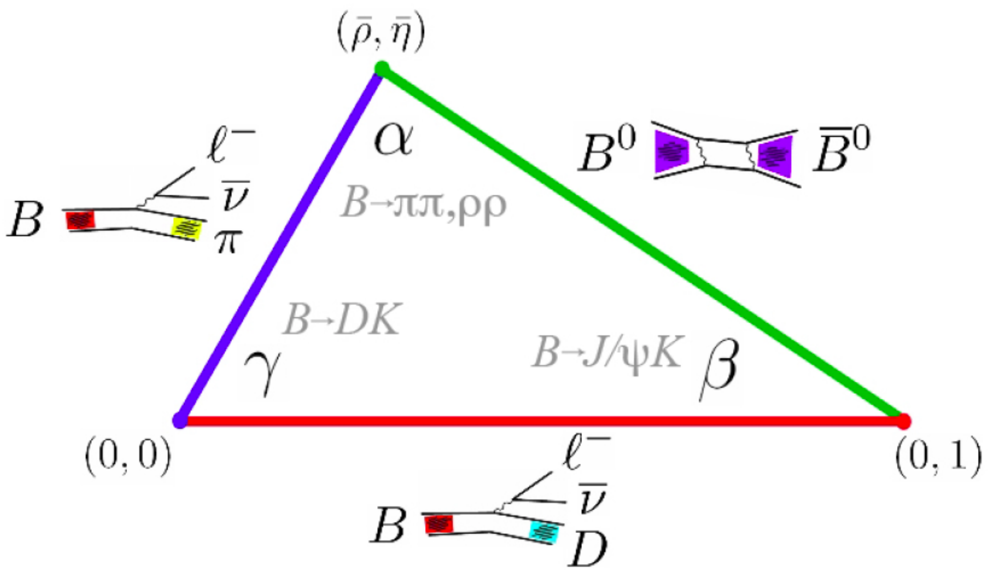
Belle II perspectives on Unitarity Triangle sides and angles



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on behalf of the Belle II collaboration

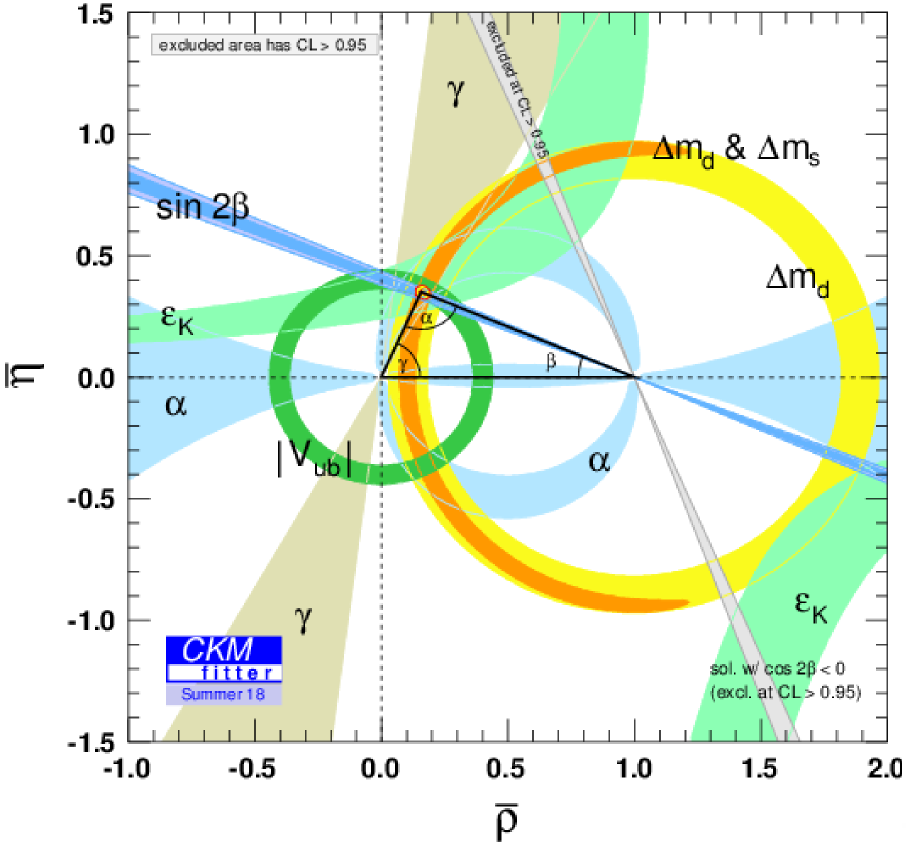
INFN Sezione di Roma Tre

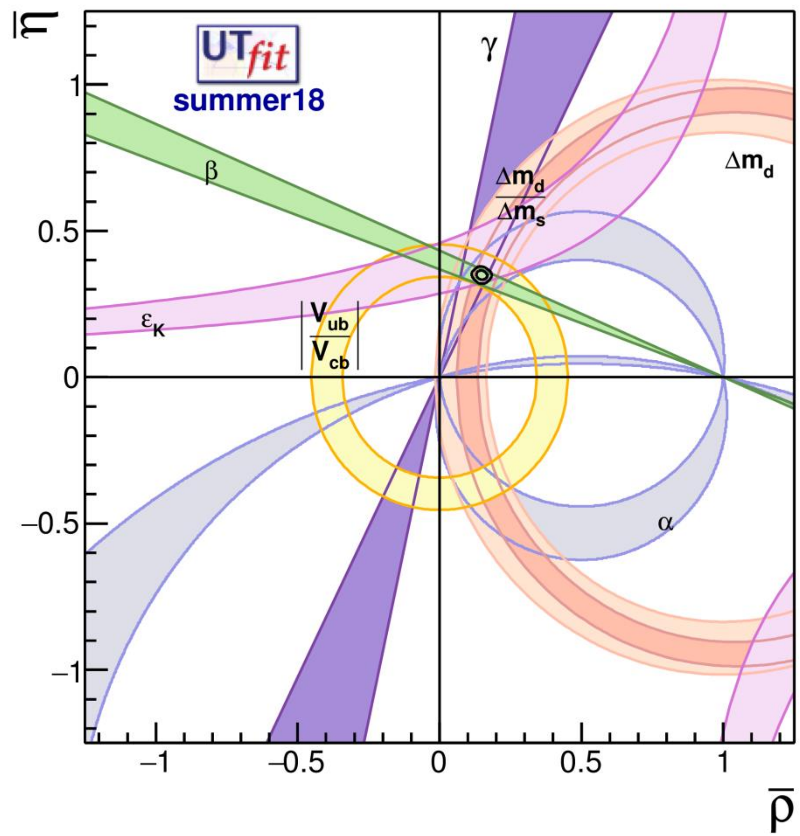
JENNIFER
EU grant 644294

XIII Meeting on B Physics – Marseille october 1st 2018

UT status

Still large uncertainties: room for NP !





Complementarity from different experiments and approaches is essential to constrain the field.

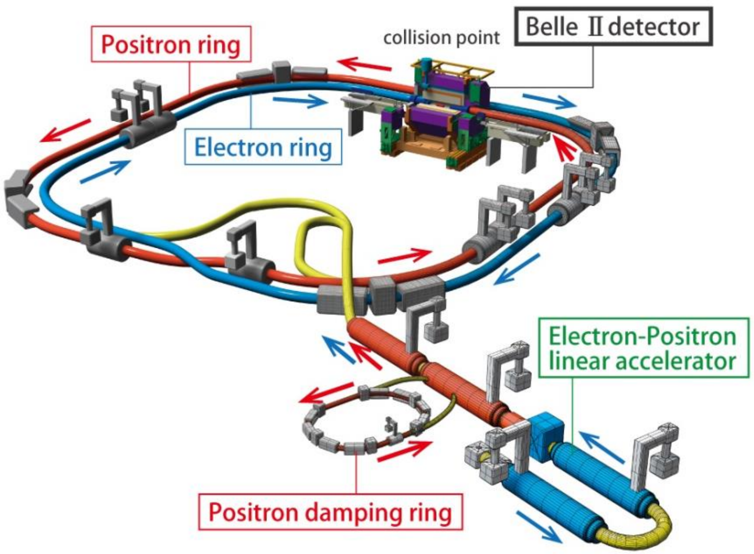
For all Belle II expected performances, please refer to:
The Belle II Physics Book - arXiv:1808.10567

SuperKEKB project

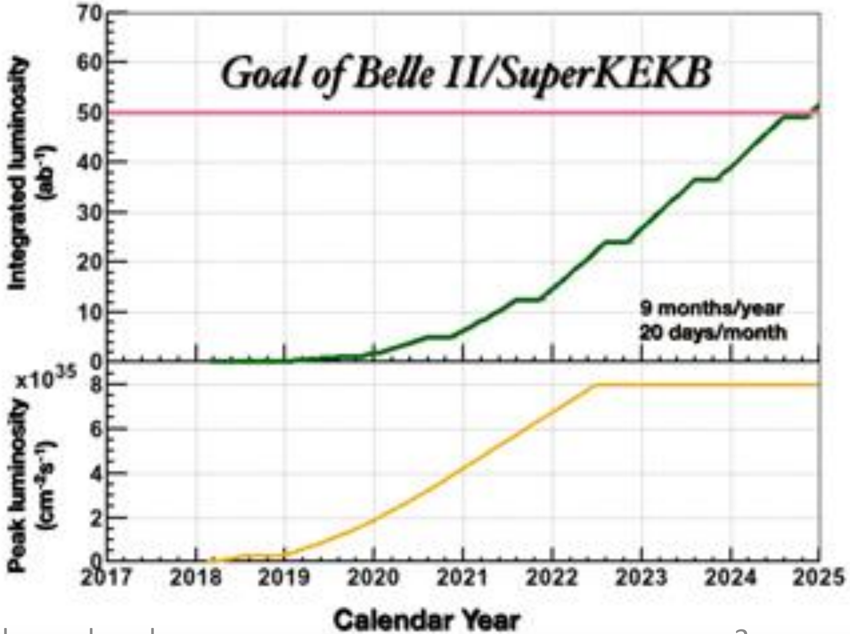
	LER (e^+)	HER (e^-)	
Energy	4.000	7.007	GeV
Half crossing angle	41.5		mrad
Horizontal emittance	3.2	4.6	nm
Emittance ratio	0.27	0.25	%
Beta functions at IP (x/y)	32 / 0.27	25 / 0.30	mm
Beam currents	3.6	2.6	A
Beam-beam parameter	0.0881	0.0807	
Luminosity	8×10^{35}		$cm^{-2}s^{-1}$

KEKB machine heavily upgraded:

- New positron damping ring
- New 3 km positron ring vacuum chamber
- New superconducting final focus

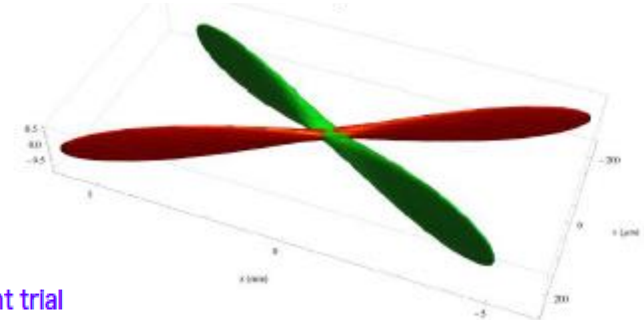


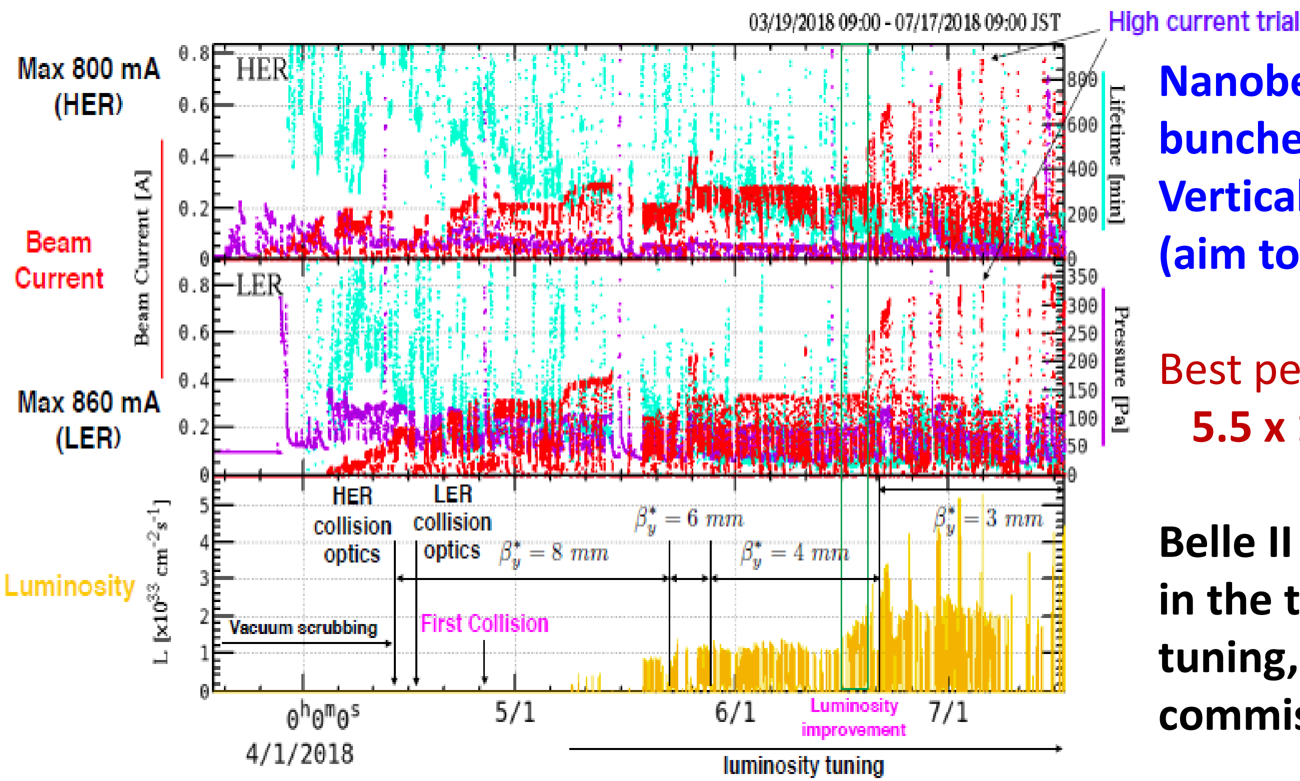
Aim to deliver 50 ab^{-1} in 6 years !



