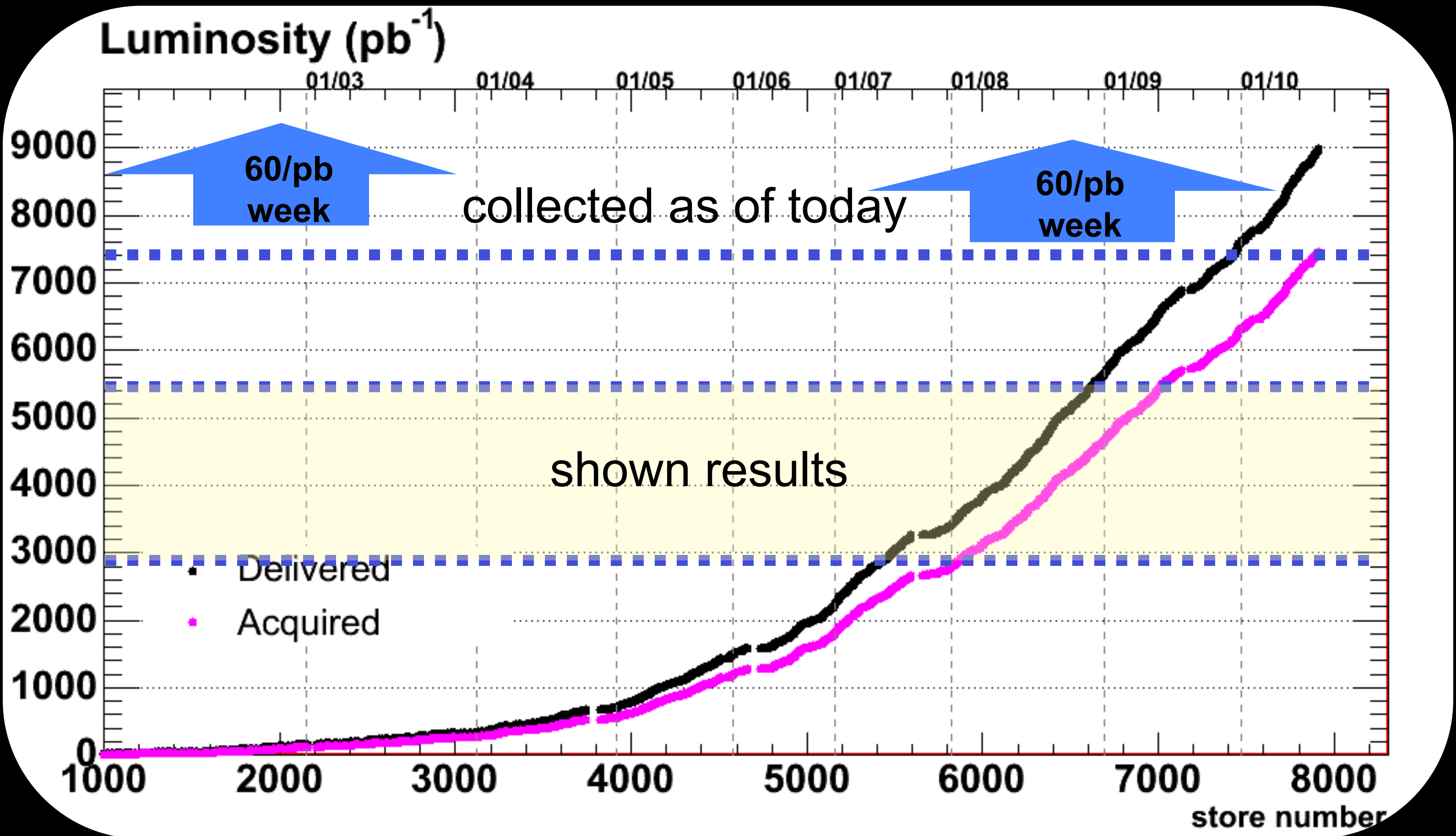
Getting hot





Tevatron 2012: discover or exclude NP in wide range of phases.
LHCb competitive (if everything turns out as expected)

Next



More than 10 fb^{-1} of physics-quality data on tape by end of 2011 (and perhaps keep running beyond)

Concluding remarks

B^0_s: one of our last resorts to avoid the MVF suicide.

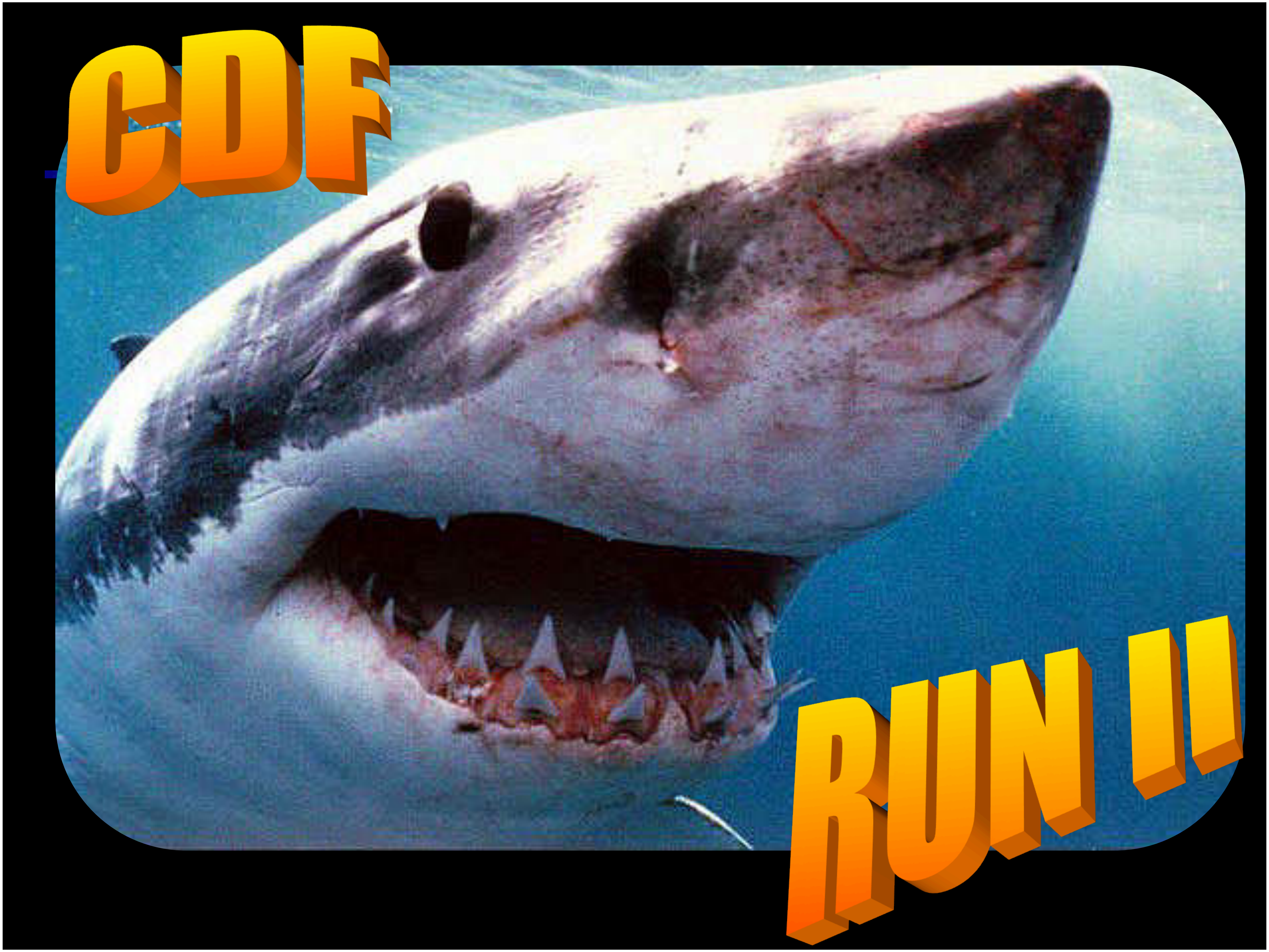
CDF leading experimental force. With D0, unique exploration of this physics. May disclose long-awaited first whimpers of NP at the TeV scale.

