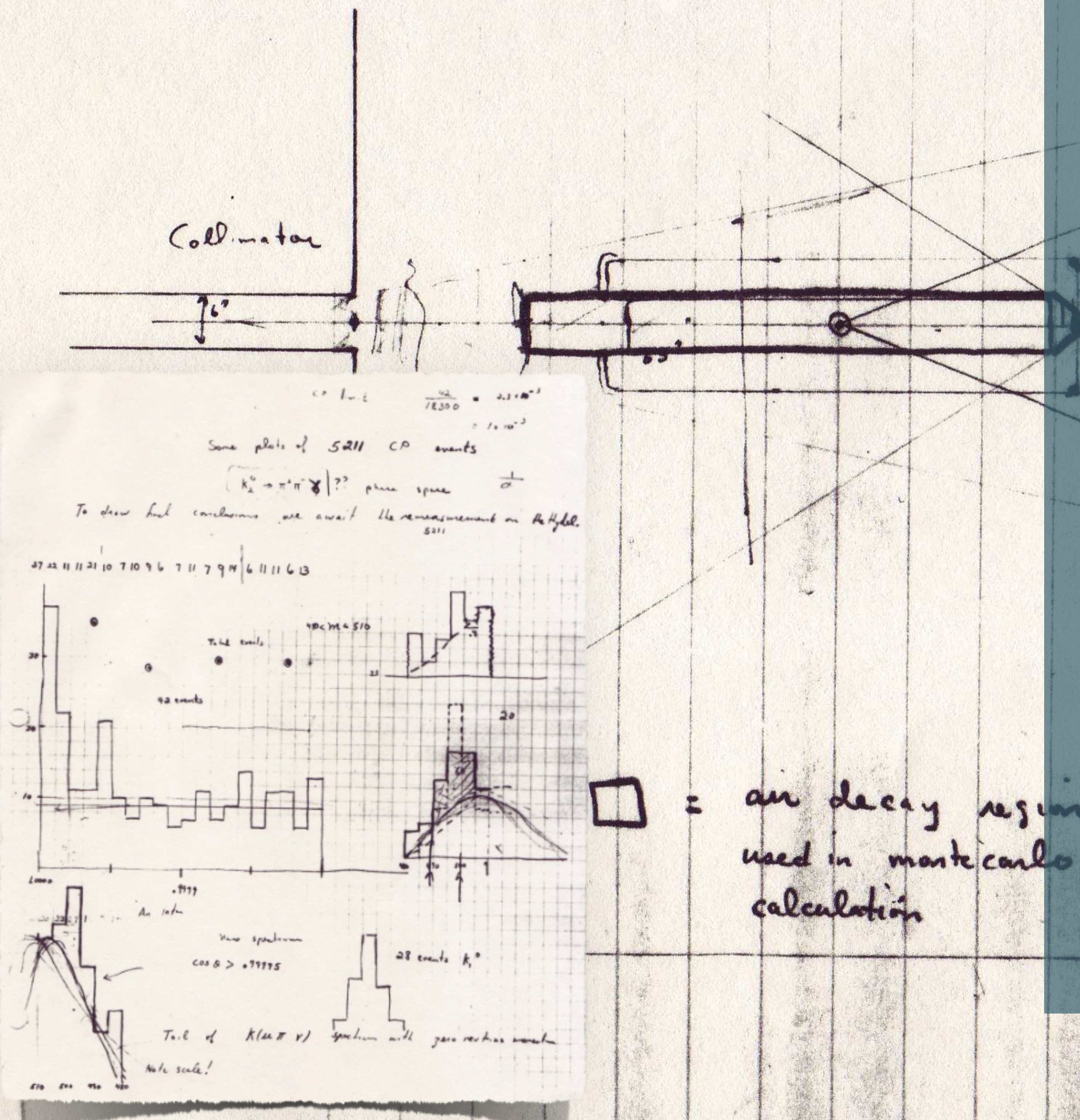


Experimental opportunities in CKM physics and CP violation

Diego Tonelli - INFN Trieste

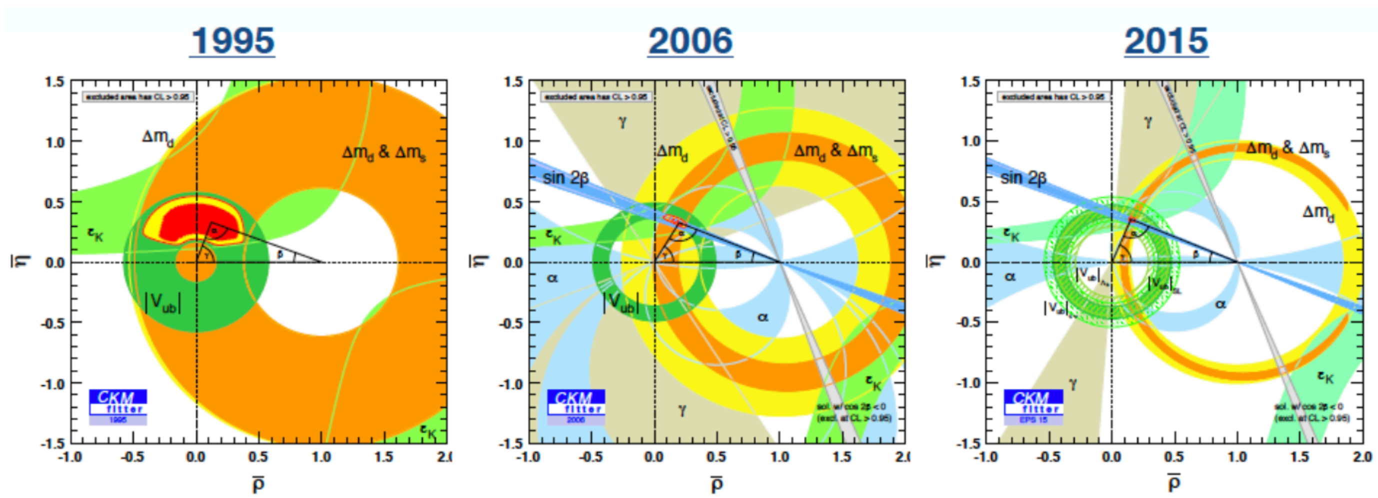
RF1 Snowmass workshop
Cincinnati - May 17, 2022

CKM physics — we’ve come a long way

1964: weak interactions of quarks show that laws of nature are not invariant if particles are replaced with antiparticles and their spatial coordinates inverted.

Diverse deep conceptual implications: impacts fundamental paradigms of QFT description of nature, microscopic time-reversibility of physical laws; dynamical generation of baryon asymmetry, etc.

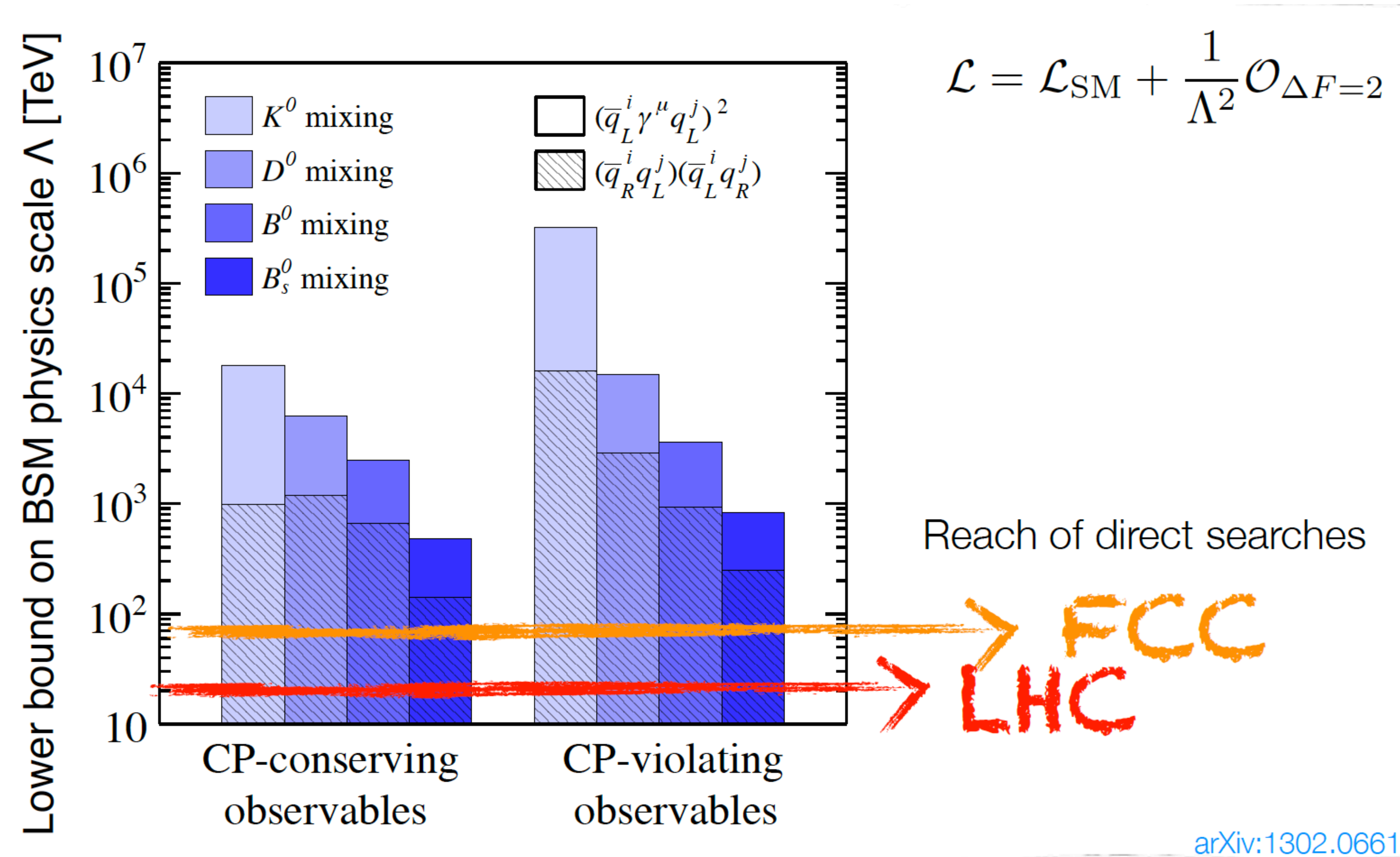
Following 35 years: characterizing CPV and accommodating in the SM.