SuperKEKB phase 2 run

- Single beam commissioning, without final focus, performed in 2016 (phase 1)
- Collision commissioning , with final focus, nanobeam scheme, and Belle II detector in place (without vertex detector), happened this year from april to july.
  What we call «Phase 2».





Nanobeam scheme produces short bunches, effective length 0.5 mm Vertical size still to be optimized (aim to 50 nm).

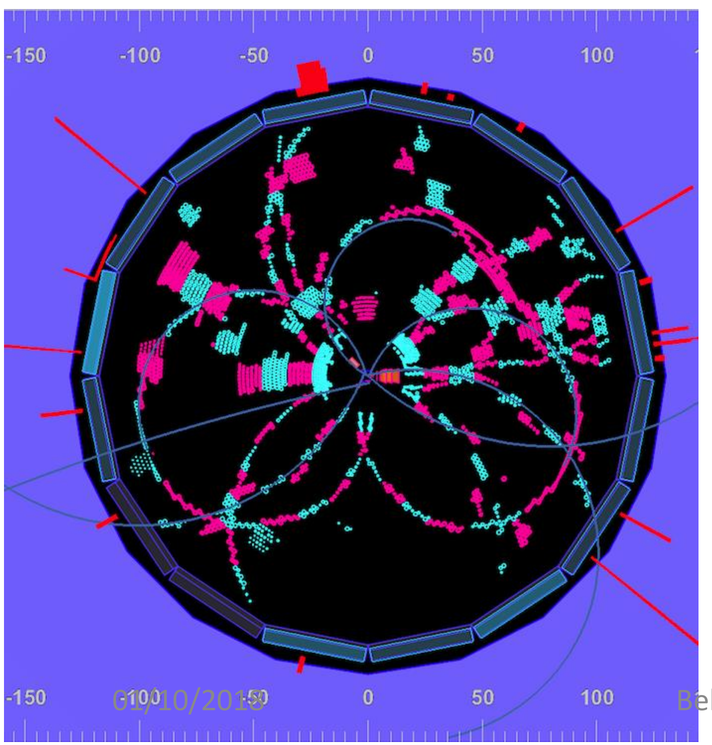
Best peak luminosity reached is
$5.5 \times 10^{33}\ cm^{-2}\ s^{-1}$

Belle II managed to collect $0.5\ fb^{-1}$ in the time left from machine tuning, very useful sample for commissioning and first physics.

… x40 luminosity means also much higher background…!

…but Belle II is equipped with upgraded detectors capable to rescue rare signals and reject garbage !

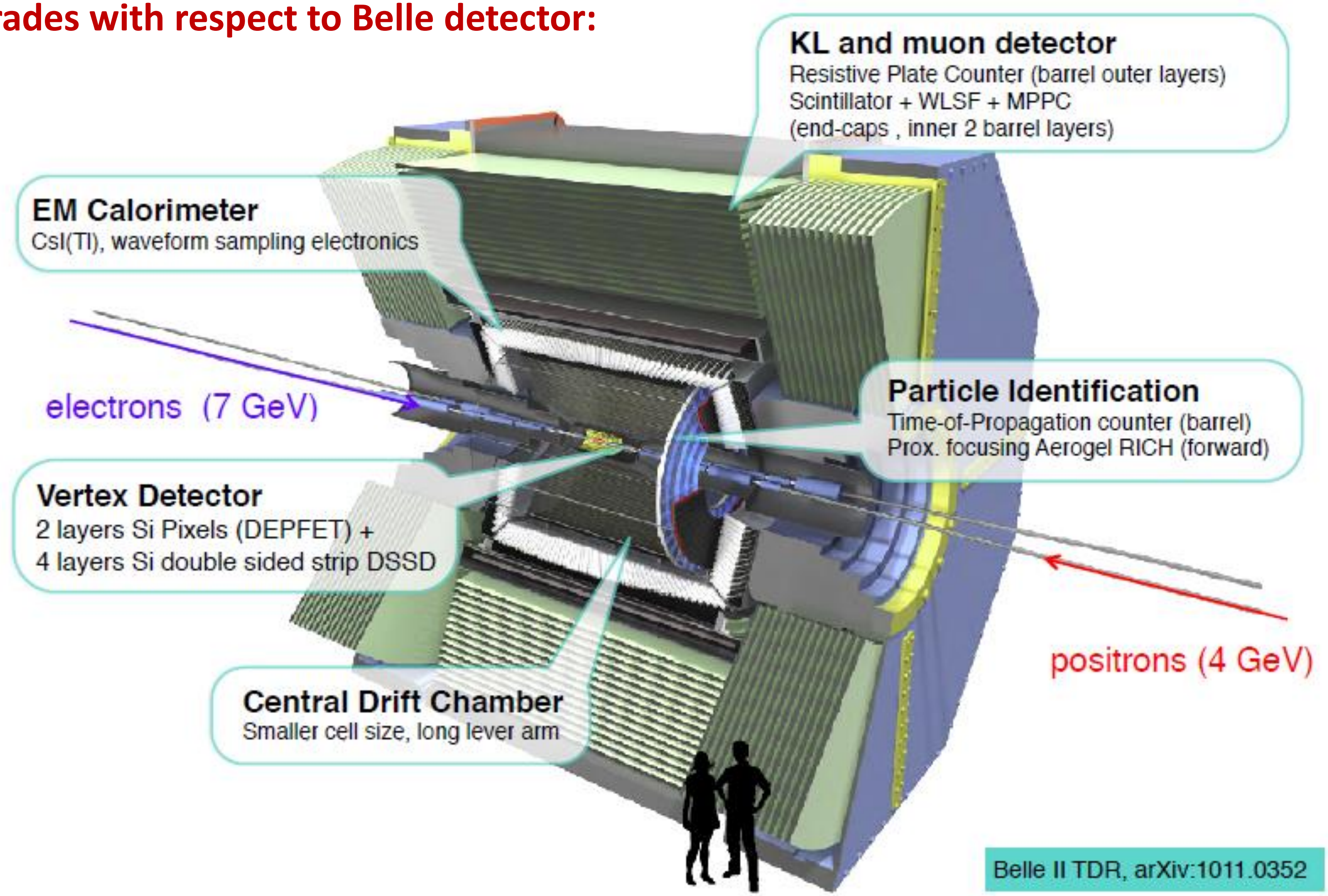
Belle II real event in Phase2 run



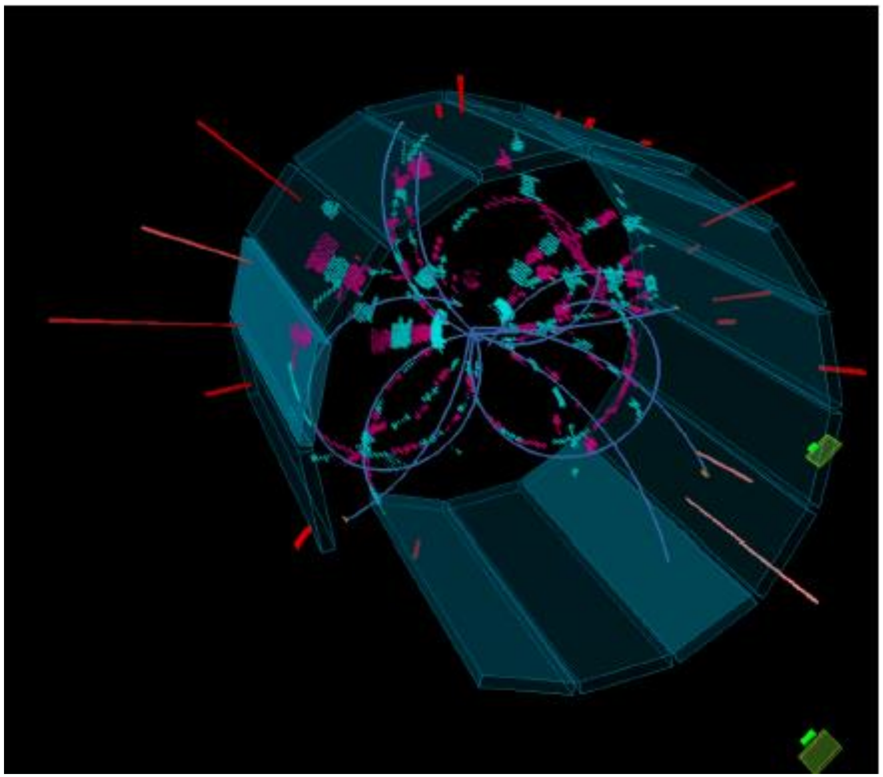
- A new and larger drift chamber: longer lever arm, smaller cells in the inner region, fast readout.
- An imaging Time of Propagation detector to perform PID in the barrel region
- A PID detector in the forward region (ARICH)
- An improved z resolution in the interaction region, thanks to Pixel (2 layers) + strip (4 layers) vertex detector.
- Fast ECL readout to reduce pile-up
- KLM 2 inner layers replace with scintillators

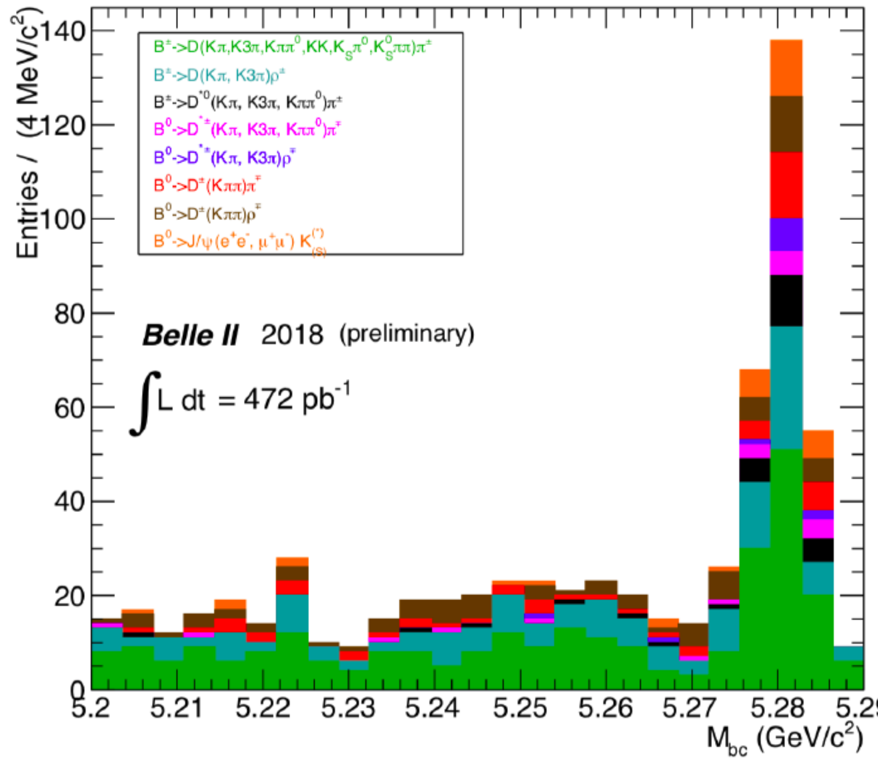
The Belle II detector

Upgrades with respect to Belle detector:

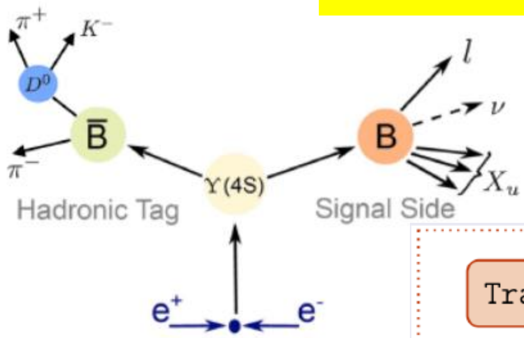


Belle II detector shows already good performance in phase 2 data: all anticipated particles have been re-discovered. B mesons mass peak is well reconstructed.

