Belle 2 Backup Slides

R. de Sangro

Beam Parameters: KEKB vs SuperKEKB

	KEKB Design	KEKB Achieved (Crab)	SuperKEKB Nano-Beam	
Energy (GeV) (LER/HER)	3.5/8.0	3.5/8.0	4.0/7.0	
β_y^* (mm)	10/10	5.9/5.9	0.27/0.30	×20
β_x^* (mm)	330/330	1200/1300	32/25	
ε_x (nm)	18/18	18/24	3.2/4.6	
$\varepsilon_y / \varepsilon_x$ (%)	1	0.85/0.64	0.27/0.28	
σ_y(mm)	1.9	0.94	0.048/0.062	
ξ_y	0.052	0.129/0.090	0.088/0.081	
σ_z (mm)	4	6 ~ 7	6/5	
I_{beam} (A)	2.6/1.1	1.64/1.19	3.6/2.6	×2
$N_{bunches}$	5000	1584	2500	
Luminosity (10^{34} cm^{-2} s^{-1})	1	2.11	80	

LNF-KEK Collaboration Present Status

- Benchmark studies of ring lattice has started
- Feedback studies and implementation is continuing
- Meeting with KEK and Belle-II management next June 26th during the Belle-II collaboration meeting to better define topics and assignments
- Open to other topics and collaborators

