Conference summary

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& All Souls College

EPS HEP2023 HAMBURG

Illustration by Katinka Reinke

THE ROYAL SOCIETY

UNIVERSITY OF OXFORD

EPS–HEP 2023

- 38 plenary talks
- c. 500 parallel talks
- c. 120 posters
- 7 prizes
- Total $\sim$ 16,000 slides on my laptop $\rightarrow$ $\sim$ 40 slides in this summary

Strategy

- Looking for results that are new and either important or fun
- “important” and “fun” are both subjective!

How to view this “summary”

An invitation for each of us to think about what highlights we would like to tell our friends & colleagues about back home

EPS–HEP 2023

- 38 plenary talks
- c. 500 parallel talks
- c. 120 posters
- 7 prizes
- Total ~ 16,000 slides on my laptop → ~ 40 slides in this summary

Other fascinating topics I could not cover

Disclaimer: Only a small fraction of the experimental efforts and achievements on dark matter and axion searches can be shown. My apologies if your favortie experiment is missi

→ Disclaimer: our field is diverse, based on many experiments and full of fascinating physics. In the following, I am only able to show a small personal selection.

Disclaimer: not a comprehensive review.

Strategy

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- "important" and "fun" are both subjective!

How to view this "summary"

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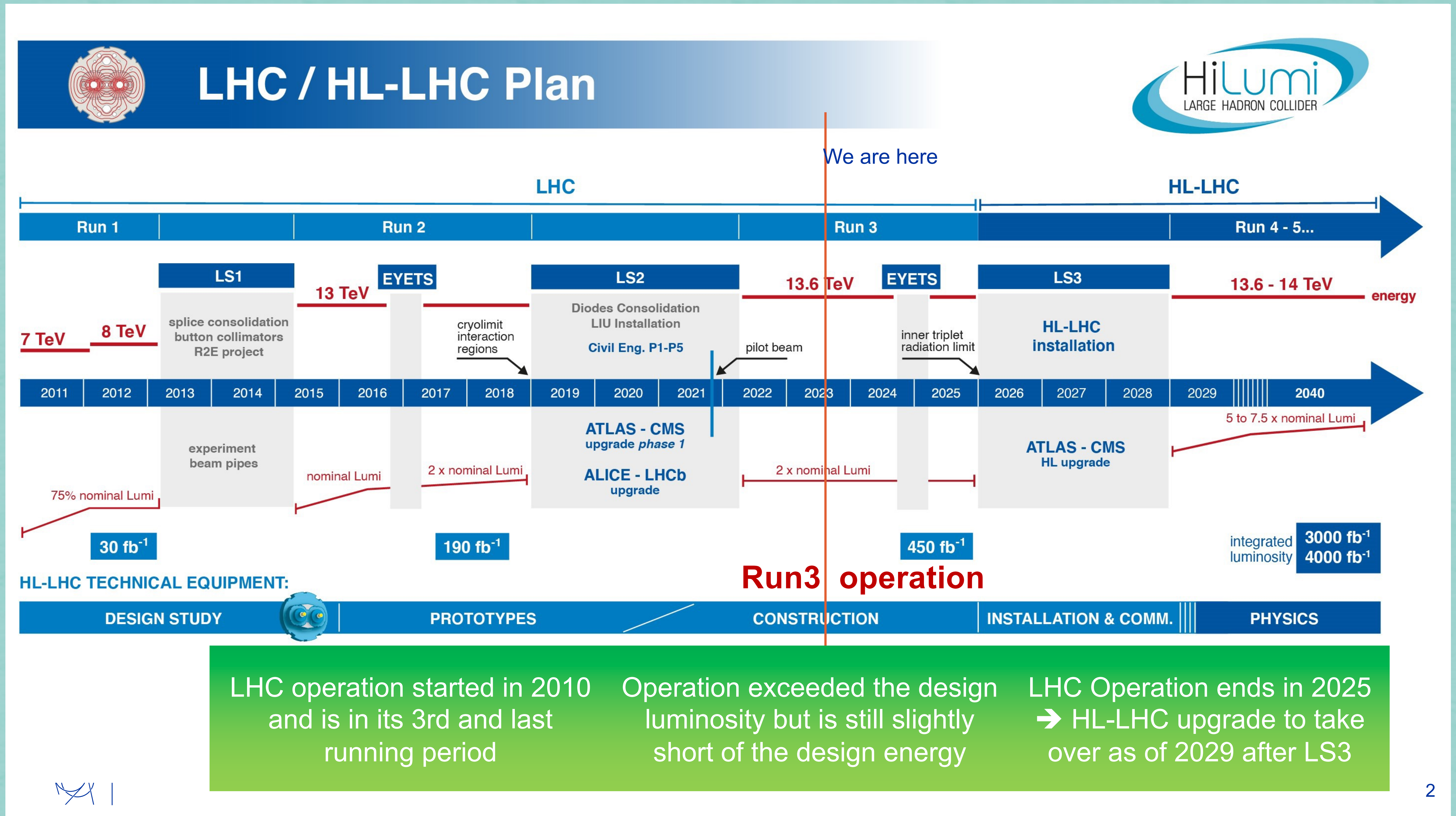
colliders

LHC status [talk by Brüning]

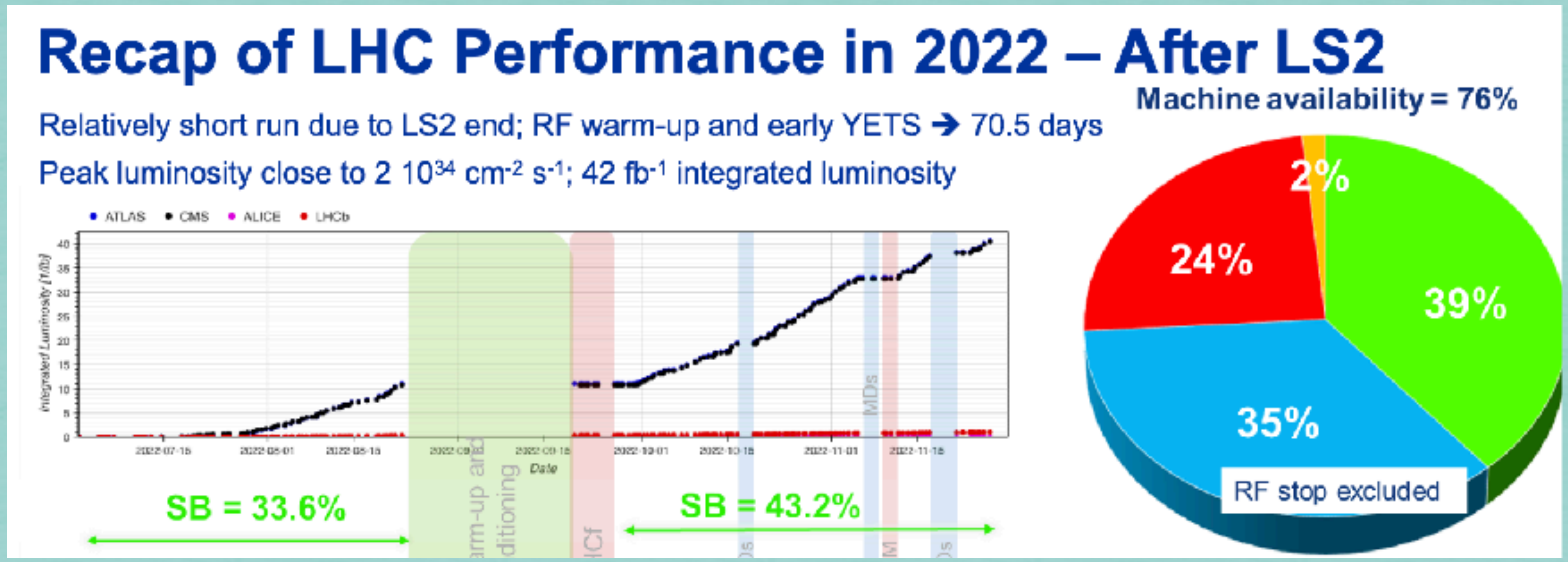


Issues in Run 3, 2023

1) Equipment heating

2) Faulty bellows

3) Electron Cloud



The key question is if this level of electron cloud remains stable or if will it degrade further over coming shutdown period?!

Airborne Cu Hydroxide [$Cu(OH)_2$] and venting of the apertures during Long Shutdowns have been identified as the root cause for this degradation

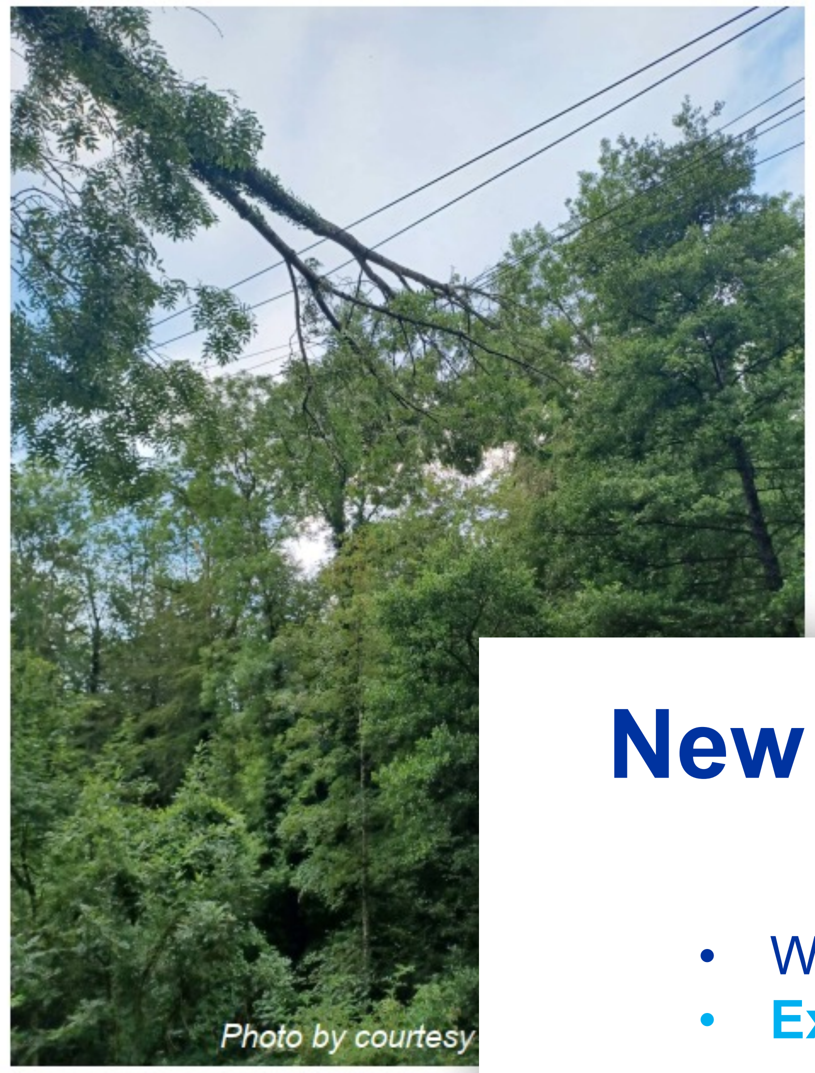
LHC status [talk by Brüning]

IR8 IT.L8 Triplet incident

Power glitch cause LHC and AD beam dump 17.07.23

The cause of the events seen at CERN

- A tree fell on two lines 125 kV of Romande Energie which are on the same support towers:
  - Morges — Vaux-sur-Morges
  - Bussigny — Etoy — Vaux-sur-Morges
- The two lines are both connected to Vaux-sur-Morges 220/125 kV substation
- The recording from Romande Energie was at 01:01:08.607 (it is consistent with our last recording at 01:01:08.610) and there were several attempts to re-energize the lines (fast reclosures) before the final trip



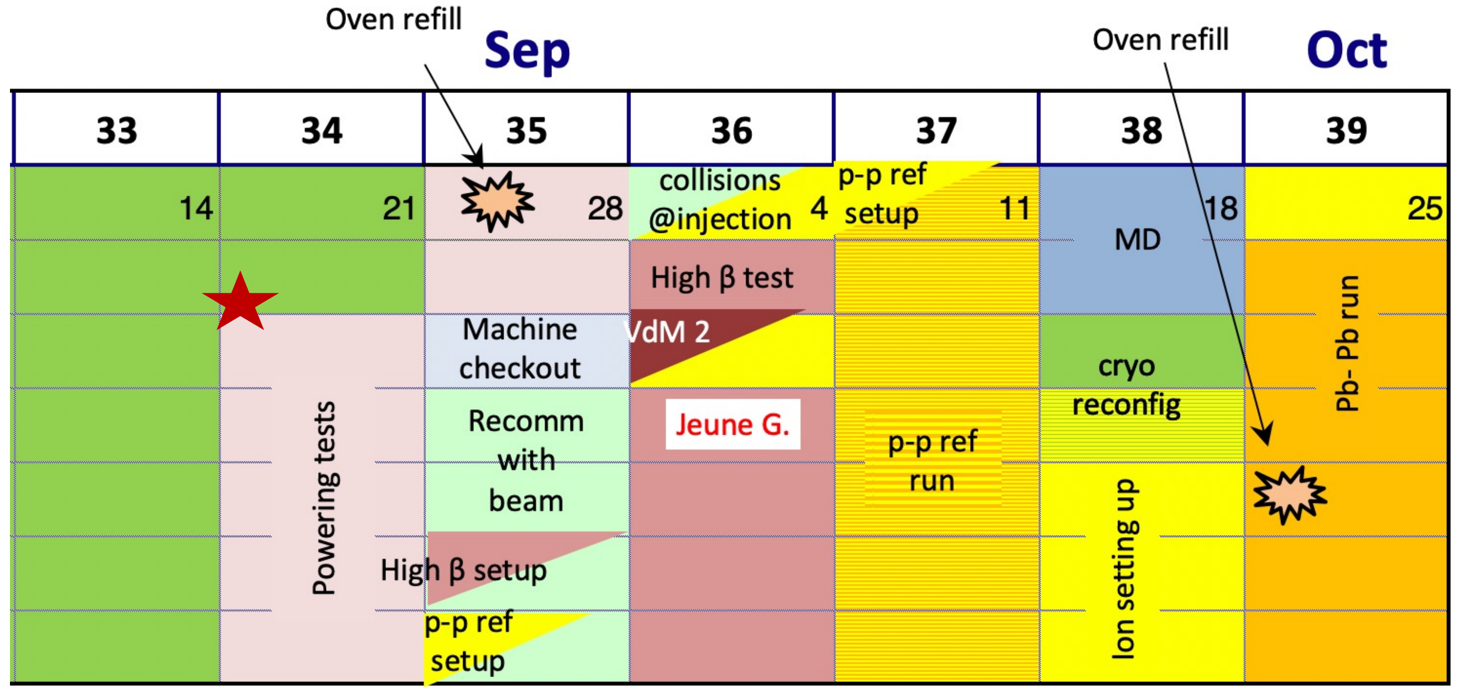
New schedule proposal

Present week = 34

- We expect to be ready for **machine operation with beam sometimes in week 35**
- **Experimental caverns** should be closed and patrolled by **Monday 28th August morning**

11 (+7) days gained wrt to 2nd August

- **4+1 days** HB
- **1/2 day** (+preparation) VdM
- **2 additional days** of pp ref (VdM+intensity ramp-up)
- **2 days** MD
- **1-2 days** for CRYO reconfiguration (not initially planned)
- **6-7 additional days** to ION run (VIP on 29th September & 7th October)



Draft schedule to be approved by LMC this afternoon!

physics-wise, EPS saw some of the final Run 2 results and first Run 3 results

Higgs mass

- At discovery in 2012, mass known with accuracy of about ±0.6 GeV in each experiment
- one reason it matters is that uncertainties on mass are magnified by ×10 on critical ZZ* branching ratio.

LHC Higgs WG

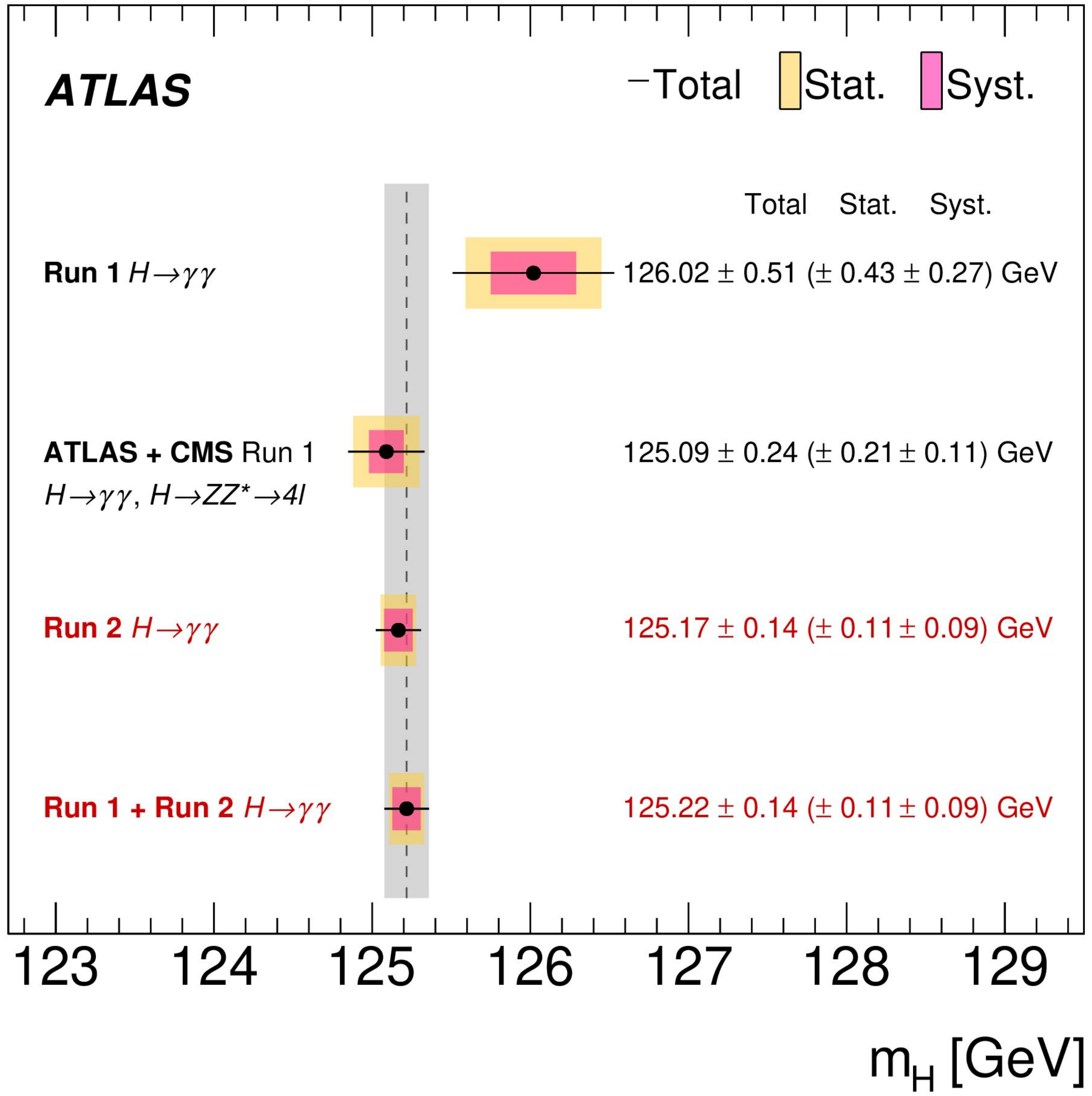
$H \to llll$ Br ratio

M_H (GeV)	$H \to l^+l^- l^+l^-$
125.10	2.771E-04
125.20	2.796E-04

+0.1% [ ] +1.0%

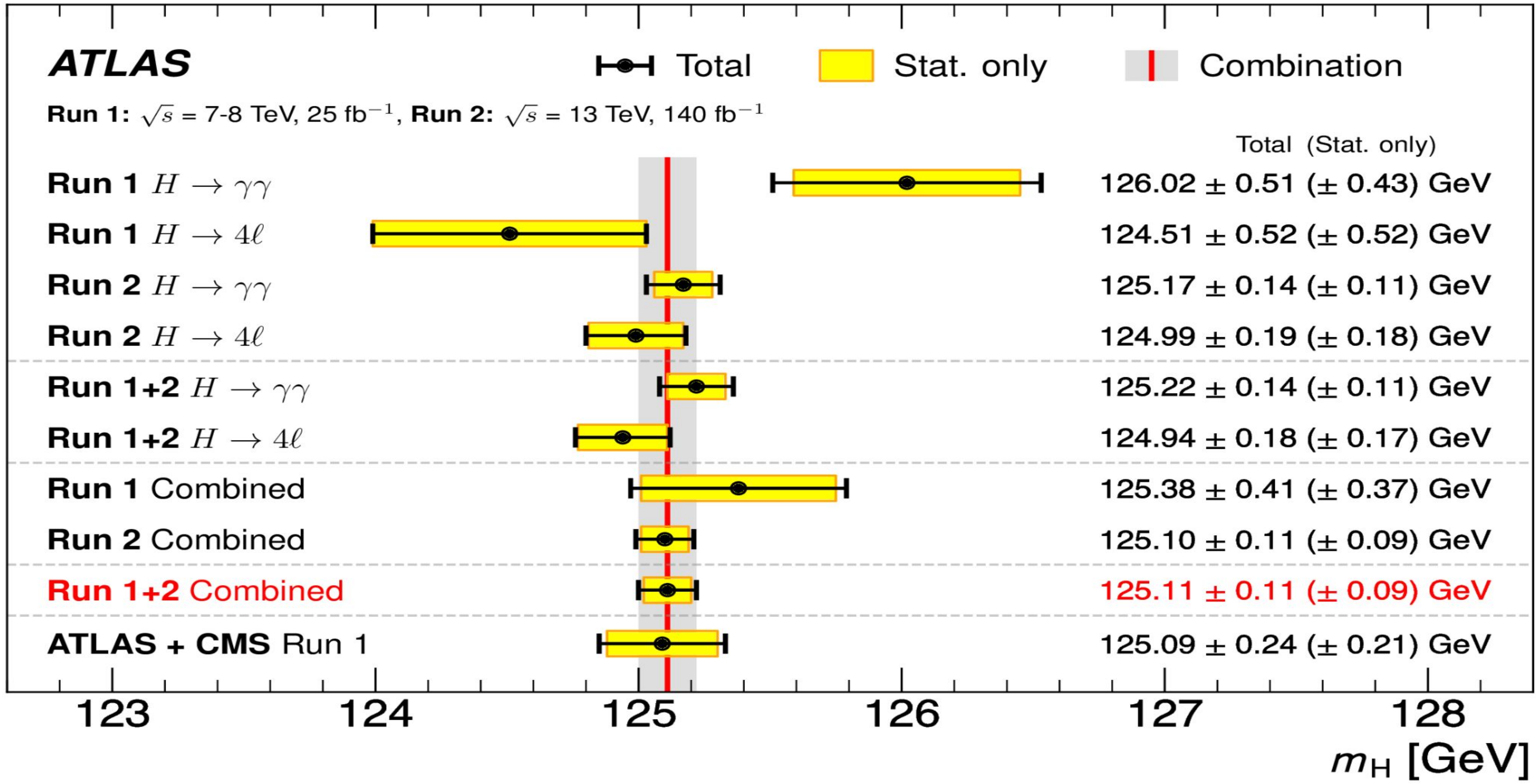
Higgs mass [cf talks by Manzoni & Ferrari]

new: ATLAS H→γγ mass



m_H = 125.22 ± 0.11 ± 0.09

new: ATLAS combined γγ & ZZ*



m_H = 125.11 ± 0.09 ± 0.06 = 125.11 ± 0.11 GeV

~ factor 5–6 improvement relative to discovery (in line w. ×30 increase in # of Higgses)