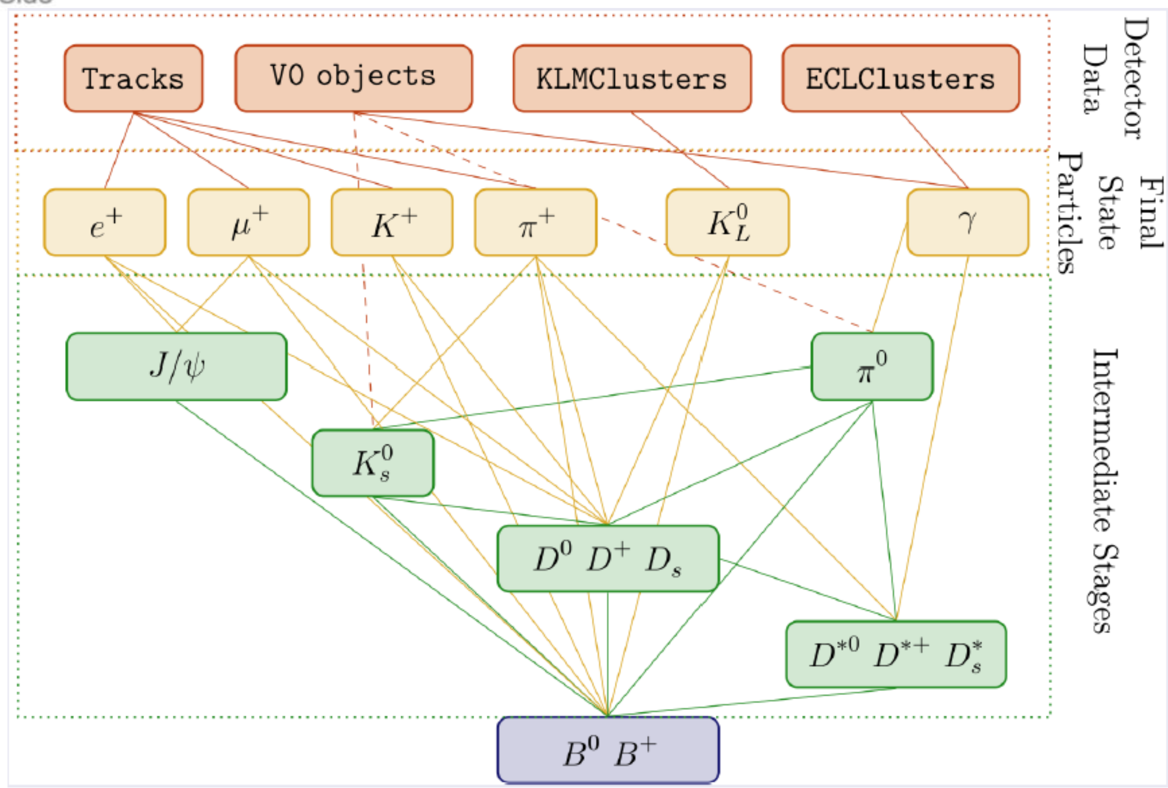




FEI: Full event interpretation, enhances by a factor of 2 the event tagging efficiency

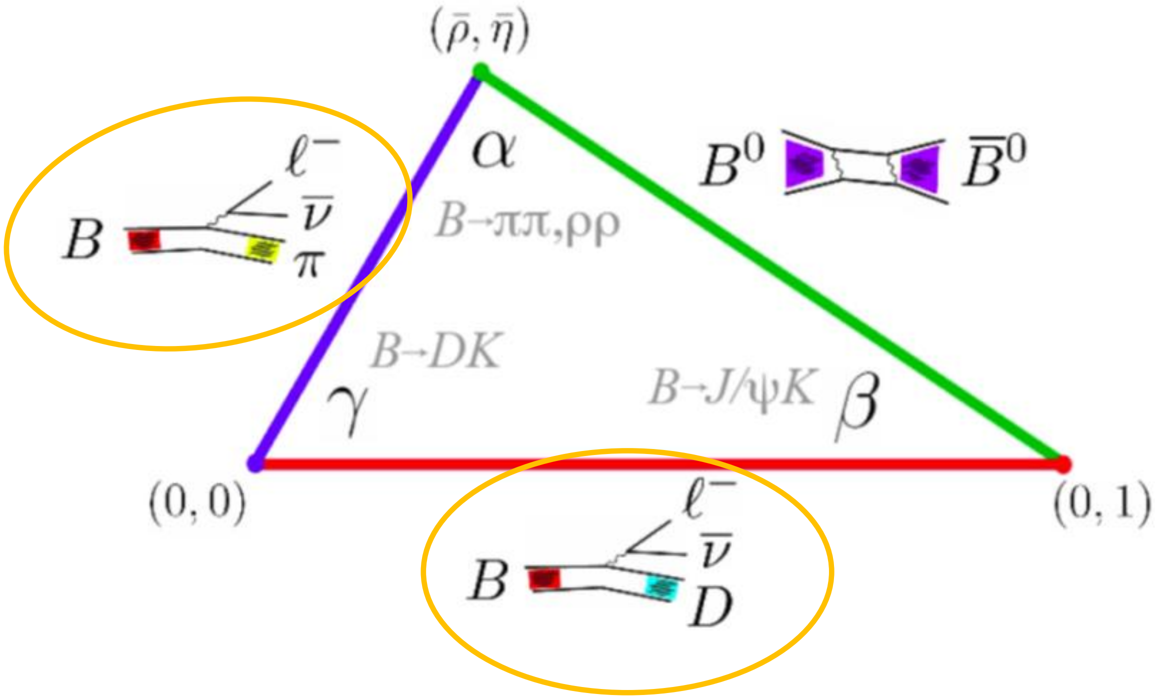


A dedicated boosted decision tree for each step
More than 100 decay channels are reconstructed



Very powerful tool for all tagged analyses: high purity but usually low statistics
Untagged analyses by converse have high statistics, high background, and less kinematical constraints (Rest of the Event)

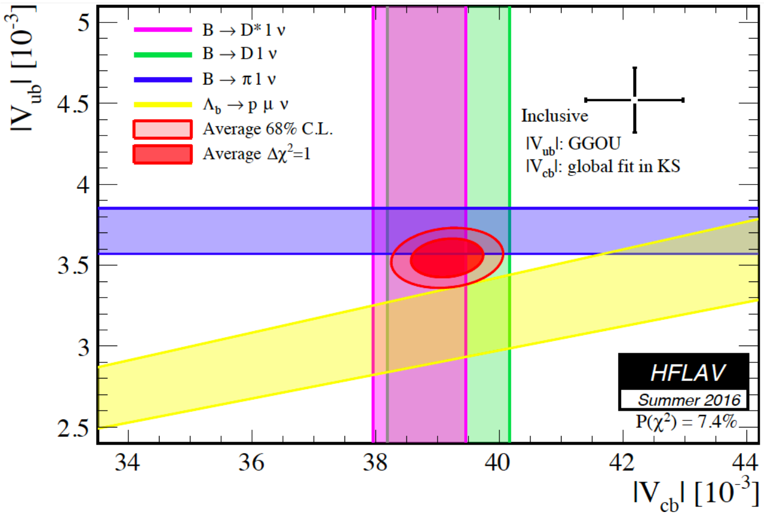
UT sides



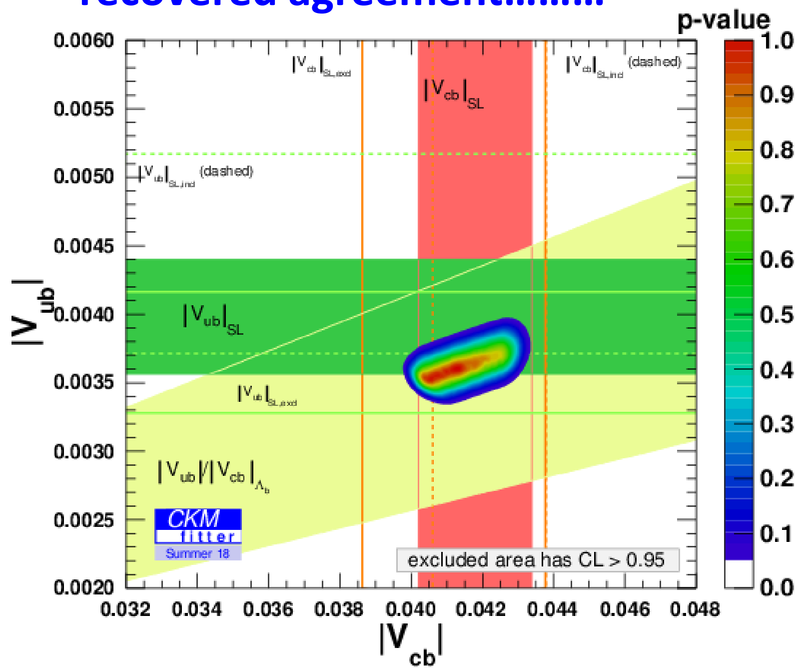
i.e. measure V_{ub} and V_{cb}

Vub/Vcb

Inclusive vs exclusive measurements showed since years ~ 3 σ discrepancy



Recent averages and model independent FF parametrization recovered agreement........



Aim to reduce systematics and improve theory errors !

Exclusive measurements:

reconstruct final states: $B \to D \ell \nu$, $B \to \pi \ell \nu$

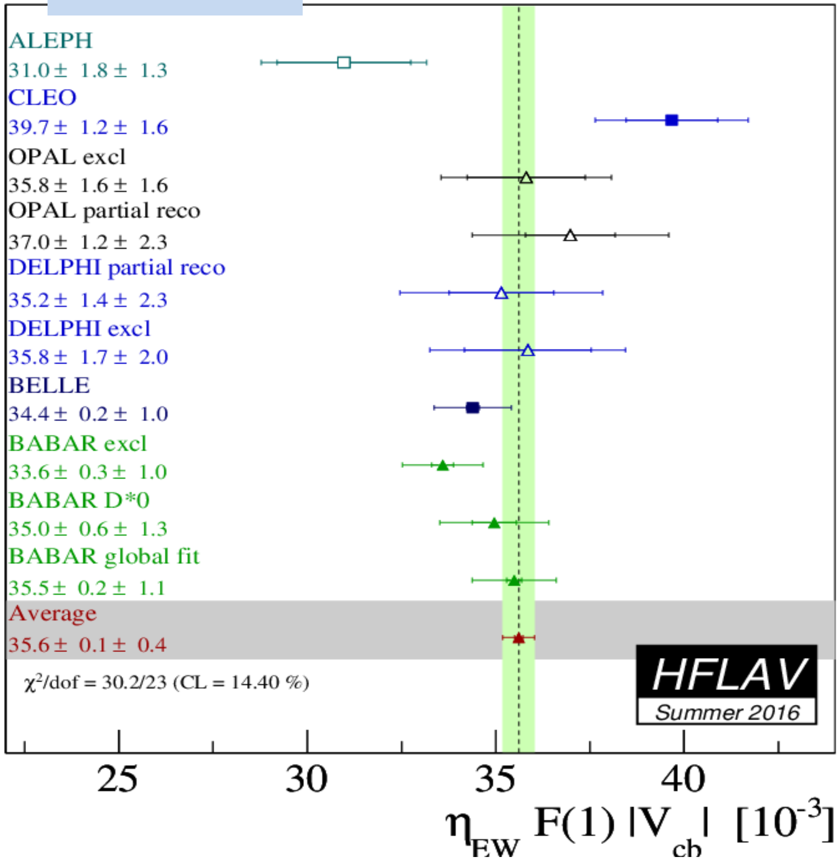
BR ∝ $|V_{qb}|^2$ *F (w)* (*F* form factor)
need input from lattice QCD

Inclusive measurements:

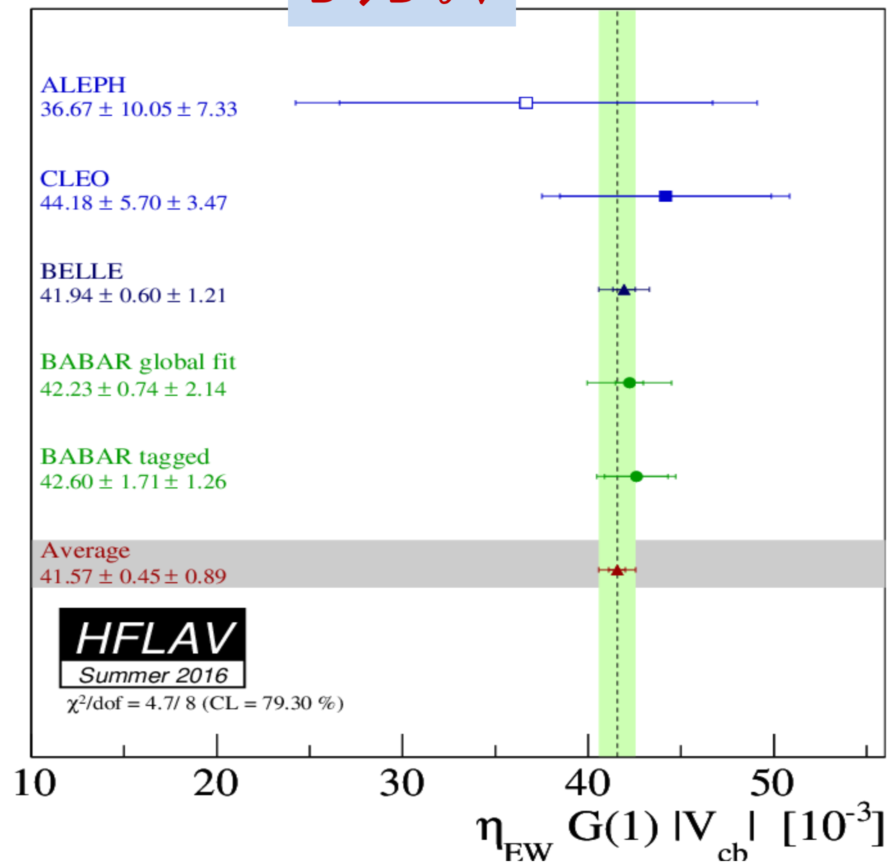
Include all $B \to X_q \ell \nu$.
via optical theorem:
BR ∝ $|V_{qb}|^2$ ($\Gamma(b \to q \ell \nu)$ + ……)
HQE needed to determine total rate

Exclusive V_{cb}

$B \to D^* \ell \nu$



$B \to D \ell \nu$



Both measurements are systematics limited !

Vcb determination from the 2 channels gives compatible results, but depends on FF parametrization: CLN vs BGL i.e. discrepancy or not with inclusive determination.

Belle II will reduce systematic uncertainty, mainly coming from hadronic tag calibration. Its large dataset can afford FF fit from differential $B \to D \ell \nu$ decay rates and help reducing theory error on parametrization.

Inclusive V_{cb}

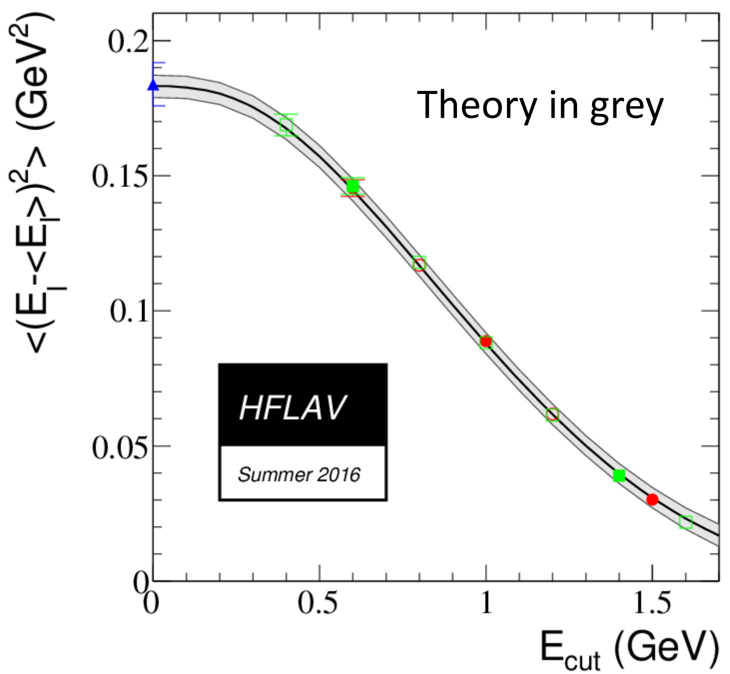
Perform a simultaneous fit of V_{cb}, the b and c quark masses and other OPE parameters, to the semileptonic inclusive width, the moments of the lepton energy spectrum and the moments of the hadronic mass spectrum squared.