First hints promising. Next 2-3 years crucial to determine whether we see BSM or just Poisson fluctuations around SM.

In addition, largest *B* and *D* samples available, challenge B factories (charged final states)

Today just a small selection of recent results. Many others not mentioned. Stay tuned for 4+ brand new results at ICHEP in 2 weeks.

CDF have a key role in HF now, will keep it for a while, hopefully challenged by LHCb soon

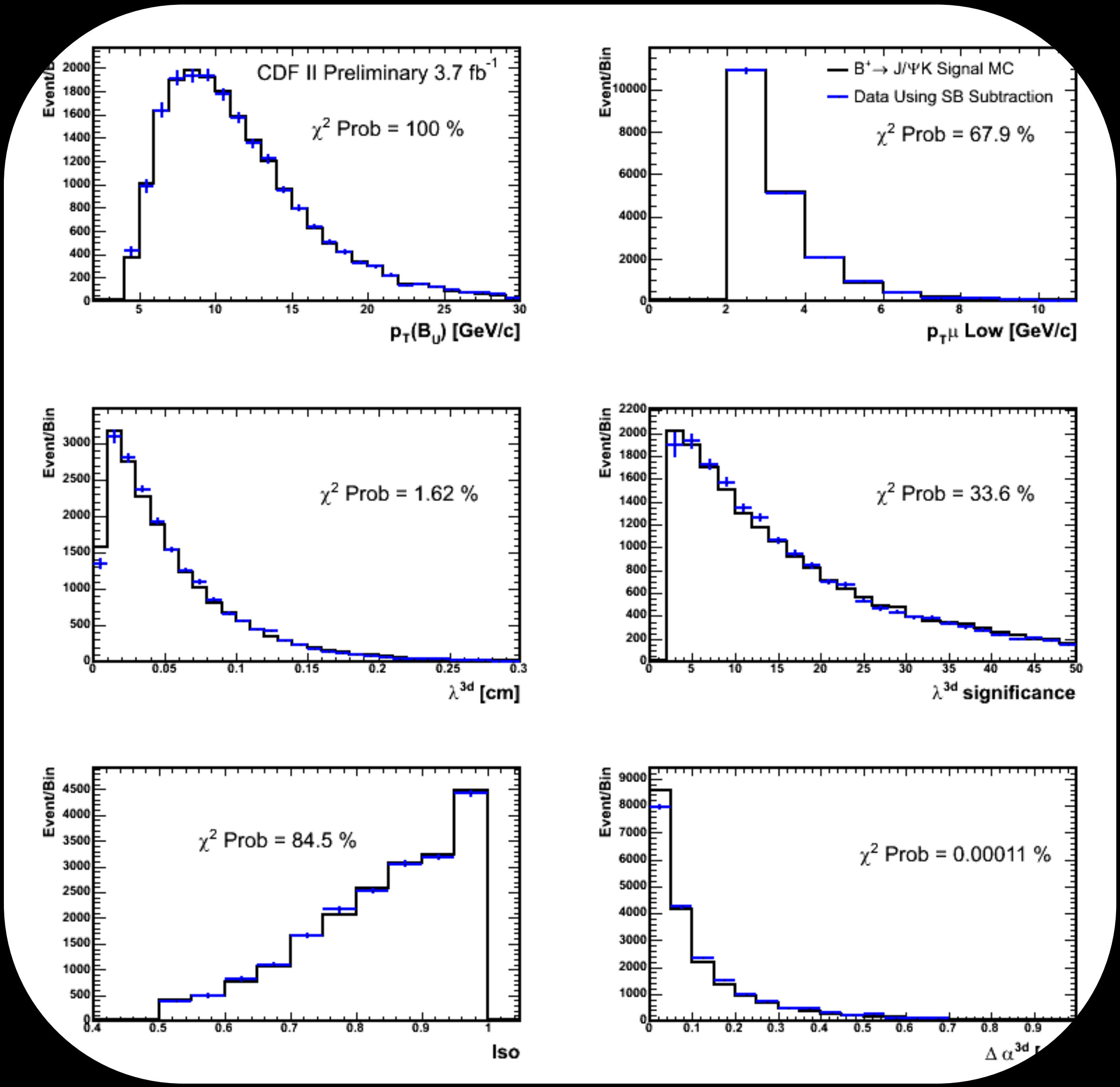

CDF
RUN II

$B \to \mu^+\mu^-$ – *NN validation*

Detailed MC-data validation using control mode.

Need for isolation and momentum reweighing.