Since early 2000’s, CKM physics seen as an indirect probe for non-SM dynamics

Non-SM physics naturally introduces additional CPV in known processes: comparison of precise measurements with precise SM predictions probes energy scales higher than directly accessed at the energy frontier.

How high?

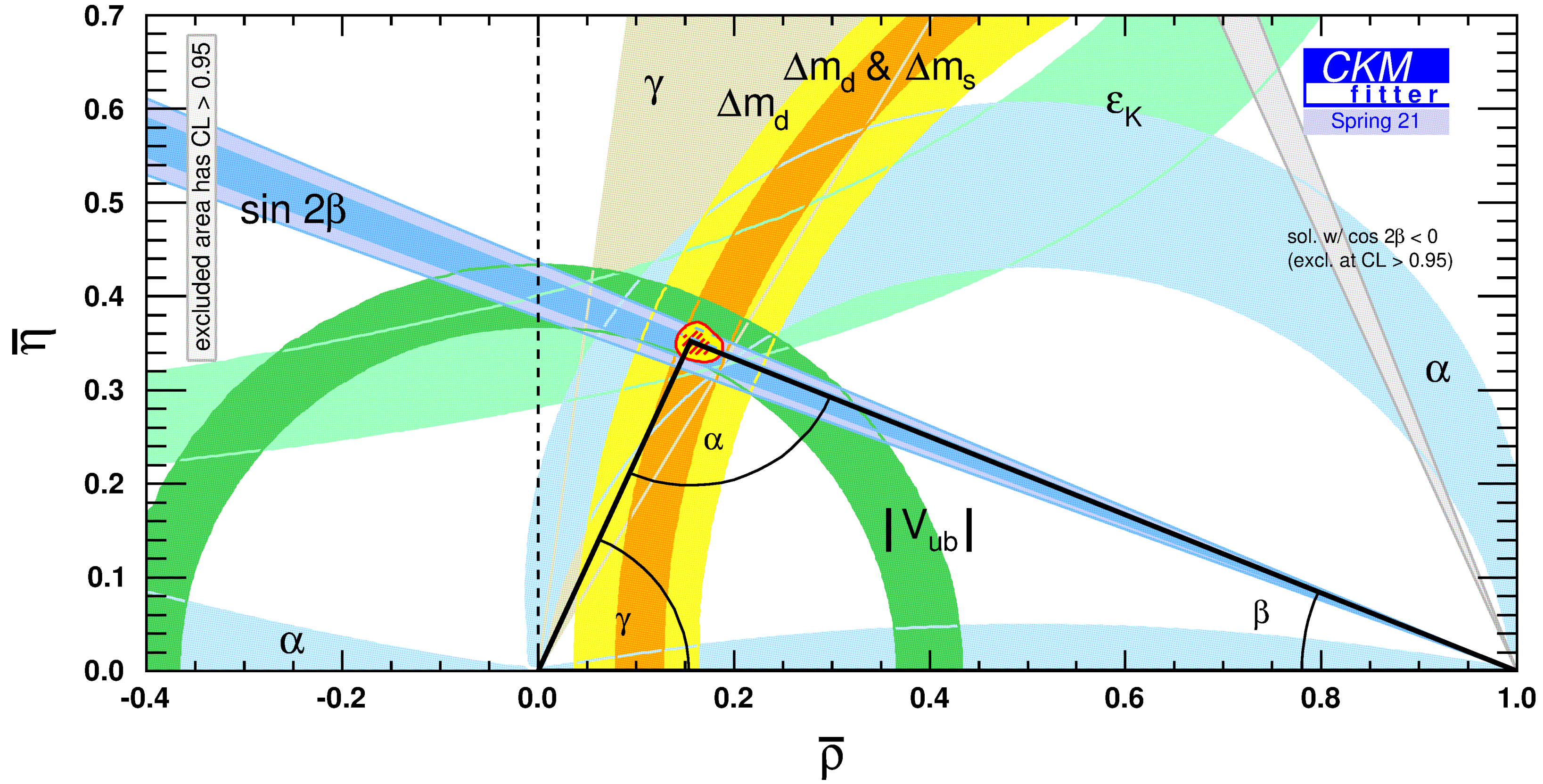


The challenge is not only in getting precise measurements.

Precise predictions/interpretations are also hard: pervasive strong-interaction phases enhance CP violating effects but makes their interpretation challenging

Status

CKM mechanism predicts all observations to within ~10-15% residual uncertainties



Not *just another SM success.*

Strongly predictive — flavor indicated *prior to LHC* no ewk-BSM was there

How to probe the wiggle room left? Achieve precision on suppressed processes similar to that achieved in favored ones.

The next decade, and beyond

Bad news: no more “killer apps” — golden channels almost over.

Advances now require combining inputs — often from different experiments, and theory — to reduce the interpretation unknowns. *Complementarity* is truly the name of the game.

Good news: reach mostly dominated by statistical uncertainties — intensity.

Unique circumstances: first time that two experiments dedicated to flavor operate simultaneously in the complementary environments of Y(4S) and hadron collisions (along with experiments dedicated to charm and rare kaons).

Unprecedented opportunity of making the most out of the physics (and pinpoint reliably any unexpected finding, thanks to experimental redundancy/mutual cross-checking)

“More is different”

This is not “business as usual — just more”.

More data enable transformative progress

Access new quantities, provide new detail in known distributions, allow new checks, generate new ideas etc.

4 August 1972, Volume 177, Number 4047 SCIENCE

More Is Different

Broken symmetry and the nature of the hierarchical structure of science.

P. W. Anderson

The reductionist hypothesis may still be a topic for controversy among philosophers, but among the great majority of active scientists I think it is accepted without question. The workings of our minds and bodies, and of all the animate or inanimate matter of which we have any detailed knowledge, are assumed to be controlled by the same set of fundamental laws, which except under certain extreme conditions we feel we know pretty well.

It seems inevitable to go on uncritically to what appears at first sight to be an obvious corollary of reductionism: that if everything obeys the same fundamental laws, then the only scientists who are studying anything really fundamental are those who are working on those laws. In practice, that amounts to some astrophysicists, some elementary particle physicists, some logicians and other mathematicians, and few others. This point of view, which it is the main purpose of this article to oppose, is expressed in a rather well-known passage by Weisskopf (*1*):

> Looking at the development of science in the Twentieth Century one can distinguish two trends, which I will call "intensive" and "extensive" research, lacking a better terminology. In short: intensive research goes for the fundamental laws, extensive research goes for the explanation of phenomena in terms of known fundamental laws. As always, distinctions of this kind are not unambiguous, but they are clear in most cases. Solid state physics, plasma physics, and perhaps also biology are extensive. High energy physics and a good part of nuclear physics are intensive. There is always much less intensive research going on than extensive. Once new fundamental laws are discovered, a large and ever increasing activity begins in order to apply the discoveries to hitherto unexplained phenomena. Thus, there are two dimensions to basic research. The frontier of science extends all along a long line from the newest and most modern intensive research, over the extensive research recently spawned by the intensive research of yesterday, to the broad and well developed web of extensive research activities based on intensive research of past decades.

The effectiveness of this message may be indicated by the fact that I heard it quoted recently by a leader in the field of materials science, who urged the participants at a meeting dedicated to “fundamental problems in condensed matter physics” to accept that there were few or no such problems and that nothing was left but extensive science, which he seemed to equate with device engineering.

The main fallacy in this kind of thinking is that the reductionist hypothesis does not by any means imply a “constructionist” one: The ability to reduce everything to simple fundamental laws does not imply the ability to start from those laws and reconstruct the universe. In fact, the more the elementary particle physicists tell us about the nature of the fundamental laws, the less relevance they seem to have to the very real problems of the rest of science, much less to those of society.

The constructionist hypothesis breaks down when confronted with the twin difficulties of scale and complexity. The behavior of large and complex aggregates of elementary particles, it turns out, is not to be understood in terms of a simple extrapolation of the properties of a few particles. Instead, at each level of complexity entirely new properties appear, and the understanding of the new behaviors requires research which I think is as fundamental in its nature as any other. That is, it seems to me that one may array the sciences roughly linearly in a hierarchy, according to the idea: The elementary entities of science X obey the laws of science Y.

X	Y
solid state or many-body physics	elementary particle physics
chemistry	many-body physics
molecular biology	chemistry
cell biology	molecular biology
⋮	⋮
psychology	physiology
social sciences	psychology

But this hierarchy does not imply that science X is “just applied Y.” At each stage entirely new laws, concepts, and generalizations are necessary, requiring inspiration and creativity to just as great a degree as in the previous one. Psychology is not applied biology, nor is biology applied chemistry.

In my own field of many-body physics, we are, perhaps, closer to our fundamental, intensive underpinnings than in any other science in which nontrivial complexities occur, and as a result we have begun to formulate a general theory of just how this shift from quantitative to qualitative differentiation takes place. This formulation, called the theory of “broken symmetry,” may be of help in making more generally clear the breakdown of the constructionist converse of reductionism. I will give an elementary and incomplete explanation of these ideas, and then go on to some more general speculative comments about analogies at

The author is a member of the technical staff of the Bell Telephone Laboratories, Murray Hill, New Jersey 07974, and visiting professor of theoretical physics at Cavendish Laboratory, Cambridge, England. This article is an expanded version of a Regents' Lecture given in 1967 at the University of California, La Jolla.

Intensity, intensity, intensity — challenges

For machines: achieving high intensities is hard. Accelerator colleagues too explore (technologically) uncharted territory — plus, labs face external challenges (rising electric bills, etc)

For experiments: high intensities means more data and higher backgrounds. Harder to operate detectors (noise, track-finding, PID, identifying, triggering). Harder to process data. Harder to make sense of them. Most* upgrades aim at *maintaining* performance under harsher conditions. Key when precision driven by systematics.

For the community at large: timely and quality results requires competition. But efficient complementarity requires synergy. Synching result format for integration across experiments and with pheno inputs (e.g.,consistent choices of observables, consistent schemes for systematic uncertainties etc.)