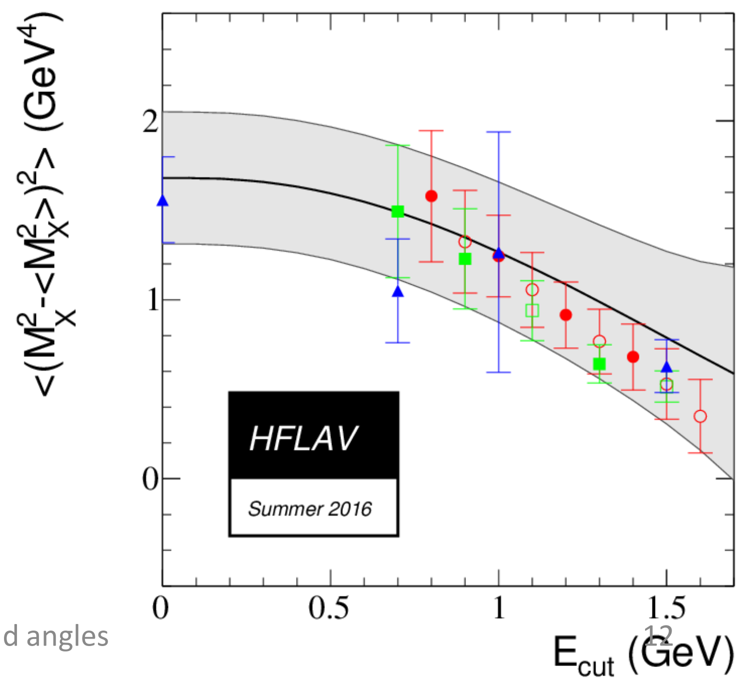
$$|V_{cb}|^{incl} = (42.19 \pm 0.78) \times 10^{-3}$$

HFLAV 2016 fit

actually dominated by theoretical uncertainties

Belle II large data set will allow accurate measurement of the E_l spectrum and of other momenta, and to test the validity of the OPE description at low energy, thus helping theorists to reduce errors.





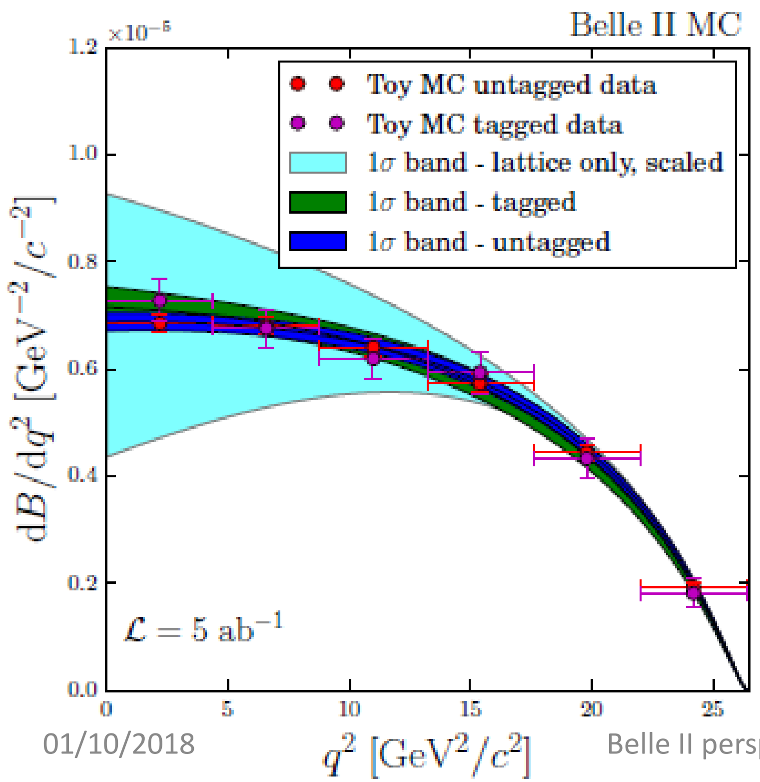
Exclusive V_{ub}

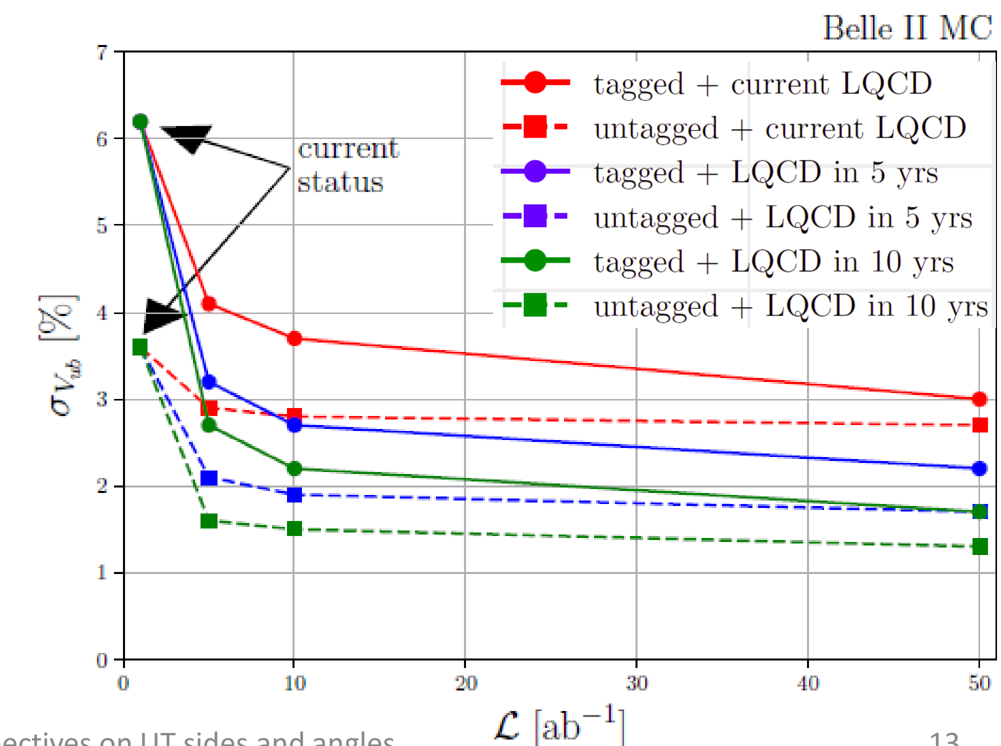
$B \rightarrow \pi \ell \nu$ both tagged and untagged.

$B_s \rightarrow K \ell \nu$ untagged only, at $\Upsilon(5s)$, less precise.

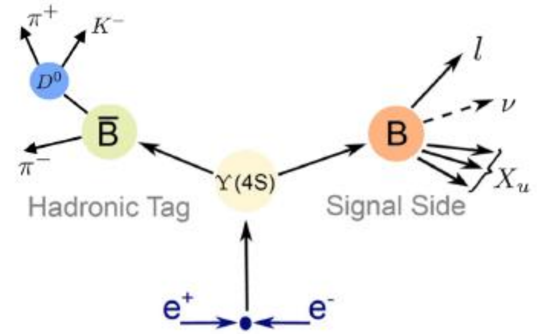
Extract V_{ub} from a combined fit to the measured q^2 spectrum and Lattice QCD predictions. Higher Belle II selection efficiencies and improved resolutions will allow to pin down the Vub error by a ~2 already with 5 ab^{-1}.

Lattice QCD improvements may gain another factor of 2.





Inclusive V_{ub}



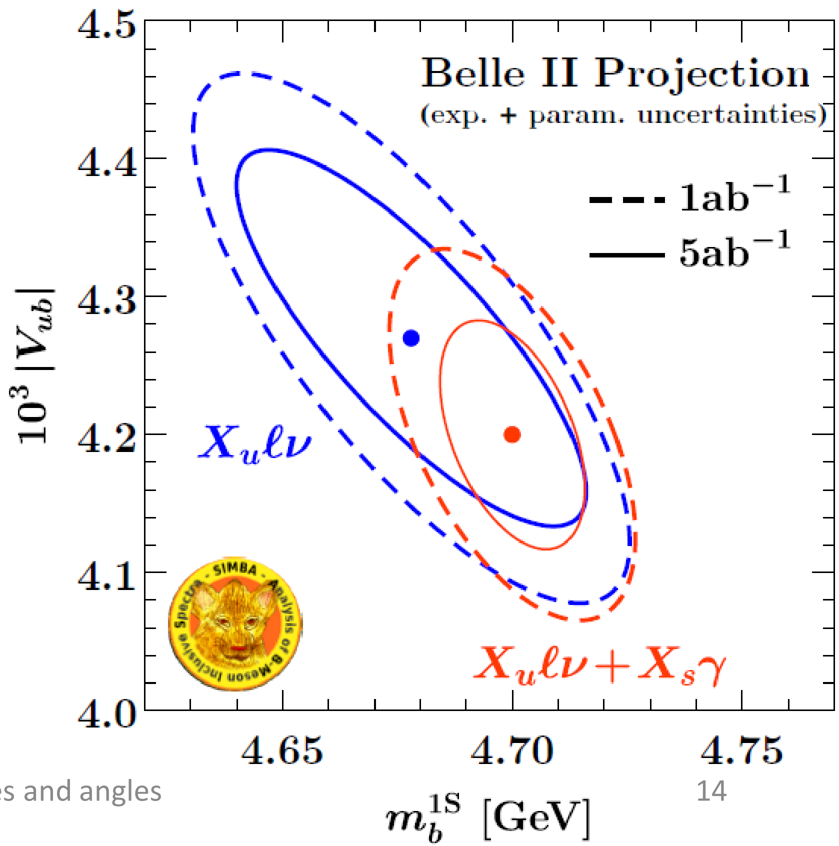
Can be obtained both from untagged and hadronic tagged analyses, where neutrino momentum is reconstructed or constrained.
Soft pions used to identify D* and reduce $B \to X_c l \nu$ background.

V_{ub} is extracted from a model independent combined fit to:

$B \to X_u l \nu$, $B \to X_c l \nu$, $B \to X_s \gamma$

together with the parameters of the same shape function F(k) taking into account b quark momentum distribution inside B meson (SIMBA technique).

Belle II precise measurements of differential distributions will further constrain the fit.



Summary of Belle II expectations for V_{ub}

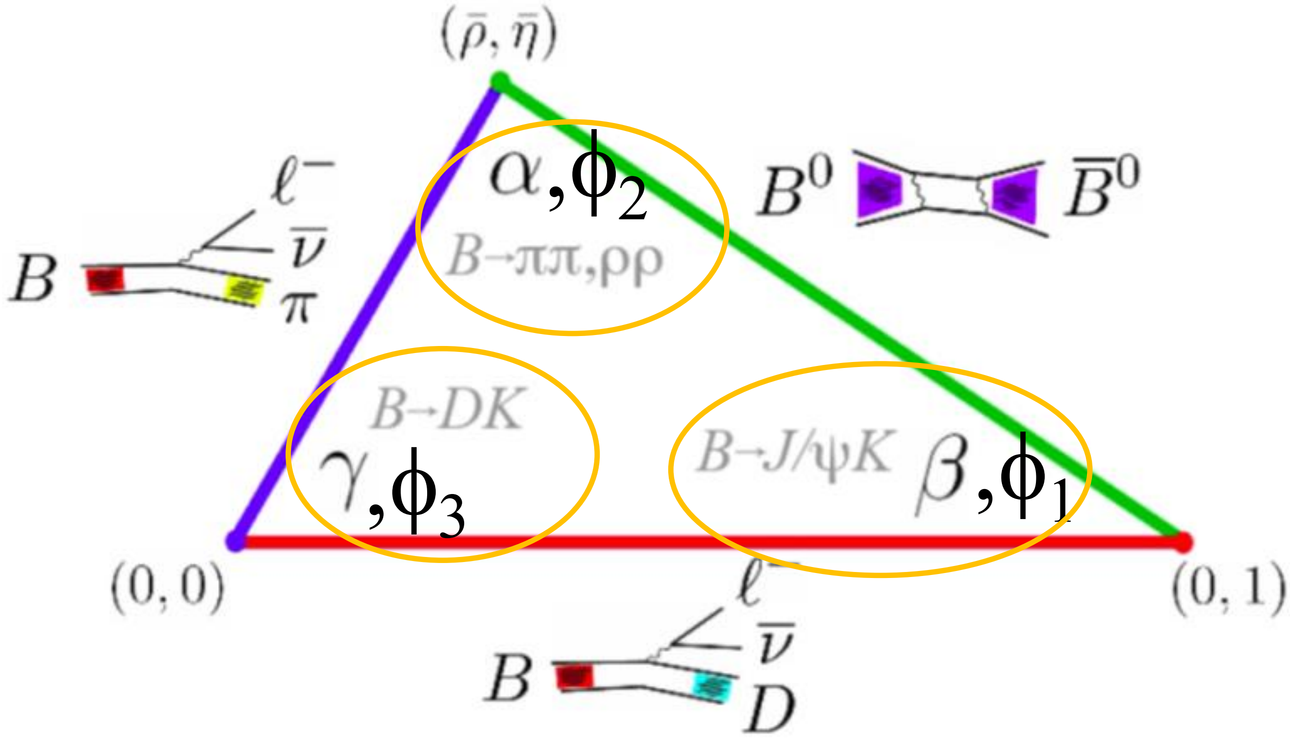
% uncertainties	Statistical	Systematic (reducible, irreducible)	Total Exp	Theory Lattice projections	Total
$\|V_{ub}\|$ exclusive (had. tagged)					
711 fb^{-1}	3.0	(2.3, 1.0)	3.8	7.0	8.0
5 ab^{-1}	1.1	(0.9, 1.0)	1.8	1.7	3.2
50 ab^{-1}	0.4	(0.3, 1.0)	1.2	0.9	1.7
$\|V_{ub}\|$ exclusive (untagged)					
605 fb^{-1}	1.4	(2.1, 0.8)	2.7	7.0	7.5
5 ab^{-1}	1.0	(0.8, 0.8)	1.2	1.7	2.1
50 ab^{-1}	0.3	(0.3, 0.8)	0.9	0.9	1.3
$\|V_{ub}\|$ inclusive					
605 fb^{-1} (old B tag)	4.5	(3.7, 1.6)	6.0	2.5−4.5	6.5−7.5
5 ab^{-1}	1.1	(1.3, 1.6)	2.3	2.5−4.5	3.4−5.1
50 ab^{-1}	0.4	(0.4, 1.6)	1.7	2.5−4.5	3.0−4.8

Large statistical sample and improved Belle II particle reconstruction will allow to reach ~ 1% experimental error on V_{ub}, both in the tagged and untagged exclusive channels, systematics dominated, and comparable with expected theory errors.