< 4% residual discrepancies

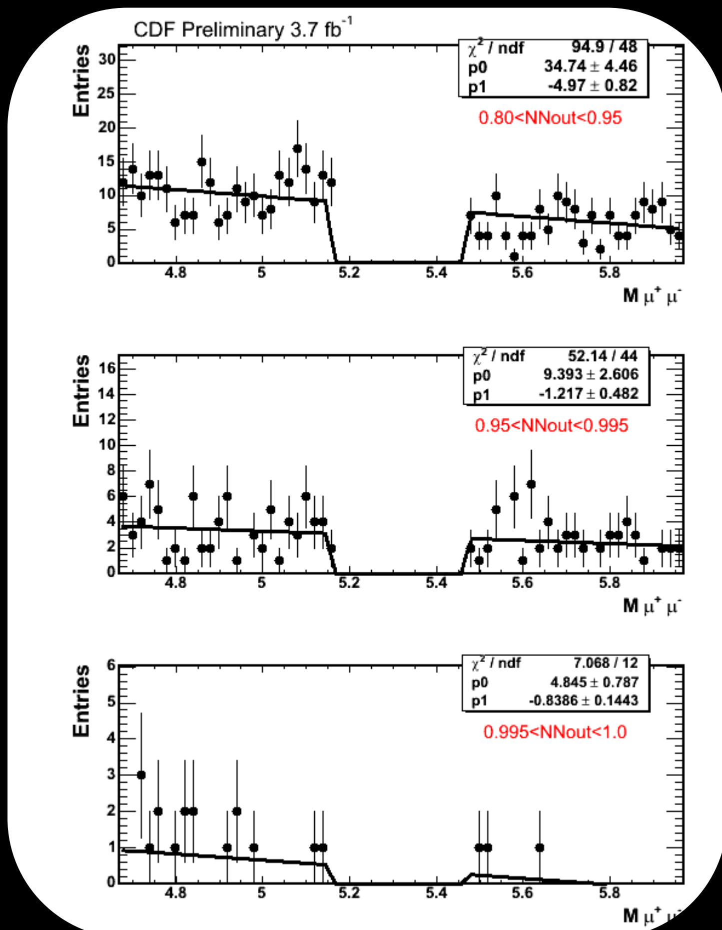


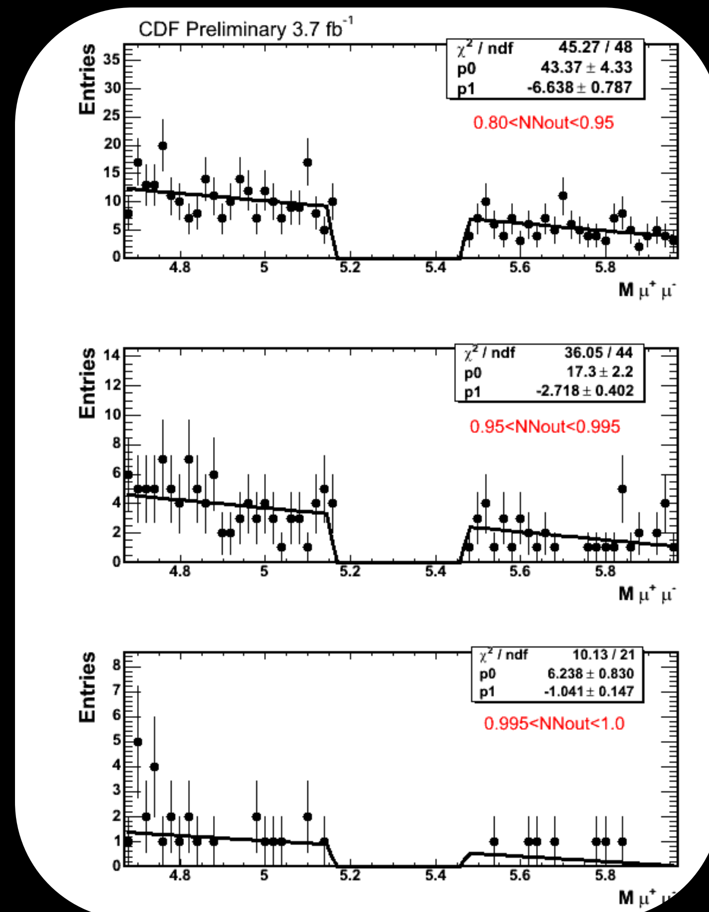
$B \to \mu^+\mu^-$ – *background control*

sample	NN cut	CMU-CMU pred	CMU-CMU obsv	CMU-CMU prob(%)	CMU-CMX pred	CMU-CMX obsv	CMU-CMX prob(%)
OS-	$0.80 < \nu_{NN} < 0.95$	$275 \pm (9)$	287	26	$310 \pm (10)$	304	39
	$0.95 < \nu_{NN} < 0.995$	$122 \pm (6)$	121	46	$124 \pm (6)$	148	3.2
	$0.995 < \nu_{NN} < 1.0$	$44 \pm (4)$	41	36	$31 \pm (3)$	50	0.4
SS+	$0.80 < \nu_{NN} < 0.95$	$2.7 \pm (0.9)$	1	29	$2.7 \pm (0.9)$	0	10
	$0.95 < \nu_{NN} < 0.995$	$1.2 \pm (0.6)$	0	34	$1.2 \pm (0.6)$	1	66
	$0.995 < \nu_{NN} < 1.0$	$0.6 \pm (0.4)$	0	55	$0.0 \pm (0.0)$	0	-
SS-	$0.80 < \nu_{NN} < 0.95$	$8.7 \pm (1.6)$	9	49	$5.7 \pm (1.6)$	2	11
	$0.95 < \nu_{NN} < 0.995$	$3.0 \pm (1.0)$	4	36	$3.6 \pm (1.0)$	2	34
	$0.995 < \nu_{NN} < 1.0$	$0.9 \pm (0.5)$	0	43	$0.3 \pm (0.3)$	0	70
FM+	$0.80 < \nu_{NN} < 0.95$	$169 \pm (7)$	169	50	$73 \pm (5)$	64	19
	$0.95 < \nu_{NN} < 0.995$	$55 \pm (4)$	43	9	$19 \pm (2)$	18	49
	$0.995 < \nu_{NN} < 1.0$	$20 \pm (2)$	20	48	$3.6 \pm (1.0)$	3	53

Predicted vs observed backgrounds in 4 control sample for 3 different NN cuts: 24 independent checks of bckg estimation method.

$B \rightarrow \mu^+\mu^-$ – *background control*





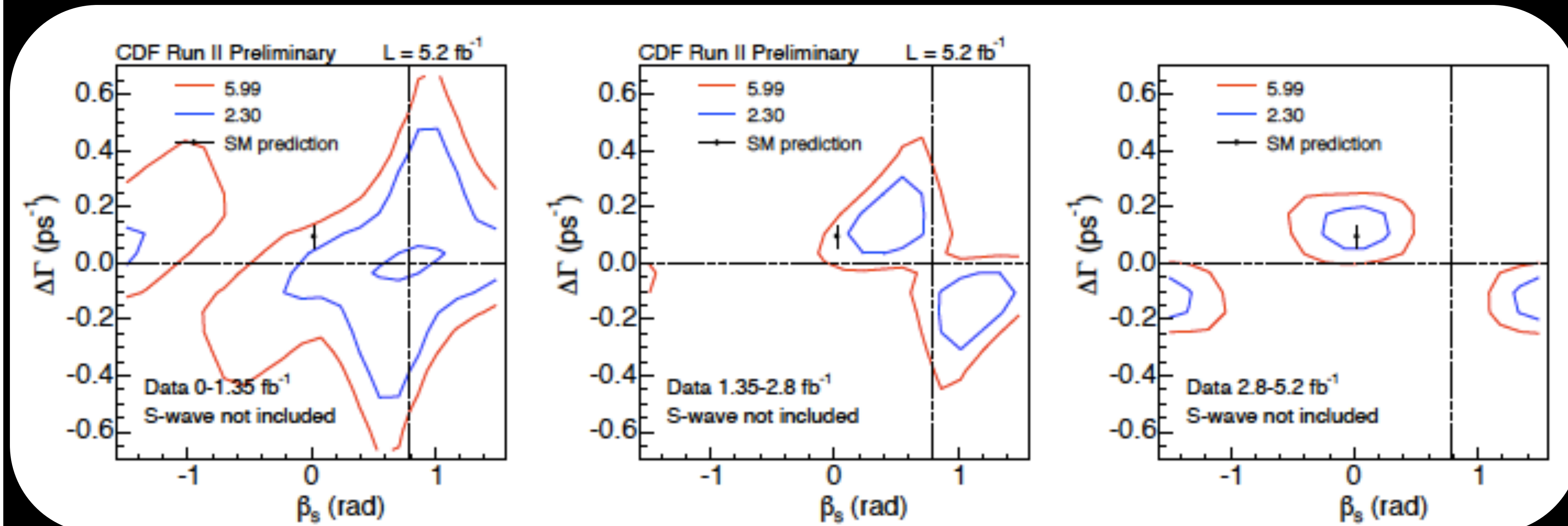
Combinatorics from linear fit to sidebands. Use exp for systematics.