Dark photon invisible decays: A'→χχ

PADME

Belle-II

note different scale ε vs ε²

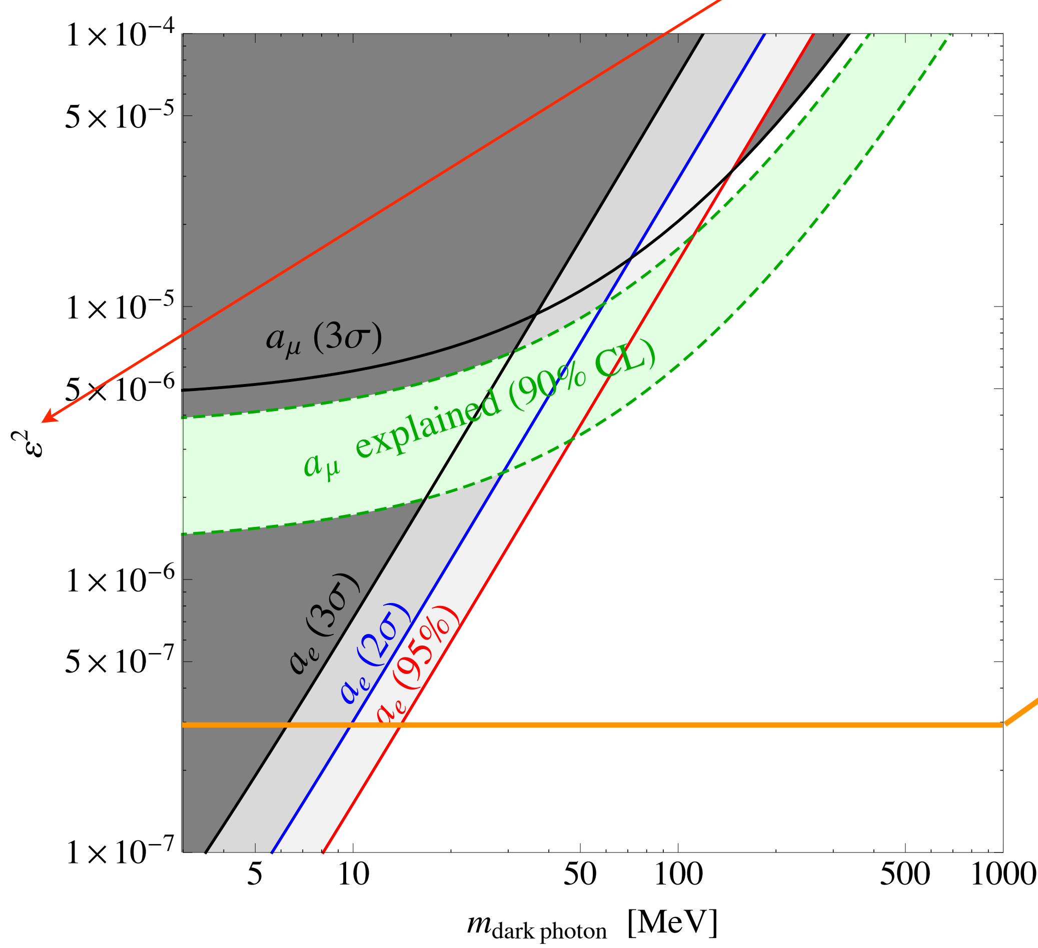
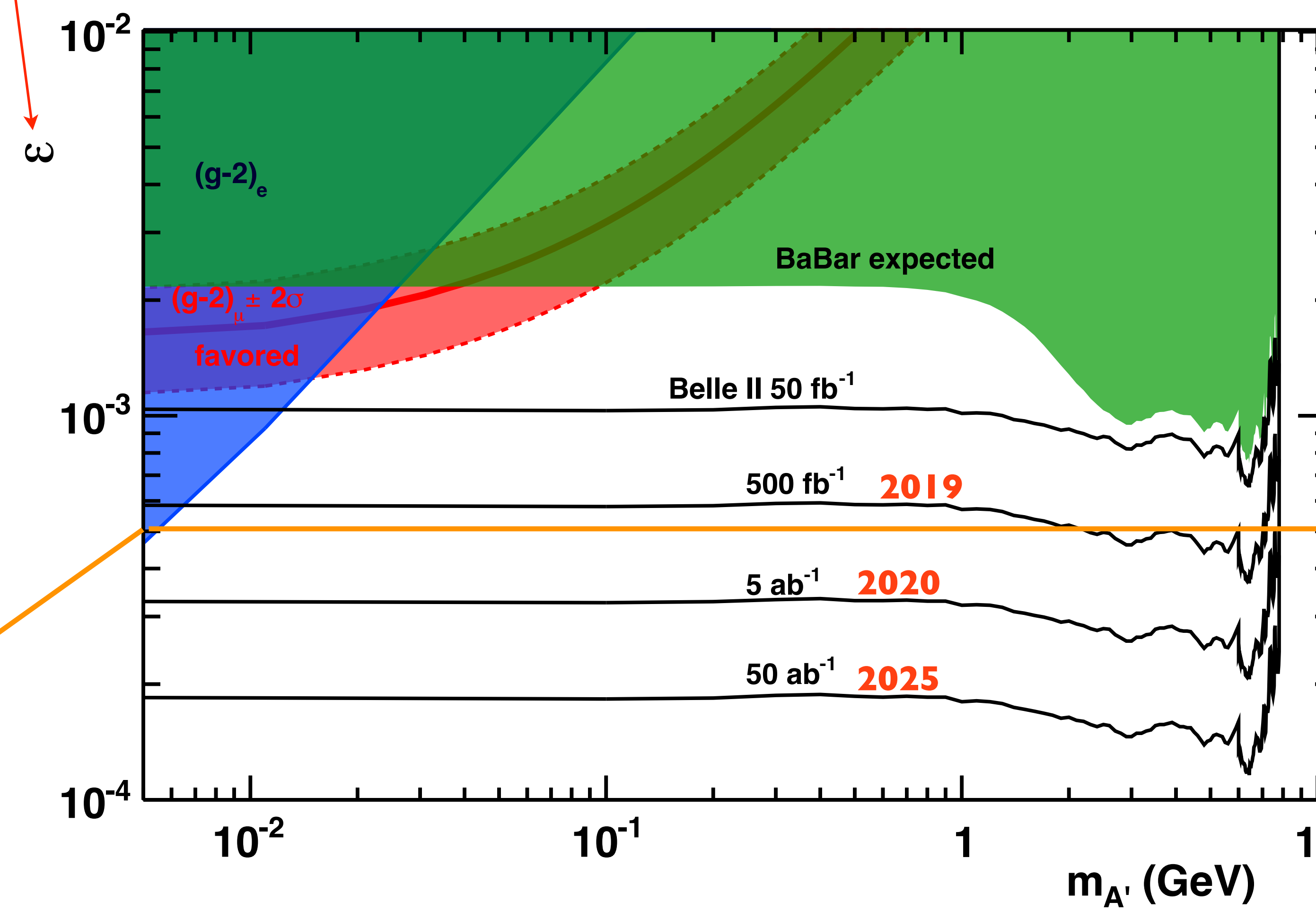
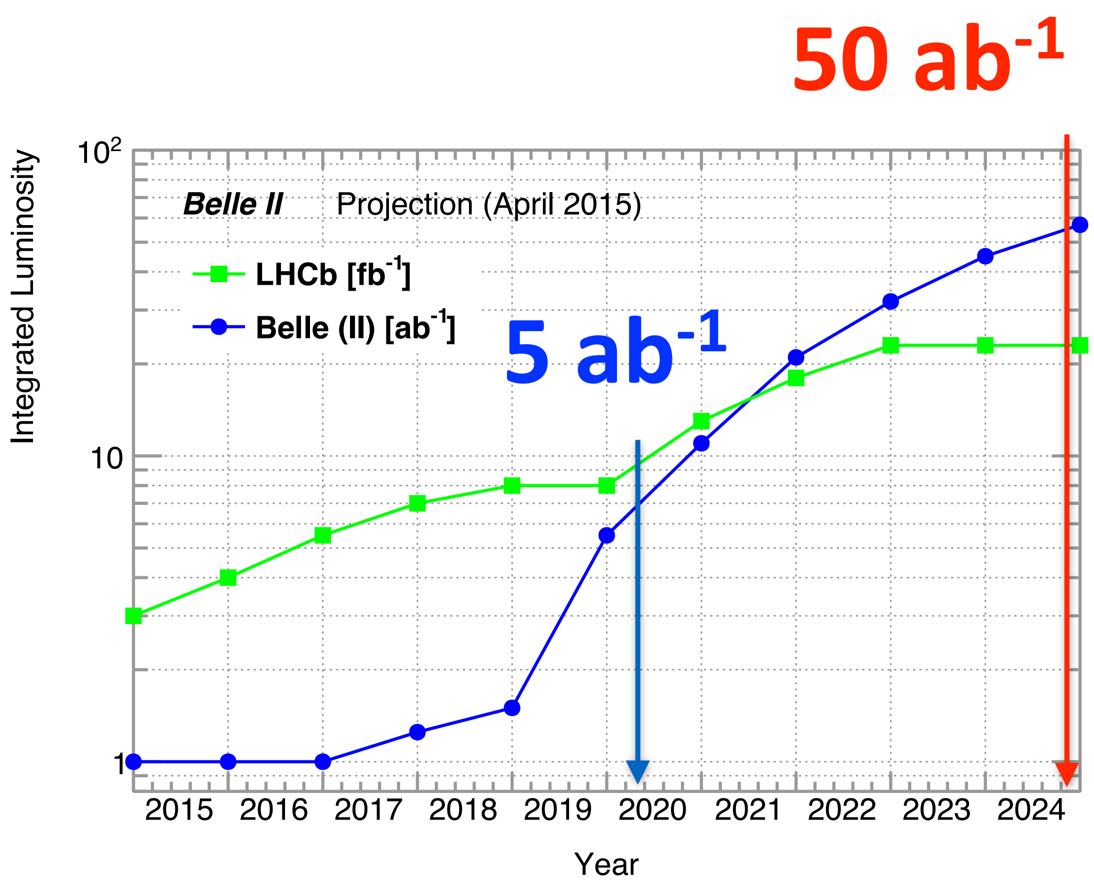