Inclusive channel has slightly higher systematics and larger theory error.

Important cross check will come from $B \rightarrow \tau \nu$ channel.

UT angles

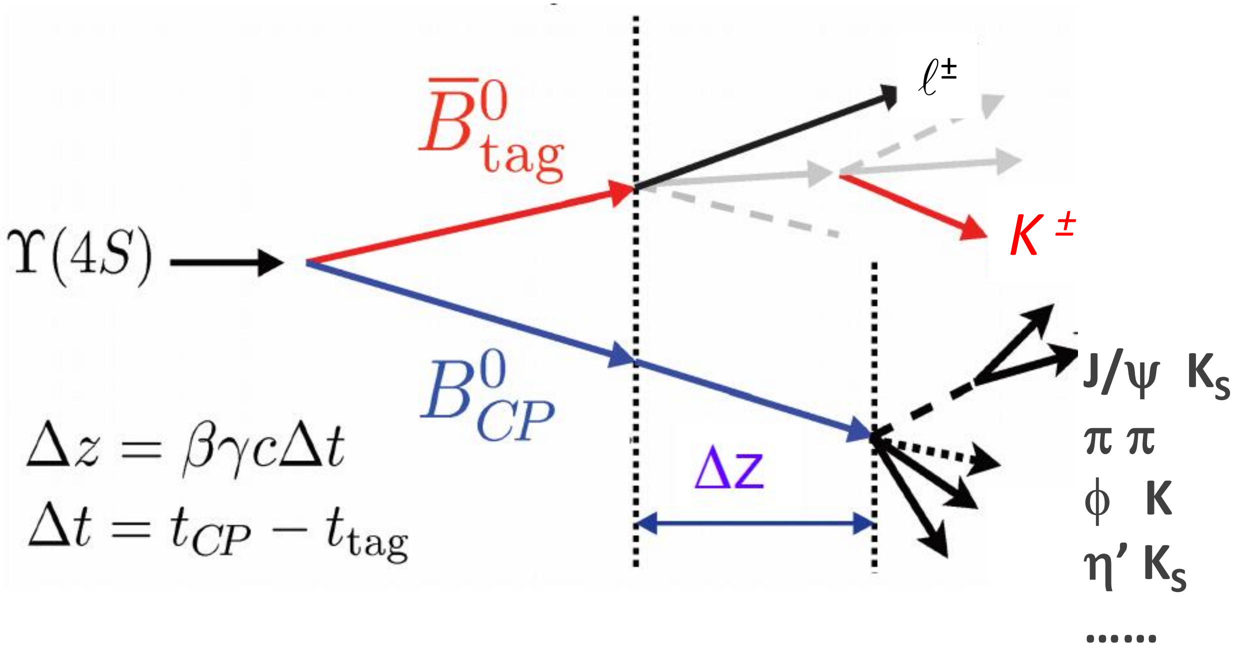


$(\bar{\rho}, \bar{\eta})$
α, ϕ_2
$B \to \pi\pi, \rho\rho$
B^0
$\overline{B}^0$
ℓ^-
$\overline{\nu}$
B
π
$B \to DK$
γ, ϕ_3
$B \to J/\psi K$
β, ϕ_1
$(0, 0)$
$(0, 1)$
ℓ^-
$\overline{\nu}$
B
D

Determination of α, β (ϕ_2 , ϕ_1)

Time dependent CP asymmetries:

$$a_{CPV}(\Delta t) = \frac{\Gamma_{\bar{B}\to\bar{f}}(\Delta t) - \Gamma_{B\to f}(\Delta t)}{\Gamma_{\bar{B}\to\bar{f}}(\Delta t) + \Gamma_{B\to f}(\Delta t)} = S\sin(\Delta m_d \Delta t) - C\cos(\Delta m_d \Delta t)$$



S → indirect C̸P̸
C = -A → direct C̸P̸

at Belle II:
- Δz ~ 130 μm
- βγ ~ 0.28
- (was 0.45 in Belle)

Need efficient flavour tagging with charged tracks.

Position of both B decay vertexes is required. Δt resolution dominated by the error on the position of the B-tag vertex.

Belle II new vertex detector provides excellent resolution!

Flavour tag at Belle II

$$\overline{B}^0 \to D^{*+}\ \overline{\nu}_\ell\ \ell^- \quad \hookrightarrow D^0\ \pi^+ \quad \hookrightarrow X\ K^-$$

$$\overline{B}^0 \to D^+\ \pi^-\ (K^-) \quad \hookrightarrow K^0\ \nu_\ell\ \ell^+$$

$$\overline{B}^0 \to \Lambda_c^+\ X^- \quad \hookrightarrow \Lambda\ \pi^+ \quad \hookrightarrow p\ \pi^-$$

Charged leptons, kaons, pions and Λ's allow to tag the B flavour without reconstructing it, thanks to quantum correlation of the two B mesons.

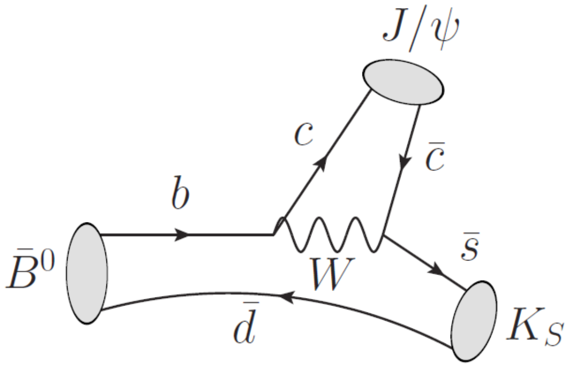
Multivariate discriminating algorithm provides optimized tagging, already tested on Belle data:

$$\varepsilon_{eff} = \Sigma_i\ \varepsilon_i(1-2w_i)^2 \quad , \quad w_i \text{ mistag probability}$$

Tagging efficiency improved by 10% already on Belle data.
Belle II will profit of its improved PID.

Old FT Belle data:	ε_{eff} =(30.1±0.4)%
New FT Belle data:	ε_{eff} =(33.6±0.5)%
New FT Belle MC:	ε_{eff} =(34.18±0.03)%
New FT Belle II MC:	ε_{eff} =(37.16±0.03)%

$\sin 2\beta$ ($\sin 2\phi_1$) from $b \rightarrow c\,\bar{c}\,s$

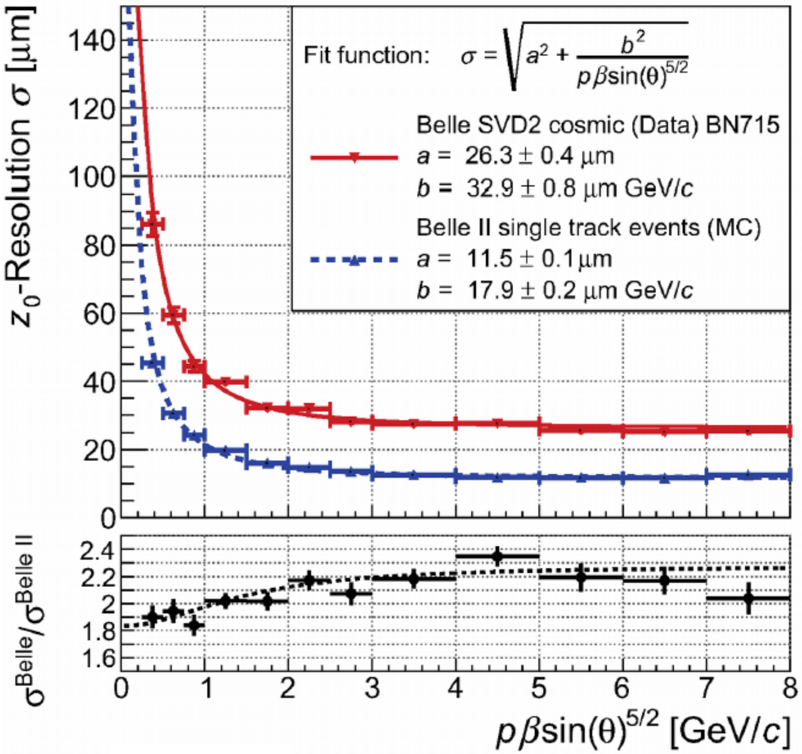


Tree dominated modes, only small penguin pollution.

Experimentally clean: **$B \rightarrow J/\psi\, K_s$** golden mode, but also other final states: **$\psi(2S)\, K_S$, $\chi_{c1}\, K_S$, $J/\psi\, K_L$** .
Penguin pollution can be constrained by π^0 modes.

$S_f \sim \sin(2\,\phi_1)$
$A_f = -\,C_f \sim 0$

Actual error still statistically dominated.
Most systematics sources scale with statistics
(wrong tag fraction, signal fraction, fit bias, backgroud Δt, B^0 lifetime and mixing).



Non-scaling systematics are:

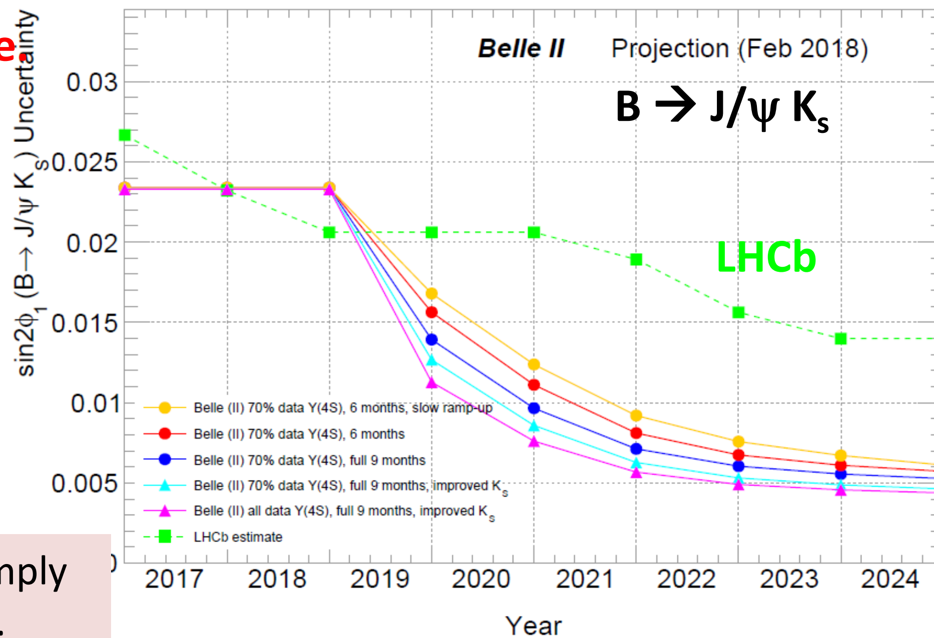
- tag-side interference: avoided using only leptonic tags, at the price of lower statistics
- Vertex reconstruction: expect to improve by 50%

b → c c s   Belle II expected uncertainties

Combining all b → c c s modes:

Belle results	stat $x10^{-3}$	syst $x10^{-3}$	stat	syst scaling	syst non-scaling (with vtx improve)	@50 ab^{-1}
S = 0.667	23	12	2.7	2.6	7.0 (3.6)	Belle II estimated
			4.8	2.6	3.5	Only leptonic tag
C=-0.006	16	12	1.9	1.4	10.6 (8.7)	Belle II estimated
			3.3	1.4	3.5	Only leptonic tag

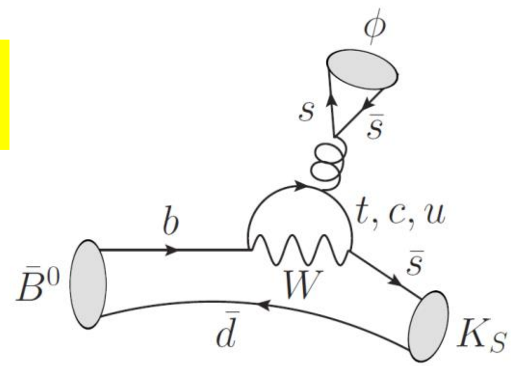
< 1% final uncertainty on β angle is recheable.



Time evolution of the uncertainty on sin(2β) with the only golden b→ccs channel in different operation scenario shows competitive improvement already with first years statistics.

Disclaimer: LHCb expectations are simply based on available public documents.