$B \rightarrow \mu^+\mu^-$ – *results*

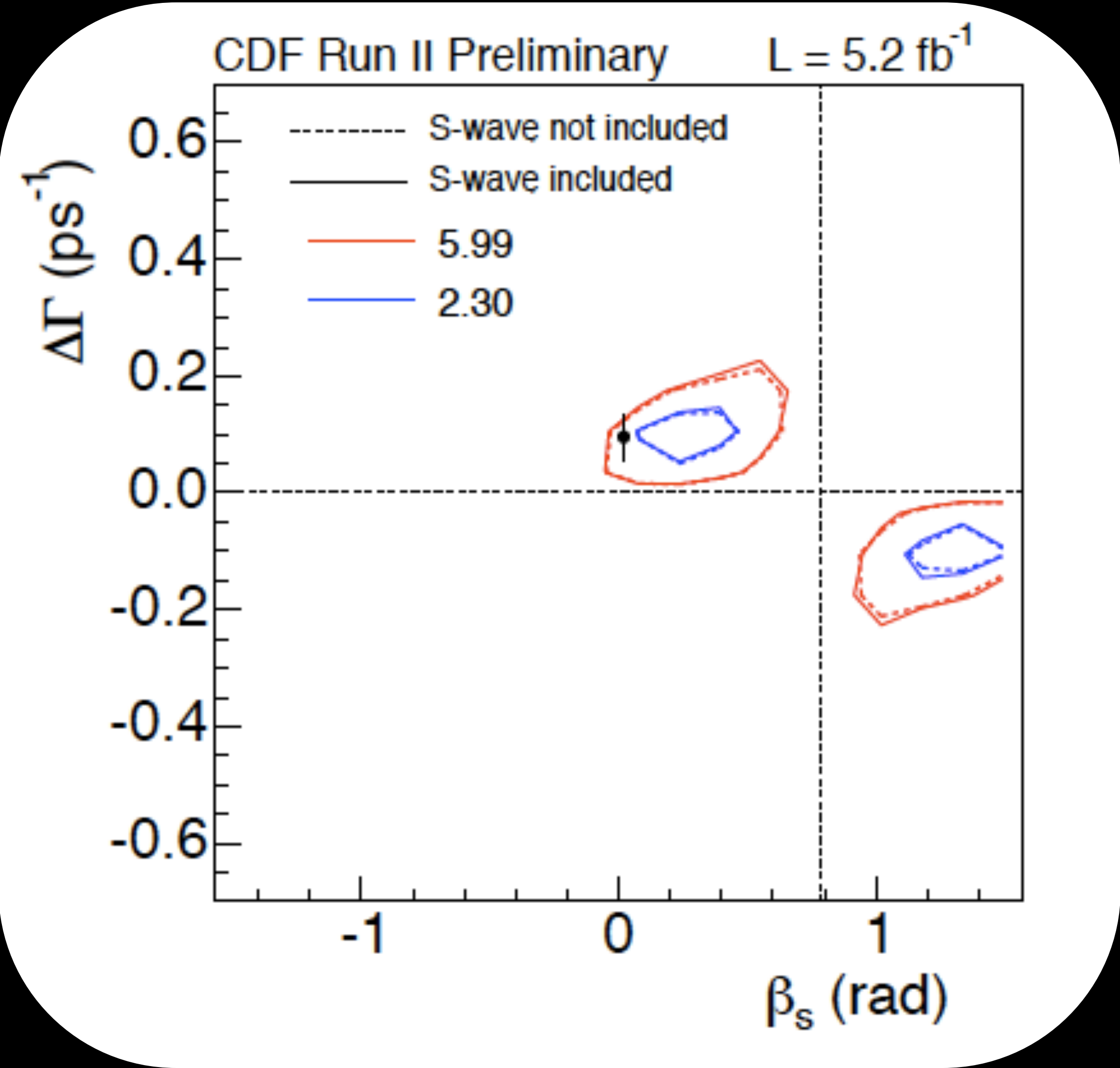
	Mass Bin (GeV)	5.310-5.334	5.334-5.358	5.358-5.382	5.382-5.406	5.406-5.430	Total
UU NN bin 0.80-0.95	Exp Bkg	9.66 ± 0.47	9.46 ± 0.46	9.27 ± 0.46	9.08 ± 0.46	8.88 ± 0.45	46.3 ± 2.4
	Obs	7	5	10	5	5	32
UU NN bin 0.95-0.995	Exp Bkg	3.42 ± 0.27	3.33 ± 0.27	3.25 ± 0.27	3.17 ± 0.26	3.09 ± 0.26	16.2 ± 1.4
	Obs	2	3	4	3	5	17
UU NN bin 0.995-1.0	Exp Bkg	0.869 ± 0.17	0.821 ± 0.18	0.783 ± 0.19	0.75 ± 0.19	0.717 ± 0.21	4.0 ± 1.0
	Obs	0	1	2	0	0	3
UX NN bin 0.80-0.95	Exp Bkg	9.94 ± 0.48	9.8 ± 0.48	9.66 ± 0.48	9.51 ± 0.47	9.37 ± 0.47	48.3 ± 2.4
	Obs	12	8	9	9	5	43
UX NN bin 0.95-0.995	Exp Bkg	3.5 ± 0.29	3.47 ± 0.29	3.43 ± 0.29	3.39 ± 0.29	3.36 ± 0.29	17.2 ± 1.4
	Obs	3	4	3	7	0	17
UX NN bin 0.995-1.0	Exp Bkg	0.467 ± 0.14	0.438 ± 0.15	0.412 ± 0.15	0.387 ± 0.16	0.362 ± 0.16	2.08 ± 0.78
	Obs	1	1	0	1	1	4

Table 10: B_s signal window for CMU-CMU(top) and CMU-CMX(bottom): Expected backgrounds, including $B \rightarrow hh$, and number of observed events

Checks

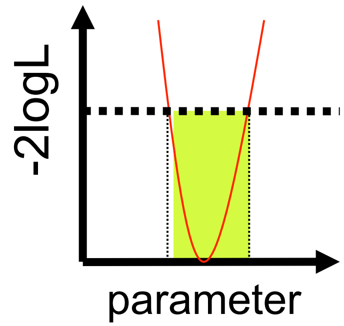

CDF Run II Preliminary
L = 5.2 fb^{-1}
5.99
2.30
SM prediction
Data 0-1.35 fb^{-1}
S-wave not included
Data 1.35-2.8 fb^{-1}
S-wave not included
Data 2.8-5.2 fb^{-1}
S-wave not included
$\Delta\Gamma$ (ps^{-1})
β_s (rad)

Checks


CDF Run II Preliminary
L = 5.2 fb-1
S-wave not included
S-wave included
5.99
2.30
ΔΓ (ps-1)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-1
0
1
βs (rad)