*important exceptions: upcoming LHCb trigger-DAQ upgrade, that will boost efficiency on hadronic decays or changing collision energies to collect samples specifically targeted at certain goals.

Players

LHCb

- Huge advantage in production rate, but large backgrounds results in lower efficiencies (advantage remains mostly for charged final states)
- Larger boost and superior decay-time resolution for time-dependent measurements
- Access to all *b*-hadron species

Belle II

- Cleaner environment allows for more generous selections — milder efficiency effects
- Unique access to fully neutral final states and decays with invisible particles
- Quantum-correlated $B\bar{B}$ production allows efficient determination of production flavor for time-dependent *CP*-violation measurements

ATLAS/CMS

- Larger inst. lumi. than LHCb, access limited to final states with dimuons

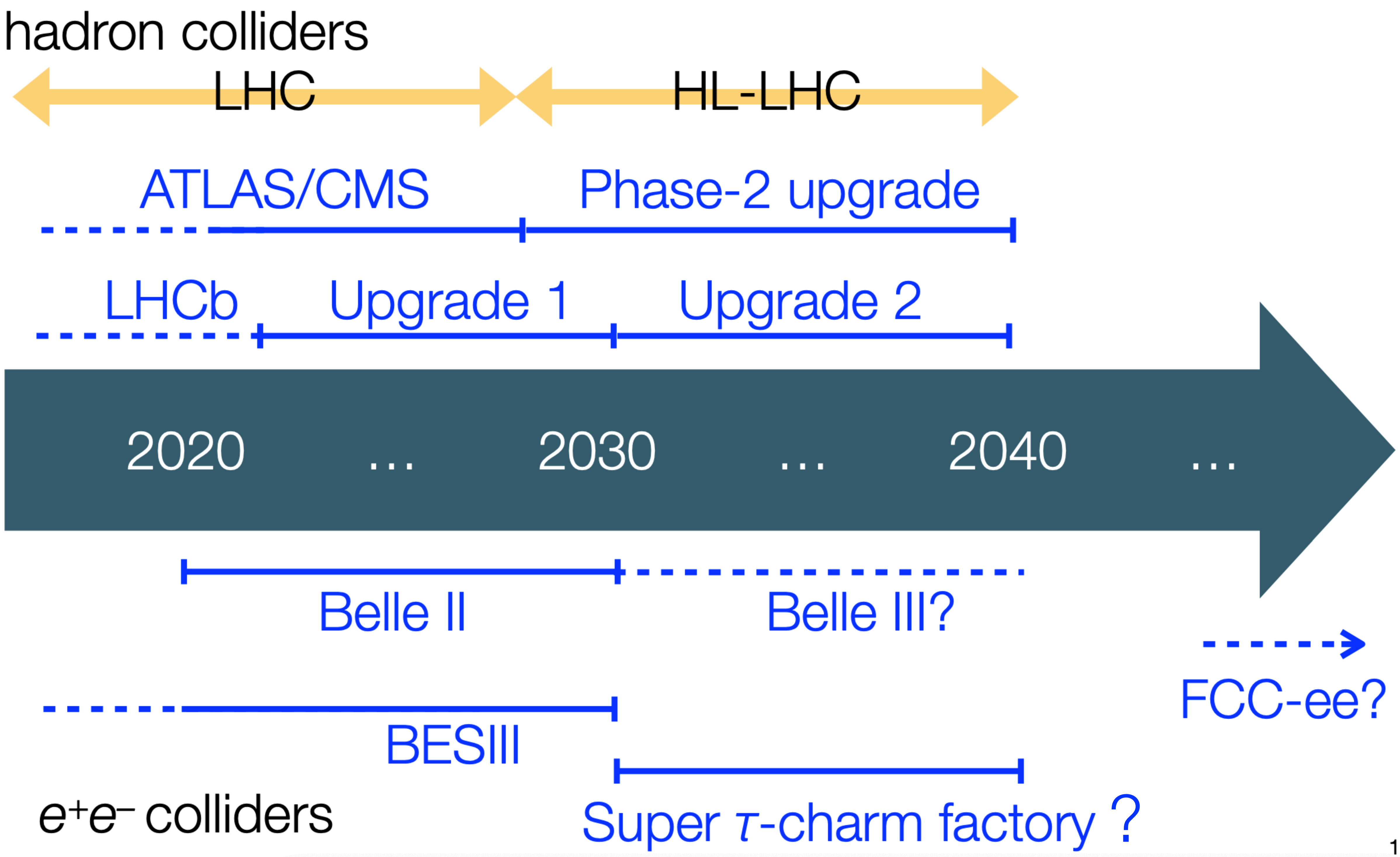
charm-τ factories (BESIII/STCF)

- Unique access to quantum-correlated $D^0\bar{D}^0$ pairs

FCC-ee

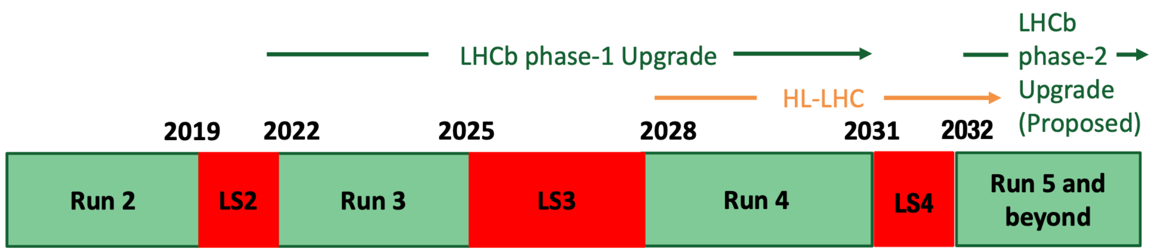
Tera-Z: 5000 billion Z decays (up to 15x Belle II HF yield)
Somehow combines most of of Belle II advantages with
pp-like boost and access to all hadron species

Timeline


hadron colliders
LHC
HL-LHC
ATLAS/CMS
Phase-2 upgrade
LHCb
Upgrade 1
Upgrade 2
2020
...
2030
...
2040
...
Belle II
Belle III?
FCC-ee?
BESIII
e^+e^- colliders
Super τ-charm factory ?

Schedules

LHCb schedule



- Int. L = 9 fb^{-1}

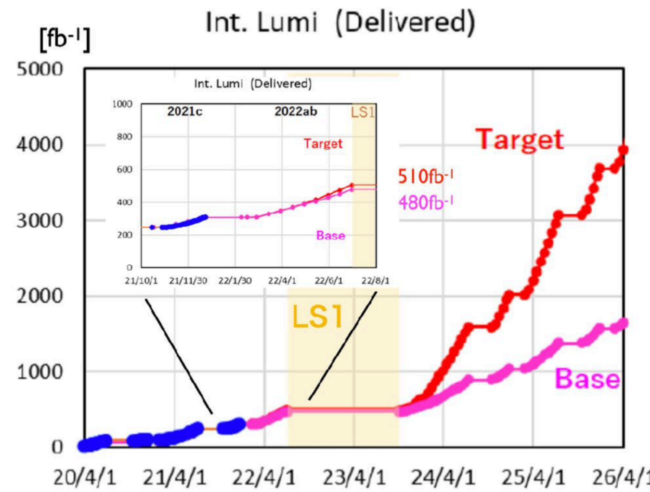
- LHCb Upgrade 1: new tracking/vertexing, new electronics, software-only trigger
- $L = 2\times10^{33}$ (5x Run 2)
- Target int. L = 50 fb^{-1} by Run 4

- LHCb Upgrade 2: all new detector
- $L = 2\times10^{34}$
- Target int. L = 300 fb^{-1} by Run 6

- ATLAS/CMS phase-2 upgrades
- LHCb incremental/consolidation upgrade (Upgrade 1b)

Belle II schedule

- Running since 2019, int. L = 380 fb^{-1}
- Target int. L = 50 ab^{-1} by 2032
  - LS1 (summer 2022-fall 2023): mainly to replace PXD
  - LS2 (~2026-2027): upgrade SuperKEKB, to reach target $L = 6.5\times10^{35}$ cm^{-2}s^{-1}, and parts of the detector, to improve robustness against machine backgrounds
- Future upgrades (beyond the currently planned program)
  - beam polarization for precision electroweak (and τ) physics
  - Belle III at ultra-high luminosity? Target $L > 10^{36}$ cm^{-2}s^{-1}, int. L = 250 ab^{-1}



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BESIII schedule

- till Jul 2024 psi(3770) up to 20 fb-1 additional running
- Jul - Dec 2024: BEPC-II upgrade (double luminosity above psi3770 peak)
- 2025-2028: beam commissioning (2.3–2.5 GeV): XYZ physics
- 2028-2030: beam commissioning (2.5–2.8 GeV) charm baryon thresholds

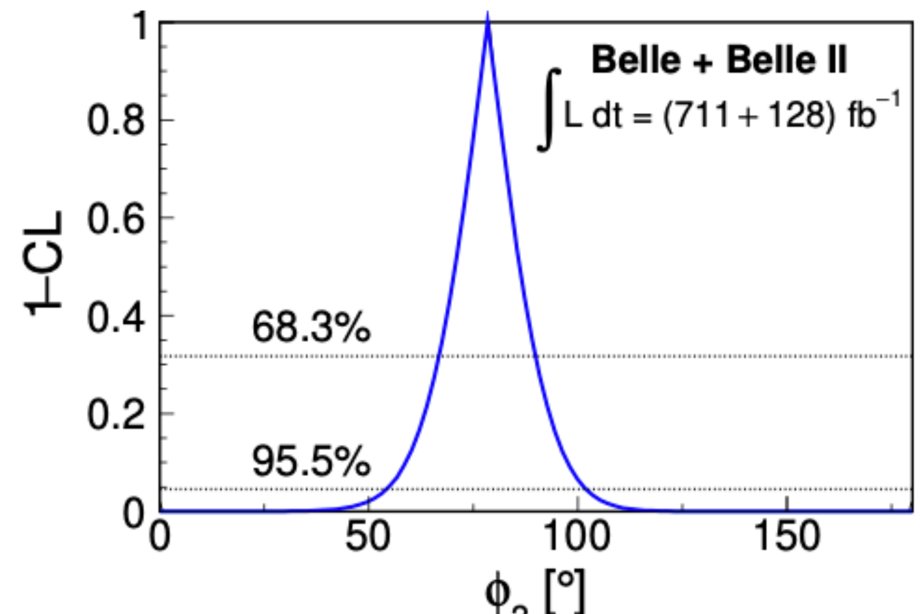
In what follows

Combined global CKM-related output in next decade will be 1000+ papers.