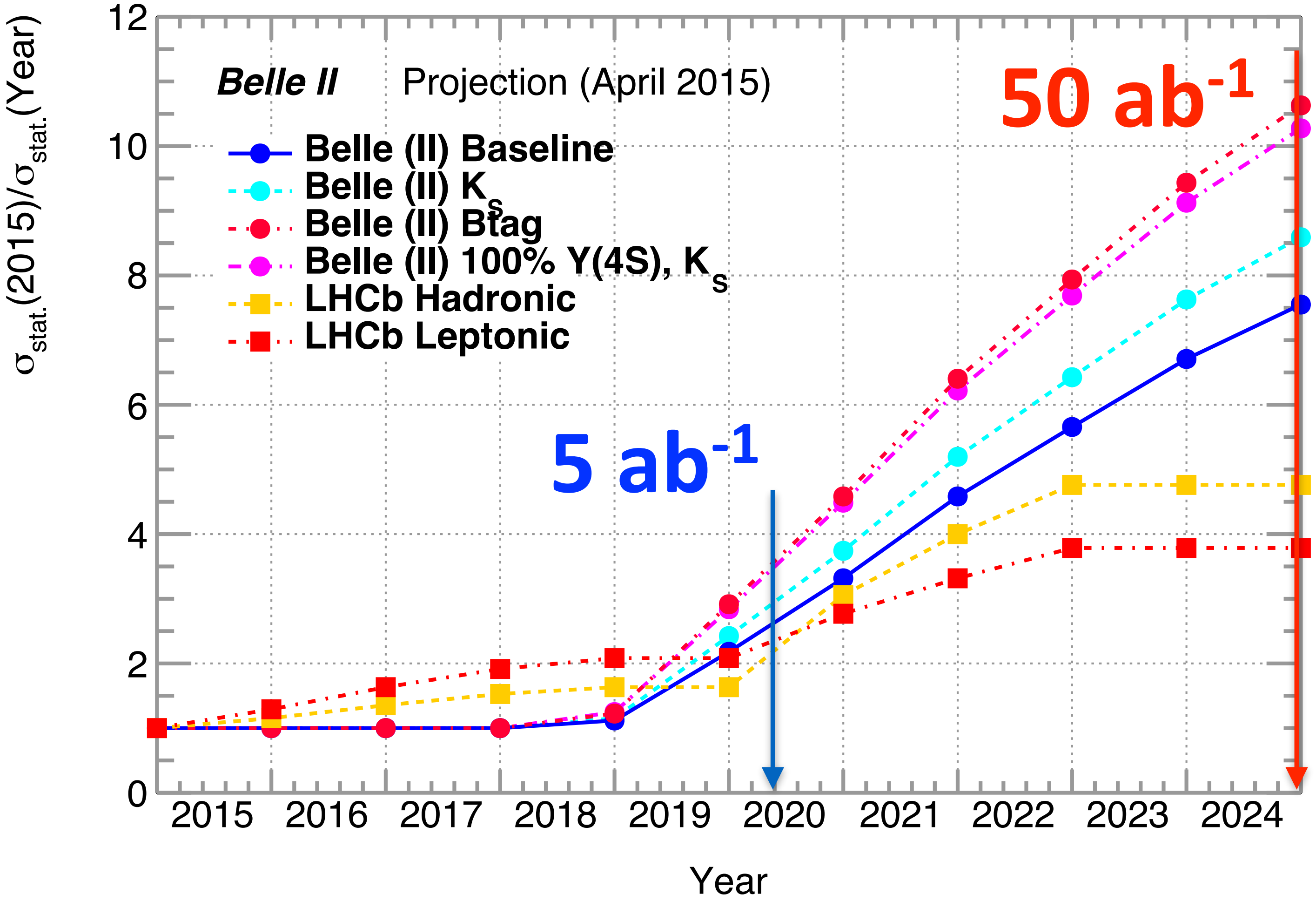
Figure 2: *Model independent bounds for $A' \to \chi\chi$ [8].*



First results likely to arrive early in Belle2 running!

Rule of thumb plots.





*Btag scenario assumes efficiency x 2

Quantitative physics cases for Υ(5S) running should be provided.

Existing data sets

Experiment	Scans/Off. Res.	$\Upsilon(5S)$ 10876 MeV		$\Upsilon(4S)$ 10580 MeV		$\Upsilon(3S)$ 10355 MeV		$\Upsilon(2S)$ 10023 MeV		$\Upsilon(1S)$ 9460 MeV	
	fb^{-1}	fb^{-1}	10^6	fb^{-1}	10^6	fb^{-1}	10^6	fb^{-1}	10^6	fb^{-1}	10^6
CLEO	17.1	0.4	0.1	16	17.1	1.2	5	1.2	10	1.2	21
BaBar	54	R_b scan		433	471	30	122	14	99	–	
Belle	100	121	36	711	772	3	12	25	158	6	102

1. Unique data sets away from Y(4S), $O(100\ \text{fb}^{-1} — 1\ \text{ab}^{-1})$, offer a chance for unique results in the first 2 years.
\+ Allow for time to calibrate the detector at Y(4S).

2. The instantaneous luminosity will be lower in early data, but the DAQ will be at design capacity — good chance for low multiplicity studies.