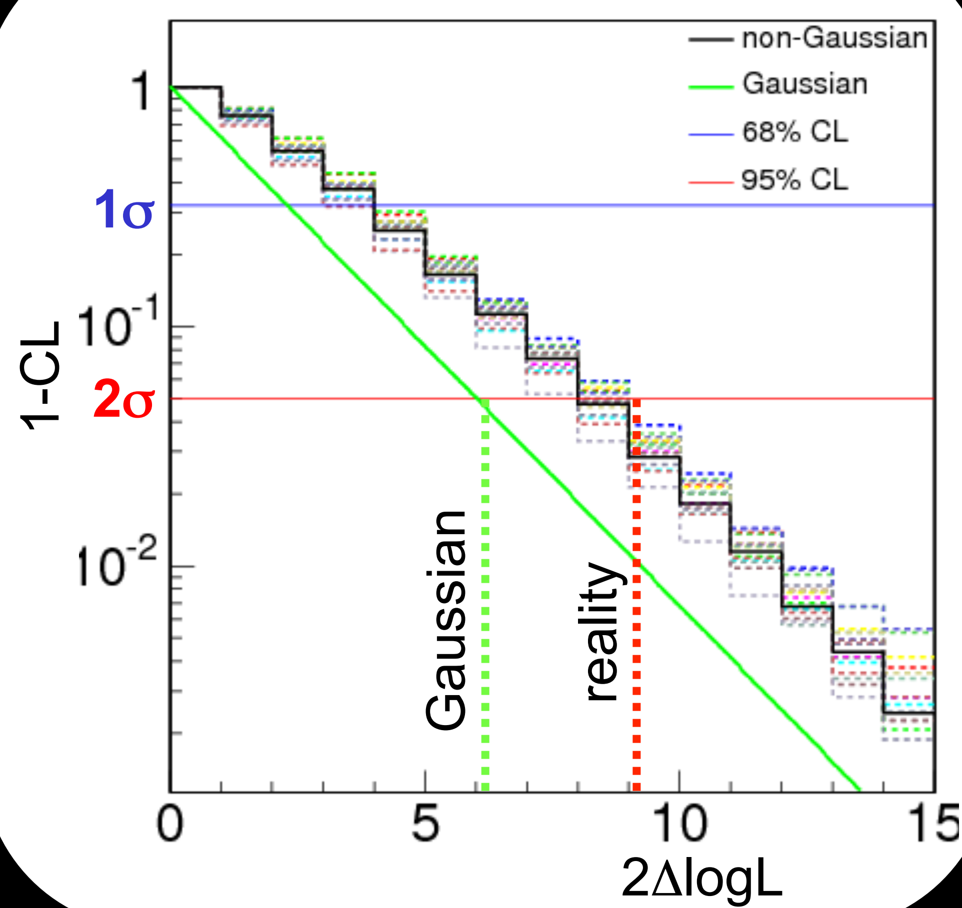
Mixing phase - *Enforcing coverage*

Standard likelihood ratio method fails



Remap observed 2ΔlogL distribution in terms of actual CL from toys.
E.g. to get the 95.5% CL, 2ΔlogL~9 units (as opposed to 5.99 asymptotic)

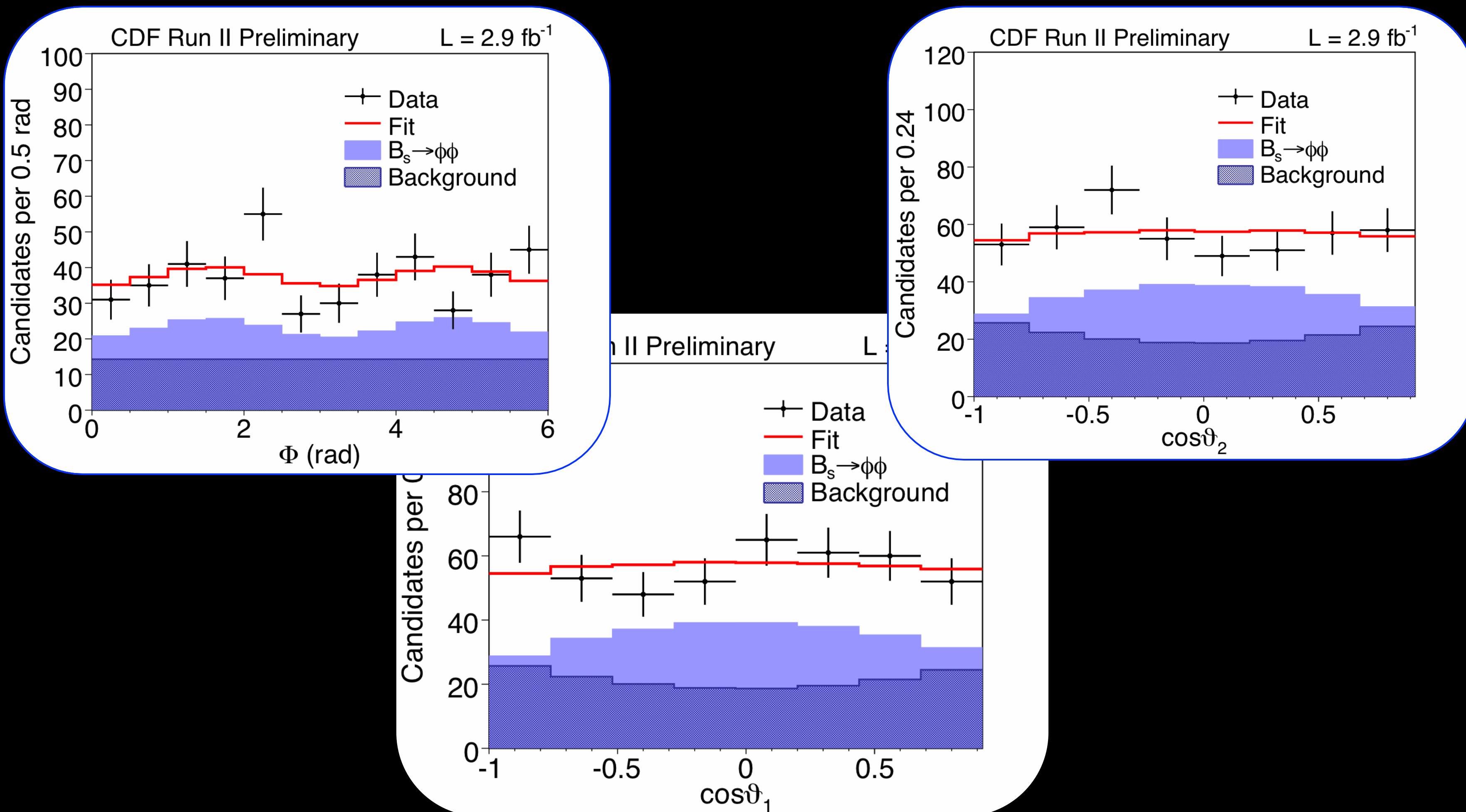
Include systematics: vary nuisance parameters within 5σ of their estimates on data.
Use worst case.