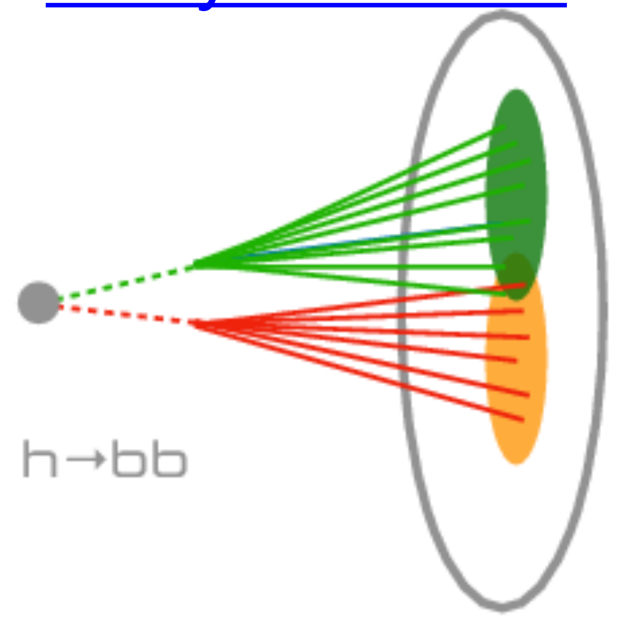
Masubuchi

Boosted topology opens new window

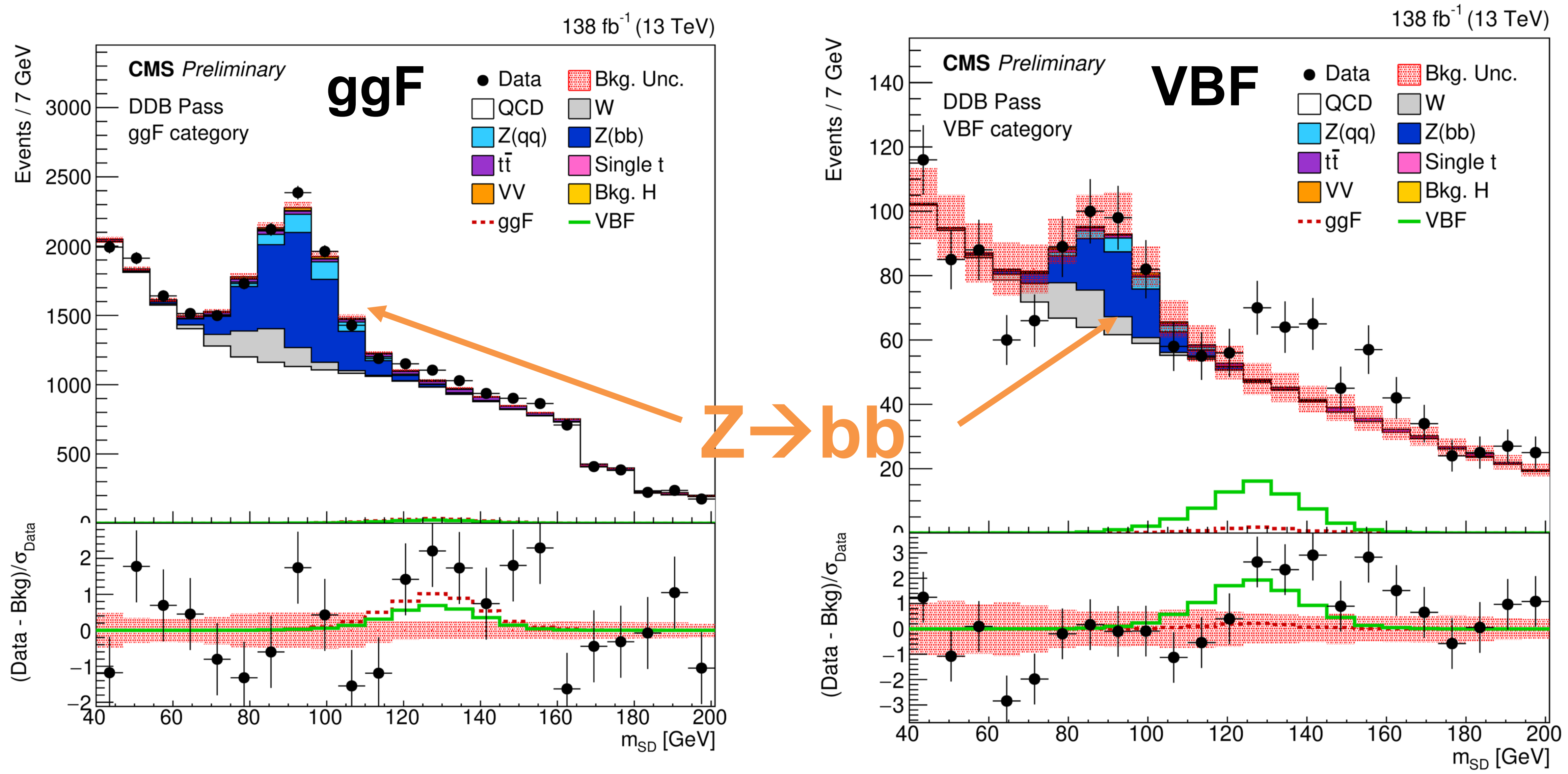
CMS-PAS-HIG-21-020

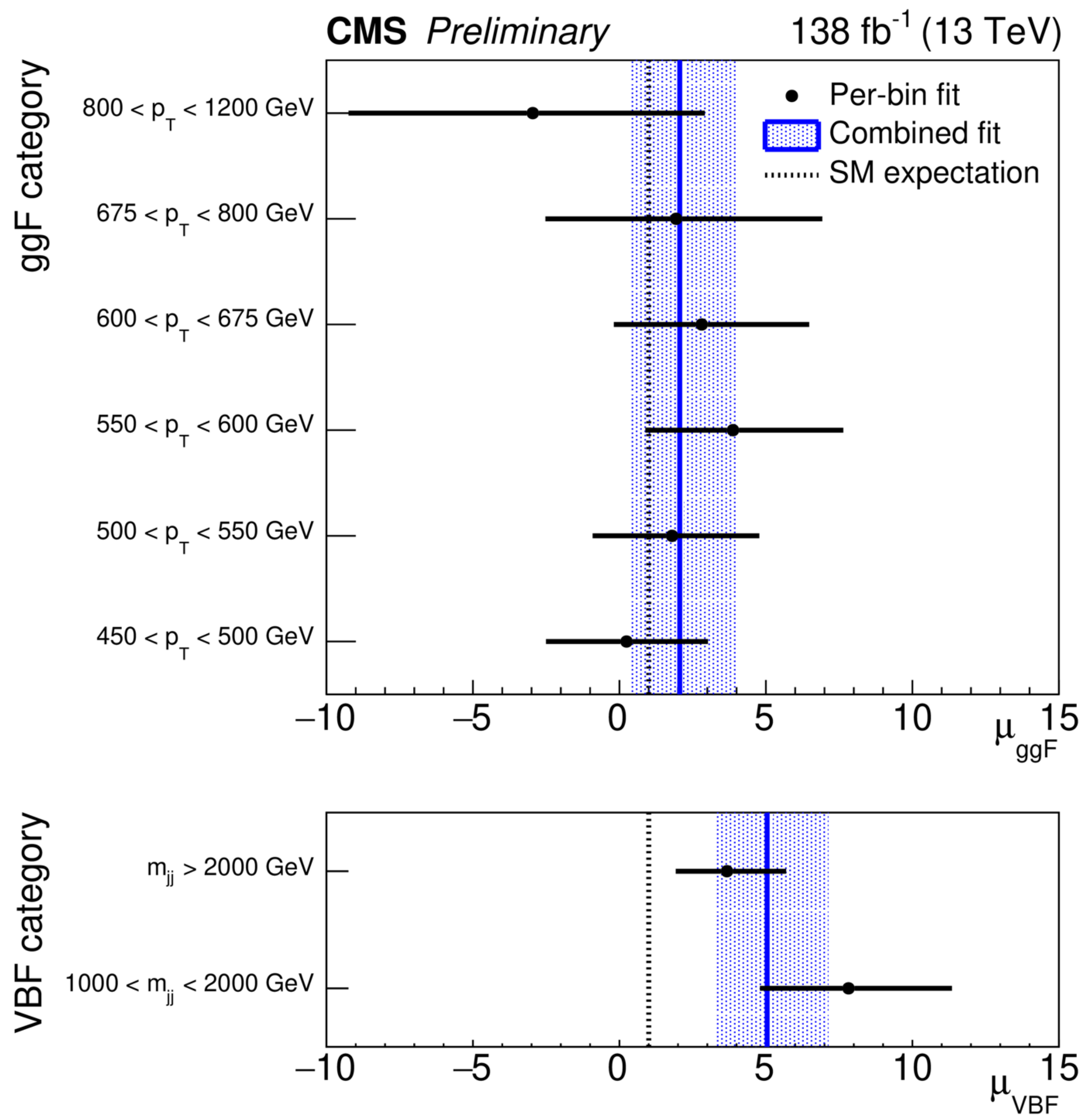
Chayanit's talk

- Search for boosted VBF and ggF production in H→bb decay
- Requirement of highly boosted Higgs (p_T^H > 450 GeV)
  - Dedicated X(H,Z)→bb tagger to distinguish signal from QCD jets
  - Separate VBF and ggF categories



NEW





$\mu_{ggF} = 2.1^{+1.9}_{-1.7}$
Significance 1.2σ(0.9σ exp.)

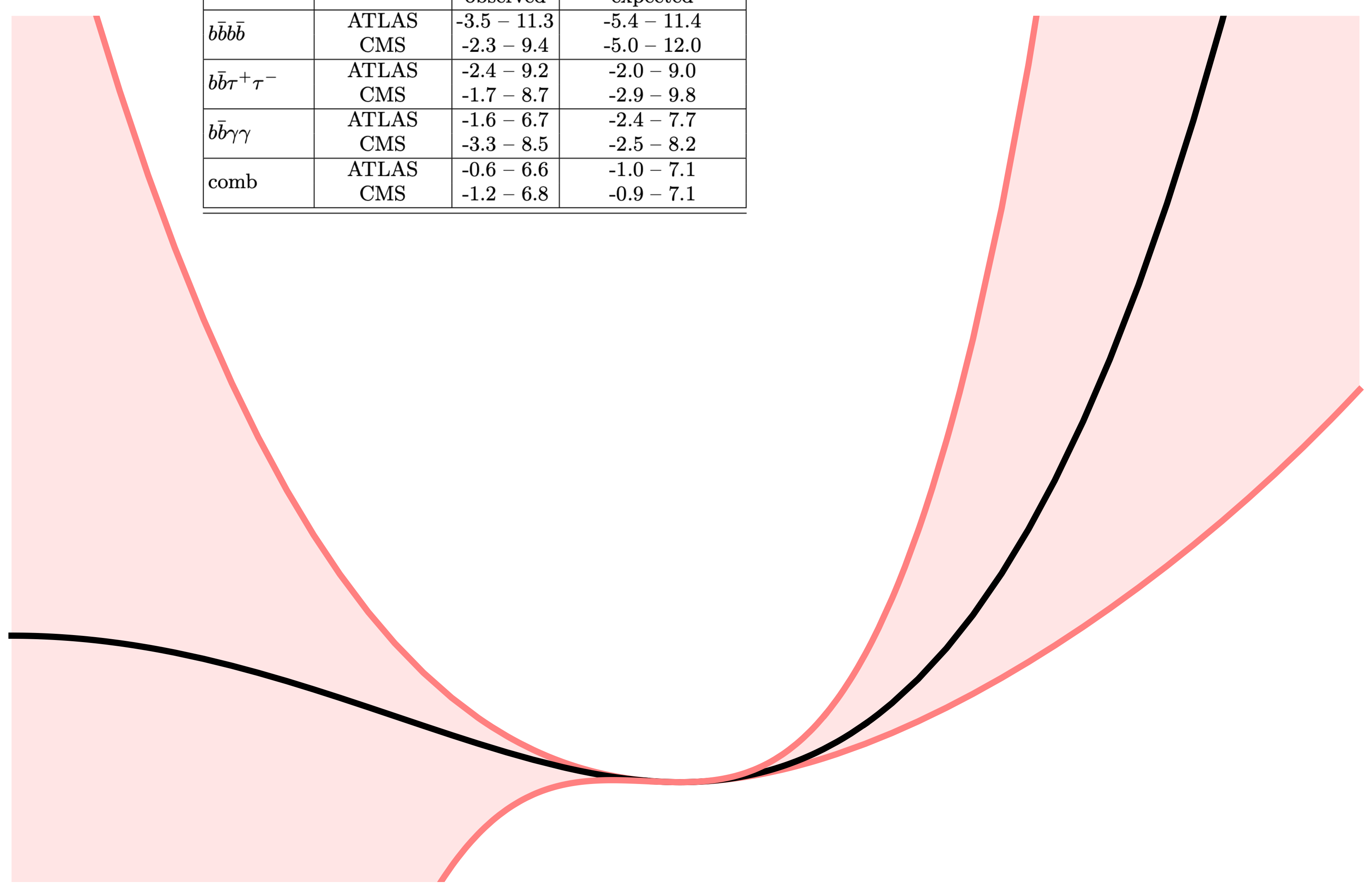
$\mu_{VBF} = 5.0^{+2.1}_{-1.8}$
Significance 3.0σ(0.9σ exp.)

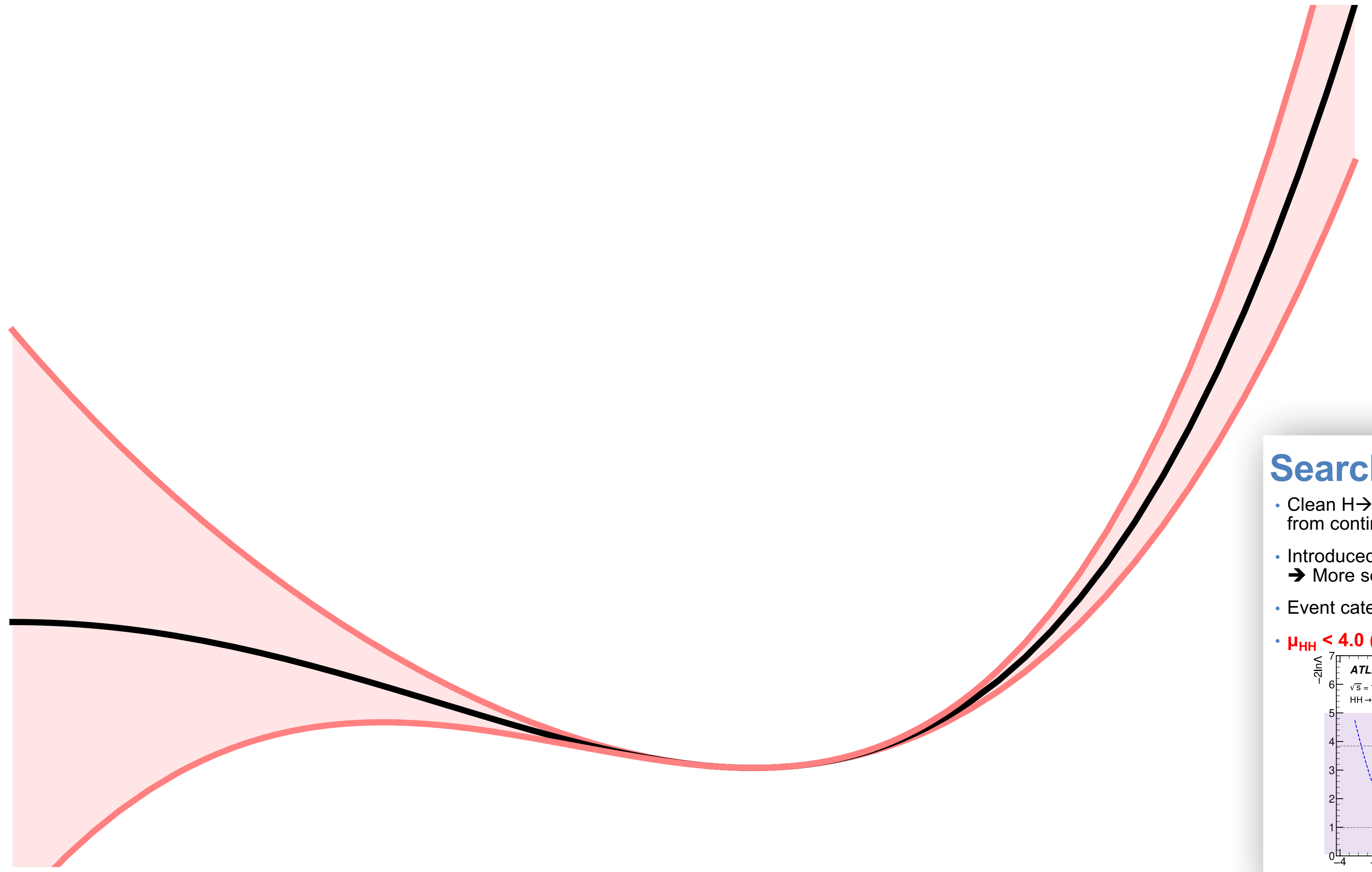
Higgs self coupling [Meade]

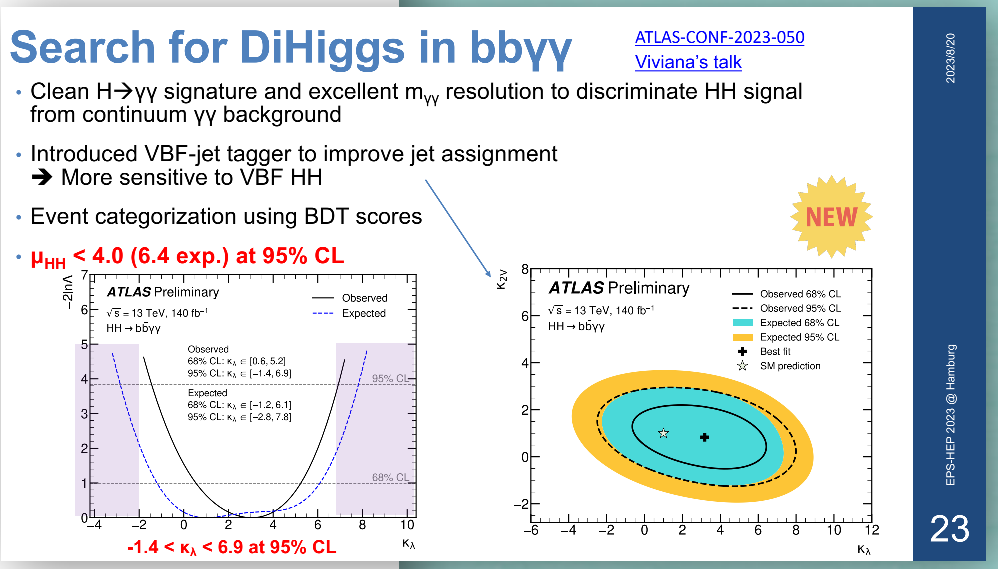
If the questions center on the Higgs, do we need to do more than sit back and wait for more data for more precision (or a Higgs factory)?

Snowmass EF Higgs Topical Report
2209.07510

Final state	Collaboration	allowed κ_λ interval at 95% CL observed	expected
$b\bar{b}b\bar{b}$	ATLAS	-3.5 – 11.3	-5.4 – 11.4
	CMS	-2.3 – 9.4	-5.0 – 12.0
$b\bar{b}\tau^+\tau^-$	ATLAS	-2.4 – 9.2	-2.0 – 9.0
	CMS	-1.7 – 8.7	-2.9 – 9.8
$b\bar{b}\gamma\gamma$	ATLAS	-1.6 – 6.7	-2.4 – 7.7
	CMS	-3.3 – 8.5	-2.5 – 8.2
comb	ATLAS	-0.6 – 6.6	-1.0 – 7.1
	CMS	-1.2 – 6.8	-0.9 – 7.1







H/T N.Craig, R. Petrossian-Byrne

When do we *really* care about non-resonant di-Higgs (λ_3) for its own sake?

Interesting to think about in more general setups beyond singlet, e.g. composite Higgs

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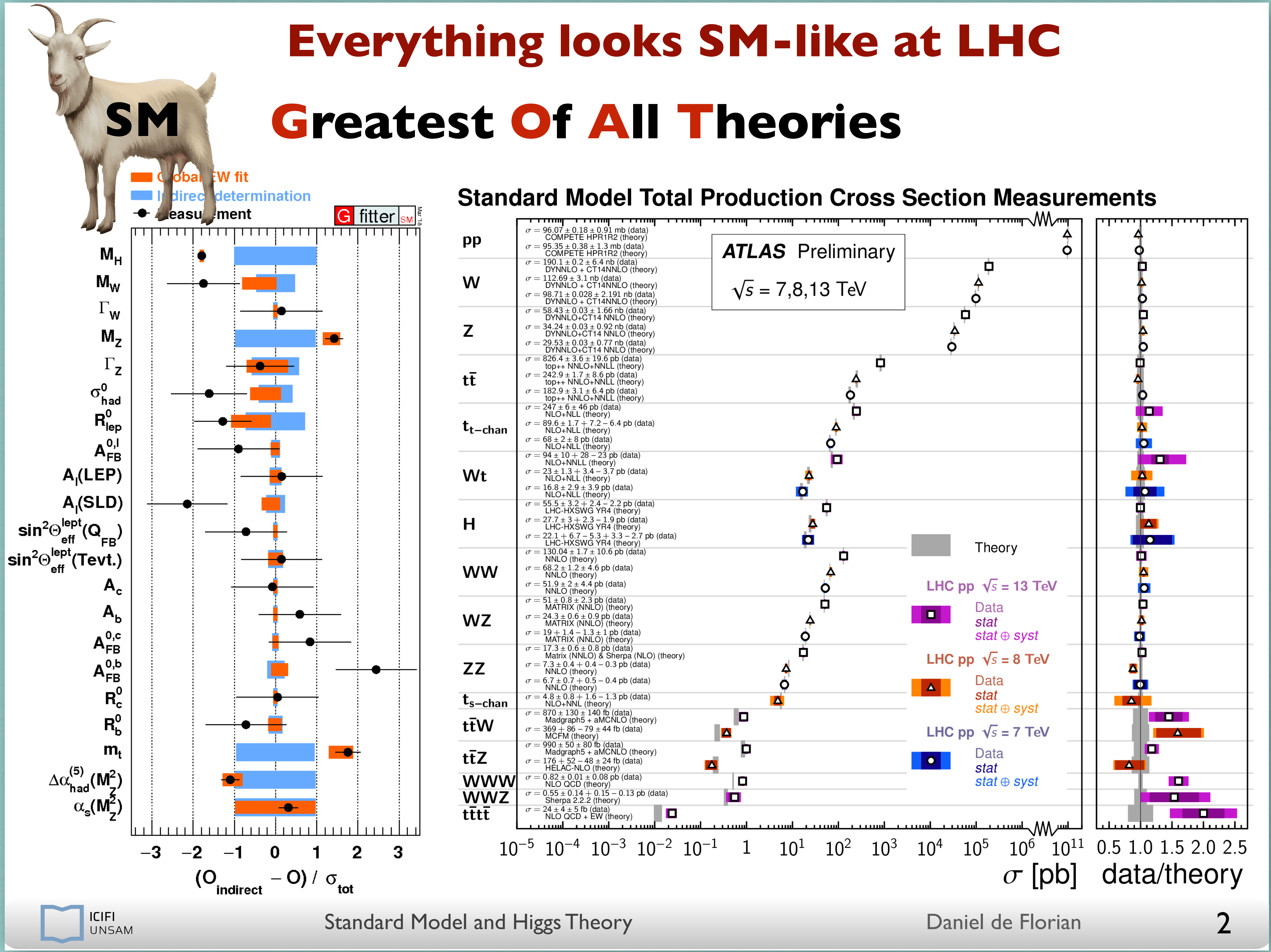
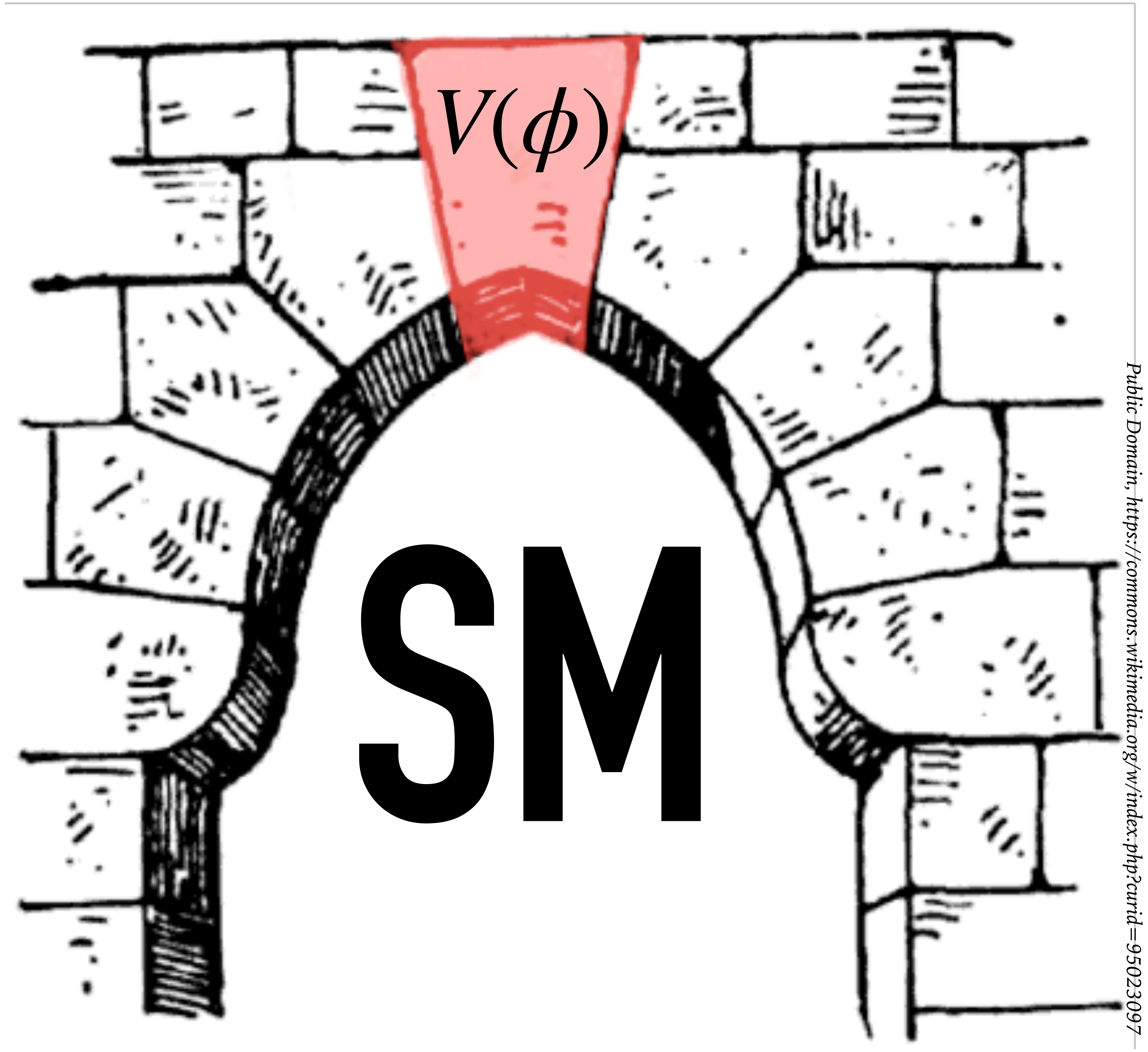
See G. Durieux et al, 2110.06941 for recent extensions