I'll sample only a few topics I believe are the most impactful and representive of the uniqueness and relevance of the program

Based on recent Snowmass WPs (and occasional personal elaborations):

- Most LHCb/BESIII projections based on data.
- Most Belle II projection based on detailed MC or Belle results.
- Most SCTF/FCC projections based on simplified MC / guesstimates



20-30% more precise with 20% more data,

Systematic uncertainty projections may involve overoptimistic biases. But new ideas that are not anticipated today typically make up for that. Final quantitative message unlikely to be too wrong

CKM benchmarks
(the more reliable your null, the more convincing the deviation)

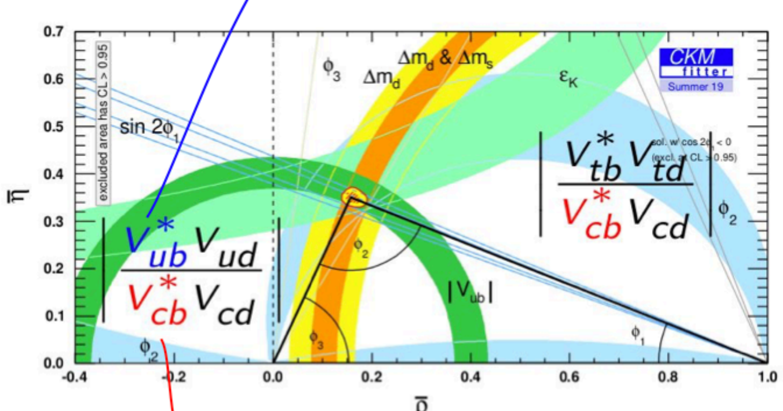
The $|V_{ub}|$ and $|V_{cb}|$ benchmarks

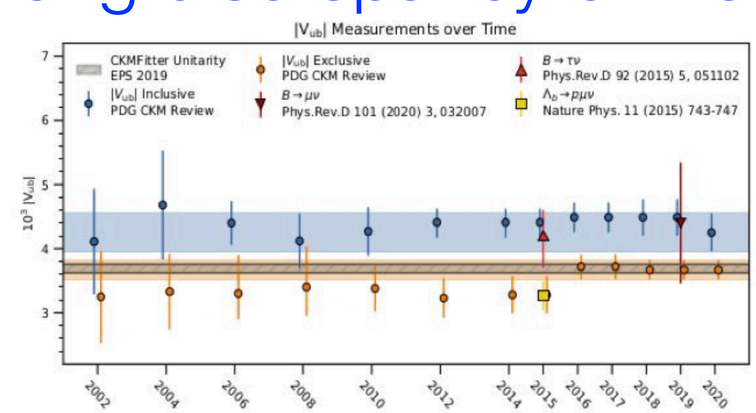
$|V_{ub}|$ — major limiting factor for precision of UT fit consistency.

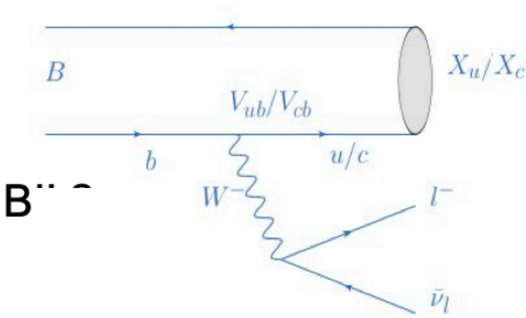
$|V_{cb}|$ similarly important — also, it limits future reach in *B* mixing and interpretation of rare $B^0_s \to \mu\mu$ and $K \to \pi\nu\nu$.

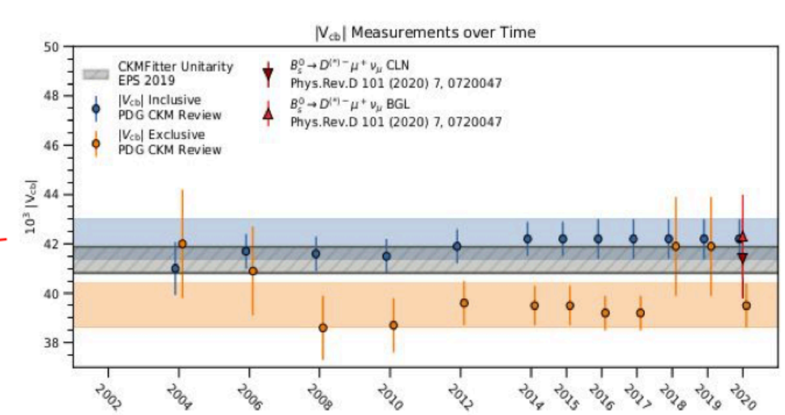
Measure from rates of $B \to \pi/D^{(*)} \ell \nu$ decays where hadronic system reconstructed exclusively or inclusively plus important inputs from LQCD.

Current averages have 3%~6% uncertainties limited by systematic uncertainties. But impasse driven by 20-year-long discrepancy btw exclusive and inclusive

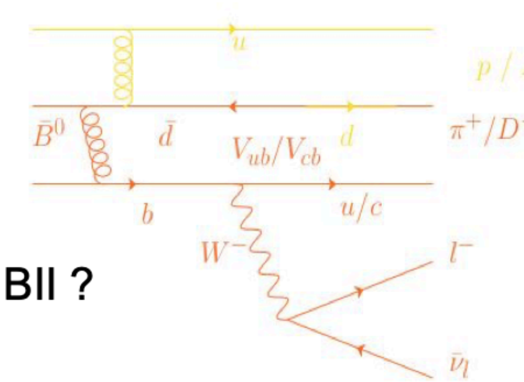








BII ?



The $|V_{ub}|$ and $|V_{cb}|$ benchmarks

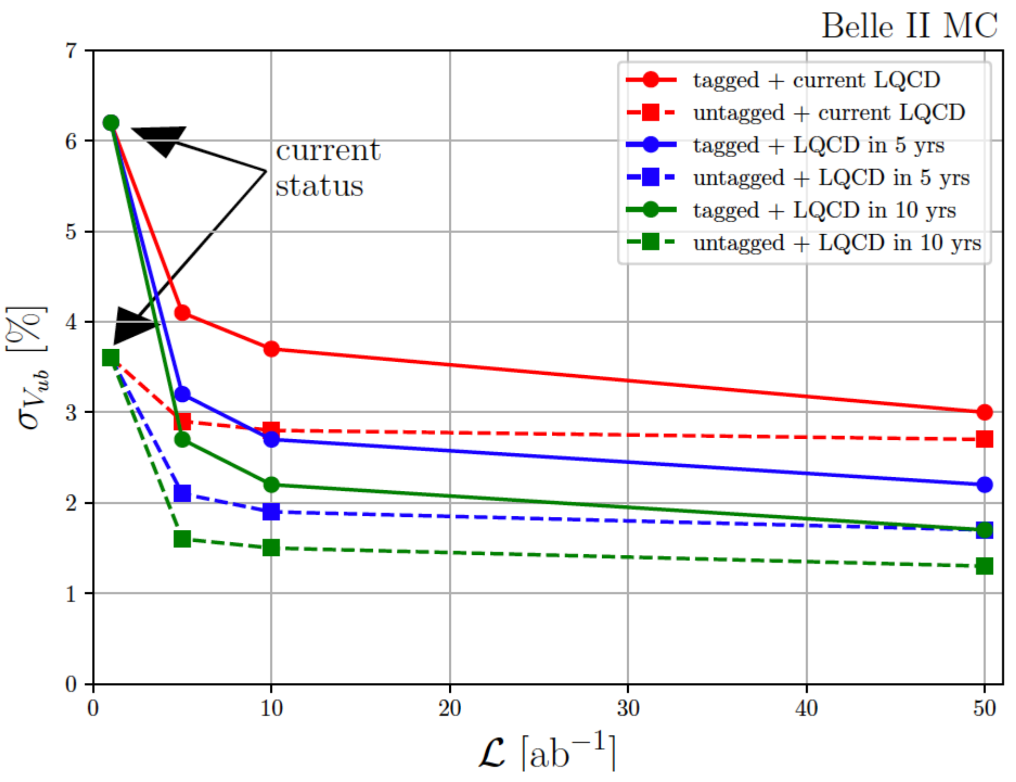
Not obvious that data deluge and pheno improvements (rad. corr., lattice, etc) will solve discrepancy — if keep doing the same, why would we get different results? Opportunity (and challenge) is to innovate.

(i) systematic effort at understanding D** feed-down and semileptonic BF gap?

(ii) More observables (e.g., lepton A_{FB})?

(iii) Can measure directly form factors (not parametrizations or unfolded data) to compare them unbiasedly with theory?

(iv) Use of B → τ/μ ν inputs?



A proxy of what lies ahead for many CKM measurements down the line?

Belle II leads with asymptotic 1-3% precisions. LHCb offers important independent checks, exploiting access to other hadrons and relative |Vub/Vcb|. FCC may also contribute using tagged W-jets, *B^0_s/Λb and B_c→ τ/μ ν*

The $|V_{cs}|$ and $|V_{cd}|$ benchmarks

$|V_{cs}|$ and $|V_{cd}|$ determinations offer additional constraining information

Currently known with 1%–2% uncertainties from $D_{(s)} \to \ell\nu$ and $D_{(s)} \to h\ell\nu$ BF and lattice inputs

Most advances expected in D^0 / D^+, driven by BESIII, as D^+_s already hitting systematic floor. Expect 30%—100% improvements in precision.

Further improvements by SCTF would need dedicated work on systematics.

Potential for complementary and precise approaches to $|V_{cs}|$ from hadronic W flavor tagging at FCC

The angle γ (or ϕ3) benchmark

Principal gauge of SM CP violation — very reliably predicted (10^{-6} relative)

Access through interfering $B^- \to D^0K^-$ and $B^+ \to \bar{D}^0K^+$ decays with D^0 and $\bar{D}^0$ reconstructed in same final state.