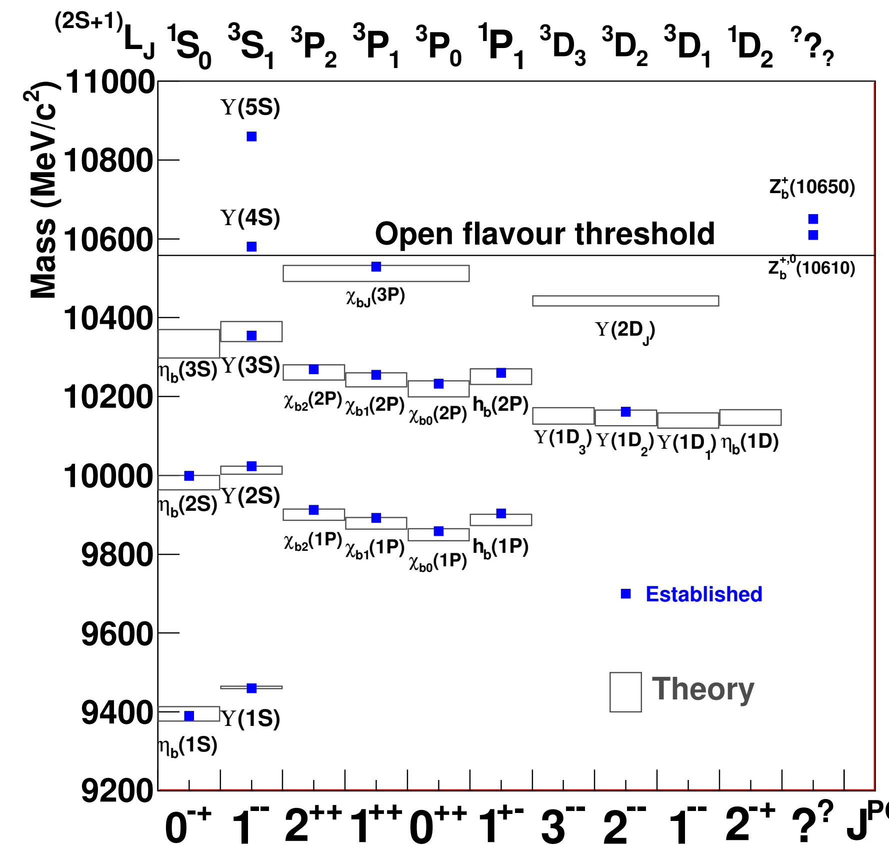
Phase 2 Physics

Silicon Vertex Detector (SVD) & Pixel detector (PXD) not installed.

- Clear limitations on flavour analyses in this period.
- Sample size < Belle @ Υ(4S), not bigger than Belle Υ(5S).
- A task force is working on checking detector performance for this configuration.

Primarily WG7 & WG8

—Topics extracted from Belle II Note 34



- ee→γγ: dark sector, particularly invisibles
- Fragmentation
- Υ(2S): dark forces, light Higgs
- Υ(3S): conventional bottomonium
- Scan around Υ(5S) and b quark mass determination
- Υ(6S): exotic bottomonium, R_b scan (E_{CM} design max 11.25 GeV)

Phase 3 Physics: First O(1 ab^{-1})

Full detector operation. Considering options for balancing unique, non-Υ(4S) samples, and Υ(4S) samples. Proposals required.

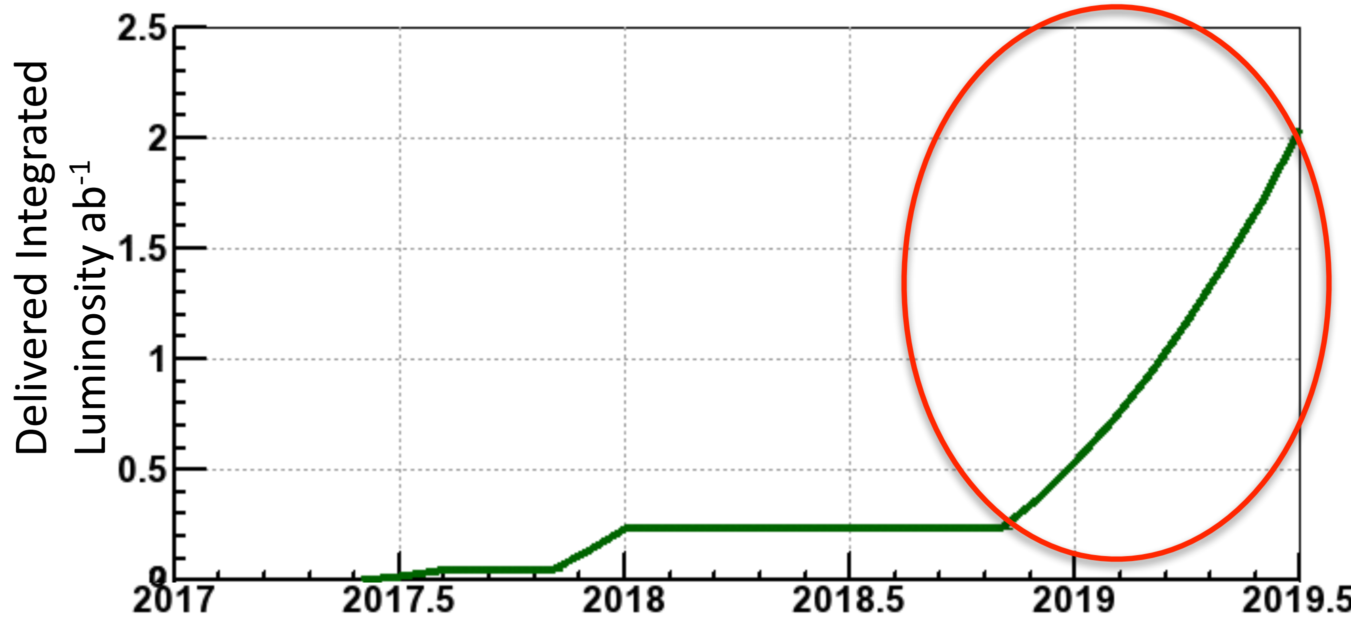
1. Υ(4S) is our core. Clear motivations to run mostly at Υ(4S) → see **Φ_3** projection.