Success of the SM [de Florian]





Higgs potential is the keystone of the SM

My view: until we've established it, we've not done our job

(established ≡ comfortably > 5σ / better than 20% "direct" constraint on λ_3, independently in at least two experiments)

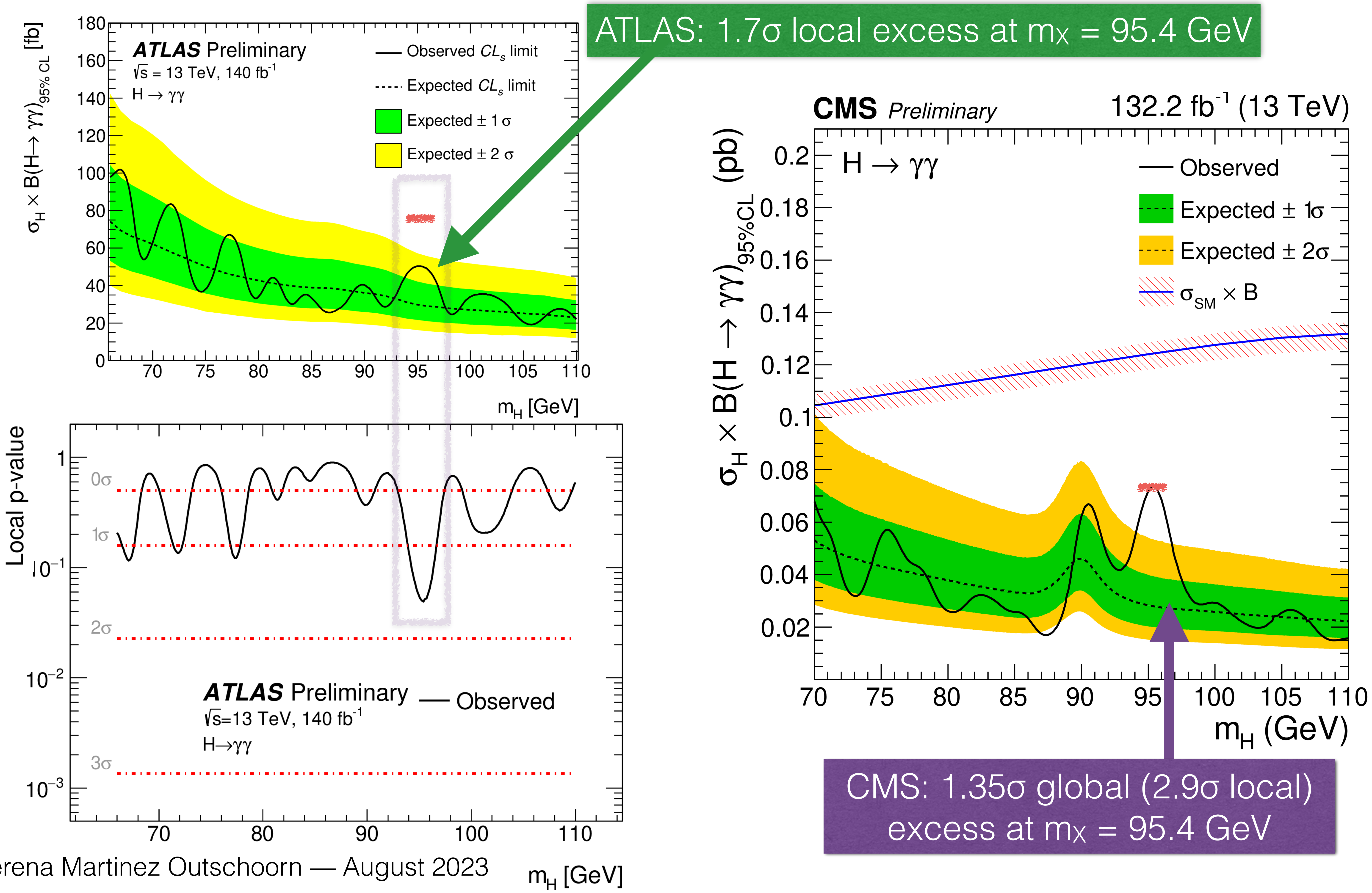
Simultaneously, we should keep in mind that concrete BSM models that extend Higgs potential often manifest first in observables other than di-Higgs production — that's why we need multi-purpose machines

di-photon at 95 GeV? [Martinez, Bierkotter]

NEW **Diphoton Resonance Searches**

CMS-PAS-HIG-20-002
ATLAS-CONF-2023-035

Search for diphoton resonance — additional Higgs boson decaying to a pair of photons



Verena Martinez Outschoorn — August 2023

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2HDM interpretations

2HDM interpretations had been discarded due to limited di-photon signal rates

With the updated experimental results the picture has changed

$h_{95} \approx A$ dominantly CP-odd state
→ Enhanced ggA production XS
→ Smaller $t\bar{t}A$ produciton XS
→ LEP excess requires CP violation

Can also describe the di-tau excess, but tensions with indirect constraints from flavour physics and electron EDMs

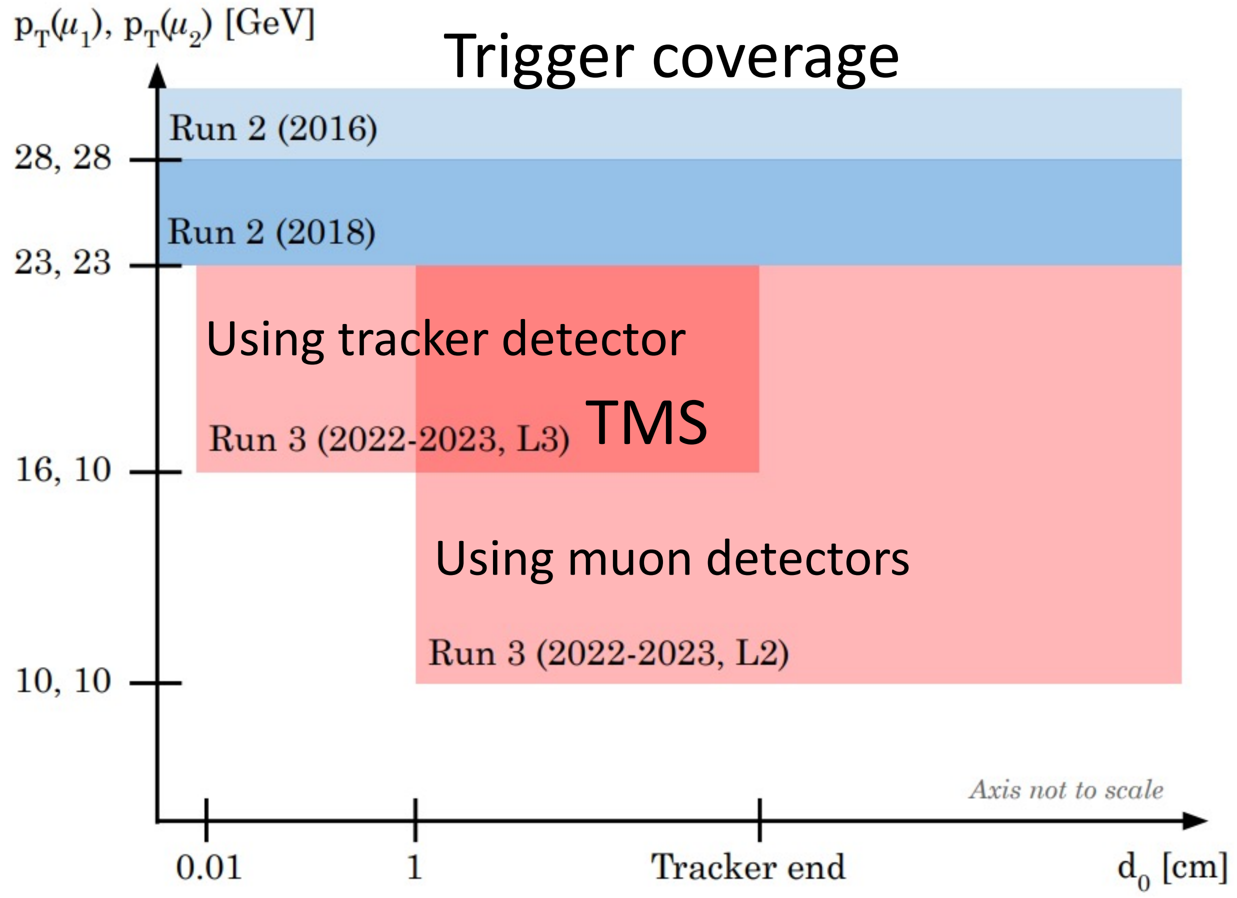
Thomas Biekötter — EPS-HEP 2023 in Haml

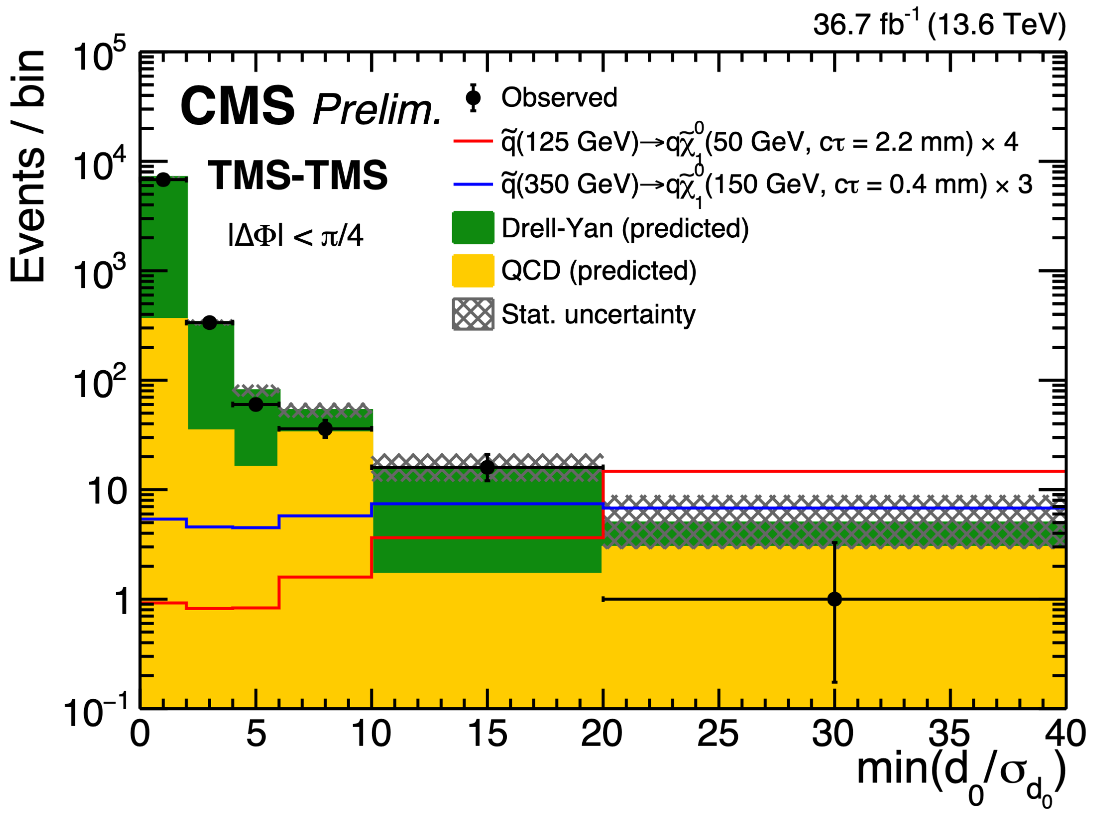
First CMS Run 3 search

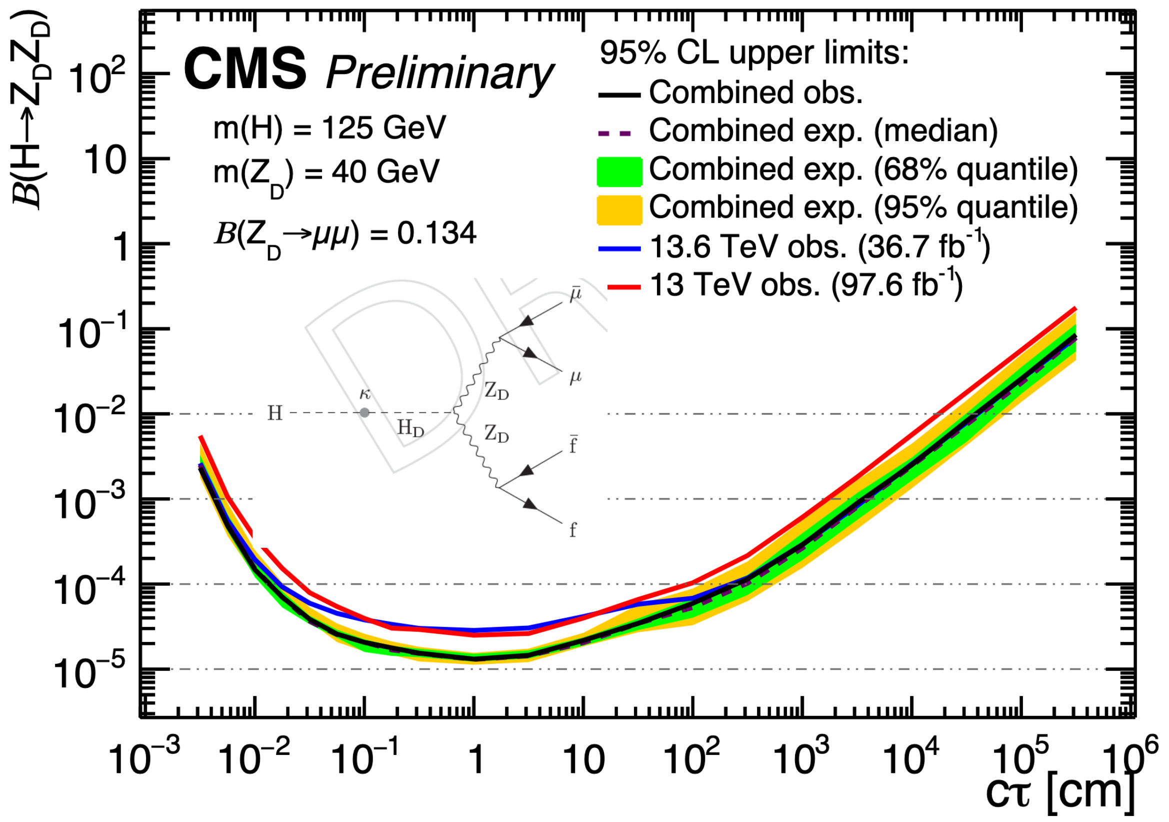
Run 3 results – long lived particles

New

first search for new physics: inclusive search for long-lived exotic particles decaying to a pair of muons
Using 36.7 fb^{-1} data taken in 2022, selecting muons originating from a common secondary vertex spatially separated from the primary interaction point by distances ranging from several hundred μm to several meters







Substantial improvements in efficiency as compared to the Run 2 analysis, particularly at low masses and long lifetimes, mainly because of improved triggers for displaced muons and analysis refinements

Limits set for two benchmark models: the hidden Abelian Higgs model (HAHM), in which displaced dimuons that could rise from dark photons, and RPV SUSY model

Run 3 is opening opportunities for exploring physics beyond statistical improvements over Run 2

CMS-PAS-EXO-23-014

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similar reach to Run 2, but using only ~1/3 of the data, thanks to better triggers!

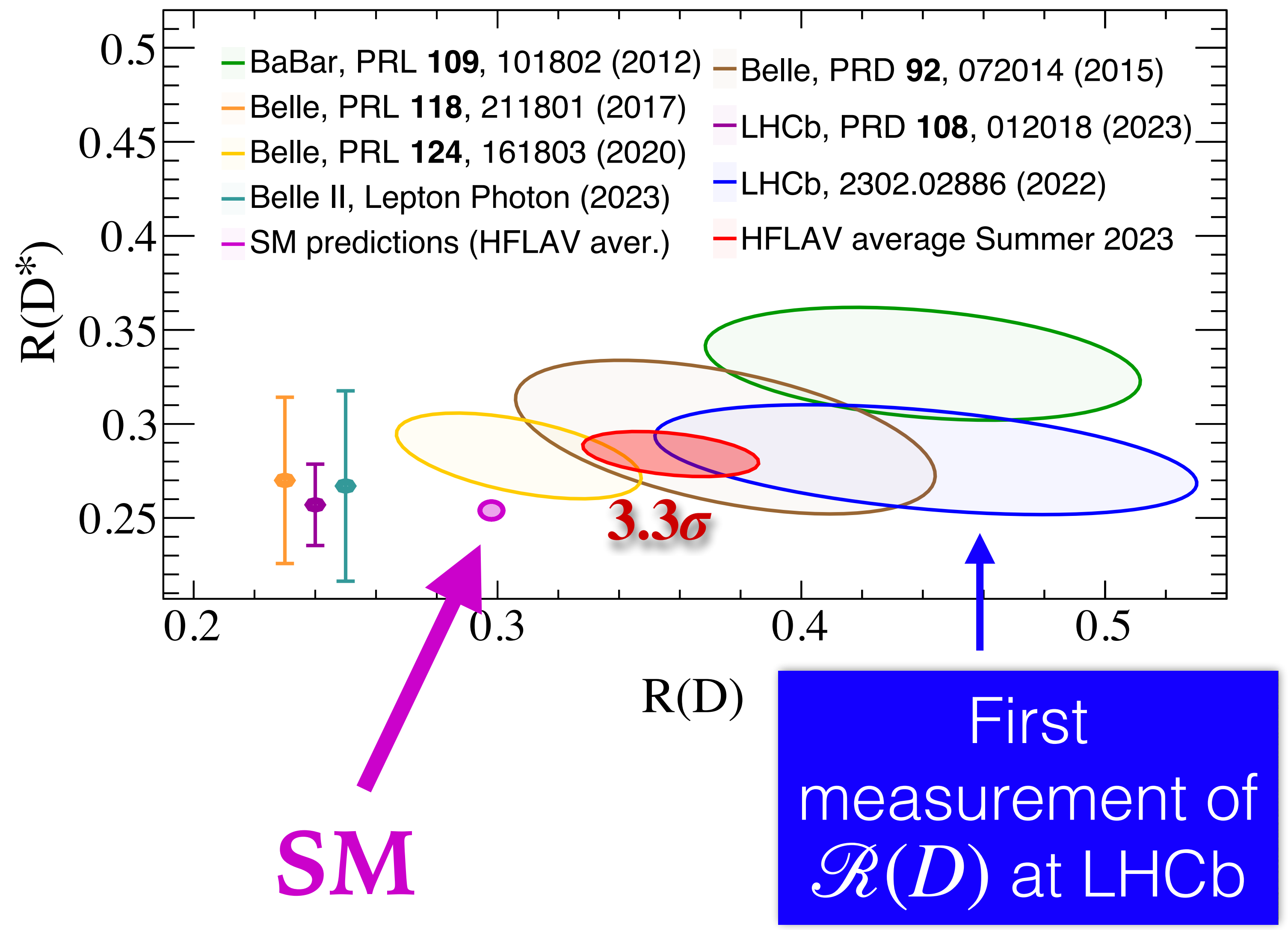
flavour physics

$\mathcal{R}(D^0)/\mathcal{R}(D^*)$ results

arXiv:2302.02886, submitted to *Phys. Rev. Lett.*

Note that less than half of the systematic uncertainty is multiplicative, so the majority does not scale with central value