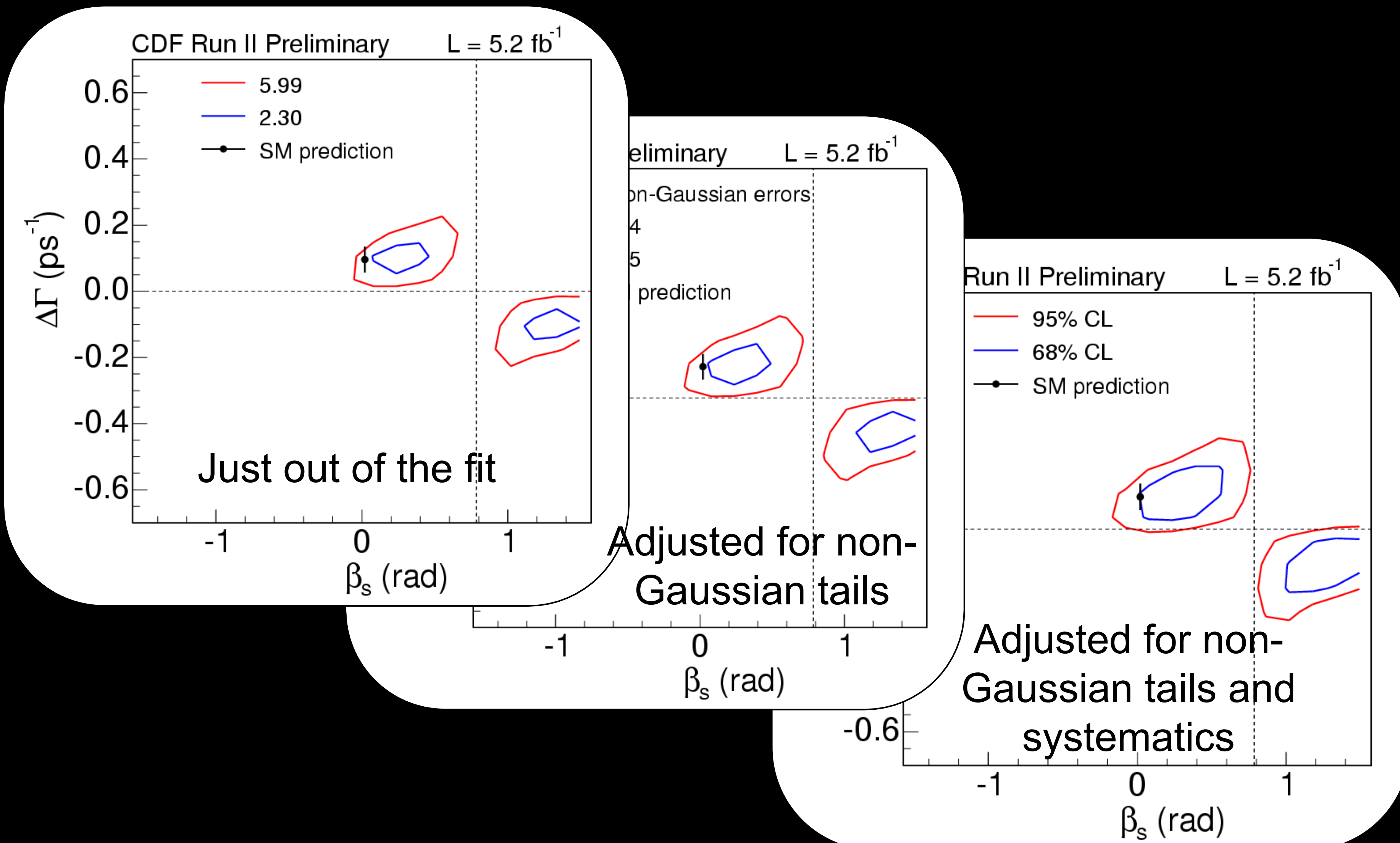
arXiv:0810.3229

$B^0_s \rightarrow \phi\phi$ – angular analysis

Fit mass and helicity angles of final state kaons.



How large correction?



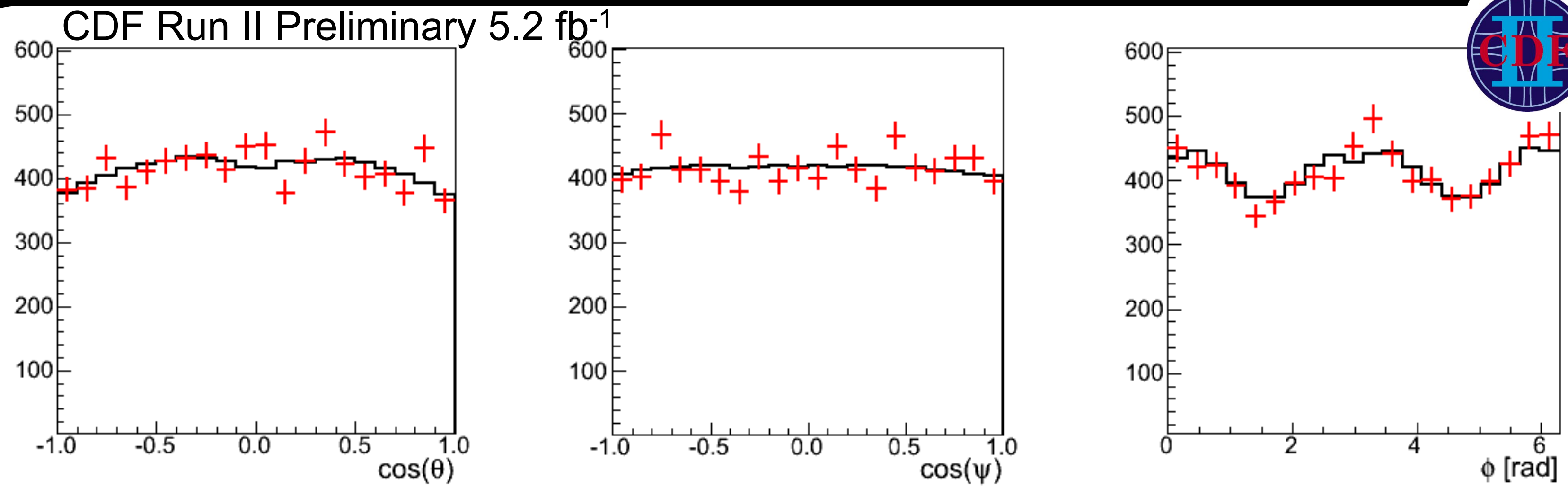
Systematics

Systematic	$\Delta\Gamma$	$c\tau_s$	$\lvert A_{\parallel}(0)\rvert^2$	$\lvert A_0(0)\rvert^2$	$\phi_{\perp}$
Signal efficiency:					
Parameterisation	0.0024	0.96	0.0076	0.008	0.016
MC reweighting	0.0008	0.94	0.0129	0.0129	0.022
Signal mass model	0.0013	0.26	0.0009	0.0011	0.009
Background mass model	0.0009	1.4	0.0004	0.0005	0.004
Resolution model	0.0004	0.69	0.0002	0.0003	0.022
Background lifetime model	0.0036	2.0	0.0007	0.0011	0.058
Background angular distribution:					
Parameterisation	0.0002	0.02	0.0001	0.0001	0.001
$\sigma(c\tau)$ correlation	0.0002	0.14	0.0007	0.0007	0.006
Non-factorisation	0.0001	0.06	0.0004	0.0004	0.003
$B^0 \to J\psi K^*$ crossfeed	0.0014	0.24	0.0007	0.0010	0.006
SVX alignment	0.0006	2.0	0.0001	0.0002	0.002
Mass error	0.0001	0.58	0.0004	0.0004	0.002
$c\tau$ error	0.0012	0.17	0.0005	0.0007	0.013
Pull bias	0.0028		0.0013	0.0021	
Totals	0.01	3.6	0.015	0.015	0.07

Detector sculpting

Angular sculpting from simulation.