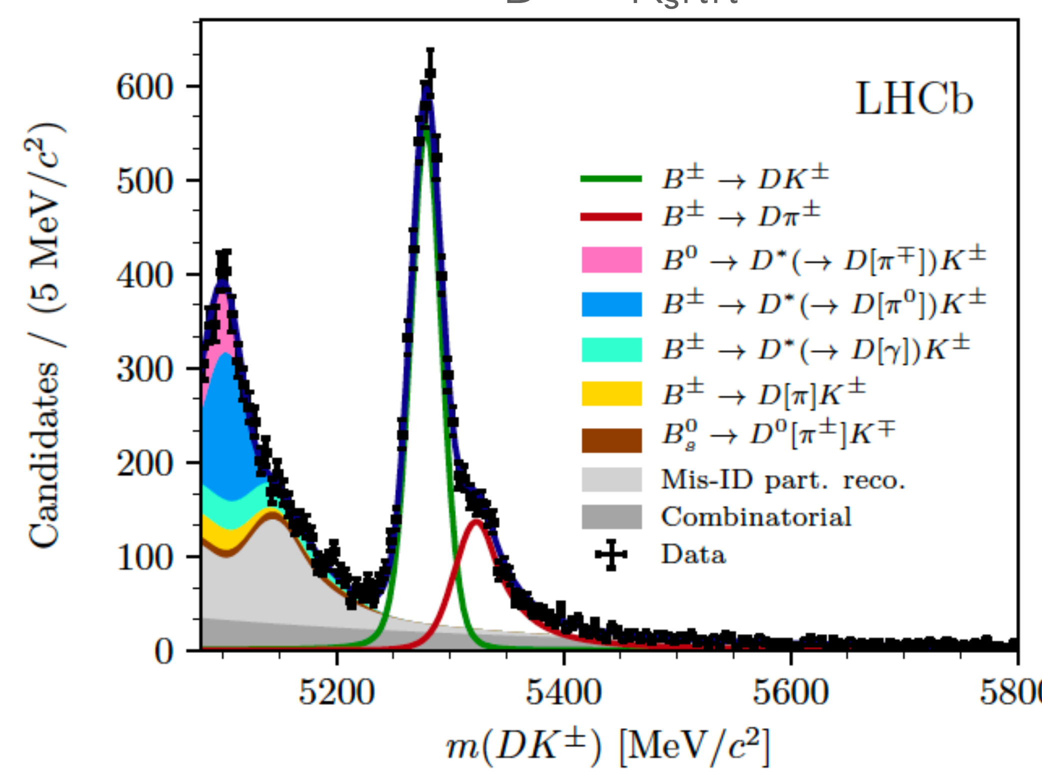
Tree level — no BSM.

4° precision, driven by LHCb sample size.

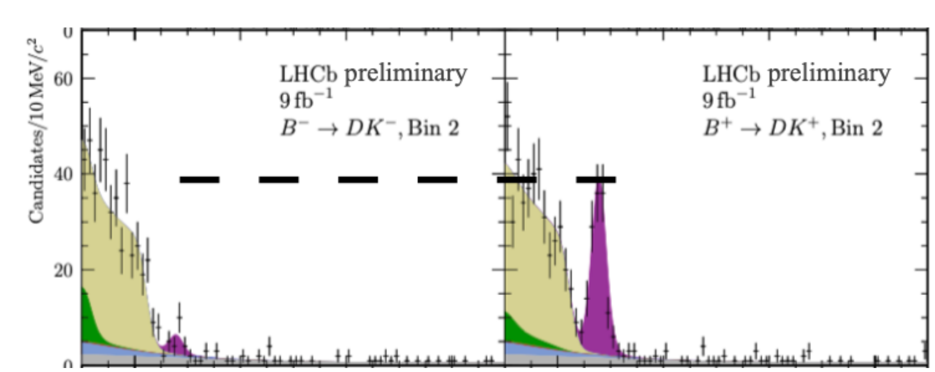
Steady refinements of approaches in the pas decade.

Converged on using yield asymmetries in Dalitz-plot bins of multibody *D* decays using charm-factory inputs for hadronic nuisance parameters. A handful of channels dominate precision.

$D^0 \to K_s\pi\pi$



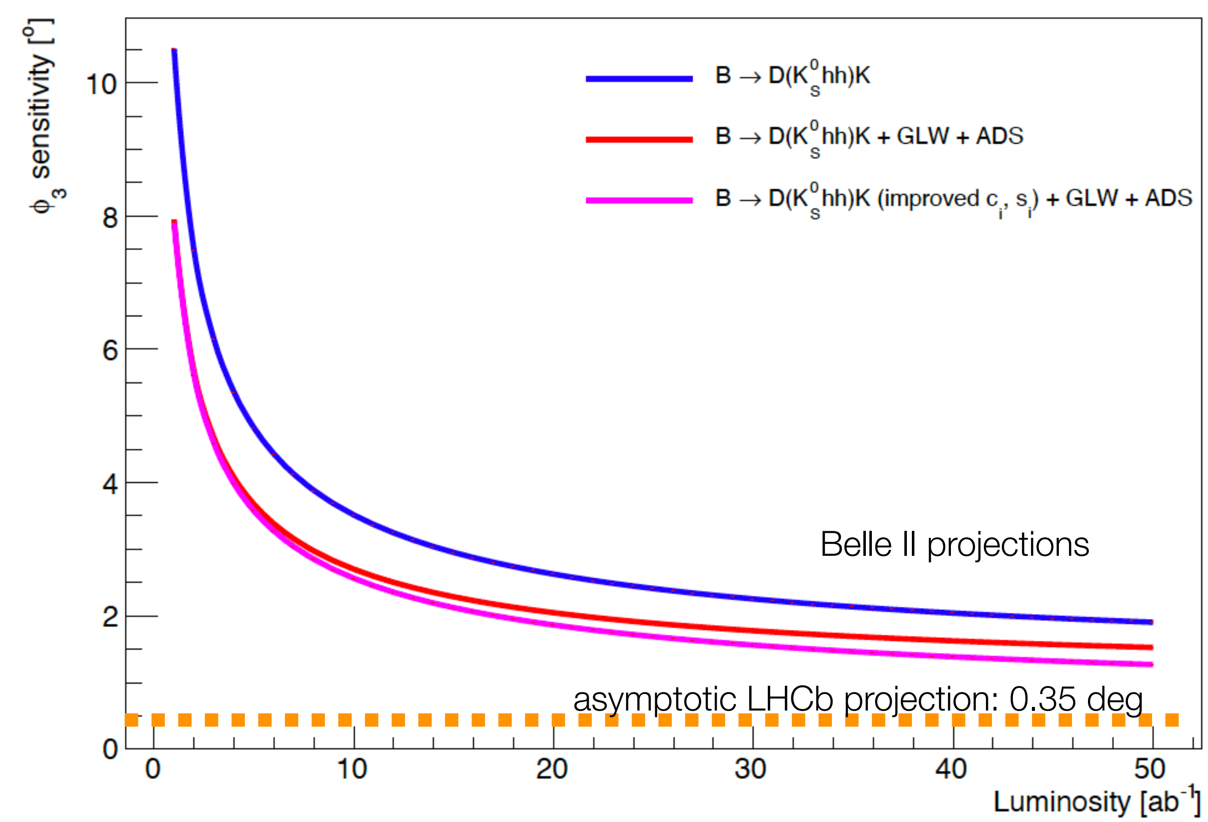
$D^0 \to K\pi\pi\pi$



γ (or ϕ3) reach

Table 2: Overview of all sources of uncertainty, σ, on $x_{\pm}^{DK}$, $y_{\pm}^{DK}$, $x_{\xi}^{D\pi}$, and $y_{\xi}^{D\pi}$. All uncertainties are quoted $\times 10^{-2}$.

Source	$\sigma(x_{-}^{DK})$	$\sigma(y_{-}^{DK})$	$\sigma(x_{+}^{DK})$	$\sigma(y_{+}^{DK})$	$\sigma(x_{\xi}^{D\pi})$	$\sigma(y_{\xi}^{D\pi})$
Statistical	0.96	1.14	0.98	1.23	1.99	2.33
Strong-phase inputs	0.23	0.35	0.18	0.28	0.14	0.18
Efficiency correction of (c_i, s_i)	0.11	0.05	0.05	0.10	0.08	0.09
Mass-shape parameters	0.05	0.08	0.03	0.08	0.16	0.17
PID efficiencies	0.03	0.03	0.01	0.05	0.02	0.02
Fixed yield ratios	0.05	0.06	0.03	0.06	0.02	0.02
Mass-shape bin dependence	0.05	0.07	0.04	0.08	0.07	0.09
Part. reco. physics effects	0.04	0.10	0.15	0.05	0.10	0.09
Small backgrounds	0.11	0.16	0.13	0.12	0.08	0.13
Dalitz-bin migration	0.04	0.08	0.08	0.11	0.18	0.10
CP violation of K_S^0	0.03	0.04	0.08	0.08	0.09	0.46
D mixing	0.04	0.01	0.00	0.02	0.02	0.01
Bias correction	0.04	0.03	0.02	0.04	0.09	0.05
Total LHCb-related uncertainty	0.20	0.25	0.24	0.26	0.32	0.54
Total systematic uncertainty	0.31	0.43	0.30	0.38	0.35	0.57



LHCb gets upper hand. Belle II offers consistency checks to establish convincingly the conclusive picture.

At ~1° precision, systematic uncertainties will matter.

Complementarity is trilateral: Belle II and LHCb use CLEO+BESIII inputs, which are instrumental to reach the asymptotic precision. Current ~1.5° contribution (CLEO+BESIII) expected to shrink to ~0.5° (BES III after 2024) and to ~0.1° (SCTF)

BSM probes

The angle α (or ϕ_2)

Alpha precision is 4°. Once γ and $|V_{xb}|$ improvements kick in, improve alpha too to avoid spoiling power of CKM test

Combine analyses of $B \to \rho\rho$ isospin family to suppress hadronic unknowns.

Belle II accesses all inputs. Ultimate results will combine LHCb inputs ($\rho^0\rho^0$) and Belle II inputs ($\rho^+\rho^0$ and $\rho^+\rho^-$) and $B \to \pi\pi$ decays.