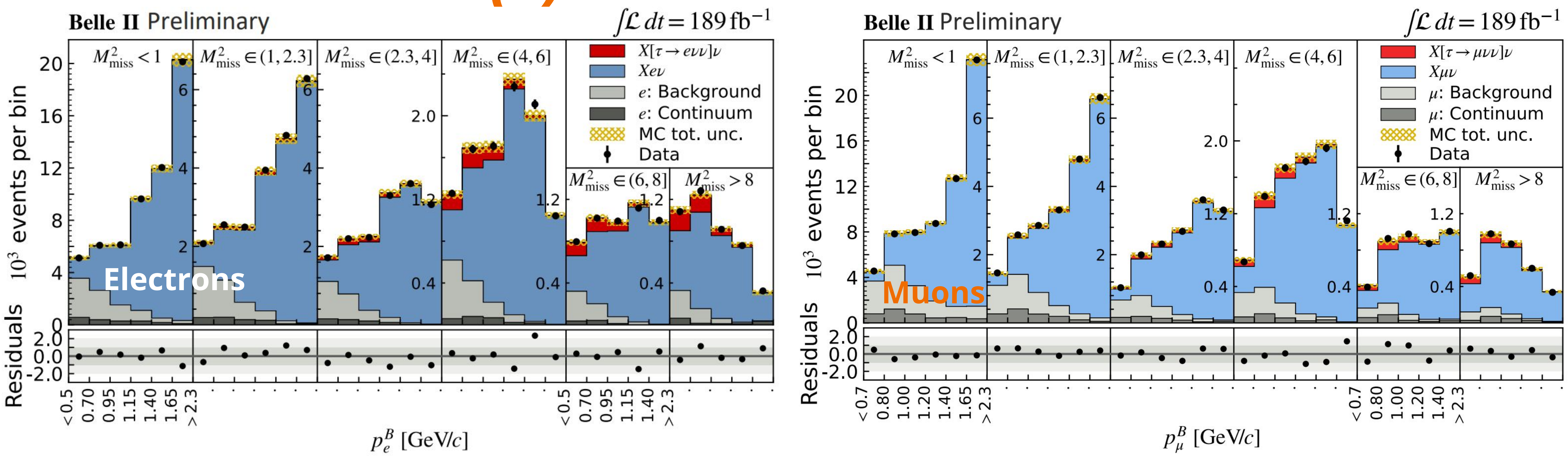
Contribution	Uncert. [%] $\mathcal{R}(D^*)$	$\mathcal{R}(D^0)$
Simulated sample size	5.3	10.2
DD bkg. shape	2.8	7.3
$\overline{B} \to D^{**}(\ell^-/\tau^-)\overline{\nu}$ FFs	2.8	2.7
Signal/norm. FFs	2.5	4.8
Misidentified μ bkg.	2.5	2.7
Baryonic bkg.	2.5	2.7
DD bkg. model	2.1	1.6
$\overline{B} \to D_s^{**}\ell^-\overline{\nu}$ model	2.1	5.4
Total systematic	**8.5**	**15.0**
Total statistical	**6.4**	**13.6**
Total	**10.7**	**20.2**



Belle II: $R(X) \equiv Br[B \to X\tau\nu_\tau] / Br[B \to X\ell\nu_\ell]$ [talks by Glazov & Koga]

Measurement of *R(X)*

See also presentation at EPS



Complex analysis, requiring multiple corrections/reweighting to simulated samples
Excellent agreement between electron and muon channel measurements:

$$R(X_{\tau/e}) = 0.232 \pm 0.020\ (\mathrm{stat}) \pm 0.037\ (\mathrm{syst})$$
$$R(X_{\tau/\mu}) = 0.222 \pm 0.027\ (\mathrm{stat}) \pm 0.050\ (\mathrm{syst})$$

Systematics is largely from data-driven corrections in control regions

Combined result

***R(X)* = 0.228 ± 0.016(stat) ± 0.036 (syst)**
is consistent with SM 0.223±0.006, but also with measurements of $R(D^{(*)})$

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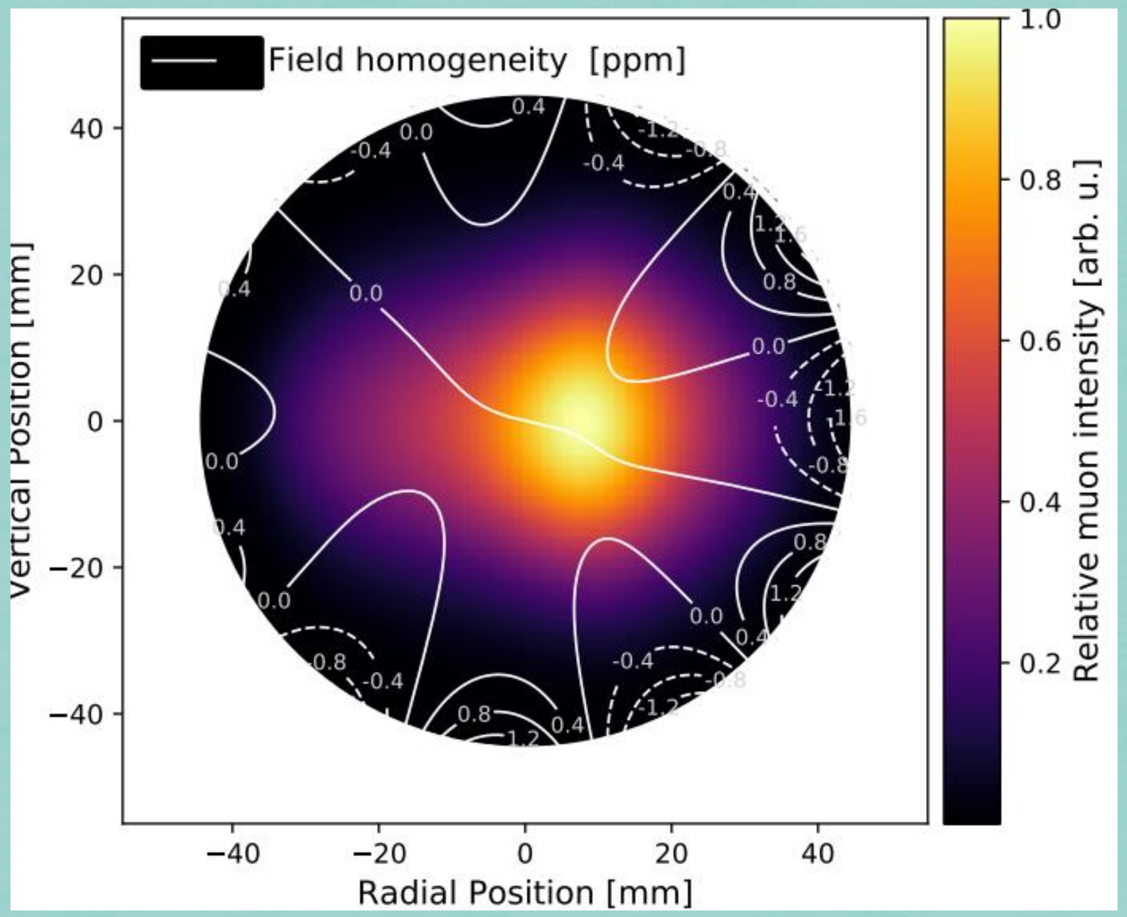
first *R(X)* result [at a B factory]

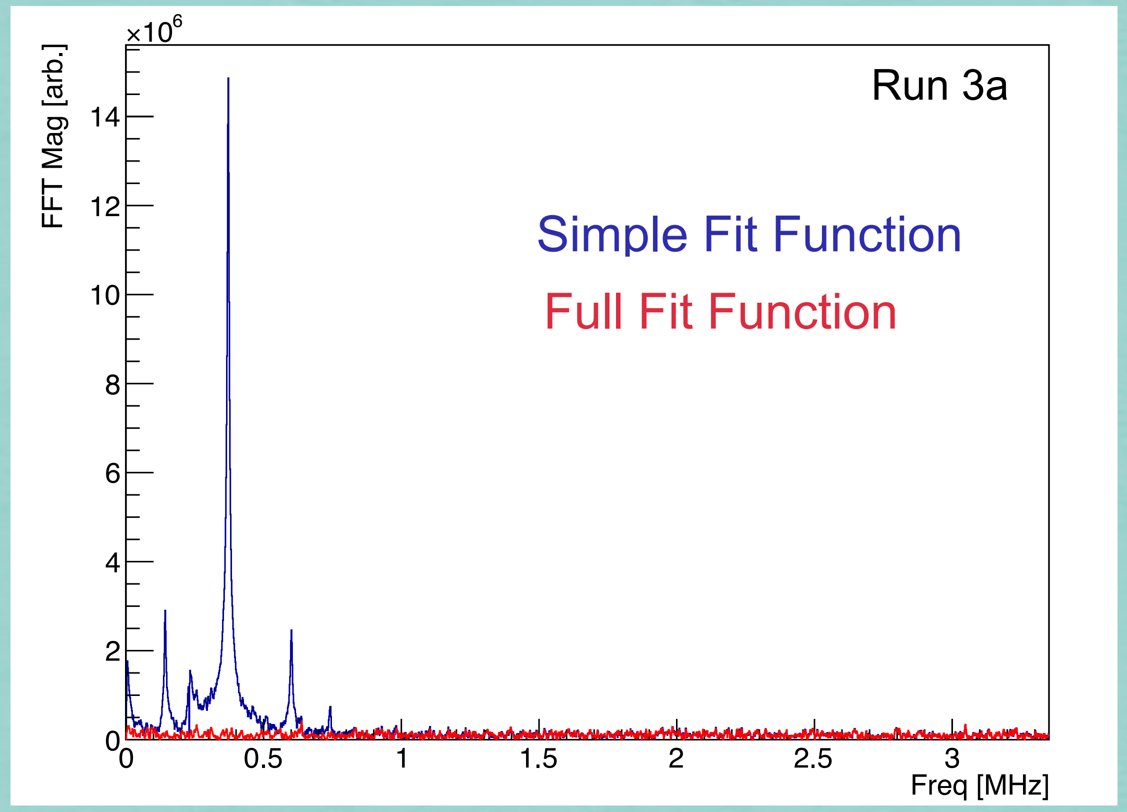
other important Belle II result: first evidence for $B^+ \to K^+\nu\bar{\nu}$

muon g-2 — ×2 reduction in exp. uncert. [Venanzoni, Charity, Foster, Kim]



track sub-ppm changes in the field over time

Saskia Charity



frequency components

Sean Foster

BD Corrections [ppb]	Run-1	Run-2/3
C_e	489 ± 53	451 ± 32
C_p	180 ± 13	170 ± 10
C_{pa}	-158 ± 75	-27 ± 13
C_{dd}	-	-15 ± 17
C_{ml}	-11 ± 5	0 ± 3
Sum	**500 ± 93**	**580 ± 40**

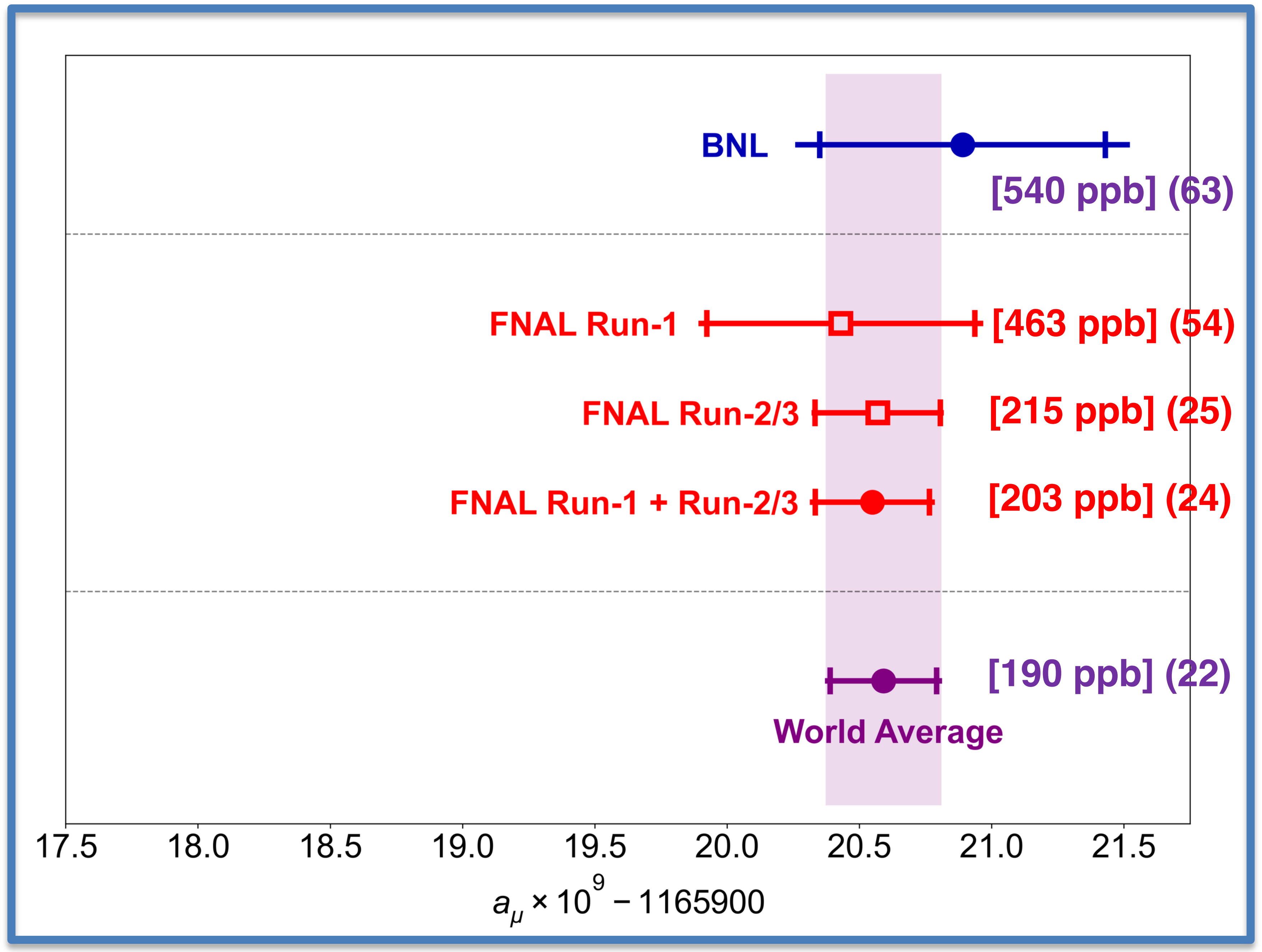
beam dynamics

On Kim

Run-2/3 Result: FNAL + BNL Combination

Muon g-2

a_μ(FNAL) = 116 592 055(24) x10^{-11} [203 ppb]



- FNAL combination: **203 ppb** uncertainty
- Both FNAL and BNL dominated by statistical error
- Combined world average **dominated by FNAL** values.

a_μ(Exp) = 116 592 059(22) x 10^{-11} [190 ppb]

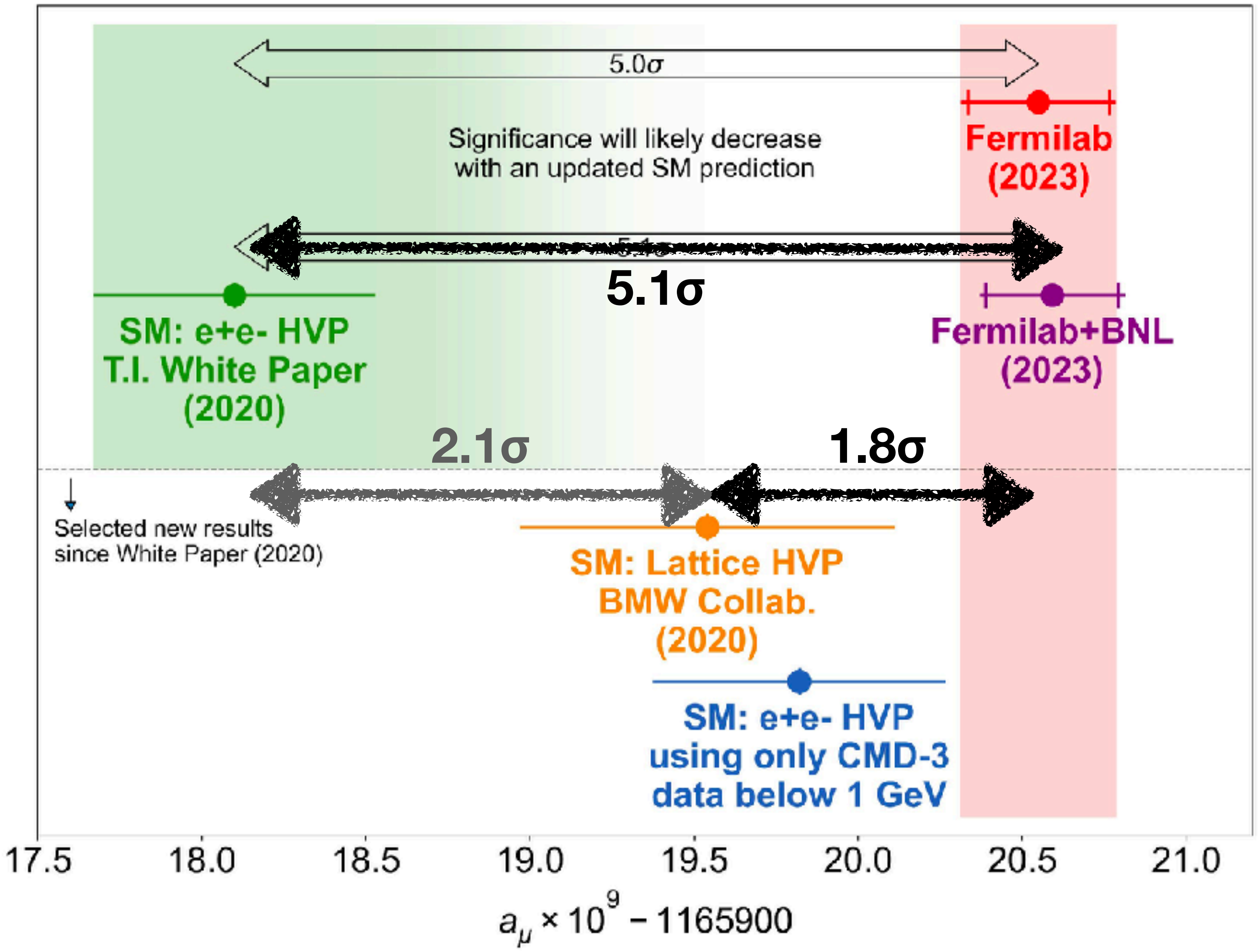
G. Venanzoni, EPS-HEP2023, Hamburg, 22 August 2023 22

Venanzoni

The Muon g-2

(see talk by G. Venanzoni and all dedicated talks in the parallels)

Exquisite experimental precision from the **muon g-2 Collaboration** @ FNAL

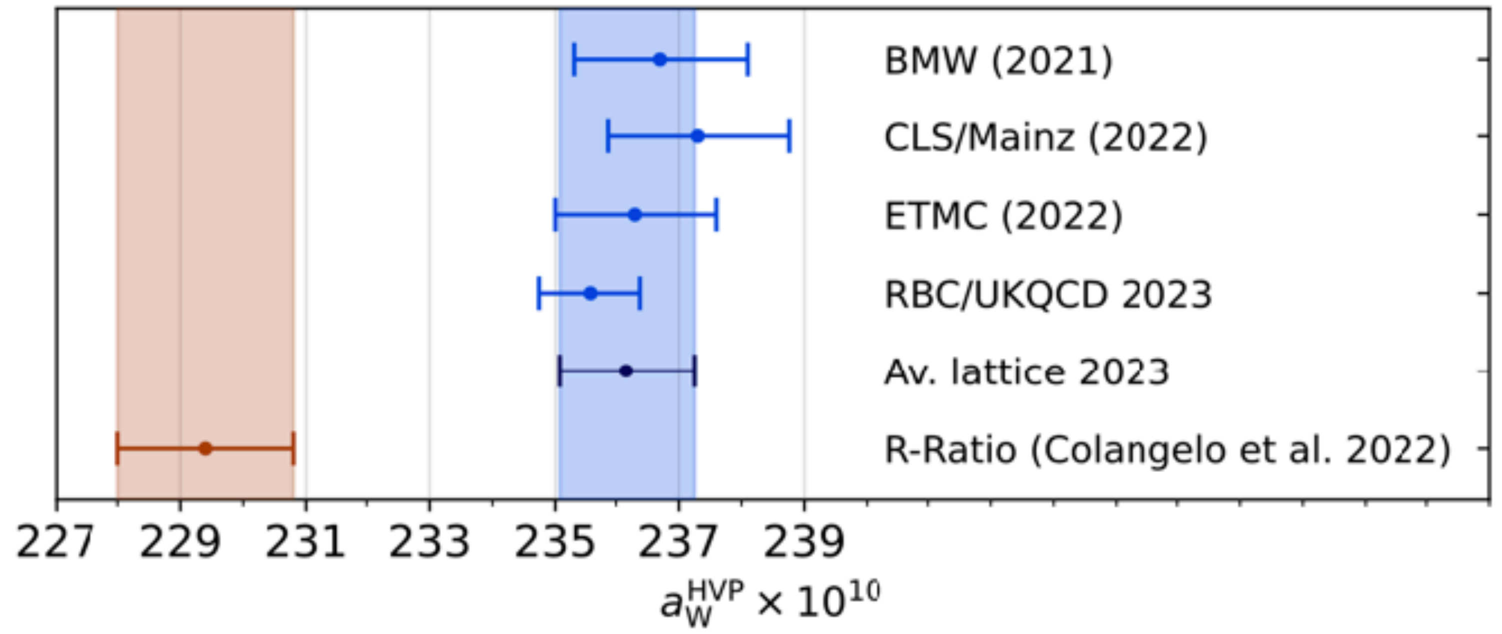


Strong discrepancy in the SM predictions between data-driven methods (R-ratio in $e^+e^- \to$ hadrons) and lattice computation (BMW collaboration).

Recent news:

1) Comparing different lattices in the *intermediate window* shows agreement, but discrepancy with R-ratio result:

Darmé, Grilli di Cortona, Nardi 2212.03877



2) The **CMD-3** data in $e^+e^- \to \pi\pi$ provides an R-ratio **result compatible with the lattice** one.