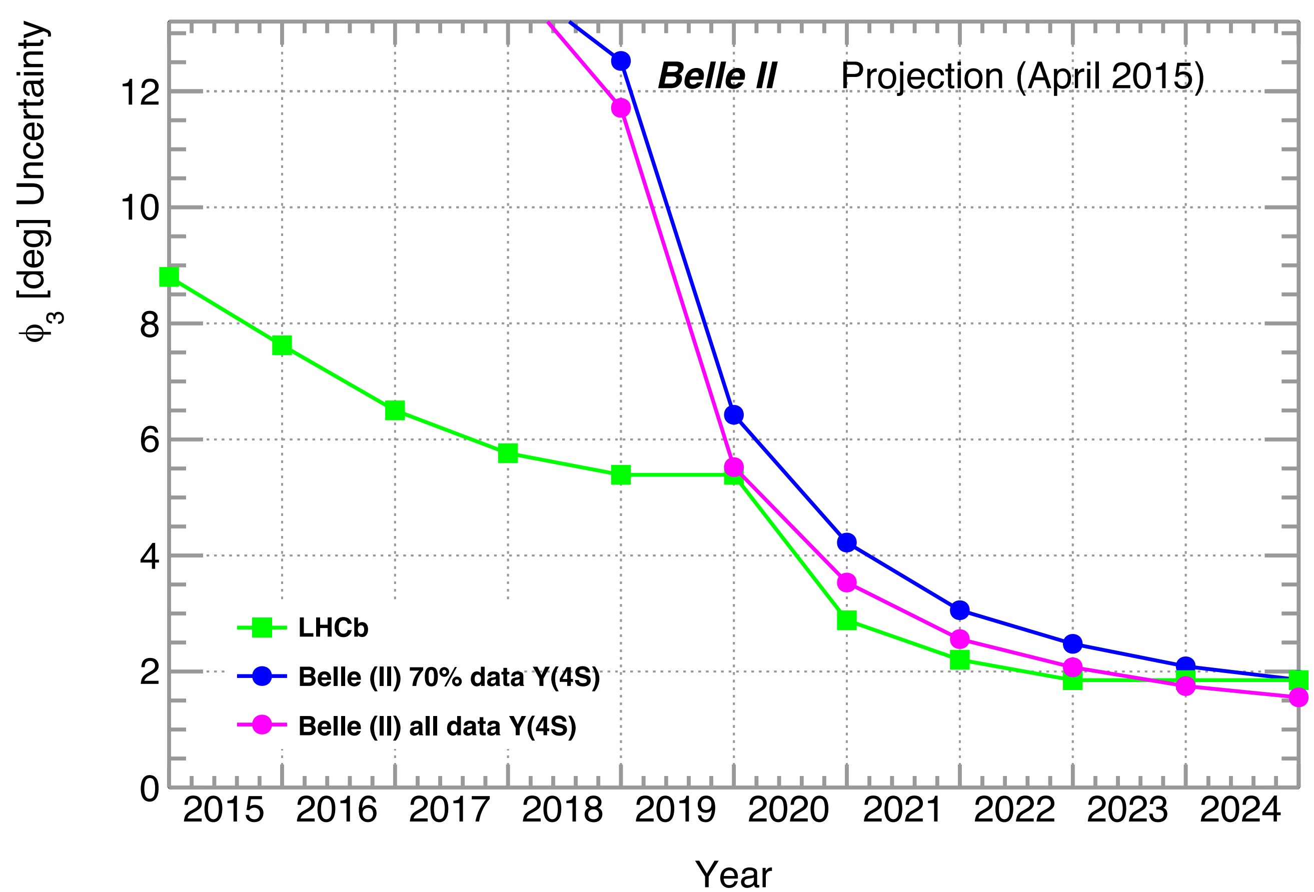
2. *Quantitative* arguments for running non Υ(4S) [for a few weeks] will be seriously considered.

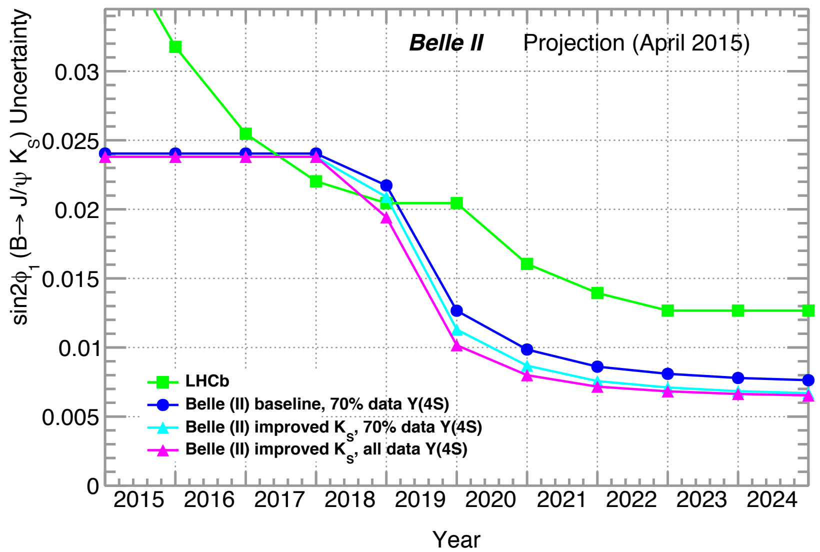
   Quarkonia(like) / **Υ(3S), Υ(6S), Scans**

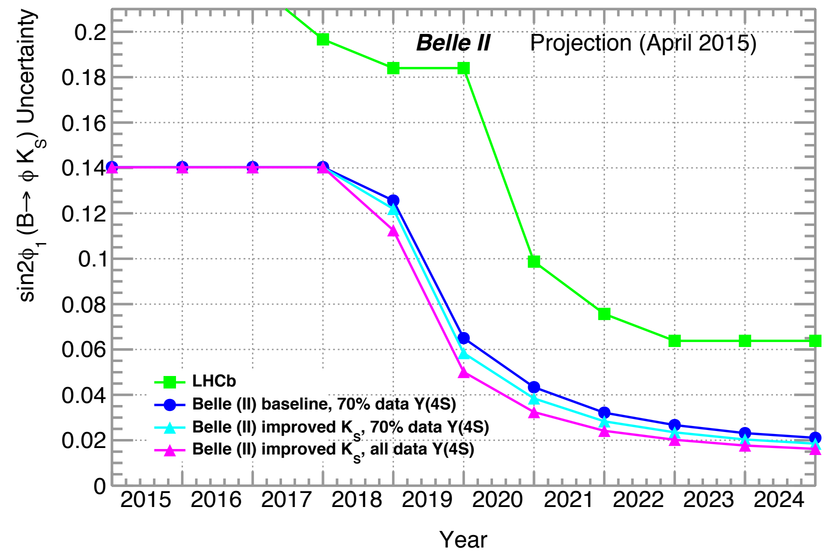
   We won't decide the program in the report, only to provide physics cases.