Expect 1° precision.

Doing better requires advances in Dalitz-plot model uncertainties and in understanding isospin-breaking size (e.g., using $B \to \pi\,\eta(')$)

Insight also from $B \to \rho\pi$ though projections hard due to peculiar statistical challenges of this analysis.

Alternate approaches involving *relative BF* promise to reduce systematics and to make LHCb self-sufficient (2110.08183)

Further in future (Belle II@50/fb/LHCb upgrade II/FCC): use $B \to \pi\pi$ decays by vertexing $B \to \pi^0\pi^0$ from conversions and Dalitz decays?

Hadronic $B \to K\pi$ decays

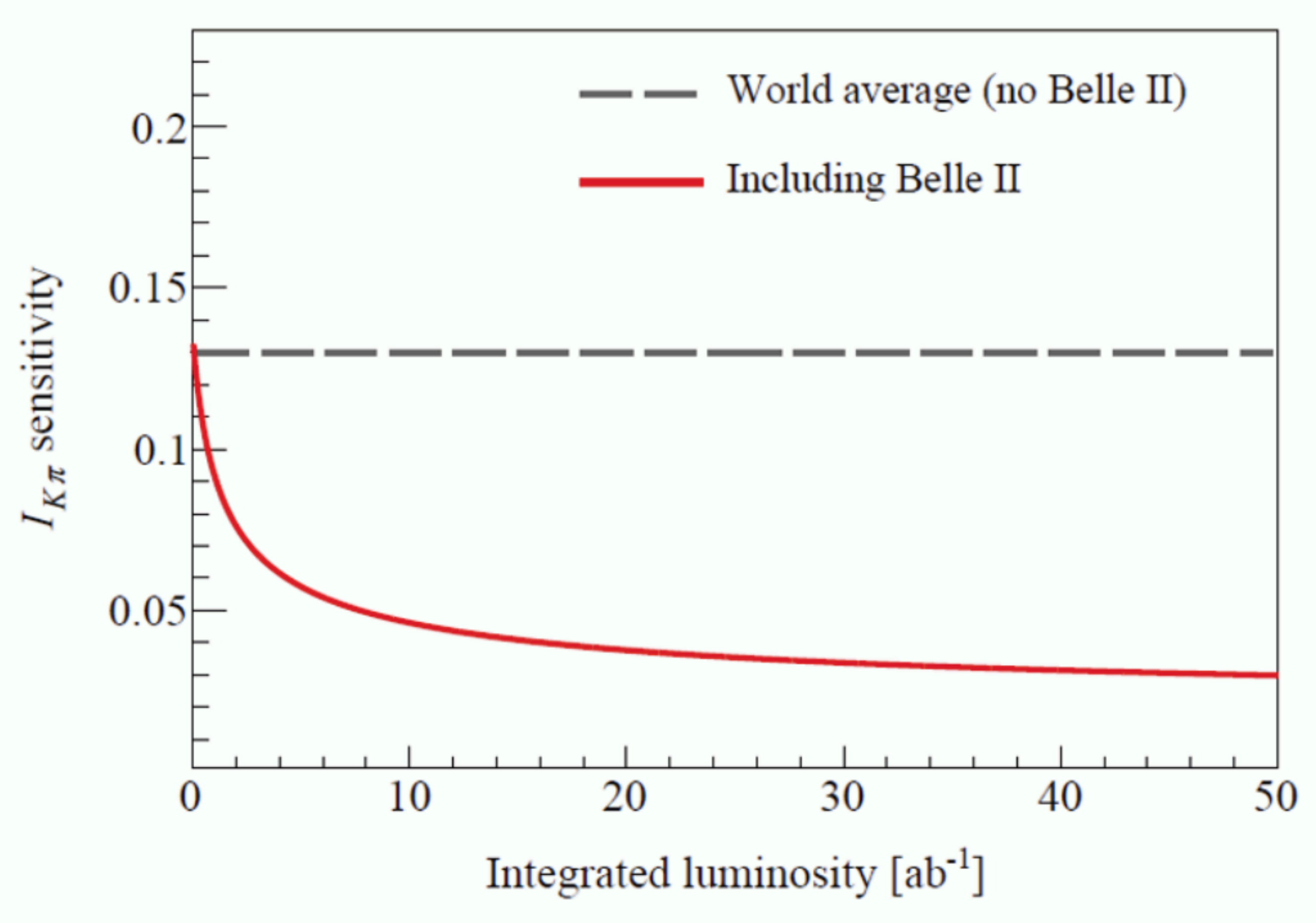
Hadronic unknowns from soft gluons: hard to extract reliably CKM phases from single processes. Appropriate combinations of channels suppress unknowns offering stringent BSM tests

$$I_{K\pi} = \mathcal{A}_{K^+\pi^-} + \mathcal{A}_{K^0\pi^+} \frac{\mathcal{B}(K^0\pi^+)}{\mathcal{B}(K^+\pi^-)} \frac{\tau_{B^0}}{\tau_{B^+}} - 2\mathcal{A}_{K^+\pi^0} \frac{\mathcal{B}(K^+\pi^0)}{\mathcal{B}(K^+\pi^-)} \frac{\tau_{B^0}}{\tau_{B^+}} - 2\mathcal{A}_{K^0\pi^0} \frac{\mathcal{B}(K^0\pi^0)}{\mathcal{B}(K^+\pi^-)}$$

Current precision 13%.

Reduce to ~2% thanks to precise LHCb determinations in final states with charged and unique Belle II access to $K^0\pi^0$

Similar tests accessible in $K^*\pi$ and $K^*\rho$ systems



Hadronic decays — in charm too

$D^+ \to \pi^+\pi^0$: one of the few golden channels left! Isospin constrains its CPV to zero in the SM offering powerful null test for BSM.

Nonzero ACP and a zero value for R would indicate BSM physics.

$$R = \frac{\mathcal{A}_{CP}(D^0 \to \pi^+\pi^-)}{1 + \frac{\tau_{D^0}}{\mathcal{B}_{+-}}\left(\frac{\mathcal{B}_{00}}{\tau_{D^0}} + \frac{2}{3}\frac{\mathcal{B}_{+0}}{\tau_{D^+}}\right)} + \frac{\mathcal{A}_{CP}(D^0 \to \pi^0\pi^0)}{1 + \frac{\tau_{D^0}}{\mathcal{B}_{00}}\left(\frac{\mathcal{B}_{+-}}{\tau_{D^0}} + \frac{2}{3}\frac{\mathcal{B}_{+0}}{\tau_{D^+}}\right)} - \frac{\mathcal{A}_{CP}(D^+ \to \pi^+\pi^0)}{1 + \frac{3}{2}\frac{\tau_{D^+}}{\mathcal{B}_{+0}}\left(\frac{\mathcal{B}_{00}}{\tau_{D^0}} + \frac{\mathcal{B}_{+-}}{\tau_{D^0}}\right)}$$

Currently $A_{CP}(D^+ \to \pi^+\pi^0)$~0 within 1% and R ~ 0 within 2.4%.

Table 7: Expected statistical uncertainties on $A_{CP}(D^{+,0} \to \pi^{+,0}\pi^0)$ as a function of Belle II integrated luminosity. The projections are based on D^{*+}-tagged decays.

Belle II

Int. luminosity	$1\,\mathrm{ab}^{-1}$	$5\,\mathrm{ab}^{-1}$	$10\,\mathrm{ab}^{-1}$	$50\,\mathrm{ab}^{-1}$
$\sigma_{A_{CP}}(D^+ \to \pi^+\pi^0)$	1.64%	0.74%	0.52%	0.23%
$\sigma_{A_{CP}}(D^0 \to \pi^0\pi^0)$	0.49%	0.22%	0.15%	0.07%

Table 6.5: Extrapolated signal yields and statistical precision on direct *CP* violation observables for the promptly produced samples.