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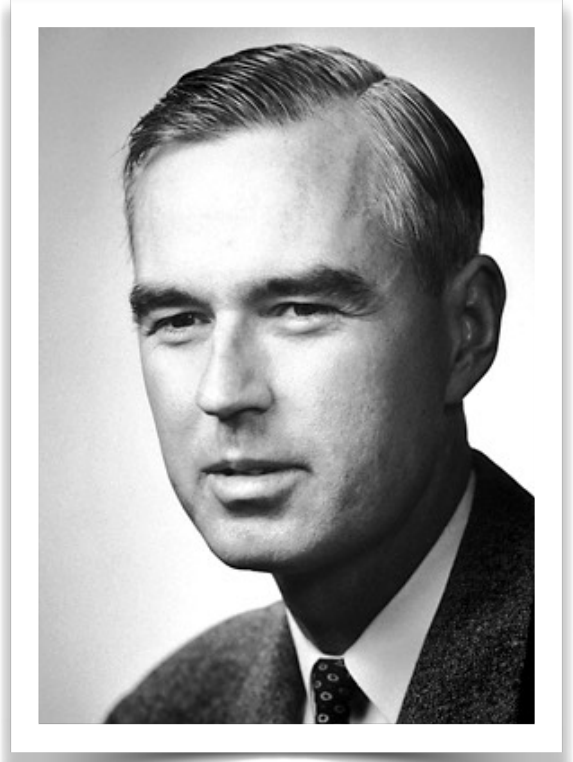
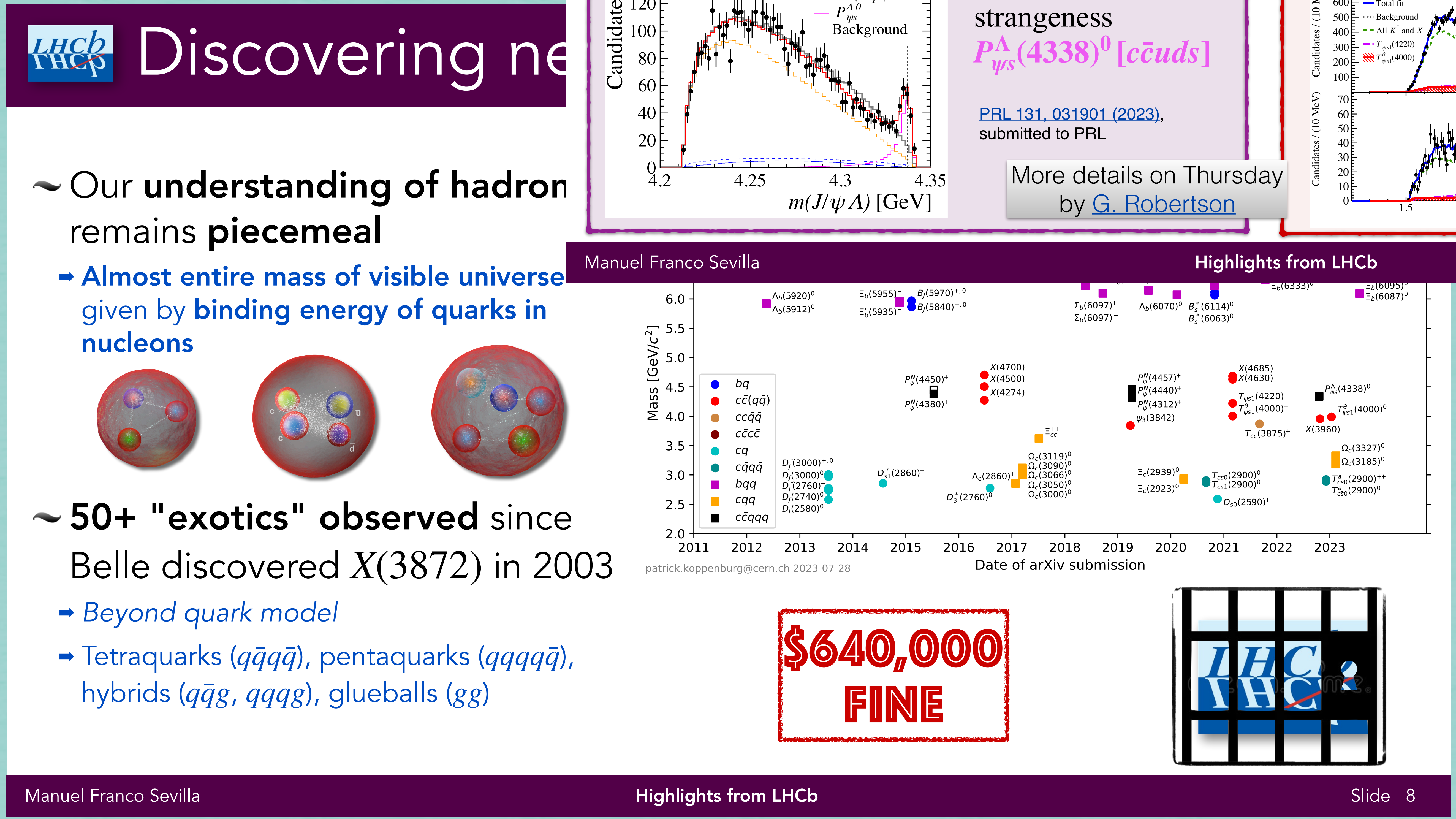
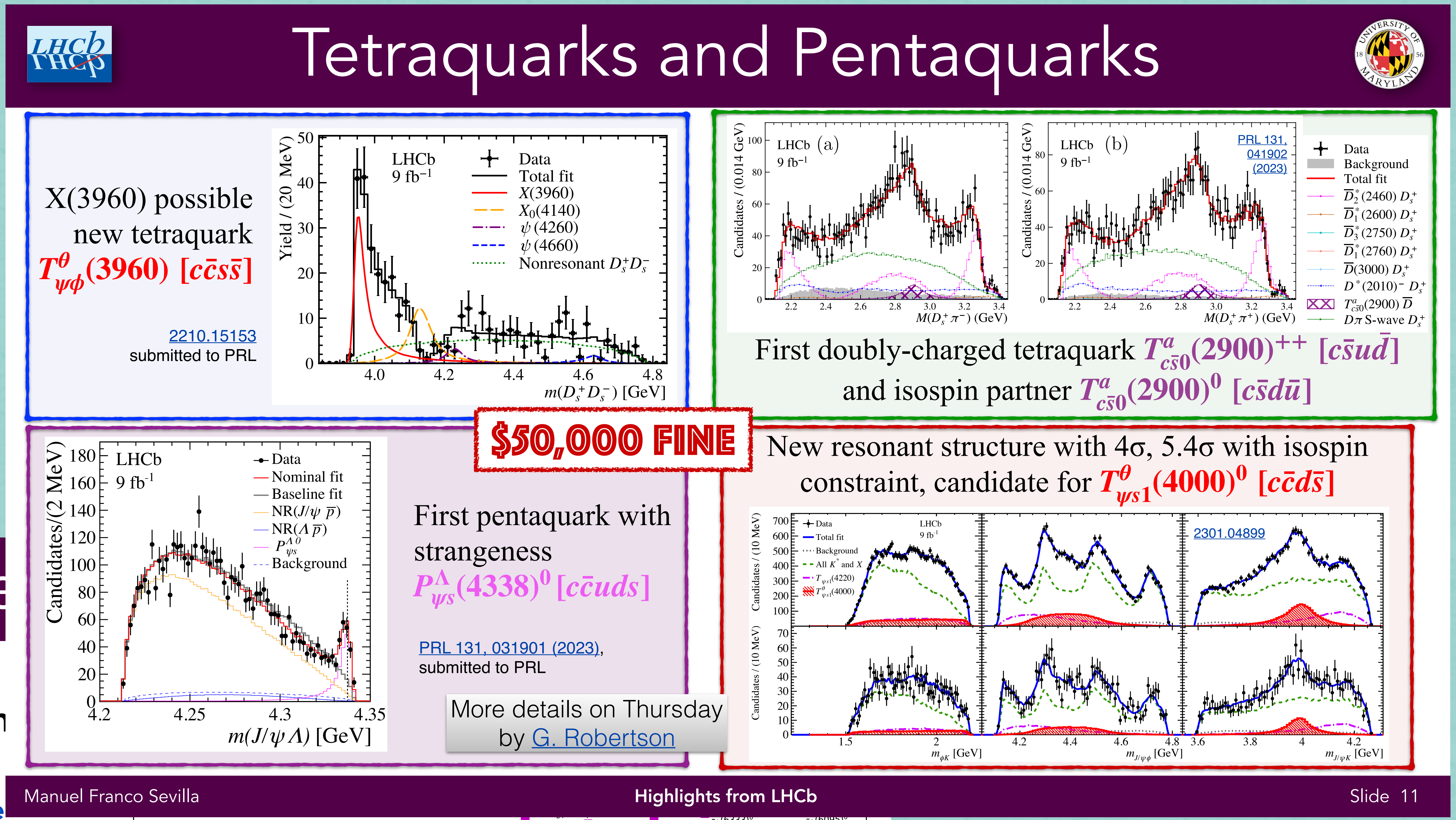
LHCb new particles [Franco Sevilla]

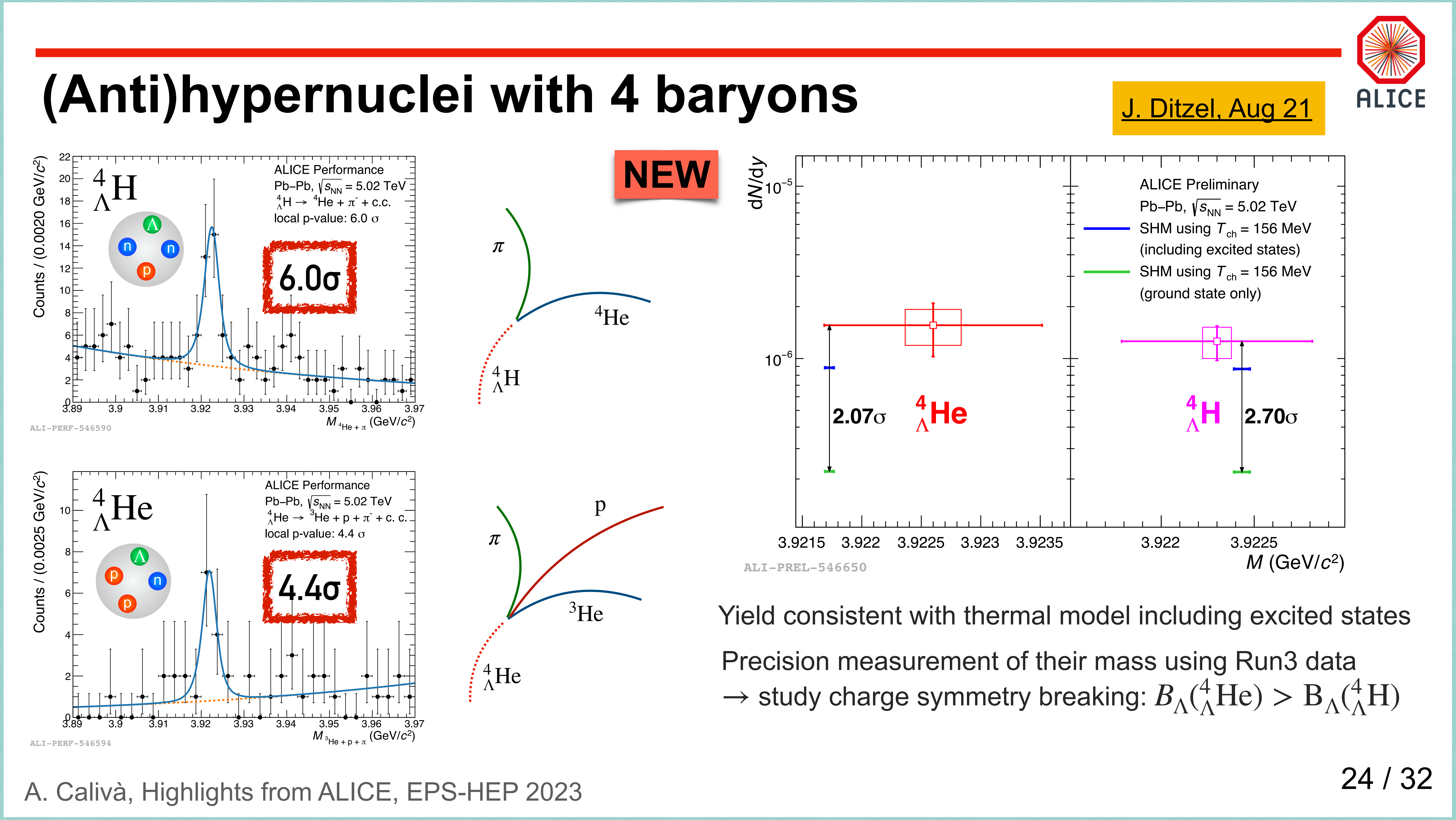


Willis Lamb, Jr.
Nobel Lecture,
December 12, 1955





ALICE: strange ^{4}H & Helium [Calivà, Ditzel]



standard nuclei with d-quark replaced by s-quark

Relevance includes question of strangeness in neutron stars

NB: see also LHCb hyper-triton observation

neutrinos

Current knowledge and open questions

- precise measurements test the 3-flavor paradigm

$\sin^2(\theta_{12}) = 0.307 \pm 0.013$

$\Delta m^2_{21} = (7.53 \pm 0.18) \times 10^{-5}$ eV^2

$\sin^2(\theta_{23}) = 0.539 \pm 0.022$ (S = 1.1) (Inverted order)

$\sin^2(\theta_{23}) = 0.546 \pm 0.021$ (Normal order)

$\Delta m^2_{32} = (-2.536 \pm 0.034) \times 10^{-3}$ eV^2 (Inverted order)

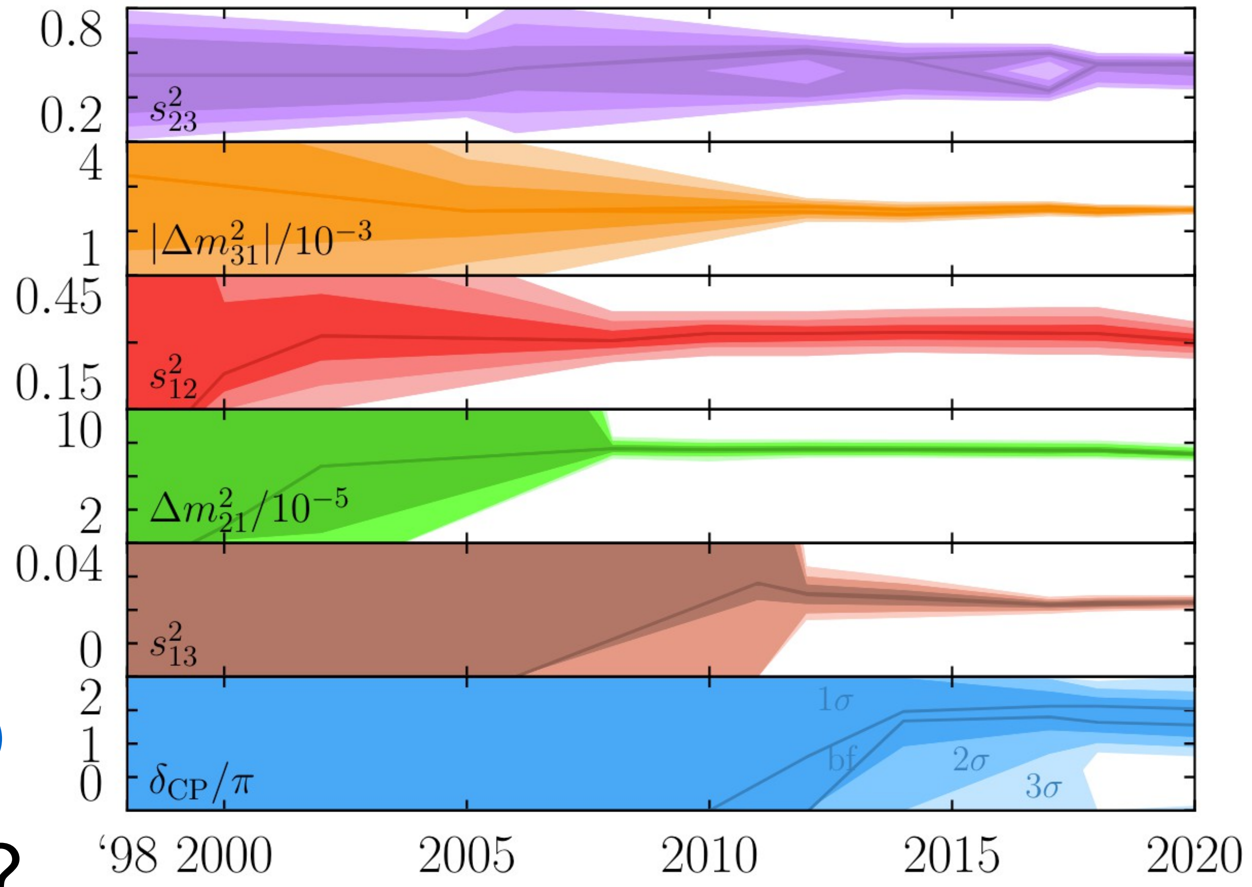
$\Delta m^2_{32} = (2.453 \pm 0.033) \times 10^{-3}$ eV^2 (Normal order)

$\sin^2(\theta_{13}) = (2.20 \pm 0.07) \times 10^{-2}$

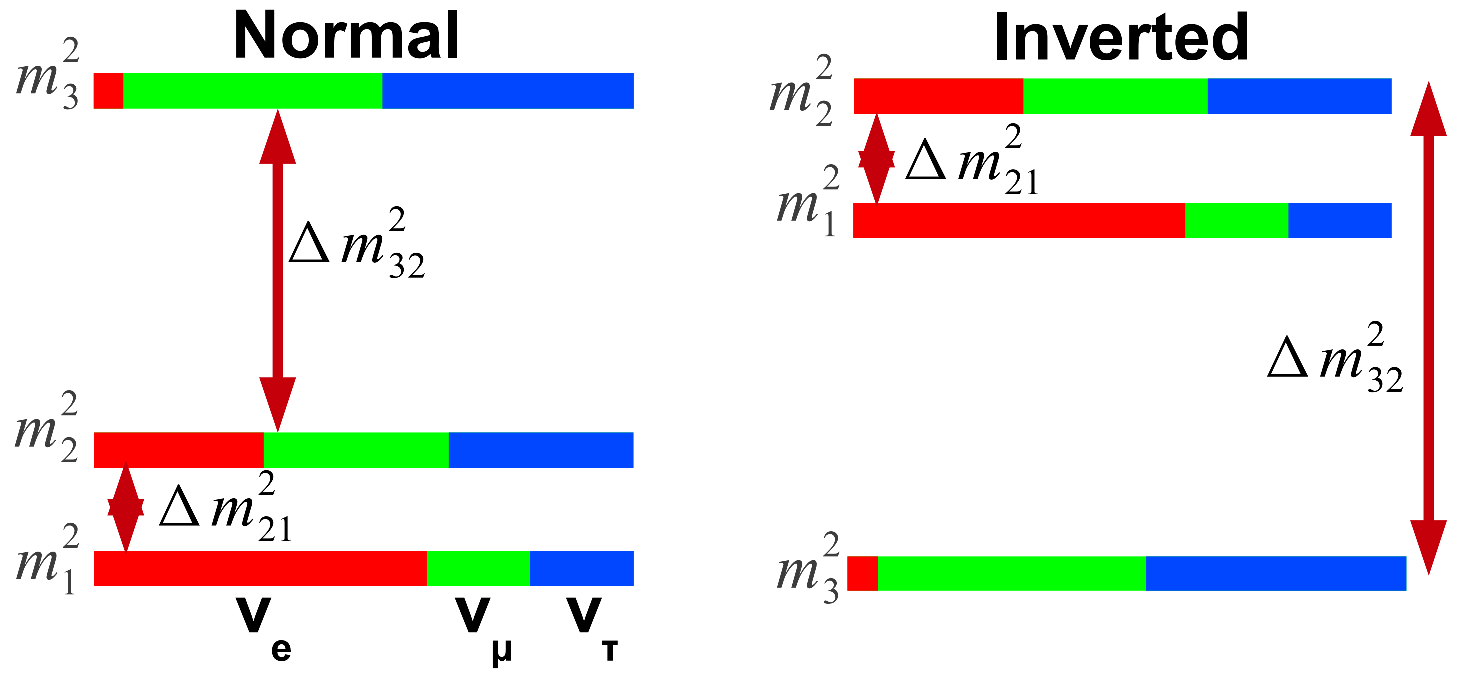
δ, CP violating phase $= 1.36^{+0.20}_{-0.16}\ \pi$ rad

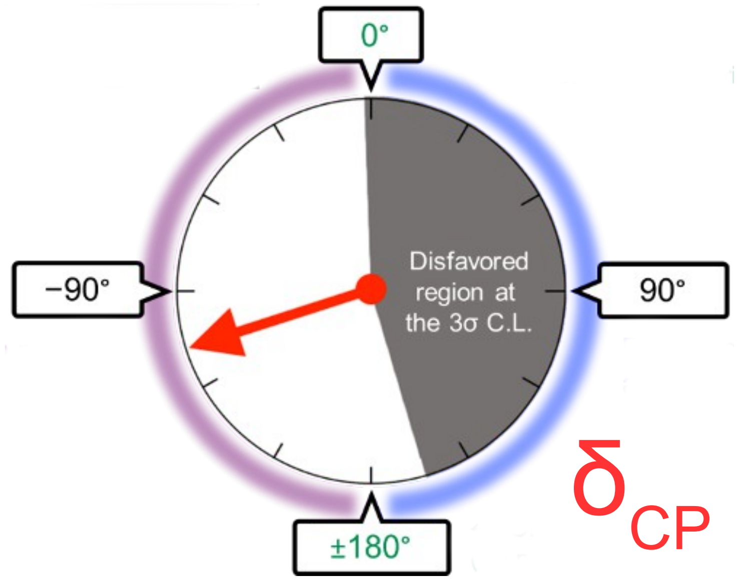
PTEP 2022, 083C01 (2022)

©P.Denton



- θ_{23} octant, mass ordering, CP violation ???





T2K Nature 580, 339 (2020)

Not covered by this talk: direct mass measurements, Dirac/Majorana nature of neutrinos, origin of masses and mixing

3

status – open questions – T2K & Nova results [Łagoda, Prabhu, Frank]

Current knowledge and op

- precise measurements test the 3-flavor parad

$\sin^2(\theta_{12}) = 0.307 \pm 0.013$
$\Delta m^2_{21} = (7.53 \pm 0.18) \times 10^{-5}\ \text{eV}^2$
$\sin^2(\theta_{23}) = 0.539 \pm 0.022 \quad (S = 1.1) \quad$ (Inverted order)
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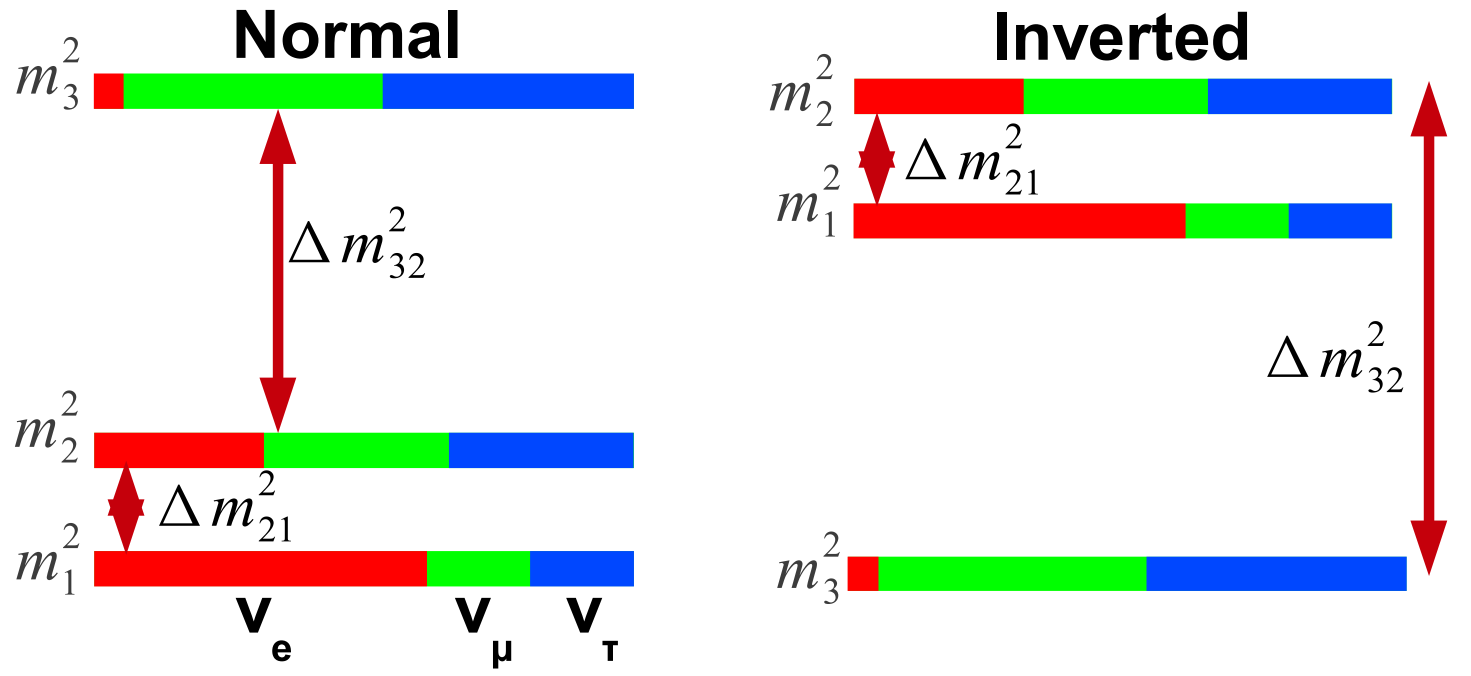
δ, CP violating phase $= 1.36^{+0.20}_{-0.16}\ \pi$ rad

PTEP 2022, 083C01 (2022)

- θ_{23} octant, mass ordering, CP violation ???