3. **Dark sectors** and low multiplicity trigger limited at Belle may have good opportunities irrespective of E_{CM}.

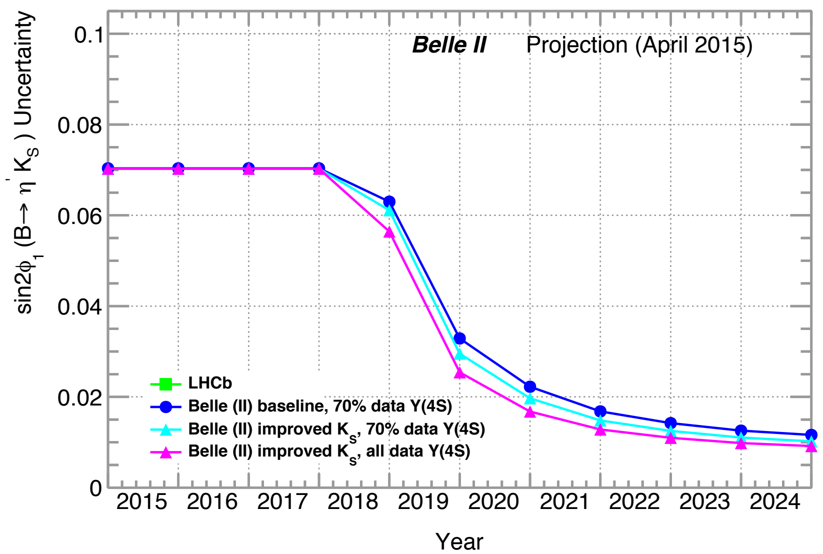








Time Dependent CVP



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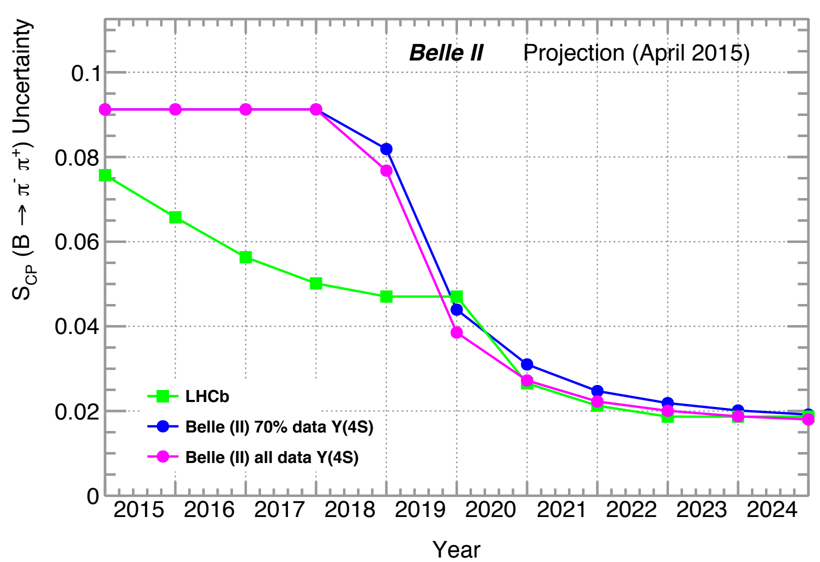

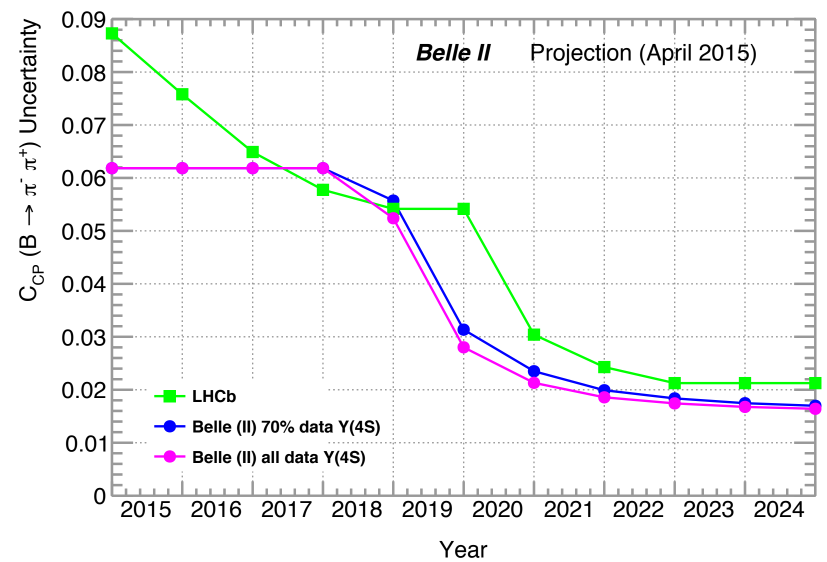

FIG. 4: Projected precision for various measurements of time dependent CP violation.