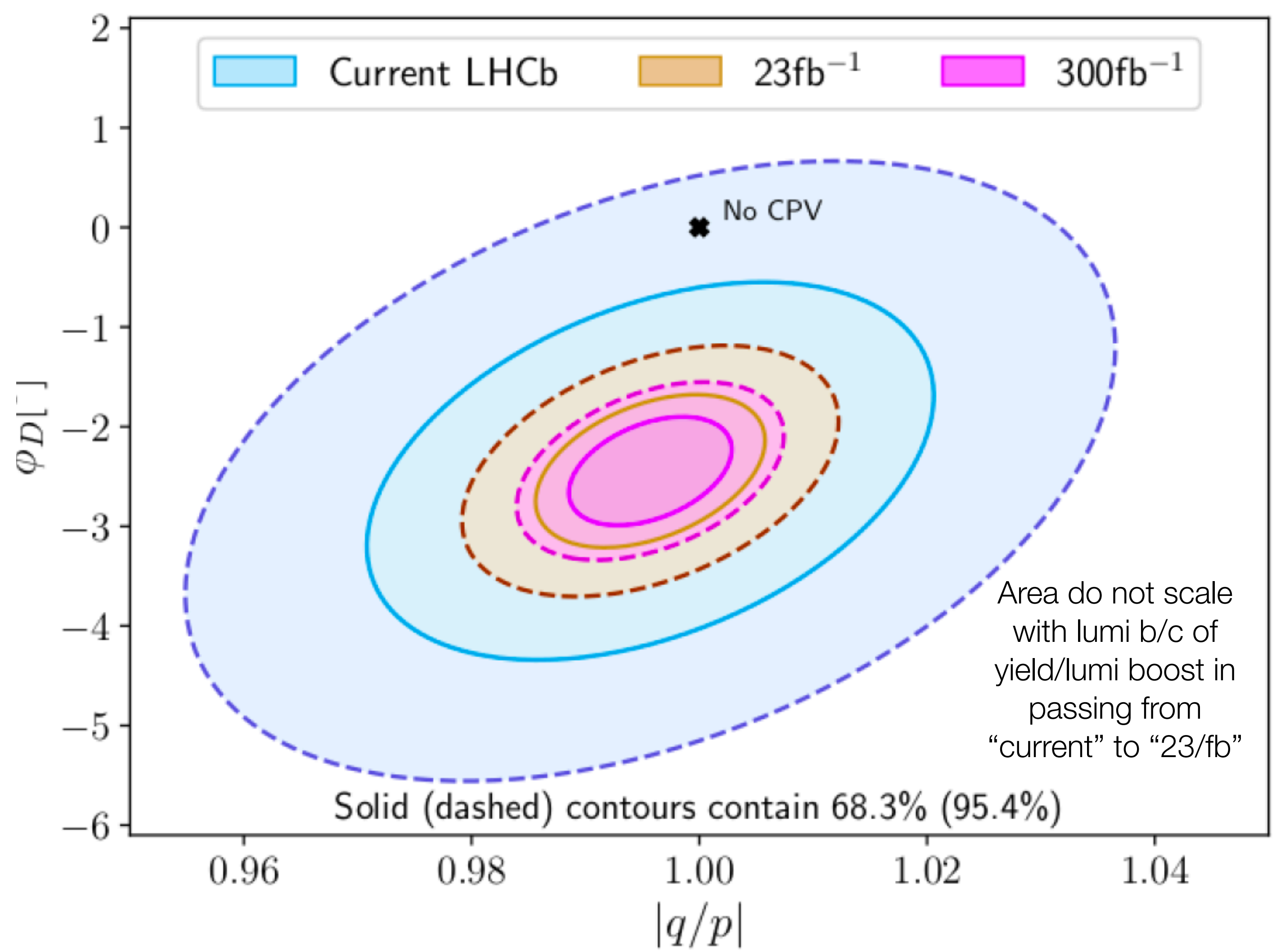
LHCb

Sample ($\mathcal{L}$)	Tag	Yield $D^0 \to K^-K^+$	Yield $D^0 \to \pi^-\pi^+$	$\sigma(\Delta A_{CP})$ [%]	$\sigma(A_{CP}(hh))$ [%]
Run 1–2 (9 fb^{-1})	Prompt	52M	17M	0.03	0.07
Run 1–3 (23 fb^{-1})	Prompt	280M	94M	0.013	0.03
Run 1–4 (50 fb^{-1})	Prompt	1G	305M	0.01	0.03
Run 1–5 (300 fb^{-1})	Prompt	4.9G	1.6G	0.003	0.007

Synergy of LHCb and Belle II will improve test power by an order of magnitude

CP violation in charm mixing

Equally compelling access to non-SM is from CP violation in charm mixing



Predictions are uncertain. But LHCb’s sensitivity to ~x10 enhancements with respect to naive SM predictions offers unique exploration probes

CP violation in *B* mixing — tree-decays

Generic null tests of non-SM physics contributing to *B* meson mixing.

Mixing strength limited by pheno uncertainties. Expected to reduce soon.

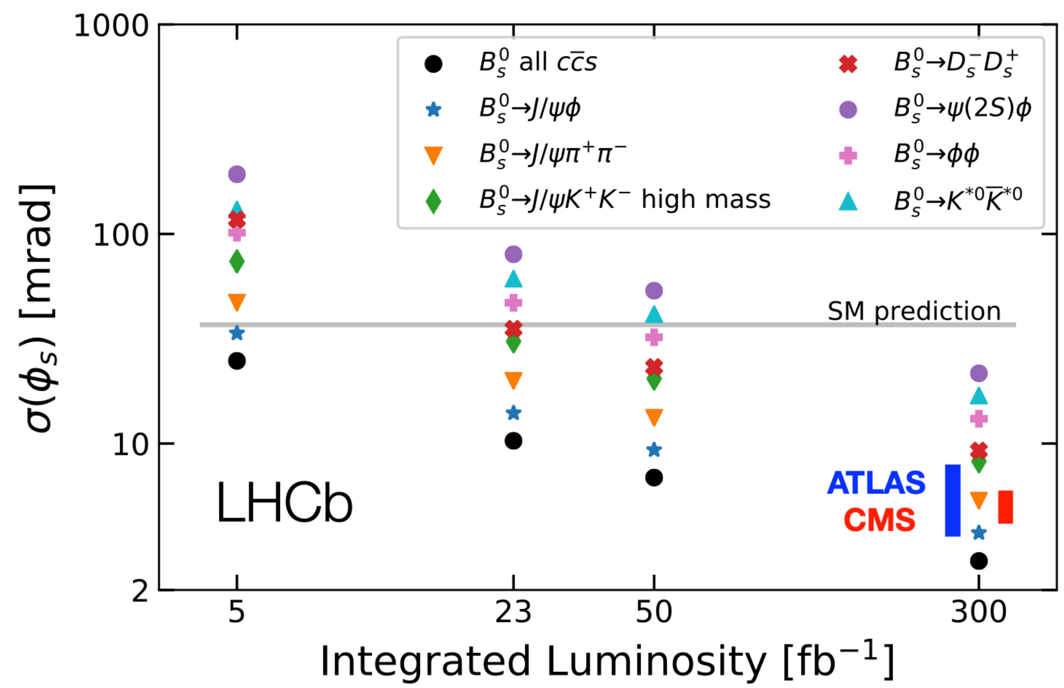
Miixing phase limited by experimental uncertainties, mostly statistical. Large room for improvement, especially for B^0_s.

Expose non-SM physics or provide reference for non-SM searches in gluonic-penguin channels. Important to assess sub-leading penguin pollution here using support channels as $B^0 \to J/\psi\ \rho$ and $B^0_s \to J/\psi\ K^*$

Similar contributions advances by Belle II and LHCb in *B* mixing

$(c\bar{c})K^0$	$\sigma_S^{\rm stat}$	$\sigma_S^{\rm syst}$
1 ab^{-1}	0.018	0.011
5 ab^{-1}	0.008	0.008
10 ab^{-1}	0.006	0.008
50 ab^{-1}	0.003	0.007

B⁰$_s$ mixing is entirely LHC's business



B mixing — a glimpse of possible impact

Charles, Descotes-Genon, Ligeti, Monteil, Papucci, Trabelsi, Vale Silva, PRD 102, 056023 (with timing of the various scenarios updated by myself)
hs and hd parameters measure “distance” in Bs and B0 mixing strength from prediction based on CKM hierarchy

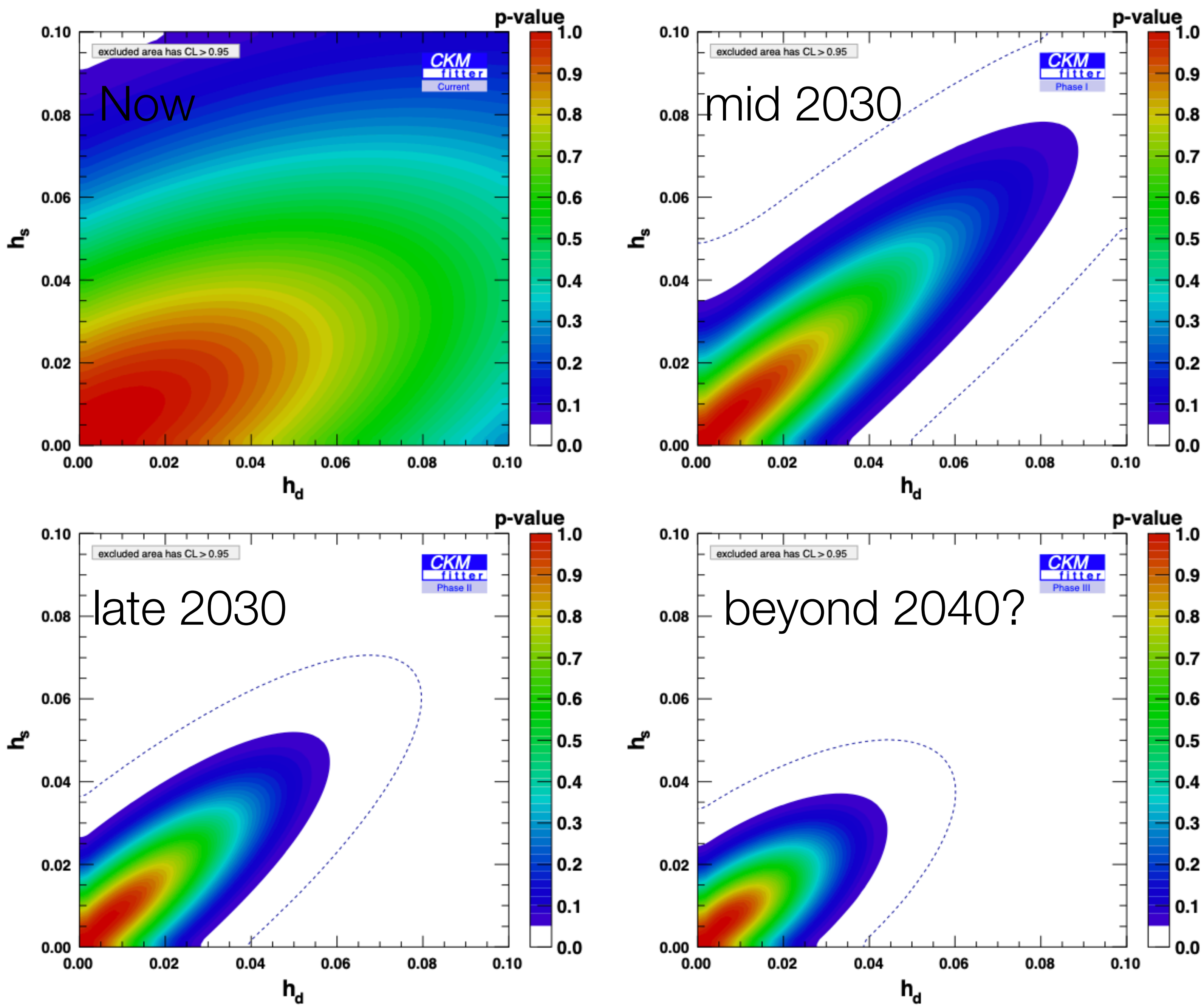


FIG. 2. Current (top left), Phase I (top right), Phase II (bottom left), and Phase III (bottom right) sensitivities to $h_d - h_s$ in B_d and B_s mixings, resulting from the data shown in Table I (where central values for the different inputs have been adjusted). The dotted curves show the 99.7% CL (3σ) contours.