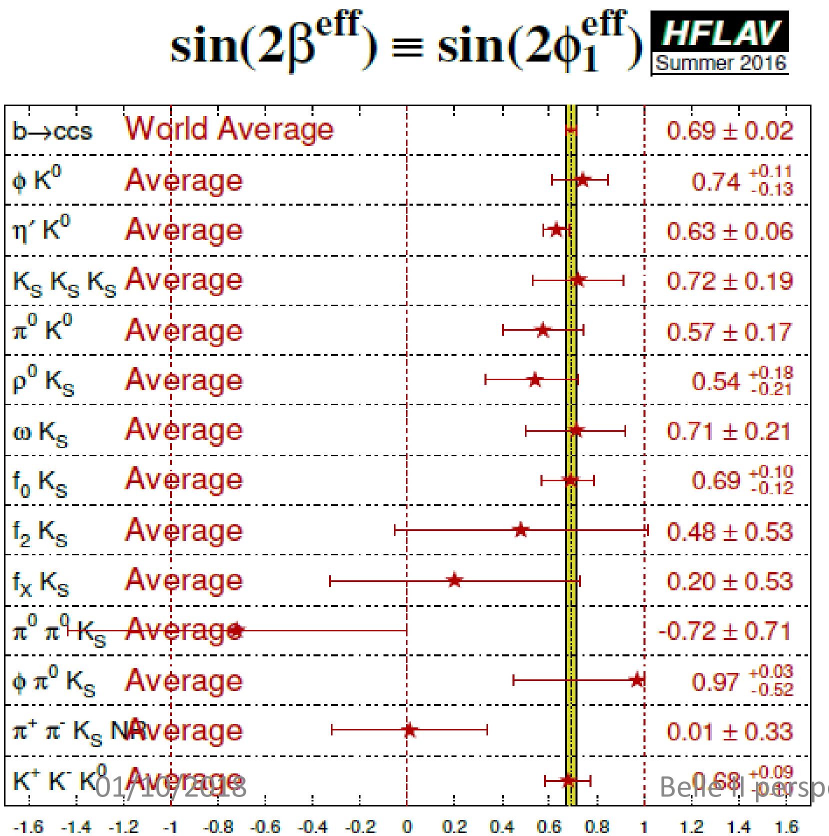
$\sin 2\beta$ ($\sin 2\phi_1$) from $b \rightarrow q \bar{q} s$



Penguin dominated modes: depend on β via different vertexes. Tree pollution under control. More sensitive to NP !

$B \rightarrow \phi K_s$, $B \rightarrow \eta' K_s$, $B \rightarrow \omega K_s$, $B \rightarrow \pi^0 K_s$
With many different final states.
At present all statistically dominated.

$S_f \sim \sin(2\phi_1) + \Delta S_f$ (tree + NP)



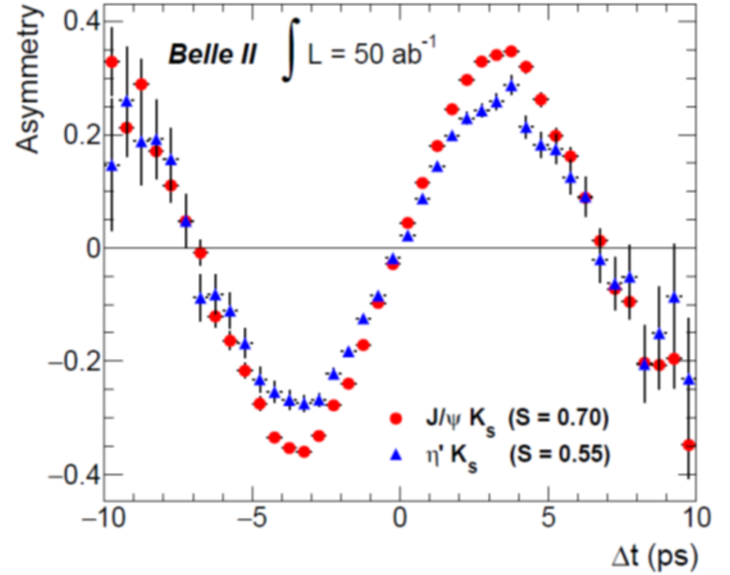
Main background is combinatorial from continuum. Small contamination from $b \rightarrow c$ decays.

Special care required by signal cross feed from other charmless CP violating B decays . Δt resolution *~0.75 (1.5) ps* for ϕK_s ($\eta' K_s$).

S and A extracted from a multidimensional fit to Δt + various backgr discriminating variables.

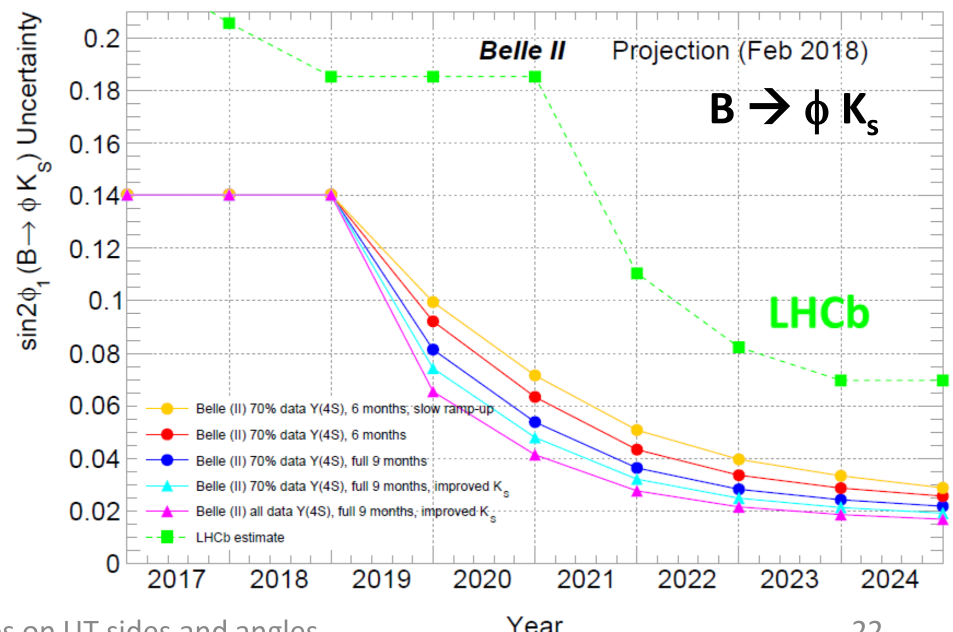
S and A from b→ccs and b→qqs expected Belle II errors @50 ab^{-1}

	WA (2017)		5 ab^{-1}		50 ab^{-1}	
Channel	$\sigma(S)$	$\sigma(A)$	$\sigma(S)$	$\sigma(A)$	$\sigma(S)$	$\sigma(A)$
$J/\psi K^0$	0.022	0.021	0.012	0.011	0.0052	0.0090
ϕK^0	0.12	0.14	0.048	0.035	0.020	0.011
$\eta' K^0$	0.06	0.04	0.032	0.020	0.015	0.008
ωK^0_S	0.21	0.14	0.08	0.06	0.024	0.020
$K^0_S \pi^0 \gamma$	0.20	0.12	0.10	0.07	0.031	0.021
$K^0_S \pi^0$	0.17	0.10	0.09	0.06	0.028	0.018



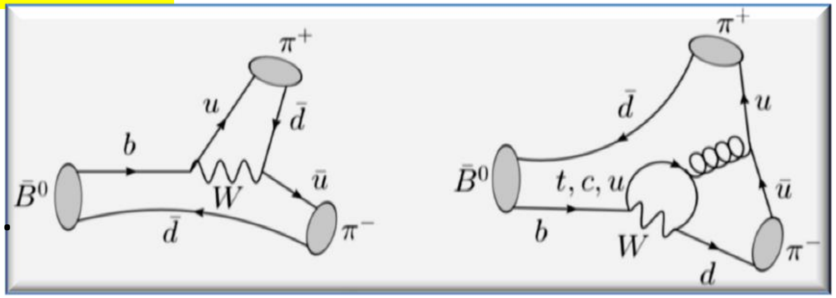
$\eta' K_s$ will reach systematics limit already with 10-20 ab^{-1}.
No competition with LHCb.

ϕK_s will keep statistically dominated.
Best sensitivity from $K^+K^-K^0$ Dalitz plot analysis.
Competition from LHCB quite strong.



α (ϕ_2) measurement

sin(2 α) is obtained from the time dependent amplitude of B→ $\pi\pi$, B→ $\rho\rho$ and B→$\pi\rho$ decays, with comparable Tree and Penguin contributions.



More strong and weak phases are also involved: **S_f ~ sin (2 α_{eff}) , α_{eff} = $\alpha + \delta\alpha_f$**

sin(2 α) extraction via isospin analysis (Gronau and London), using all possible final states and the observables:

- **BR's of all modes: B^0→ $\pi^+\pi^-$, $\pi^0\pi^0$; $B^\pm$ → $\pi^\pm\pi^0$ (same for $\rho\rho$)**
- **Direct CP asymmetries C^{+-},C^{00}**
- **Time dependent CP asymmetries S^{+-},S^{00}**

$$\frac{1}{\sqrt{2}}A^{+-} + A^{00} = A^{+0}$$
$$\frac{1}{\sqrt{2}}\tilde{A}^{+-} + \tilde{A}^{00} = \tilde{A}^{+0}$$
$$A^{+0} = \tilde{A}^{+0}$$

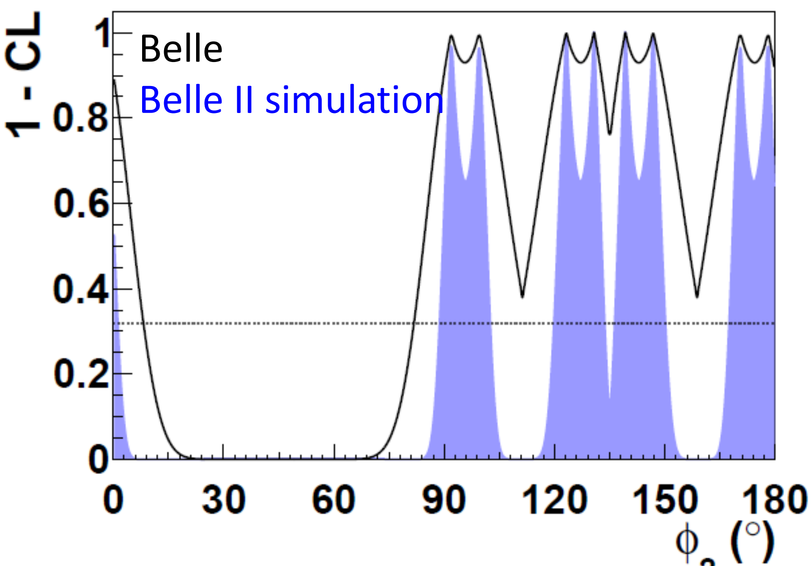
Only still missing measurement is $S_{\pi o \pi o}$ which results into 8-fold ambiguity in α determination from B—> $\pi\pi$. Belle II aims to first ever measurement exploiting π^0 Dalitz decays and γ conversions in the inner detectors.
Δt resolution of 1.14 (1.41) ps is estimated for Dalitz decays (conversions).

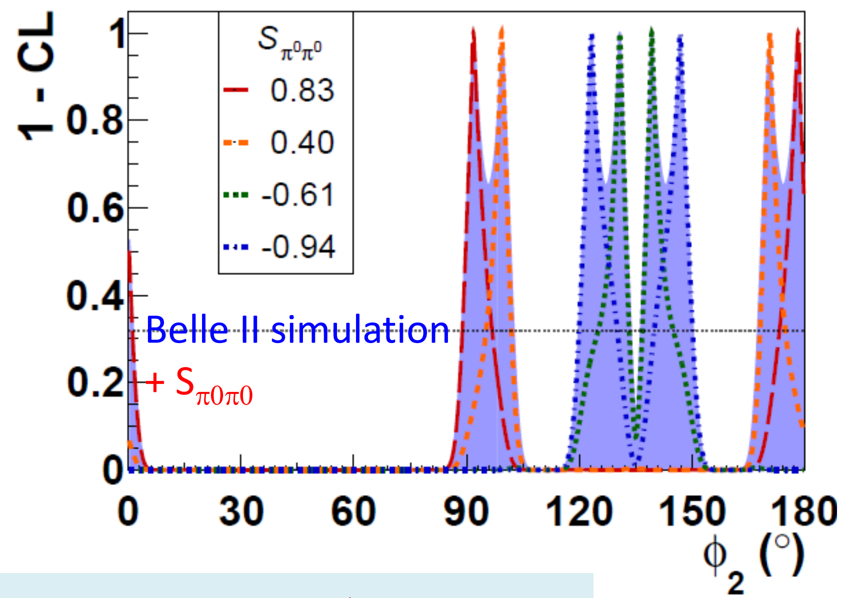
Belle II estimates for α from B→ ππ

	Value	Belle @ 0.8 ab^{-1}	Belle2 @ 50 ab^{-1}
$\mathcal{B}_{\pi^+\pi^-}$ $[10^{-6}]$	5.04	$\pm0.21 \pm 0.18$	$\pm0.03 \pm 0.08$
$\mathcal{B}_{\pi^0\pi^0}$ $[10^{-6}]$	1.31	$\pm0.19 \pm 0.18$	$\pm0.04 \pm 0.04$
$\mathcal{B}_{\pi^+\pi^0}$ $[10^{-6}]$	5.86	$\pm0.26 \pm 0.38$	$\pm0.03 \pm 0.09$
$C_{\pi^+\pi^-}$	-0.33	$\pm0.06 \pm 0.03$	$\pm0.01 \pm 0.03$
$S_{\pi^+\pi^-}$	-0.64	$\pm0.08 \pm 0.03$	$\pm0.01 \pm 0.01$
$C_{\pi^0\pi^0}$	-0.14	$\pm0.36 \pm 0.12$	$\pm0.03 \pm 0.01$
$S_{\pi^0\pi^0}$	—	—	$\pm0.29 \pm 0.03$

@50 ab^{-1} about 270 π^0 Dalitz events and 50 γ conversion events are expected.

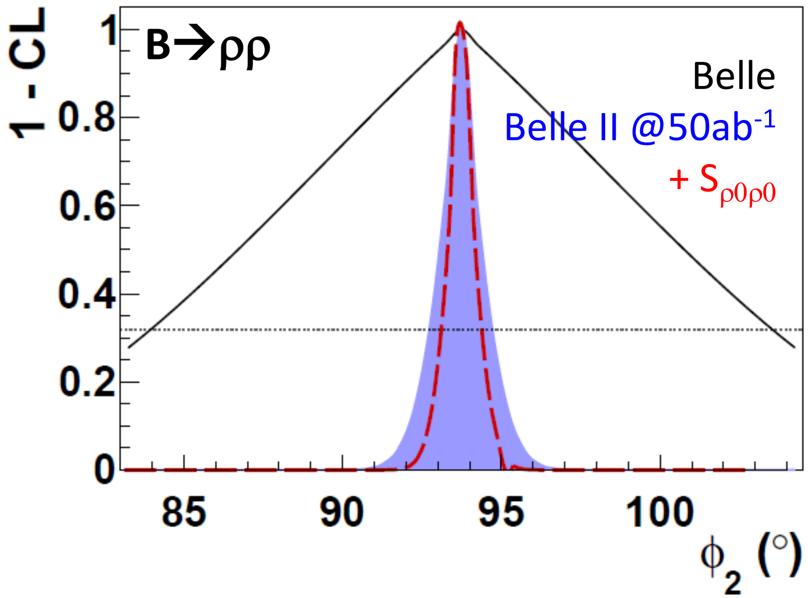
Despite the large error, $\pi^0\pi^0$ channel allows to significantly reduce ambiguity of the measurement.