Direct CVP

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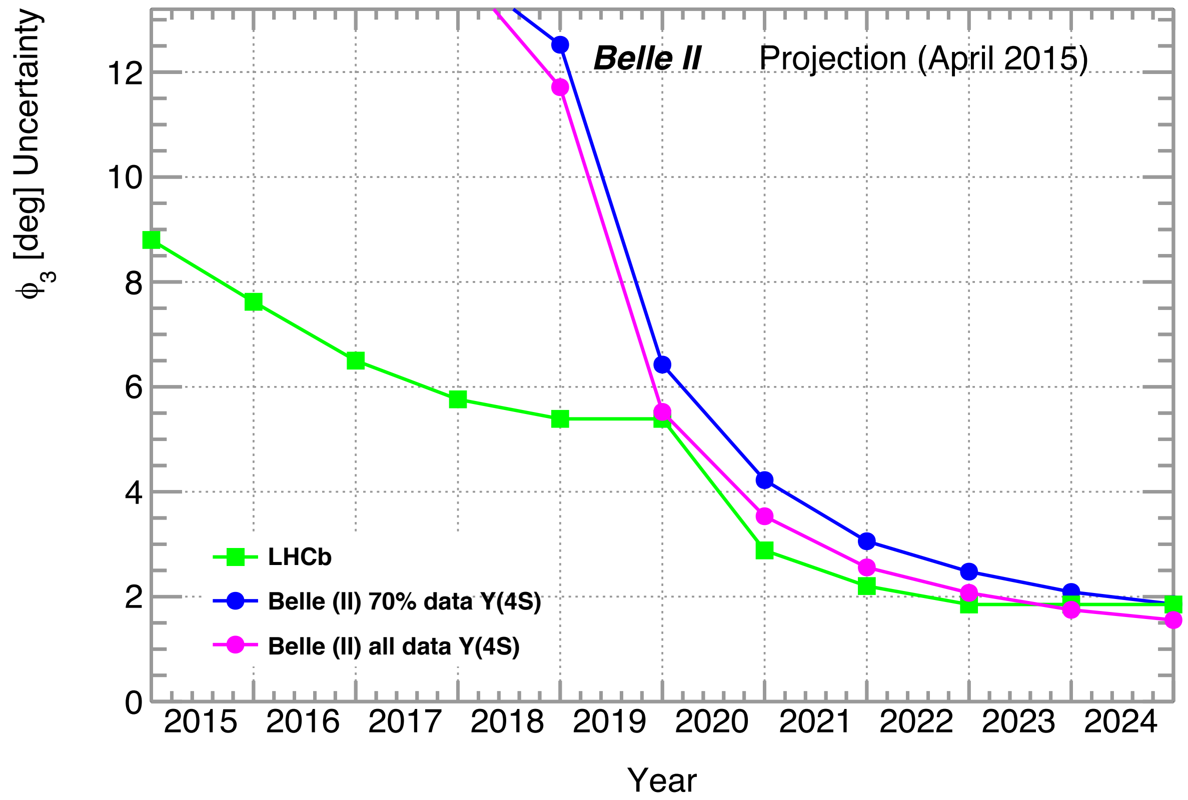