Not covered by this talk: direct mass measuremen
neutrinos, origin of masses and mixing

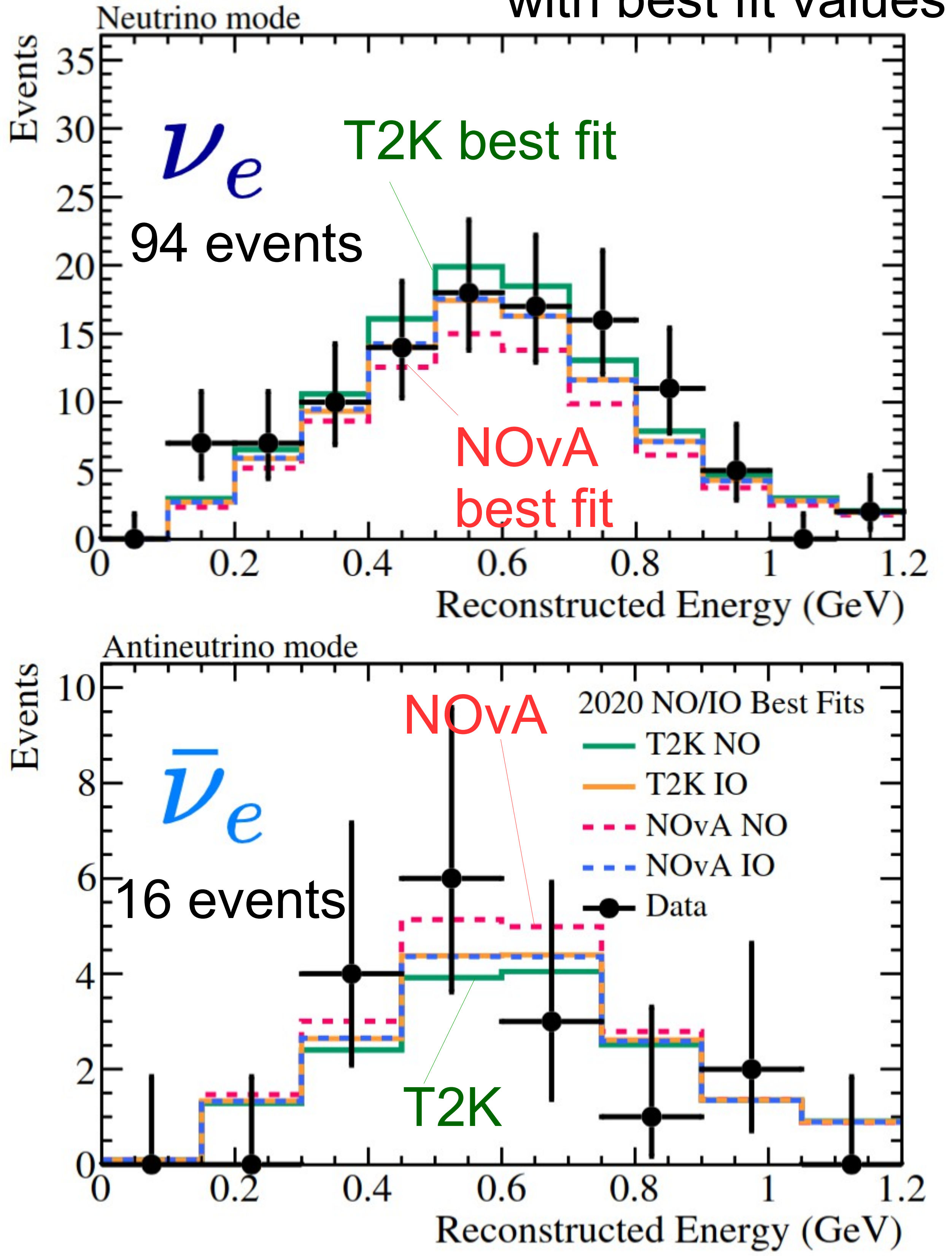
T2K vs. NOvA

- both show a **weak preference for NO**
- some tension in $\boldsymbol{\delta_{CP}}$ but remember: current results are **statistically limited!**
  - if IO: consistent preference for the 3π/2 (-π/2) region, small preference for upper octant
- **more data needed** in both experiments!

- joint analysis T2K-NOvA in progress, results expected soon
- T2K statistical update expected soon
- new analyses from both expected 2024

- Both undergoing upgrade:
  - NOvA – beam power → 900+ kW
  - T2K – beam power → 1.3 MW, ND280 upgrade, SK-Gd
  - Goal: 3σ sensitivity for CPV (T2K) and MO (NOvA)

points - T2K data
histograms – predictions with best fit values



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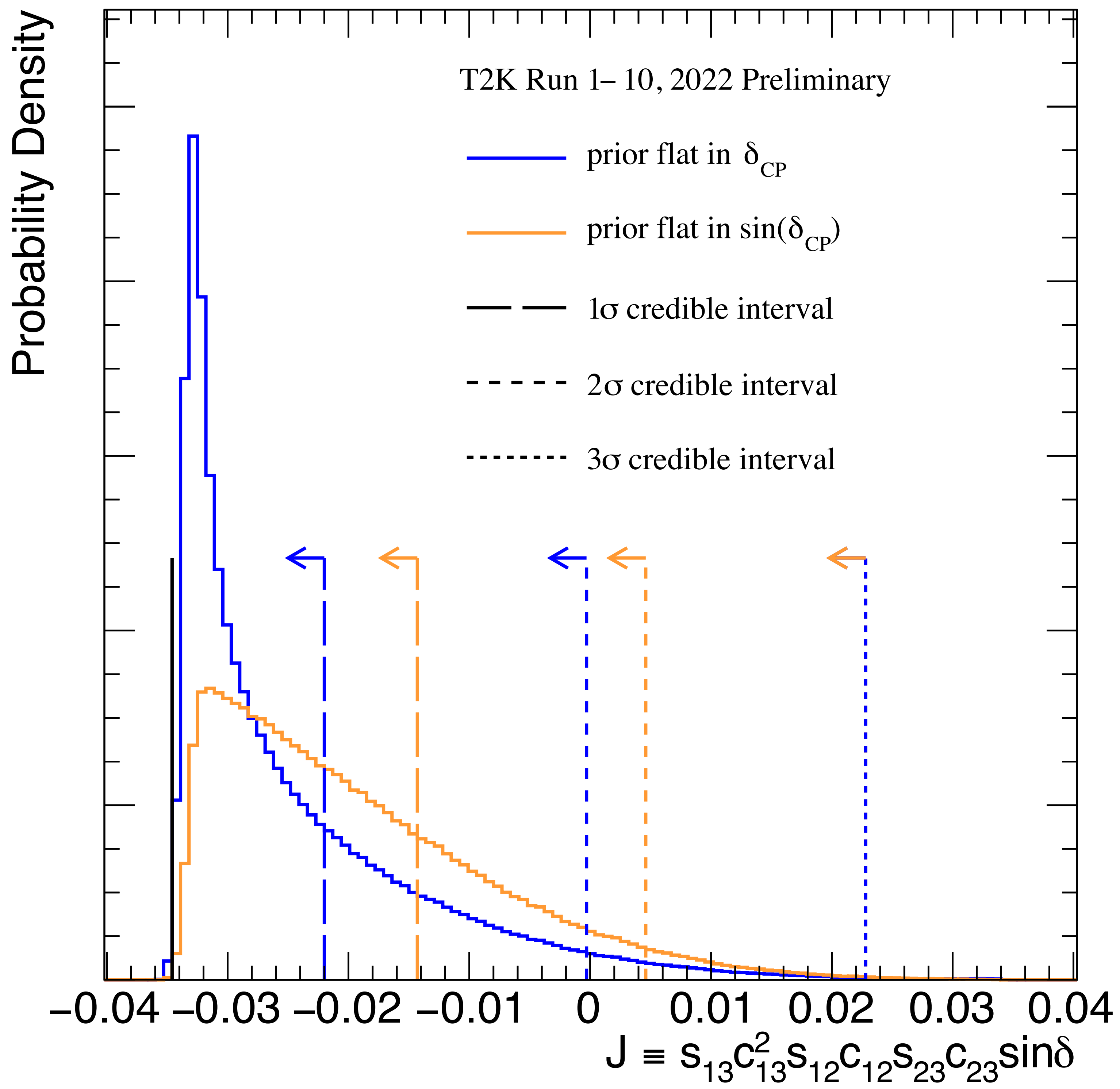
Results - Jarlskog Invariant, J_{CP}

Jarlskog Invariant, $J_{\mathrm{CP}} \equiv \sin\theta_{13}\cos^2\theta_{13}\sin\theta_{12}\cos\theta_{12}\sin\theta_{23}\cos\theta_{23}\sin\delta_{\mathrm{CP}}$

- Introduced J_{CP} as a measurable parameter to search for CP violation as it is PMNS parametrization independent.
- Although J_{CP} results depend on the choice of using flat prior in $\delta_{\mathrm{CP}}/\sin\delta_{\mathrm{CP}}$, **we still exclude $J_{\mathrm{CP}} = 0$** (implying CP conservation) at 90% credible interval.
- Preference for maximal CP violation still valid.

Jarlskog Invariant, Both Hierarchies



Yashwanth S. Prabhu/T2K

neutrinos at LHC & NA62 [Bernlocher, Ferrillo, Lazzeroni]

FASER **directly observed collider neutrinos** (ν_μ) for the first time ($16\,\sigma$)

"First Direct Observation of Collider Neutrinos with FASER at the LHC" Phys. Rev. Lett. 131, 031801

FASERν **observed collider** ν_e for the first time ($5\,\sigma$)

New Summer 2023 **result**!

Public note in preparation

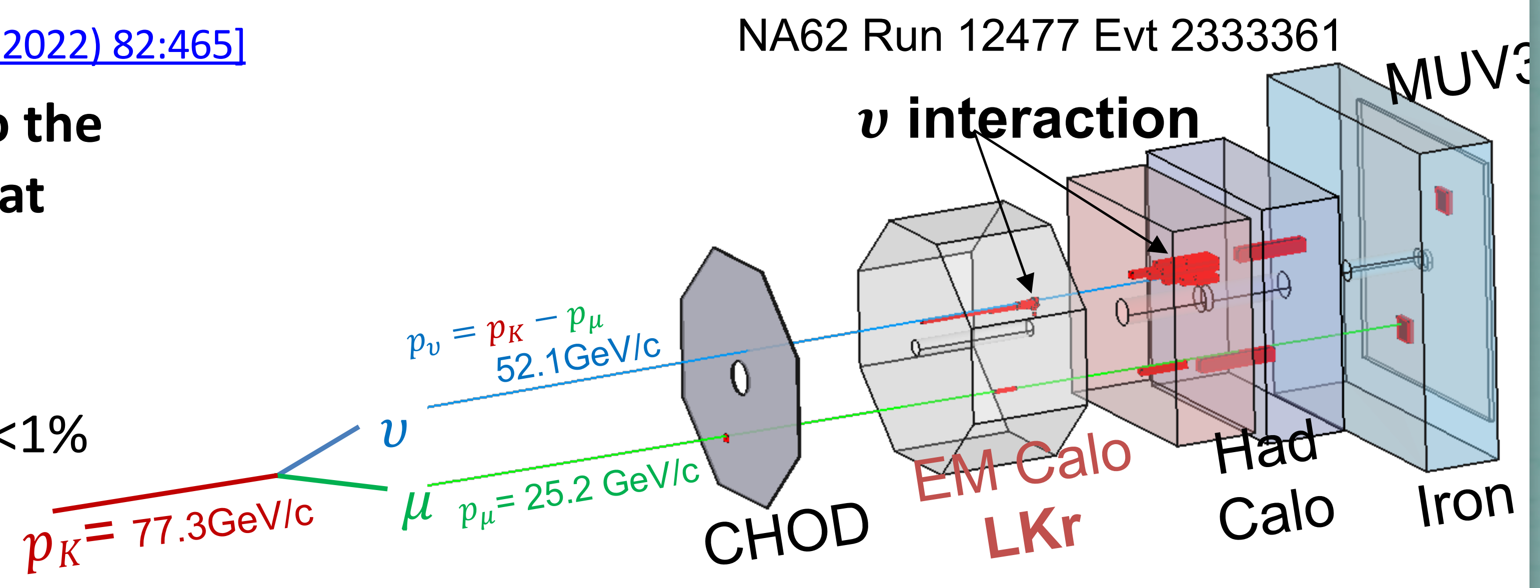
Something different: Neutrino Tagging at NA62

Proof-of-principle of a novel method for accelerator based experiments [Eur. Phys. J. C (2022) 82:465]

Associate each ν interaction to the ν reconstructed kinematically at production ($K^+, \pi^+ \rightarrow \mu^+ \nu_\mu$)

Pristine access to neutrino **flux**

Excellent ν **energy resolution:** <1%



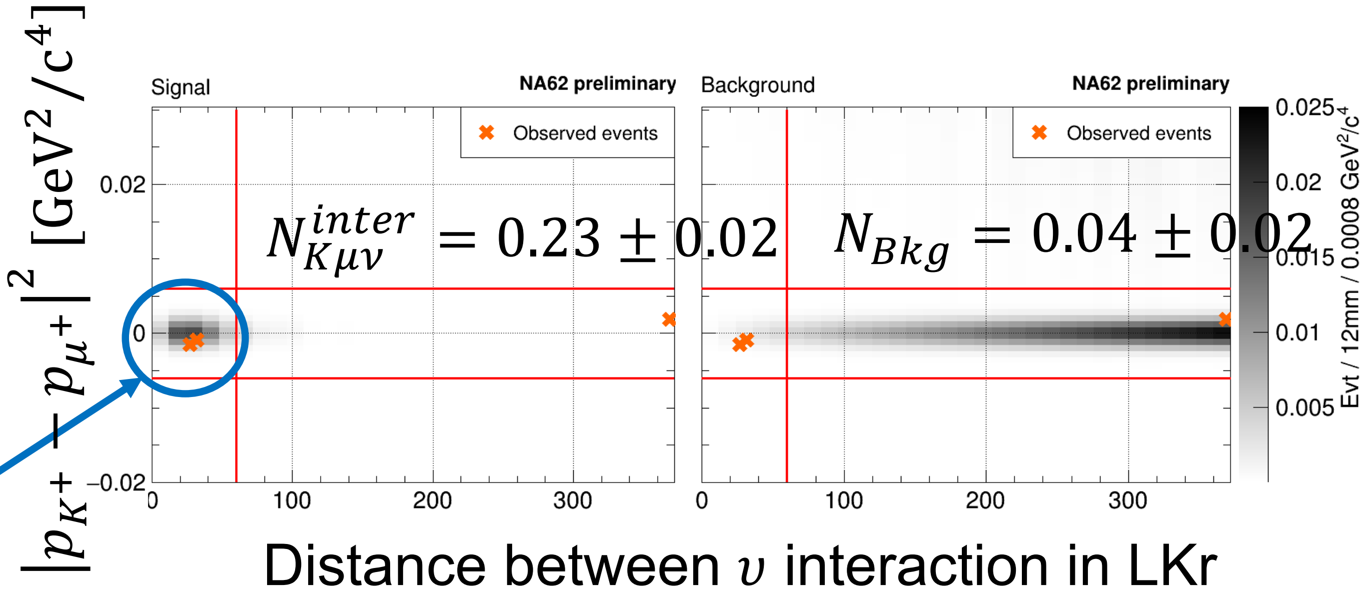
NA62 as tagged-ν experiment

~10^{12} $K^+ \rightarrow \mu^+ \nu_\mu$ per year

ν_μ interactions in the 20 ton of LKr

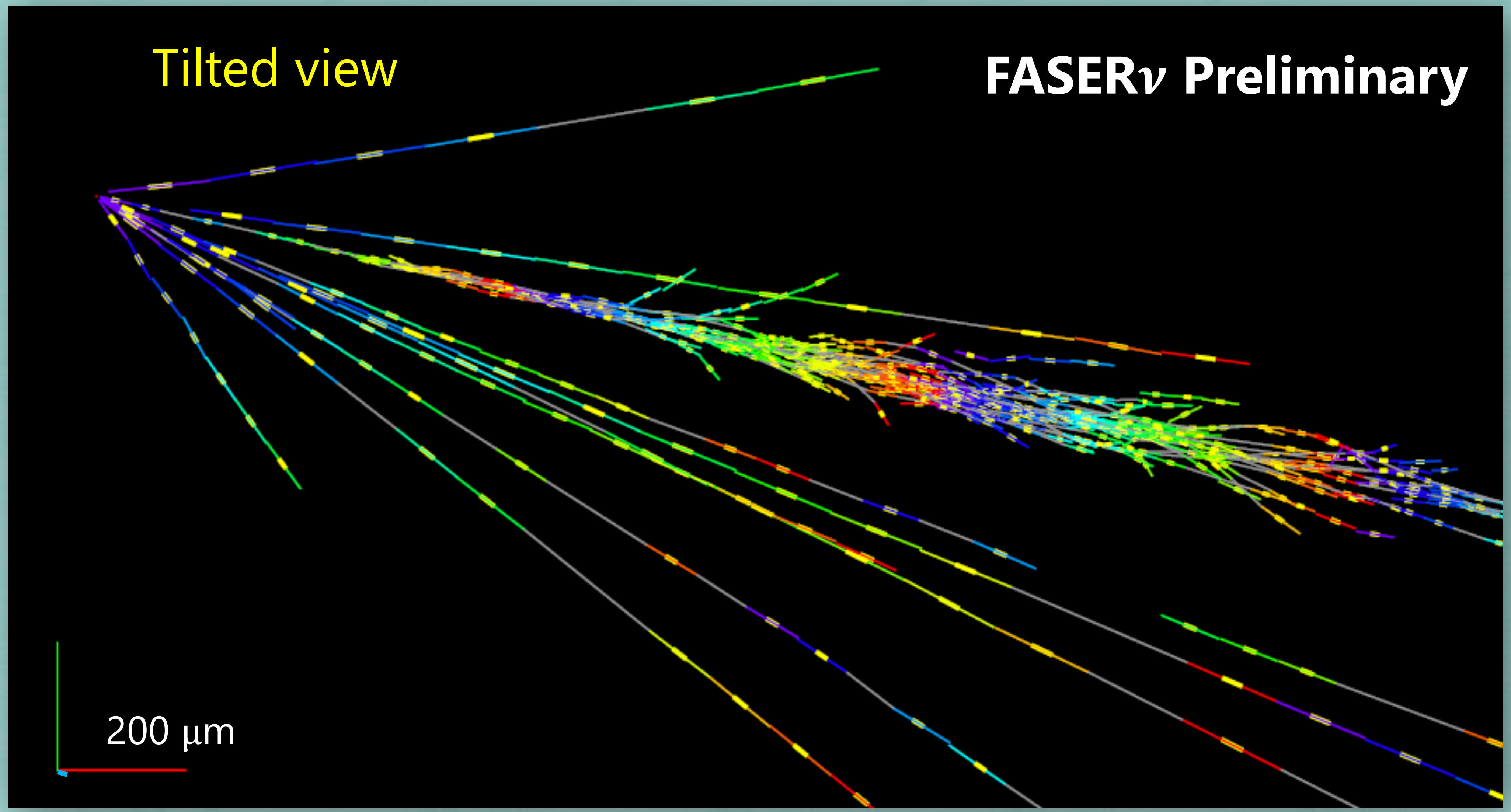
K^+ and μ^+ reconstructed in trackers

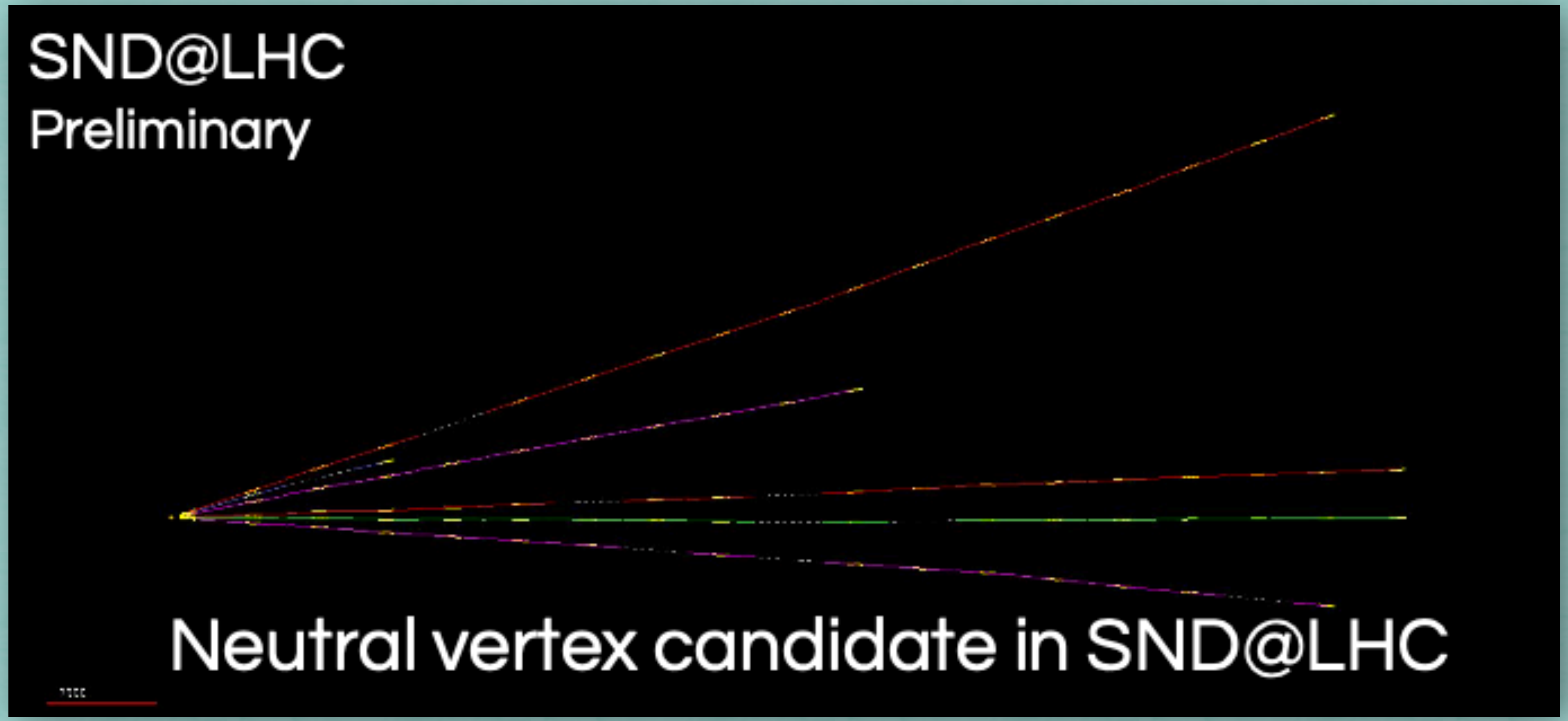
Two tagged ν candidates observed!