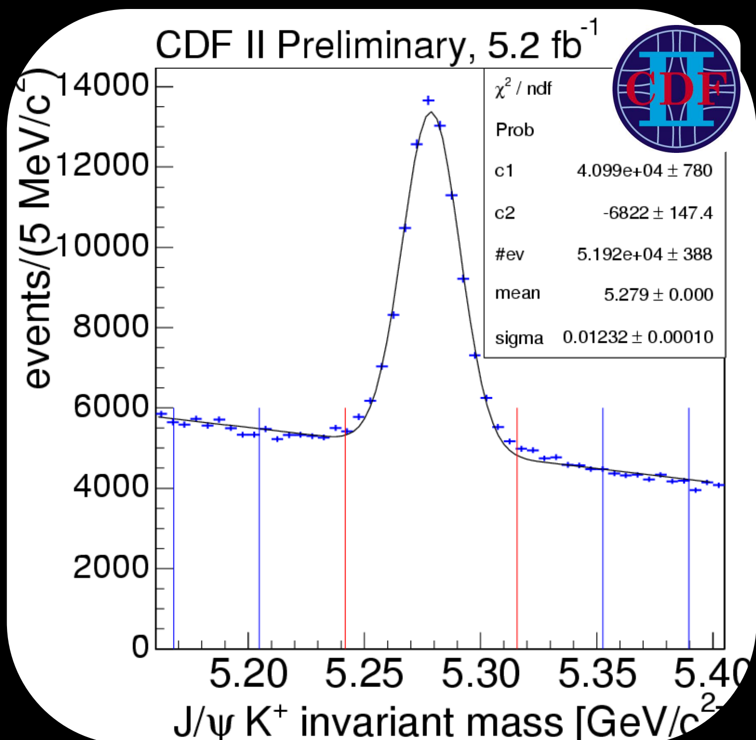
Validated comparing with combinatorial background and measuring polarization of $B^0 \rightarrow J/\psi K^*$ decays consistent with B-factories

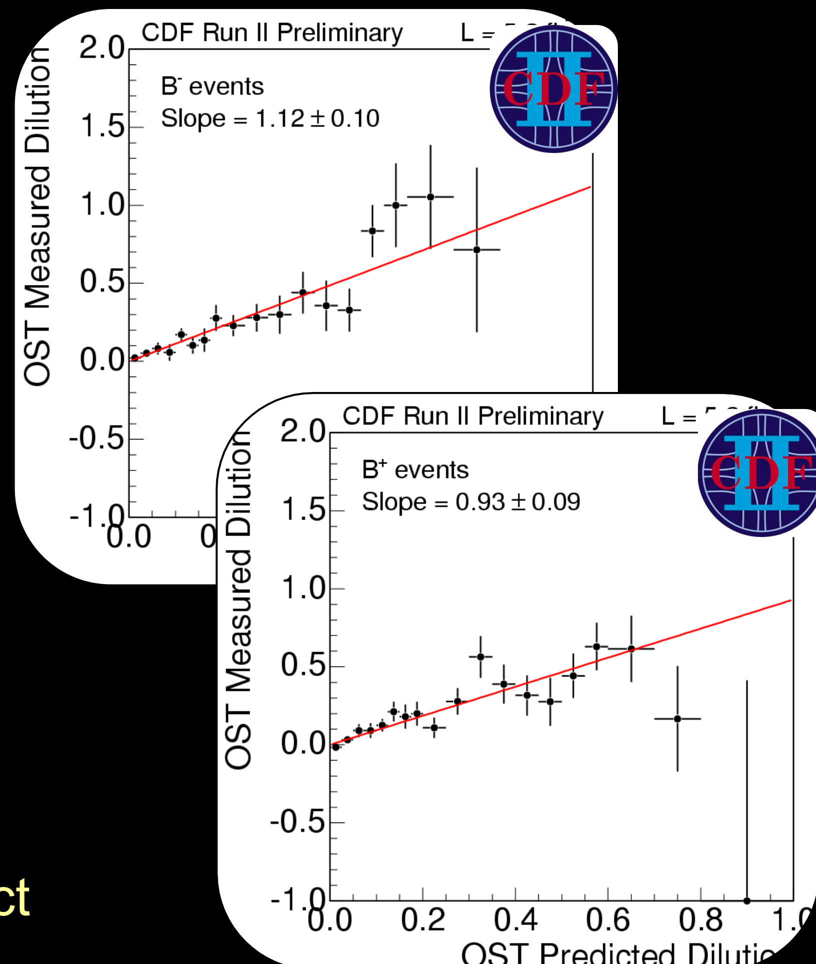


Distribution of combinatorial background (sidebands data)

Angular sculpting from simulation

Calibrating opposite-side tagger

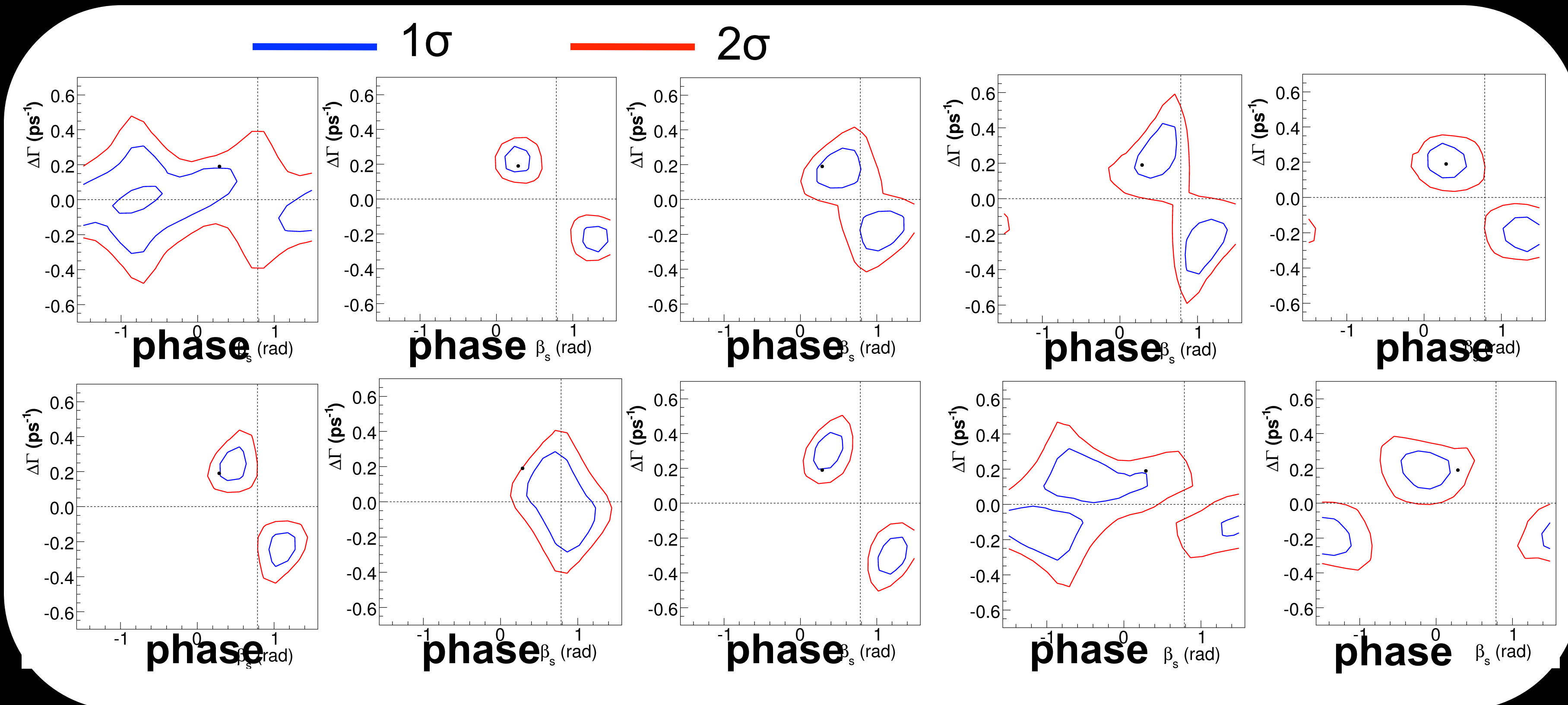




Efficiency = 94%. Dilution = 11% (correct tag probability ~56%)