CP violation in *B* mixing — loops

Perhaps more important: comparison with results in gluonic-penguin channels

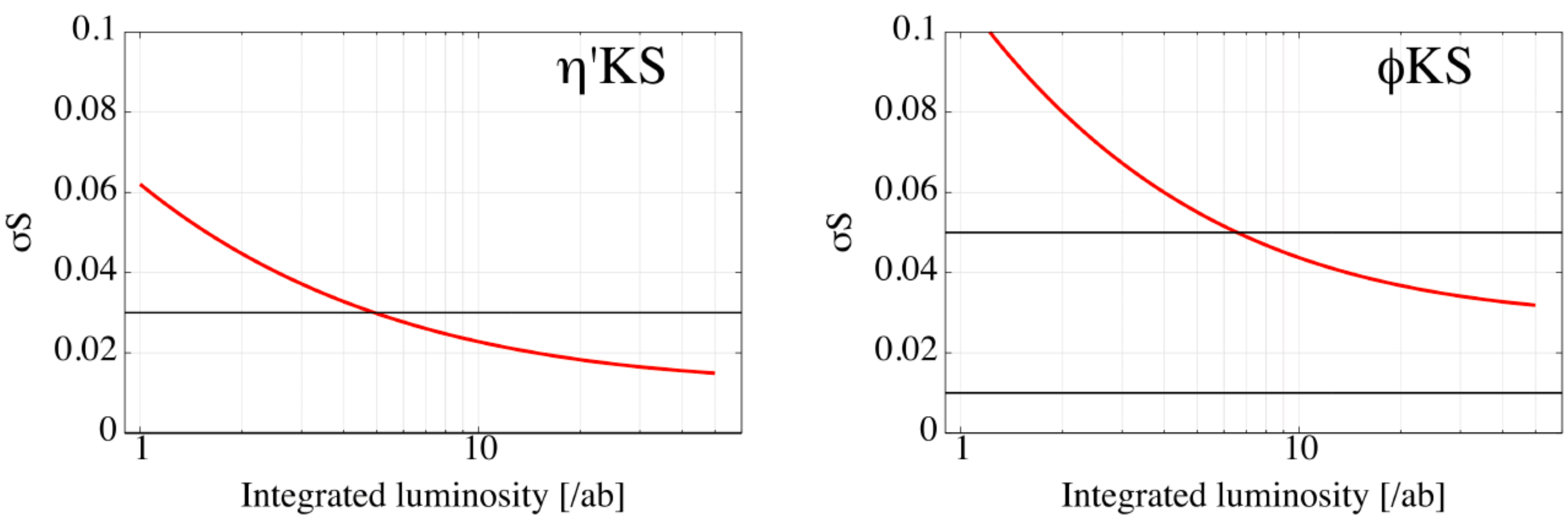


Figure 1: Projections of (solid red) total uncertainty in the relevant CP-violating parameters from (left panel) $B^0 \to \eta' K^0_S$ and (right panel) $B^0 \to \phi K^0_S$ decays as a function of the integrated luminosity. Solid horizontal black lines indicate the predicted range of $\Delta\mathcal{S}_{f_{CP}}$ based on the SM assumption, $0.00 < \Delta\mathcal{S}_{\eta' K^0_S} < 0.03$ and $0.01 < \Delta\mathcal{S}_{\phi K^0_S} < 0.05$ [14].

B^0 loops will tackled by Belle II with time-dependent $B^0 \to \eta' K^0_s$ that remain limited by sample size.

LHCb accesses $B^0_s \to K^{0*} \overline{K}^{0*}$ and expects final 0.01 rad in $B^0_s \to \phi\phi$

Epilogue

Summary

CKM physics — a most compelling probe for non-SM dynamics.

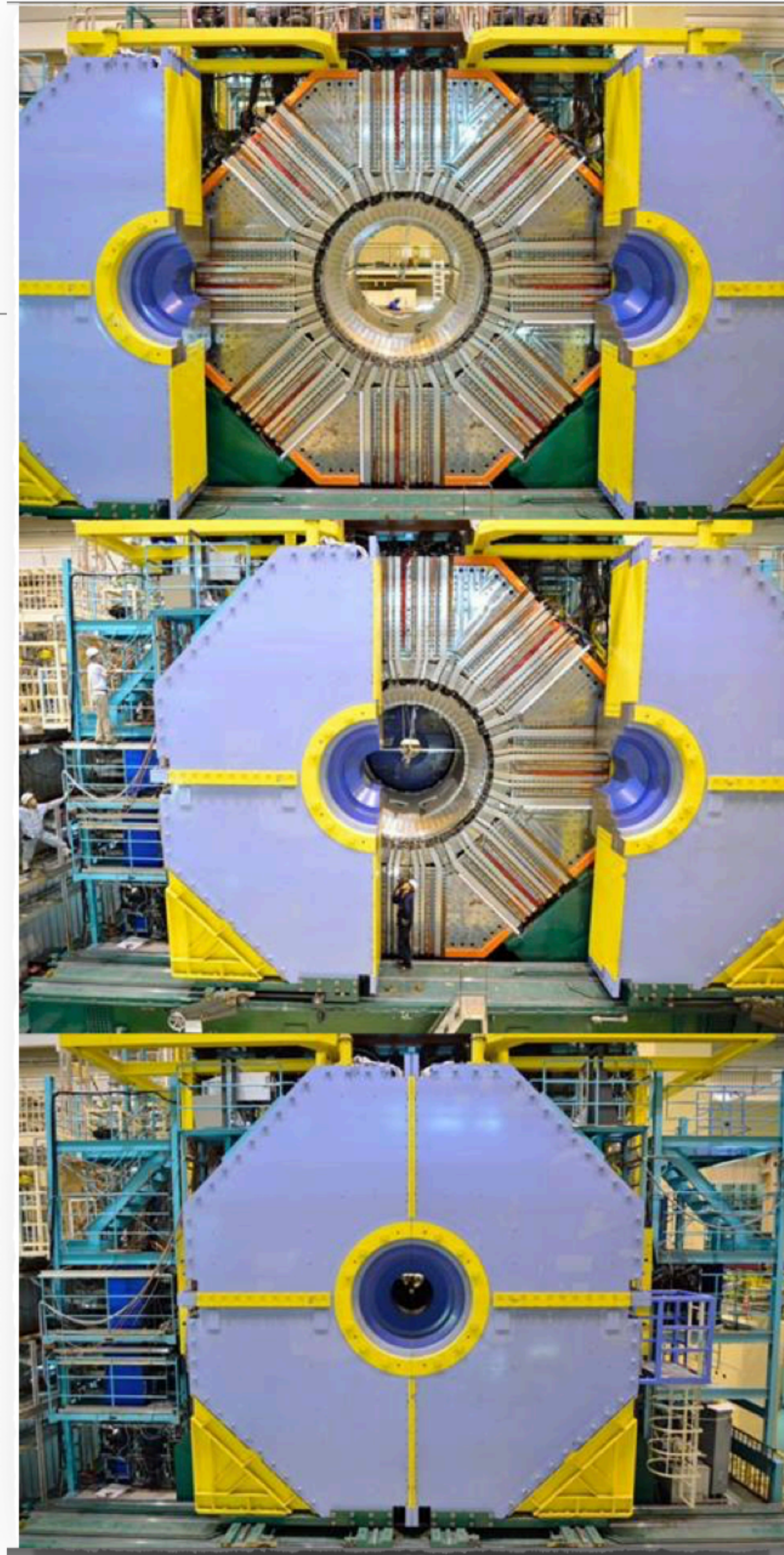
Precision, hence intensity

Multiple dedicated experiments with complementary capabilities on line for the first time

A broad and diverse program of a plethora of measurements is ahead.

Singled out those more likely to disclose indications of non-SM, or remain as our most important legacies.

An unique, probably unrepeatable, opportunity.



We will need precision…

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DECAY PROPERTIES OF K_2^0 MESONS*

D. Neagu, E. O. Okonov, N. I. Petrov, A. M. Rosanova, and V. A. Rusakov
Joint Institute of Nuclear Research, Moscow, U.S.S.R.
(Received April 20, 1961)

Combining our data with those obtained in reference 7, we set an upper limit of 0.3 % for the relative probability of the decay $K_2^0 \to \pi^- + \pi^+$. Our results on the charge ratio and the degree of the 2π-decay forbiddenness are in agreement with each other and provide no indications that time-reversal invariance fails in K^0 decay.

"[…] A special search at Dubna was carried out by Okonov and his group. They did not find a single $K_L \to \pi^+\pi^-$ event among 600 decays into charged particles (Anikira et al., JETP 1962). At that stage the search was terminated by the administration of the lab. The group was unlucky."

L. Okun — Spacetime and vacuum as seen from Moscow

…confidence in our means,

APPARENT EVIDENCE OF POLARIZATION IN A BEAM OF β-RAYS

By R. T. Cox, C. G. McIlwraith and B. Kurrelmeyer*

New York University and Columbia University†

Communicated June 6, 1928

We have made no attempt at a theoretical treatment of double scattering beyond a consideration of the question whether the results here reported are of an asymmetry of higher order than what might be expected of a spinning electron. The following suggestion is then offered not at all as a

THE SCATTERING OF FAST ELECTRONS BY METALS. II. POLARIZATION BY DOUBLE SCATTERING AT RIGHT ANGLES

By Carl T. Chase

New York University, University Heights, N. Y.

(Received July 28, 1930)

1930's findings of "anomalous polarization" from β decays were early indications of parity violation, but Cox, Chase and the community were not ready just yet ;)

..and wisdom to handle unanticipated challenges

Following the war in Ukraine, various initiatives aim at “politicizing science”.

Many well intentioned and fully understandable — from an emotional standpoint.

Still, they pose a serious threat to our science. They limit, and possibly undermine, international collaboration —the way HEP is done since 50 years.

Science is a global endeavor whose positive ramifications and impact on humanity overwhelmingly compensate in the long term for any suffering, however tragic, any war may cause today.

I wish there could be open discussions among us scientists to rationally assess the longer-term consequences of these recent initiatives.

I wish a consensus could be reached on our primary duty being to protect science — prior to any political consideration.

In my opinion, this is the only way to achieve the greater scientific good.

(And it’s probably the best way to give our own little contribution in reducing chances for future conflict)

(Hopefully not) the end