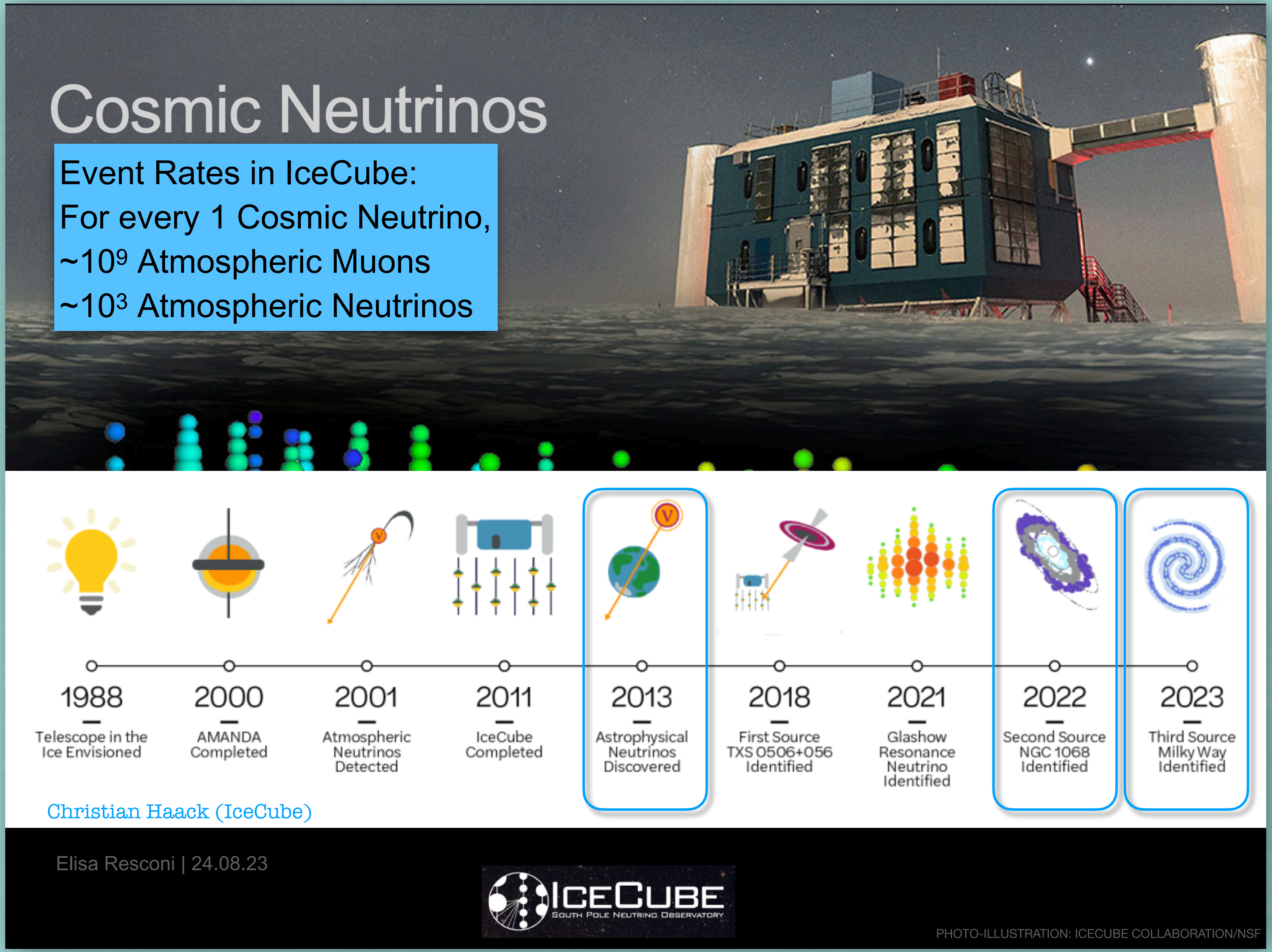
Full details on B. De Martino Talk @ NuFact-23

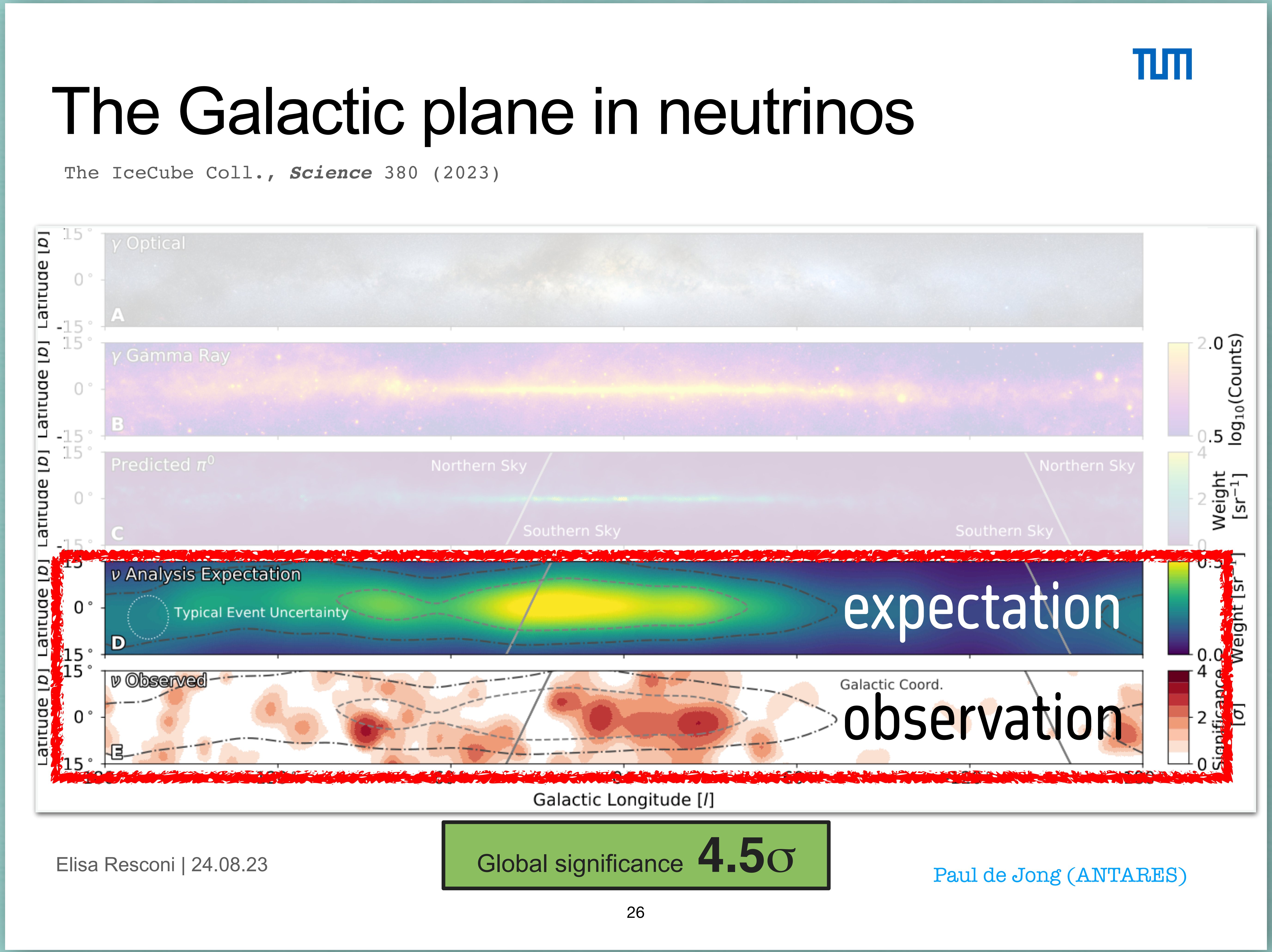
20





neutrinos at IceCube [Resconi]



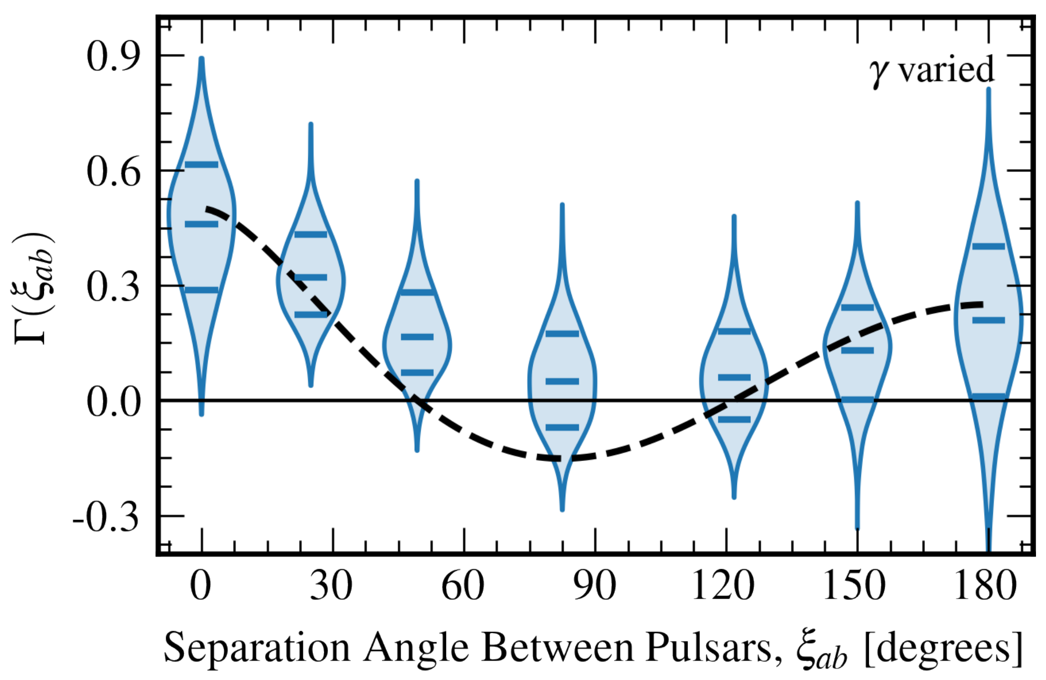


Astrophysics, GW, DM

Evidence for Gravitational Wave Background

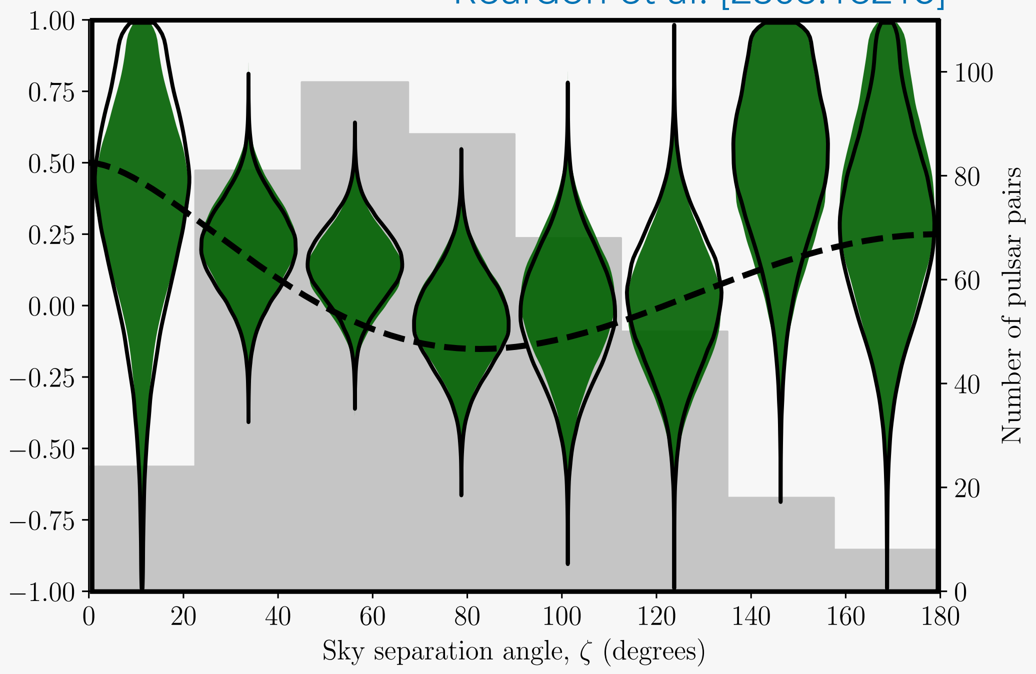
NANOGrav:
68 pulsars, 16yr of data
~3-4σ significance

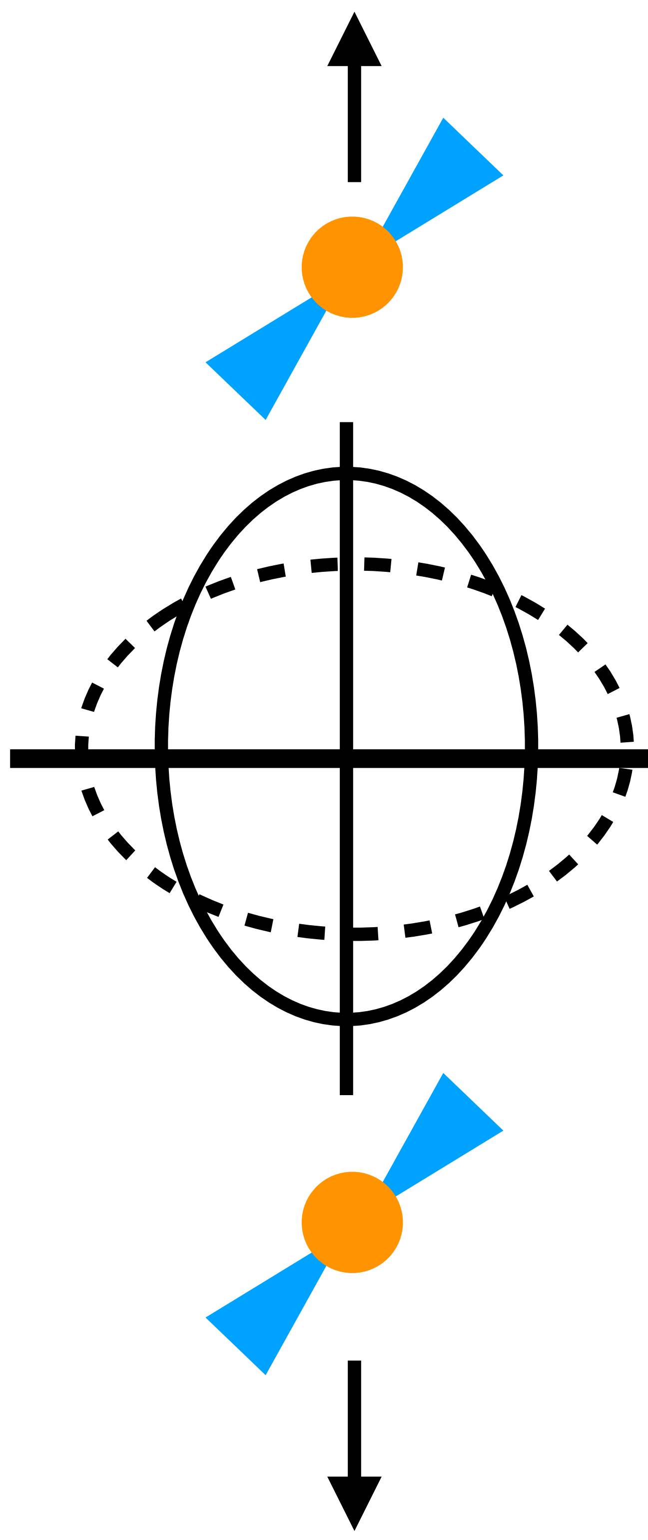
Agazie et al. [2306.16213]



PPTA:
32 pulsars, 18yr of data
~2σ significance

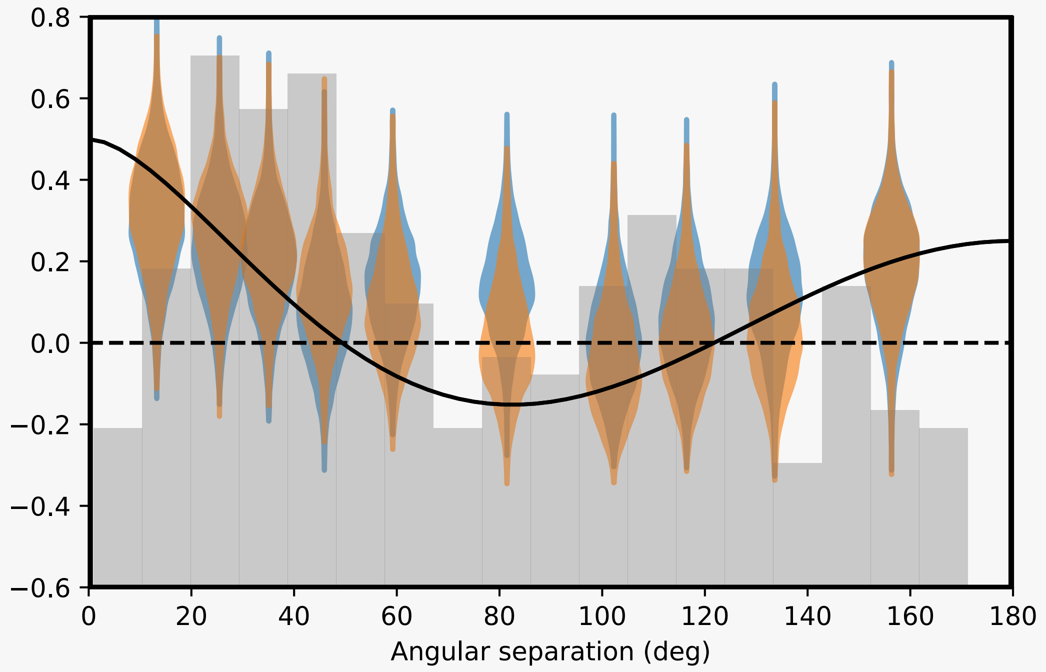
Reardon et al. [2306.16215]





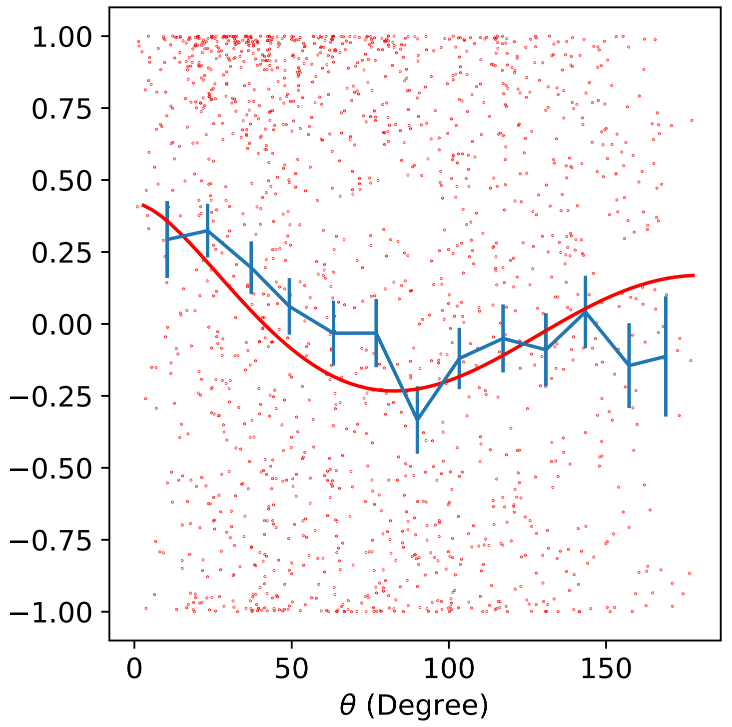
EPTA + InPTA:
25 pulsars, 24yr of data
~3σ significance

Antoniadis et al. [2306.16214]

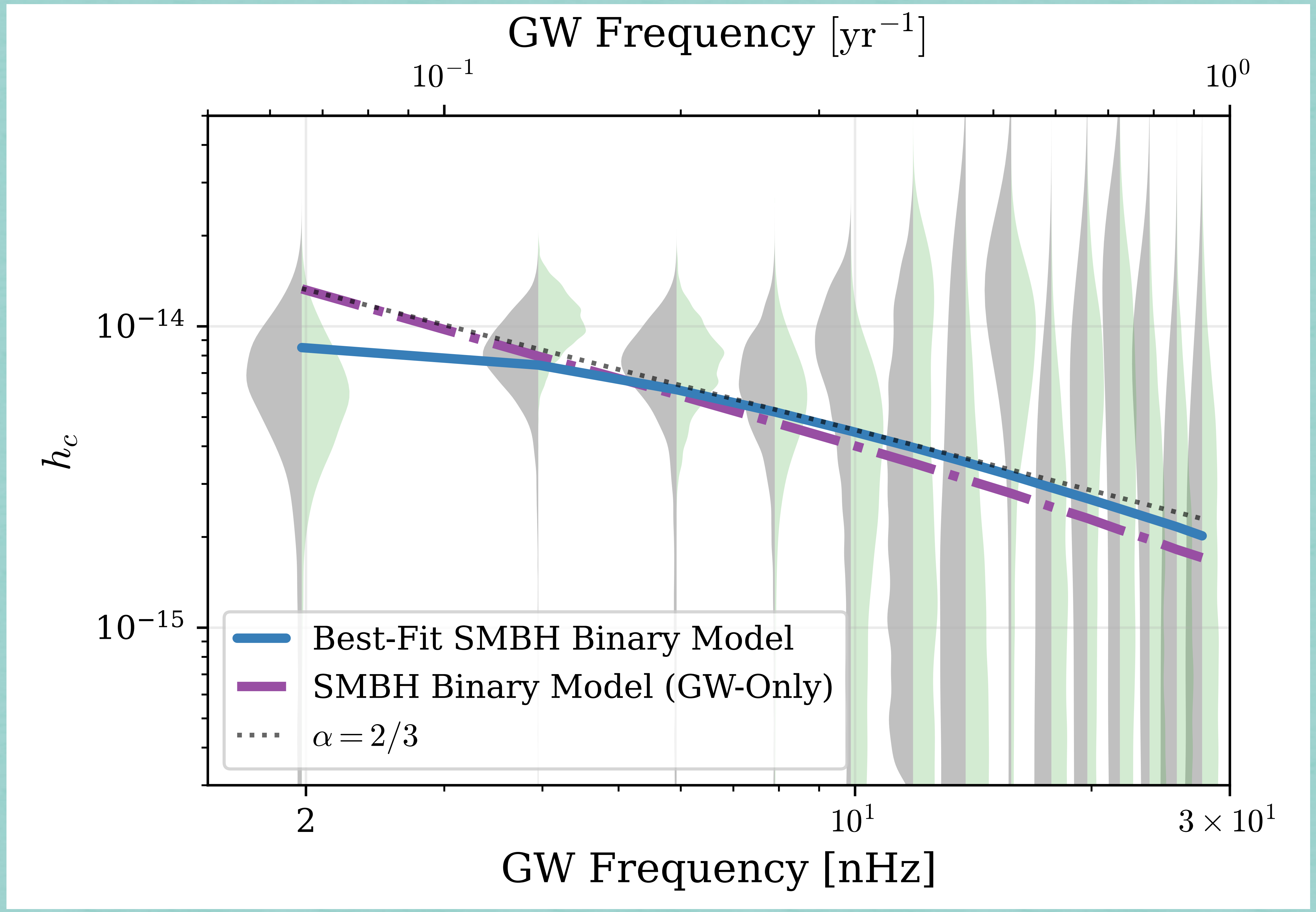


CPTA:
57 pulsars, 3yr of data
~4.6σ significance

Xu et al. [2306.16216]