Total tagging power = 1.2%

Nasty likelihood



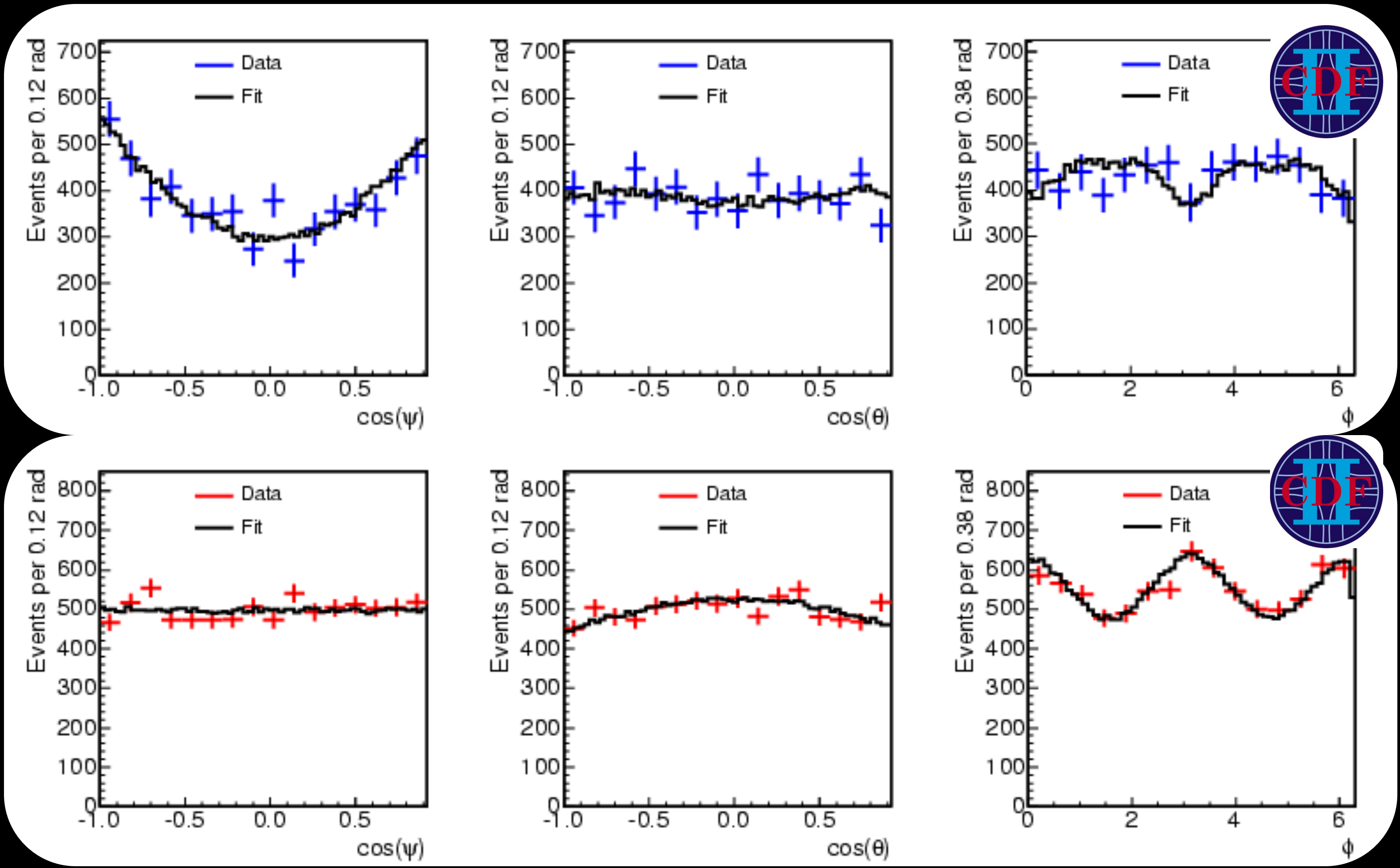
Each plot is the result of the measurement from single pseudo-experiment.

All experiments generated with same true values. Results vary wildly.

For starters – SM fit

Signal

Bckg



Determination of B^0_s polarization amplitudes by imposing βs=0

The CDF approach

Data-driven. 1.6 fb^{-1}

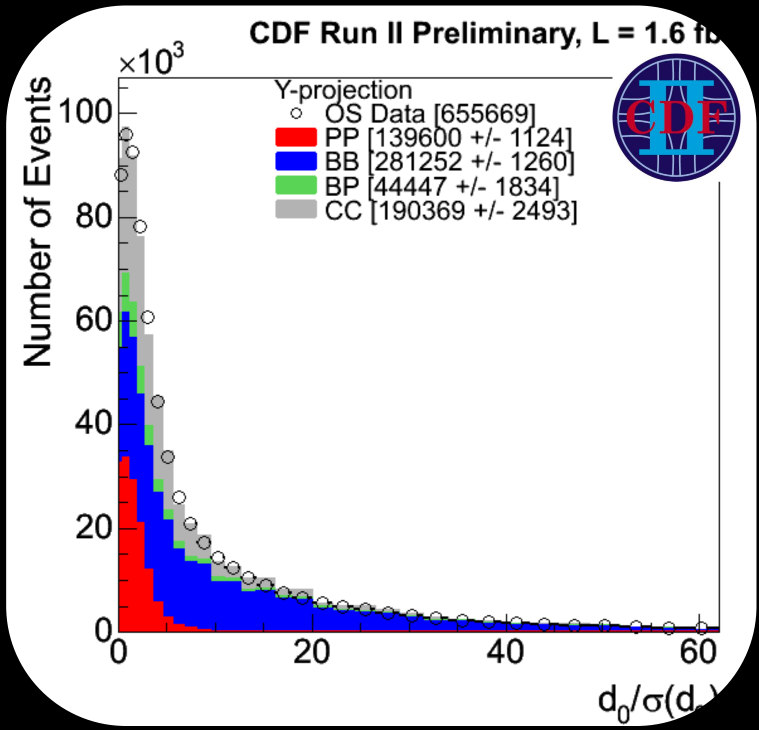
Use superior impact parameter resolution (45 μm) to unfold dimuons from *b*, *c*, and prompt sources

Nailing down sample composition ensures your dimuons come from B.

But impact parameter requires silicon tracking, which reduces statistics

If repeated on current sample a factor of ~2 worse resolution than DØ.

Would be non-informative



$A_{SL} = (0.8 \pm 0.9 \pm 0.7)$ %