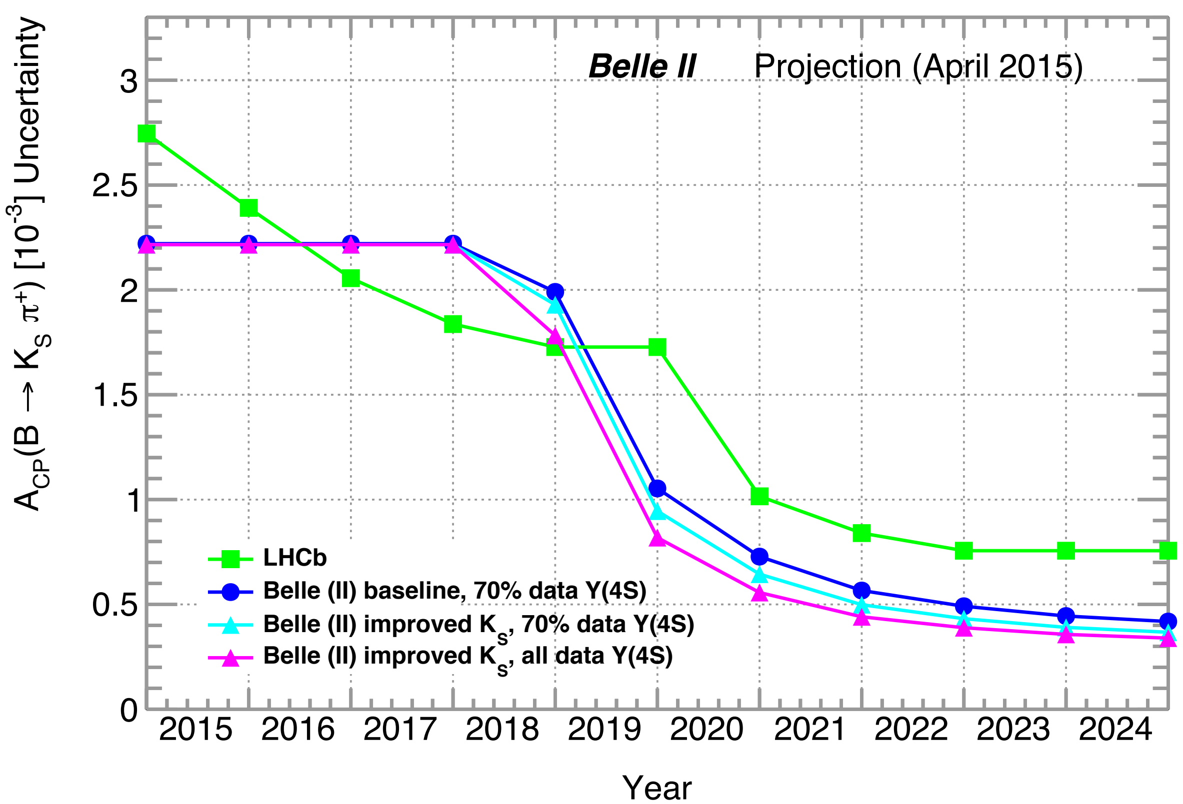

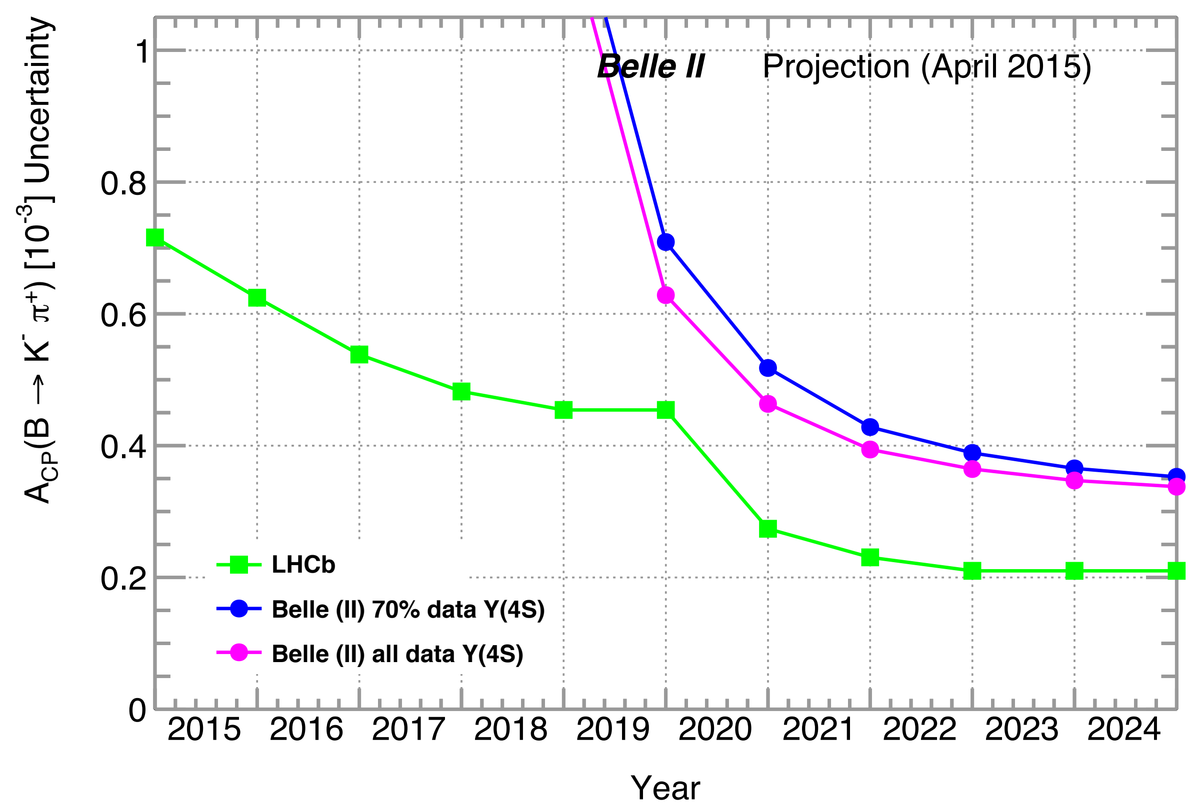

FIG. 5: Projected precision for various measurements of direct CP violation.

TABLE III: Extrapolations for selected semileptonic B decay measurements. See Table I for a description of the symbols.

Observables	Belle	Belle II	LHCb	
	(2015)	50 ab^{-1} 70%@$\Upsilon(4S)$	Run-1	23 fb^{-1}
	$(\sigma_{\rm stat}, \sigma_{\rm sys}, \sigma_{\rm th})$	$(\sigma_{\rm stat}, \sigma_{\rm sys}, \sigma_{\rm th})$	$(\sigma_{\rm stat}, \sigma_{\rm sys}, \sigma_{\rm th})$	$(\sigma_{\rm stat}, \sigma_{\rm sys}, \sigma_{\rm th})$
$\|V_{ub}\|$ Exclusive	(3.0, 2.2, 4.0)	(0.2, 0.8, 2.0)	$(4.6_{\rm exp}$,5.0)	(2.3‡,2.0)
$R(B \to D^{*}\tau\nu)$				

Semileptonic B decays

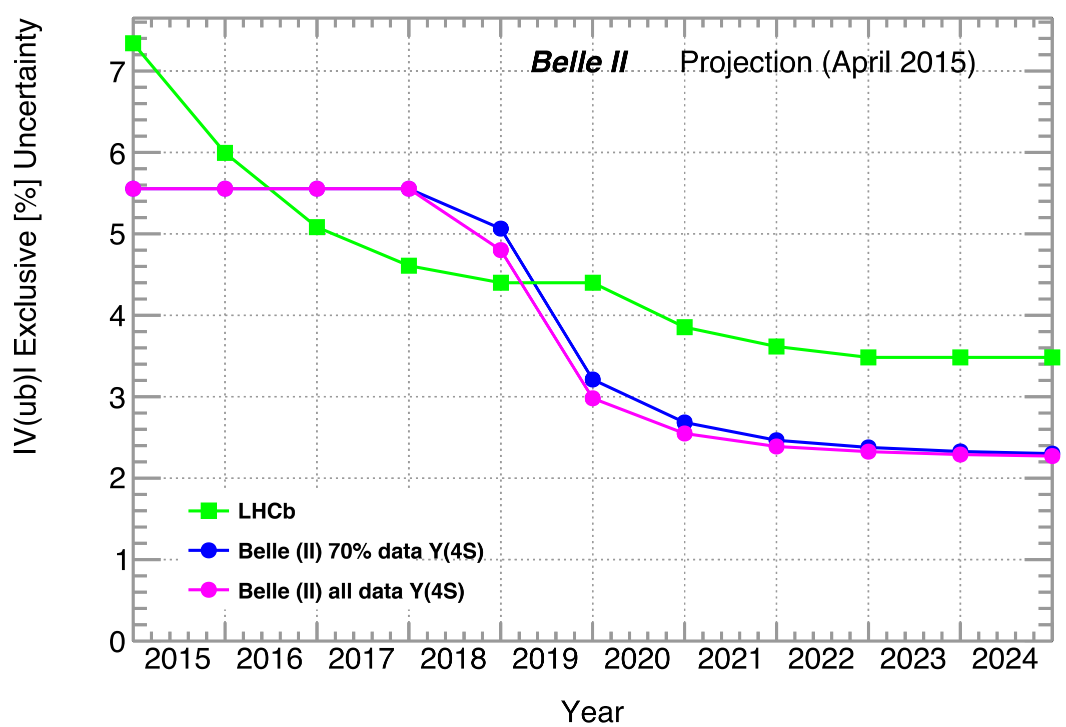

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FIG. 6: Projected precision for various measurements of semileptonic B decays.