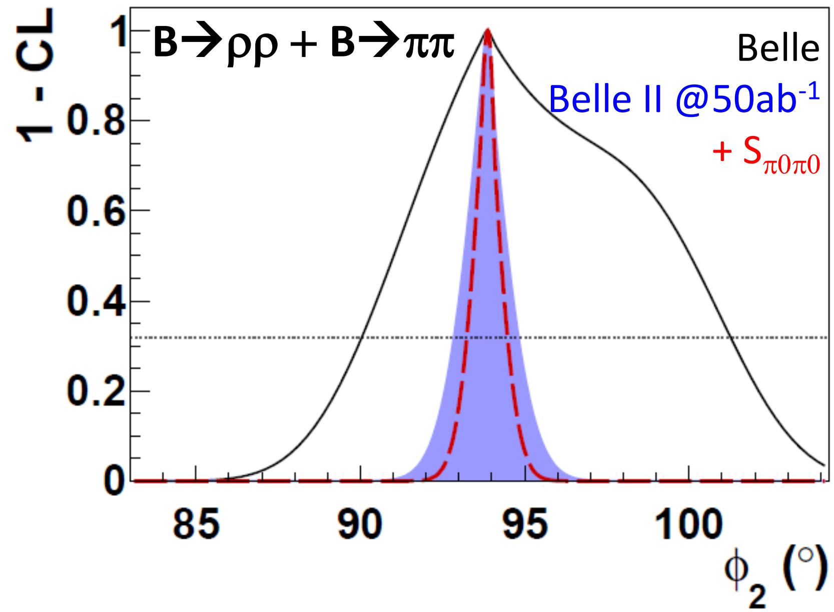


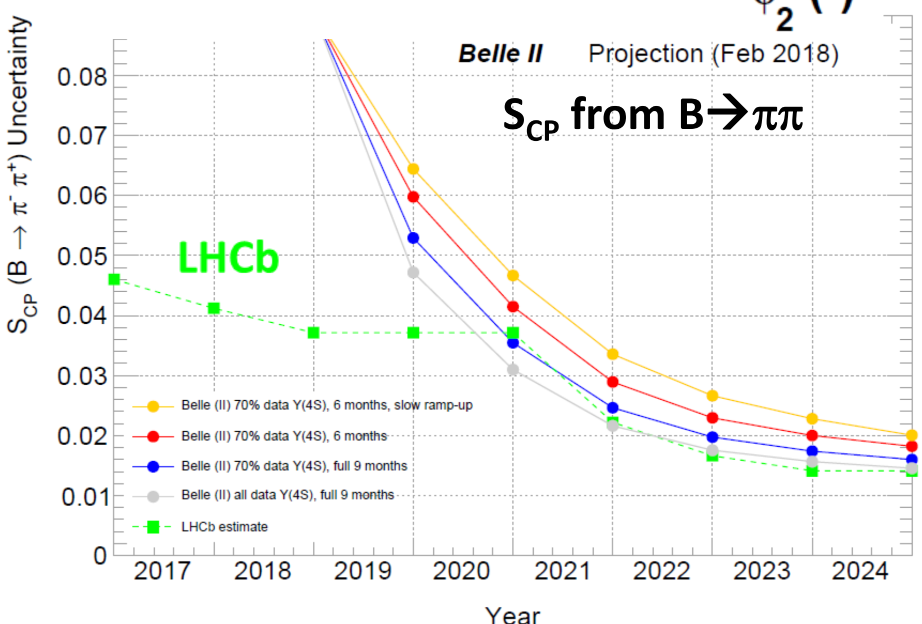


All measurements still statistically limited. Expected $\Delta\alpha_{\pi\pi}$ ~ 2°

Belle II estimates for α from B→ $\rho\rho$



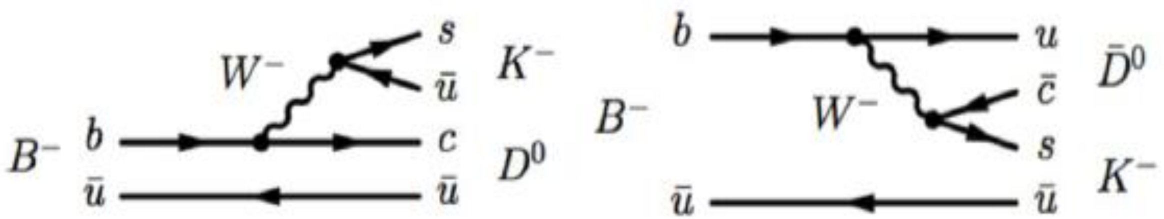




channel	$\Delta\phi_2$ (°)
WA	+4.4 -4.0
B→ $\pi\pi$	4.0
B→ $\rho\rho$	0.7
B→ $\pi\pi$ + B→ $\rho\rho$	0.6

γ (ϕ_3) measurement

The phase between b→c and b→u can be extracted from the interference of $B^{\pm} \to D(\overline{D}) K^{\pm}$ where D and $\overline{D}$ decay into the same final state.



$$A_B = A_{D^0} + r_B e^{i\varphi_3} e^{i\delta_B} A_{\overline{D}^0}$$

r_B ratio of colour suppress to colour favoured diagrams

δ_B strong phase difference. Should be taken from Cleo-c results. Expect BESIII measurement with 10 fb^{-1} at $\psi(3770)$

+ theoretically clean channel: no penguins, no mixing

- Both CKM and colour suppressed.

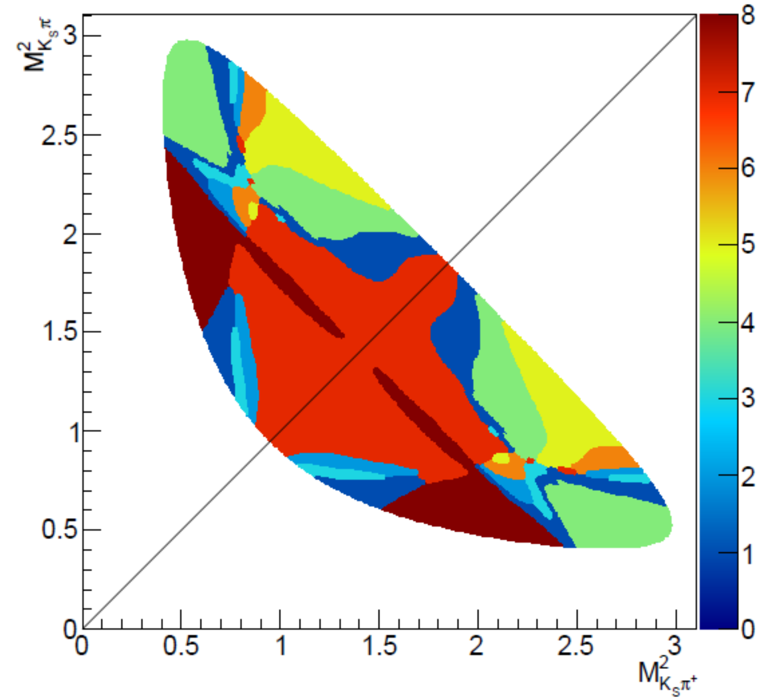
3 methods available at b-factories using different D final states:

- **GLW: CP eigenstates (K^+K^-, $\pi^+\pi^-$, $K_S\ \pi^0$)**
- **ADS: K X , where X is π, $\pi\pi^0$, 3π**
- **GGSZ: self conjugate multibody states: $K_S\ h^+h^-$, $K_S\ \pi^+\pi^-\pi^0$**

Belle II expectations for γ (ϕ_3) measurement

Estimates performed with GGSZ method, in the $K_S\pi^+\pi^-$ channel (golden for Belle II, large BR, good K_S reconstruction).

Dalitz plot symmetrically binned. Differential decay rate depends on γ, r_B, δ_B. Phase difference between D and $\overline{D}$ decay amplitude estimated from data using D*→Dπ tag.



Estimated sensitivity with such methos for ϕ_3 angle at 50 ab^{-1} is ~3° (current LHCb uncertainty is $^{+5.1^o}_{-5.8^o}$)

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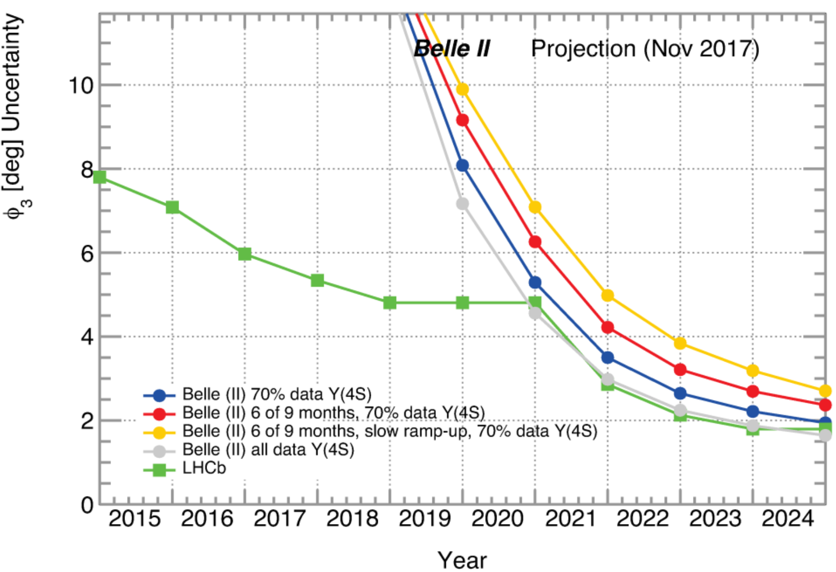


Other methods and channels can also be used: D→$K_SK^+K^-$, $B^\pm$→$D^*K^\pm$, GLW and ADS channels. Exploit sensitivity to neutrals, complementary to LHCB.

Combining all techniques Belle II estimated sensitivity is $\Delta\phi_3$ ~ 1.6°

Conclusions

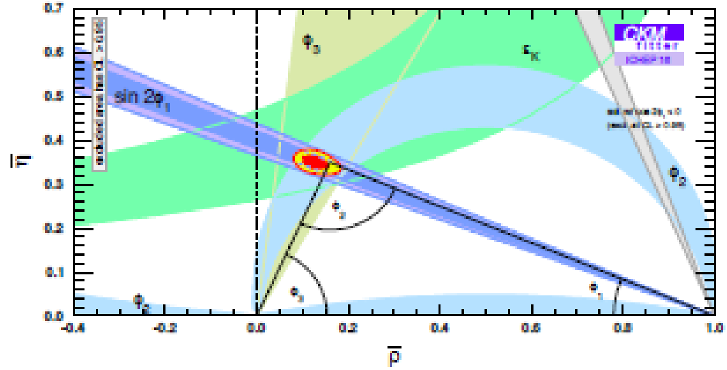
- **Belle II can measure exclusive V_{ub} at almost 1% level and inclusive one at 3%. Any discrepancy between the two can be thoroughly tested.**
- **$\sin 2\beta$ ($\sin 2\phi_1$) can be measured at 1% level from b→ccs. Penguin dominated mode b→qqs can get very close too.**
- **α (ϕ_2) angle uncertainty can get down to 0.6°**
- **γ (ϕ_3) angle uncertainty can reach 1.6°**

Competition and complementarity with LHCb are essential ingredients to better constrain the SM phase space.

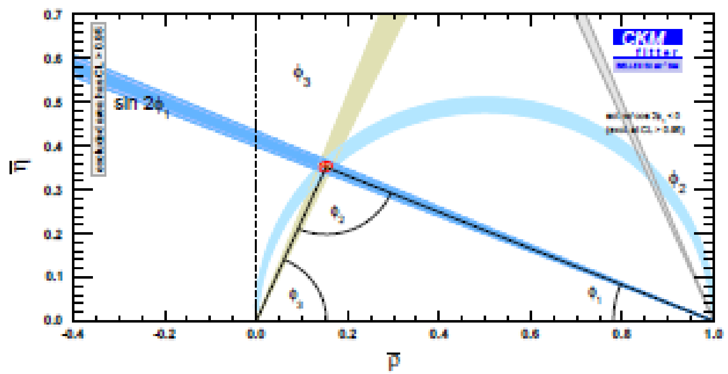
So the question is now……

Will SM survive the 2025 precision ?

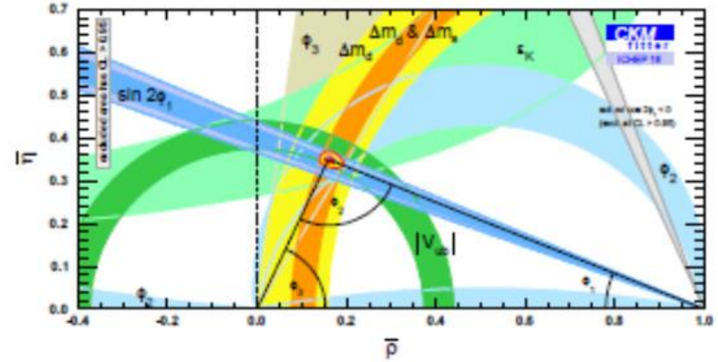
CPV only input
Current world average



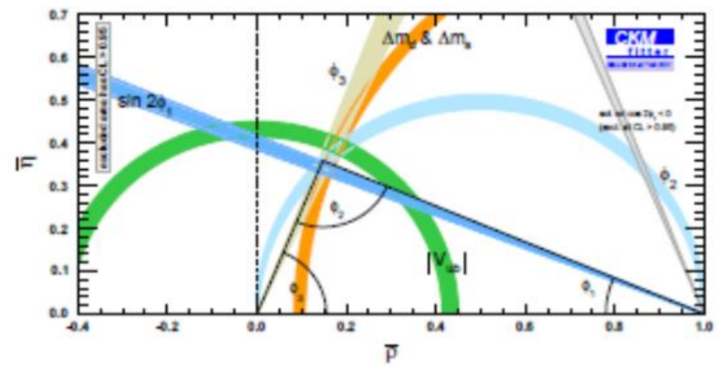
Belle II projection @ $50ab^{-1}$



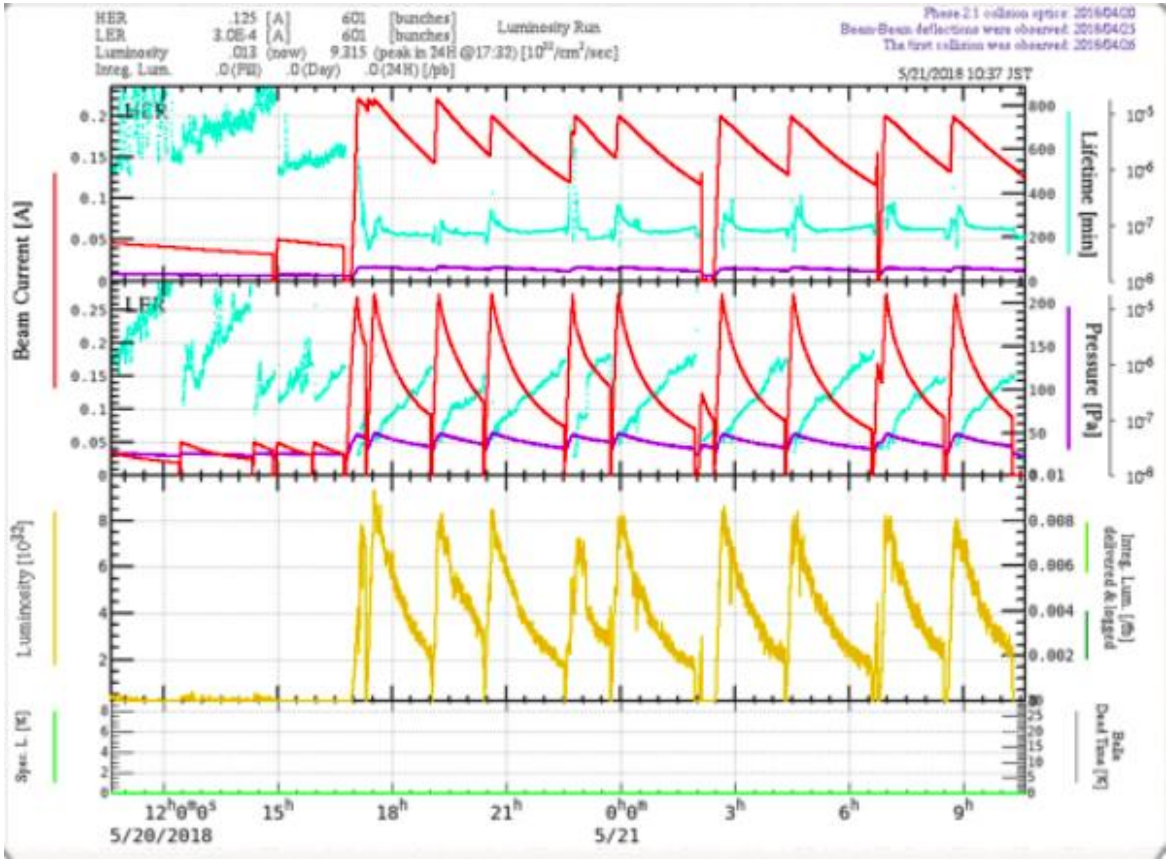
All input
Current world average



Belle II projection @ $50ab^{-1}$

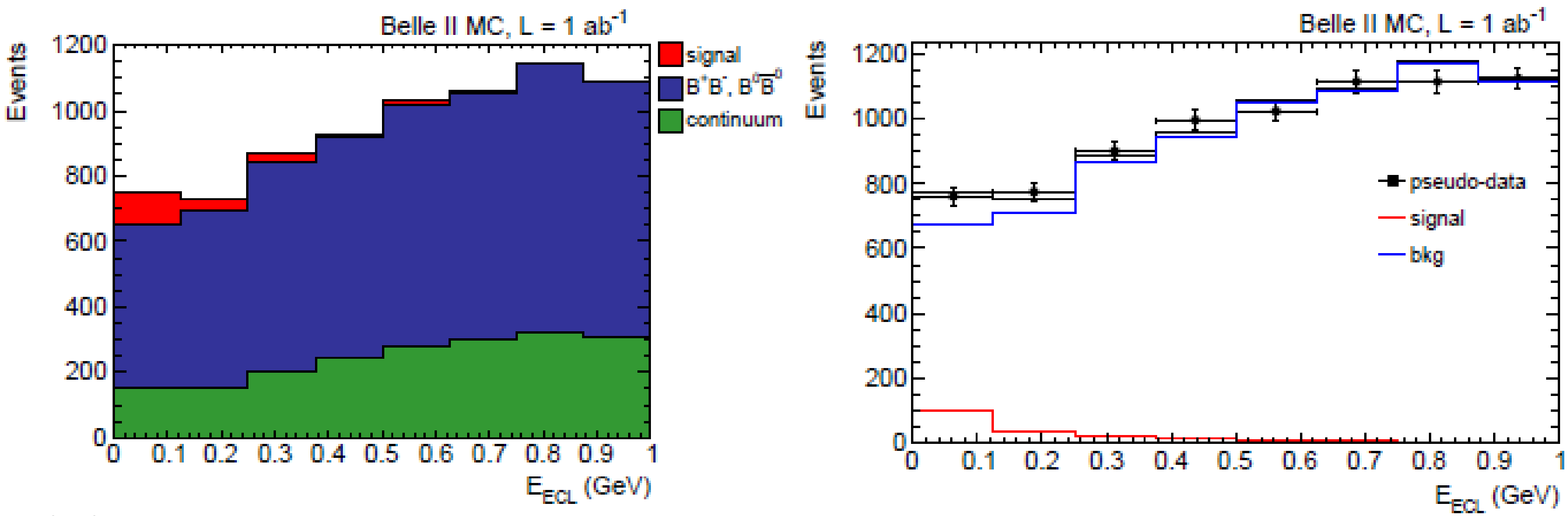


SPARES


HER .125 [A] 601 [bunches]
LER 3.0E-4 [A] 601 [bunches]
Luminosity Run
5/21/2018 10:37 JST
Beam Current [A]
Lifetime [min]
Pressure [Pa]
Luminosity [10^32]
5/20/2018
5/21

V_{ub} from $B \to \tau\,\nu$

- fully reconstruct tag side and lepton on signal side
- extract signal in E_{ECL}: sum over all neutral cluster not used for reconstruction
- $\mathcal{B} \propto |V_{ub}|^2 f_B^2 m_l^2$



B → ccs systematics souces

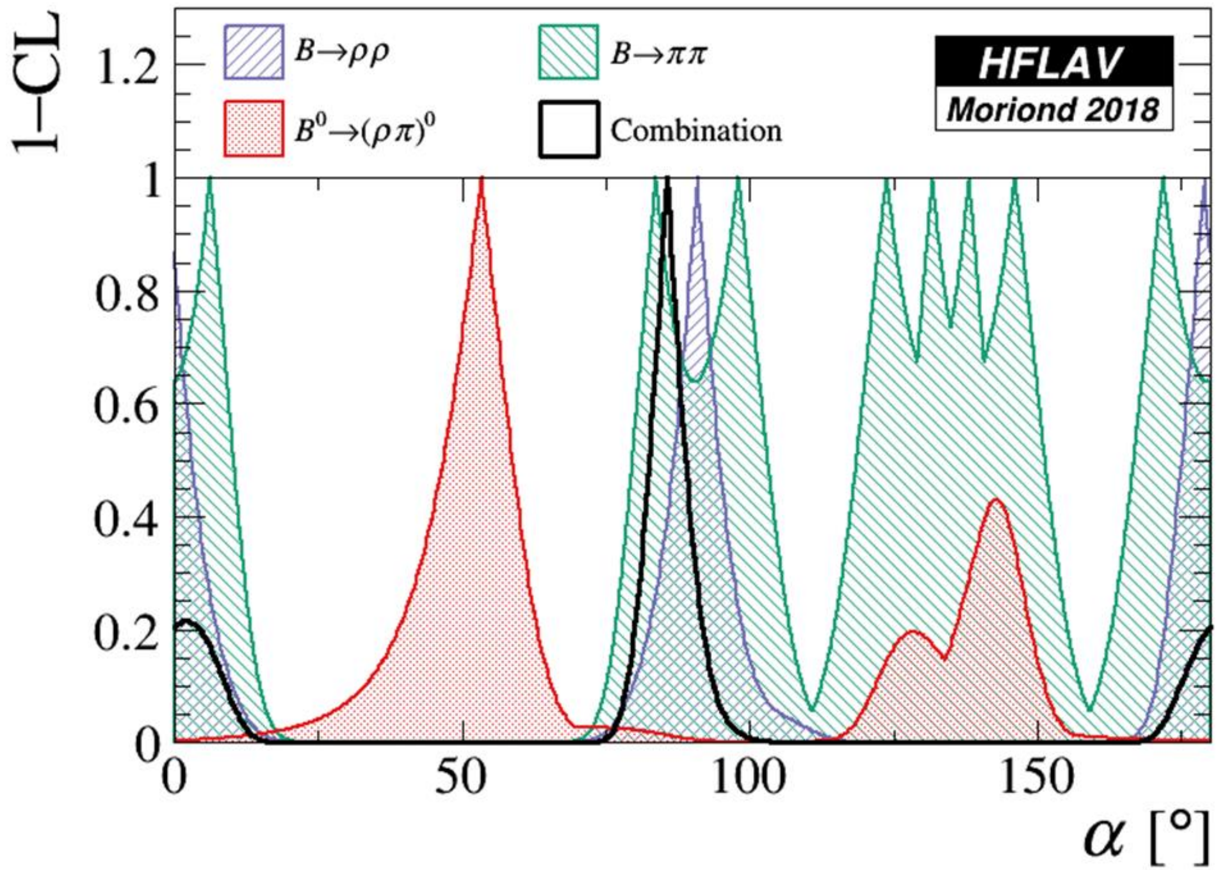
		$J/\psi K_S^0$	$\psi(2S)K_S^0$	$\chi_{c1}K_S^0$	$J/\psi K_L^0$	All
Vertexing	$\mathcal{S}_f$	±0.008	±0.031	±0.025	±0.011	±0.007
	$\mathcal{A}_f$	±0.022	±0.026	±0.021	±0.015	±0.007
Δt resolution	$\mathcal{S}_f$	±0.007	±0.007	±0.005	±0.007	±0.007
	$\mathcal{A}_f$	±0.004	±0.003	±0.004	±0.003	±0.001
Tag-side interference	$\mathcal{S}_f$	±0.002	±0.002	±0.002	±0.001	±0.001
	$\mathcal{A}_f$	$^{+0.038}_{-0.000}$	$^{+0.038}_{-0.000}$	$^{+0.038}_{-0.000}$	$^{+0.000}_{-0.037}$	±0.008
Flavor tagging	$\mathcal{S}_f$	±0.003	±0.003	±0.004	±0.003	±0.004
	$\mathcal{A}_f$	±0.003	±0.003	±0.003	±0.003	±0.003
Possible fit bias	$\mathcal{S}_f$	±0.004	±0.004	±0.004	±0.004	±0.004
	$\mathcal{A}_f$	±0.005	±0.005	±0.005	±0.005	±0.005
Signal fraction	$\mathcal{S}_f$	±0.004	±0.016	< 0.001	±0.016	±0.004
	$\mathcal{A}_f$	±0.002	±0.006	< 0.001	±0.006	±0.002
Background Δt PDFs	$\mathcal{S}_f$	< 0.001	±0.002	±0.030	±0.002	±0.001
	$\mathcal{A}_f$	< 0.001	< 0.001	±0.014	< 0.001	< 0.001
Physics parameters	$\mathcal{S}_f$	±0.001	±0.001	±0.001	±0.001	±0.001
	$\mathcal{A}_f$	< 0.001	< 0.001	±0.001	< 0.001	< 0.001
Total	$\mathcal{S}_f$	±0.013	±0.036	±0.040	±0.021	±0.012
	$\mathcal{A}_f$	$^{+0.045}_{-0.023}$	$^{+0.047}_{-0.027}$	$^{+0.046}_{-0.026}$	$^{+0.017}_{-0.041}$	±0.012

sin(2β) sensitivities per channel @ 50 ab-1

Channel	$\int \mathcal{L}$	Event yield	$\sigma(S)$	$\sigma(S)_{2017}$	$\sigma(A)$	$\sigma(A)_{2017}$
$J/\psi K^0$	50 ab^{-1}	$1.4 \cdot 10^6$	0.0052	0.022	0.0050	0.021
ϕK^0	5 ab^{-1}	5590	0.048	0.12	0.035	0.14
$\eta' K^0$	5 ab^{-1}	27200	0.027	0.06	0.020	0.04
ωK_S^0	5 ab^{-1}	1670	0.08	0.21	0.06	0.14
$K_S^0 \pi^0 \gamma$	5 ab^{-1}	1400	0.10	0.20	0.07	0.12
$K_S^0 \pi^0$	5 ab^{-1}	5699	0.09	0.17	0.06	0.10

B→qqs finals states sensitivities

Channel	σ(S)	σ(C)
$\phi(K^+K^-)\ K_S^0(\pi^+\pi^-)$	0.025	0.017
$\phi(K^+K^-)\ K_S^0(\pi^0\pi^0)$	0.042	0.030
$\phi(\pi^+\pi^-\pi^0)\ K_S^0(\pi^+\pi^-)$	0.048	0.036
ϕ(all modes) $(K_S^0 + K_L^0)$	0.015	0.011
$\eta'(\eta_{\gamma\gamma}\pi^+\pi^-)\ K_S^0(\pi^+\pi^-)$	0.019	0.013
$\eta'(\eta_{3\pi}\pi^+\pi^-)\ K_S^0(\pi^+\pi^-)$	0.035	0.025
η(all modes) $(K_S^0 + K_L^0)$	0.0085	0.0063


1−CL
1.2
1
0.8
0.6
0.4
0.2
0
0
50
100
150
α [°]
B→ρρ
B→ππ
B⁰→(ρπ)⁰
Combination
HFLAV
Moriond 2018