Nanograv



There are 19 phase shifts with noise-marginalized S/N greater than observed, with p = 5 × 10−5

https://iopscience.iop.org/article/10.3847/2041-8213/acdac6

Favours more common, more massive black hole mergers than in current models

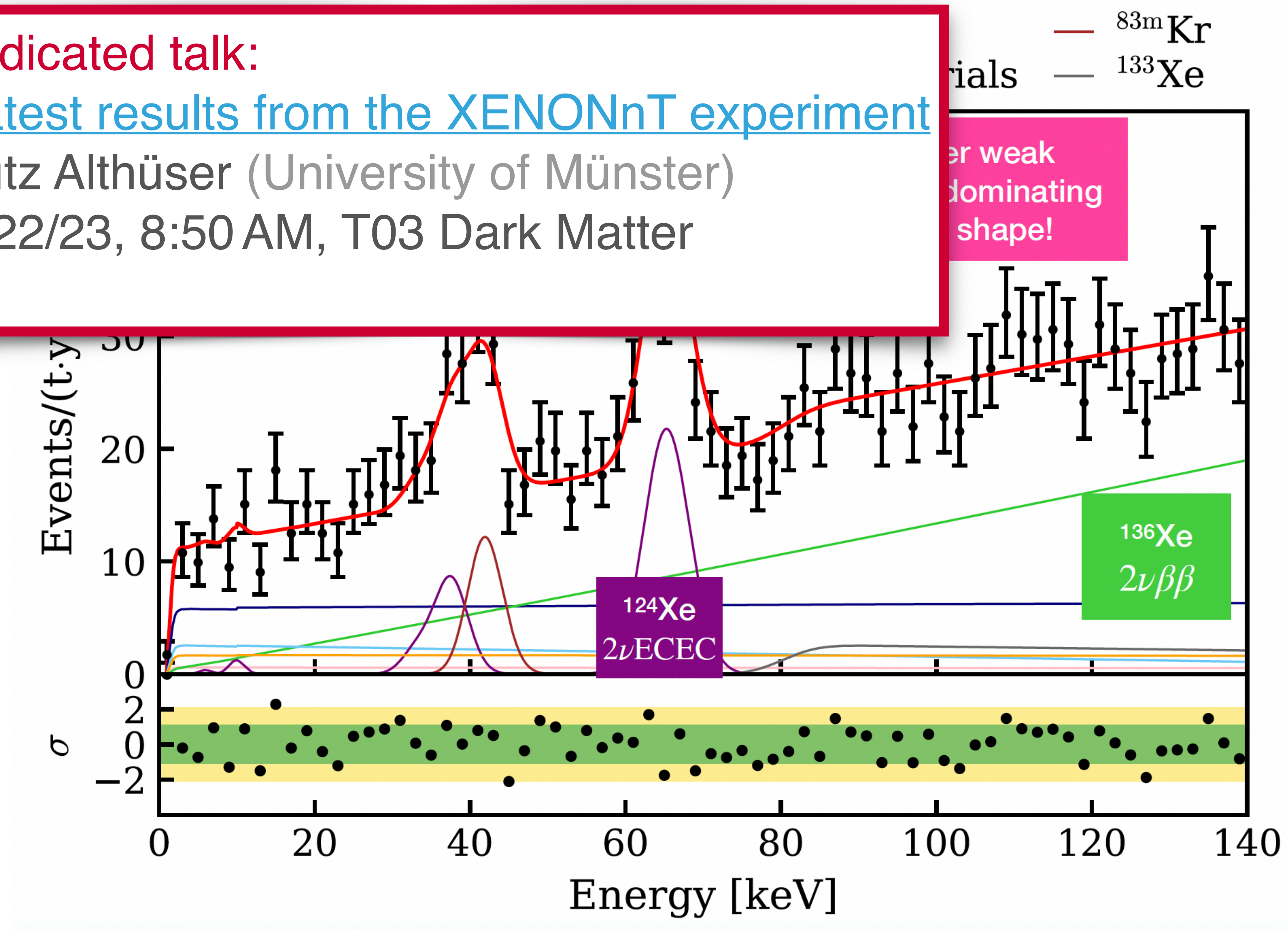
dark matter (von Krosigk, Althüser, Rischbieter)

UNIVERSITÄT HEIDELBERG ZUKUNFT SEIT 1386

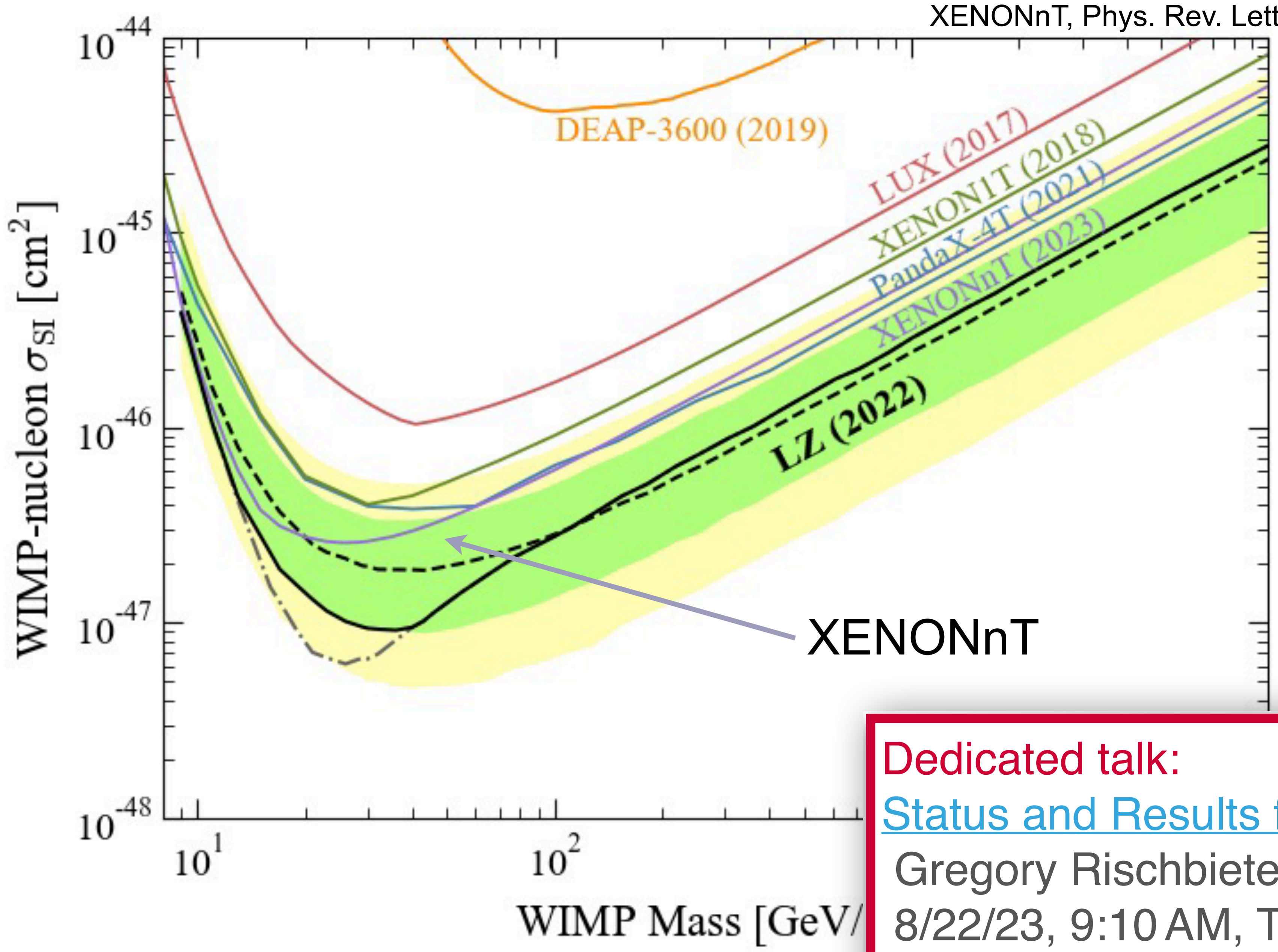
Most recent results >1 GeV: LZ, XENONnT

XENONnT, Phys. Rev. Lett. 129, 161805 (2022)

LZ, Phys. Rev. Lett. 131, 041002 (2023)
XENONnT, Phys. Rev. Lett. 131, 041003 (2023)



Dedicated talk:
Latest results from the XENONnT experiment
Lutz Althüser (University of Münster)
8/22/23, 8:50 AM, T03 Dark Matter

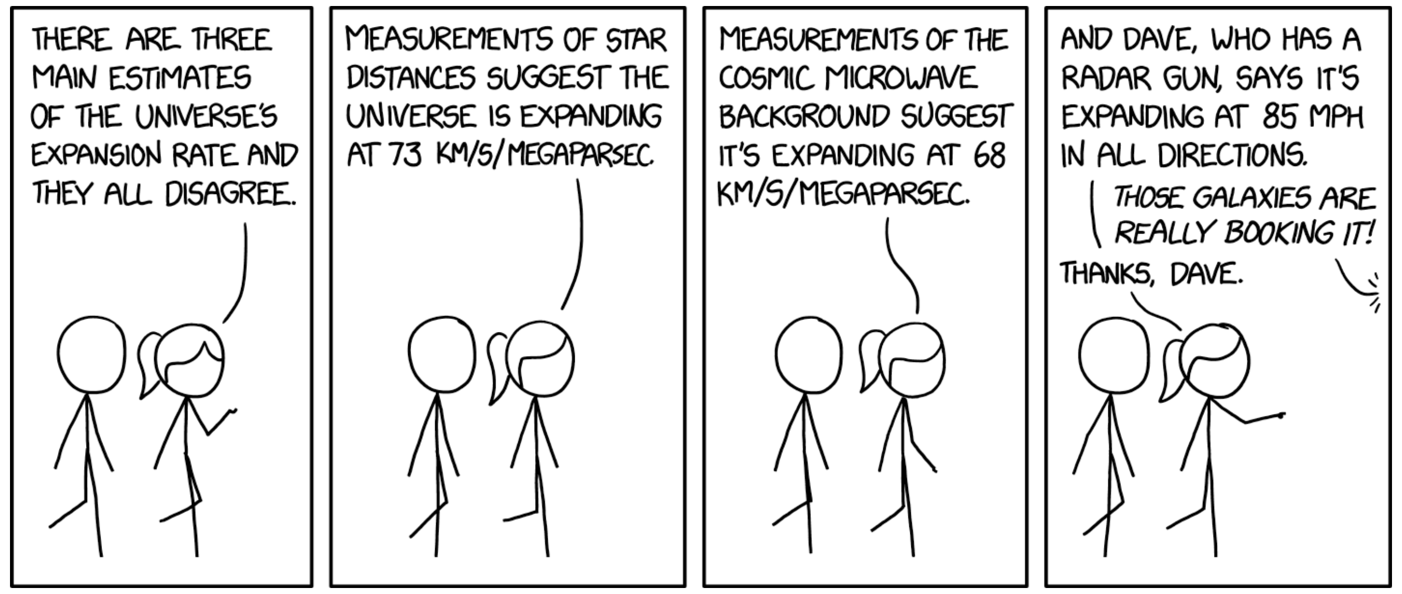


Dedicated talk:
Status and Results from the LUX-ZEPLIN (LZ) Experiment
Gregory Rischbieter (University of Michigan)
8/22/23, 9:10 AM, T03 Dark Matter

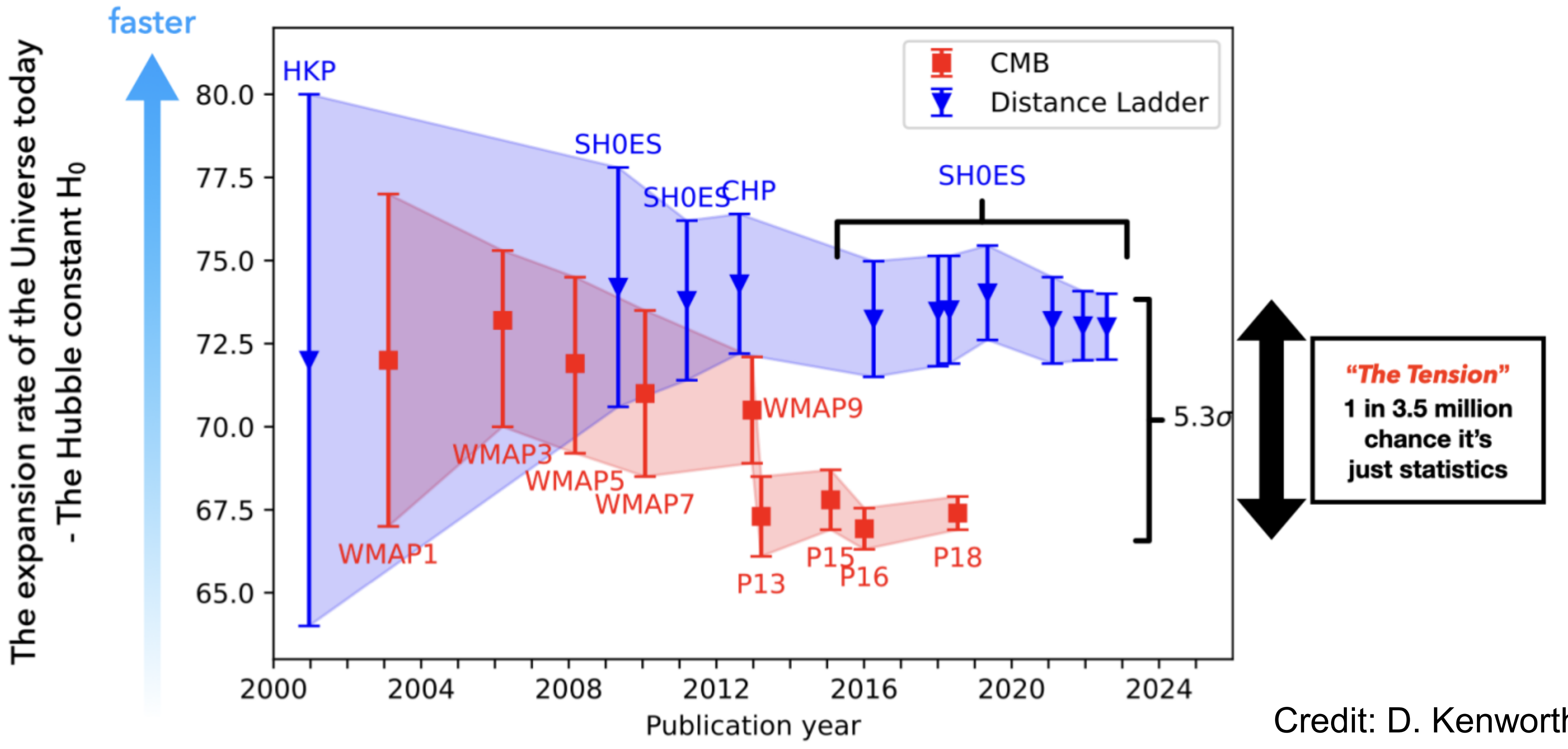
- Sensationally low electron-recoil background (and amazing field cage)
- Power-Constrained Limit defined using “rejection power”
  - *Recommended conventions for reporting results from direct dark matter searches*, D. Baxter et al., Eur.Phys.J.C 81 (2021) 10, 907

Hubble tension [Liske]

The Hubble tension

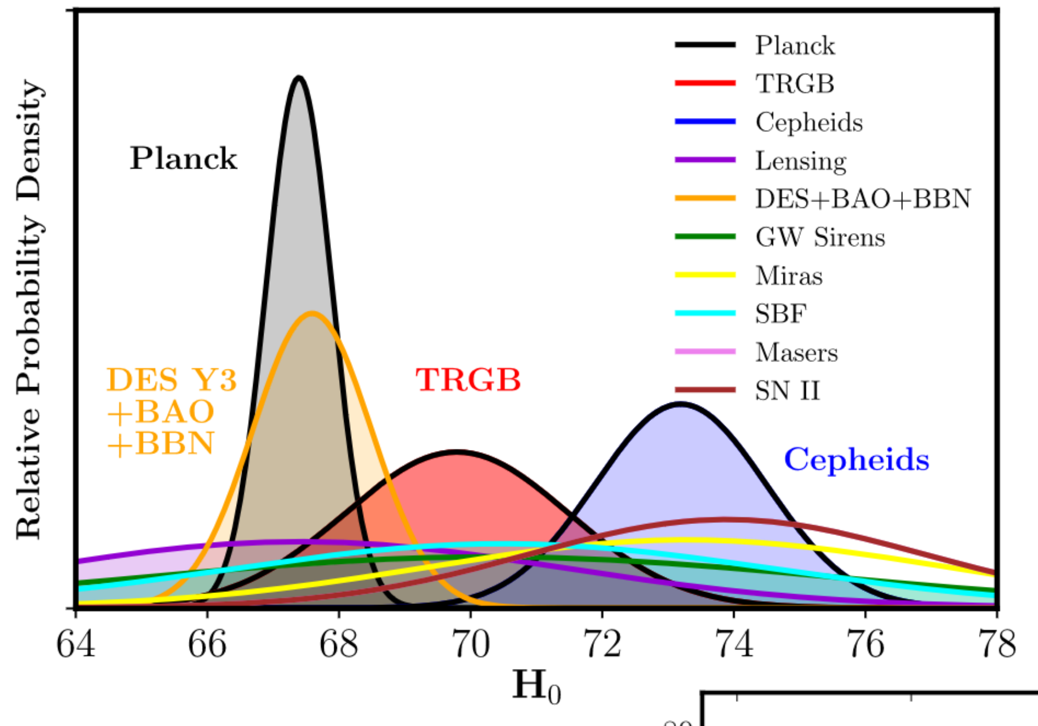


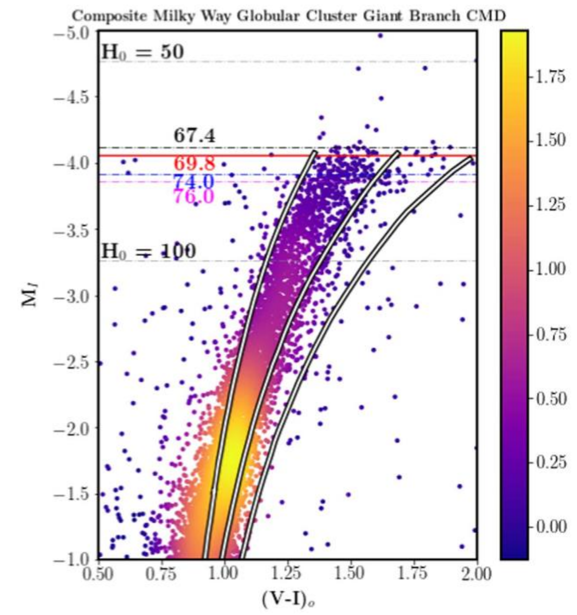
xkcd



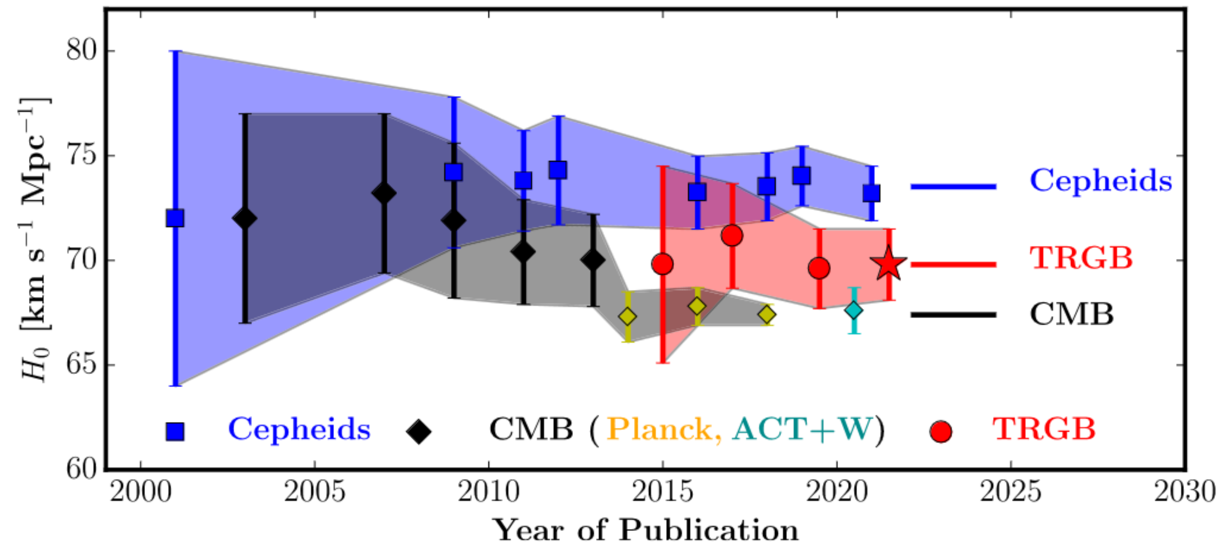
Credit: D. Kenworthy

Hubble tension alleviated?





Freedman (2021)

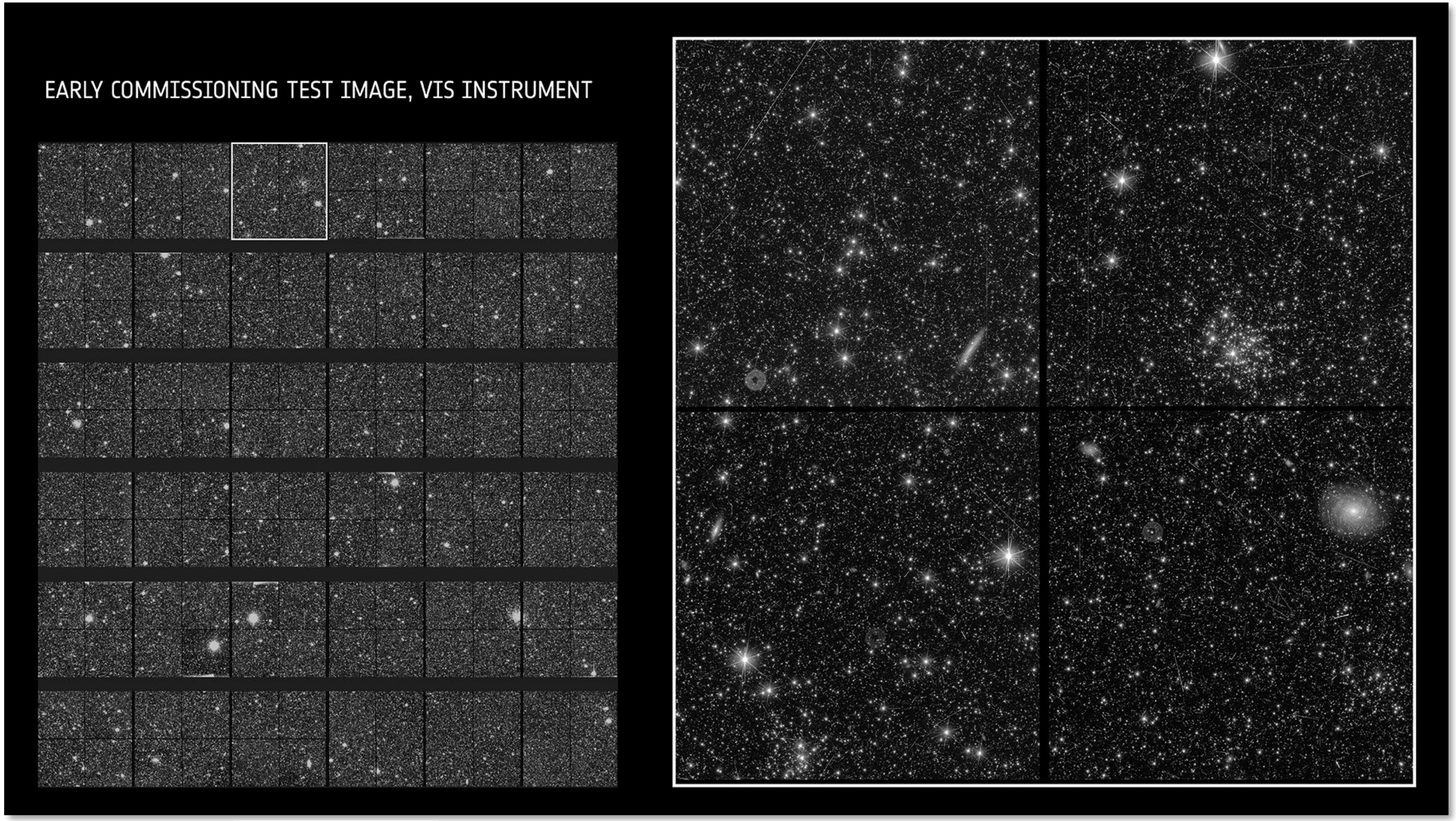


So, what causes the Hubble Tension? We do not know.

Riess & Breuval (2023)

Need to wait for more bright GW sirens?

Euclid first light, in the past few weeks [Liske]



42 arcmin

Credit: ESA / Euclid / Euclid Consortium / NASA

the future

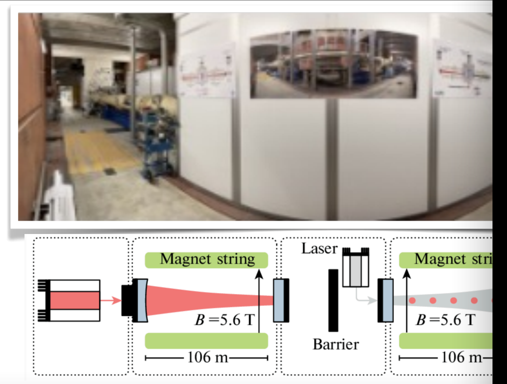
Future neutrino & GW telescopes, axion searches [etc.]

Dark Matter and Axion Searches - Belina von Krosigk

Axion searches at DESY: status

ALPS II data taking started in May 2023 !

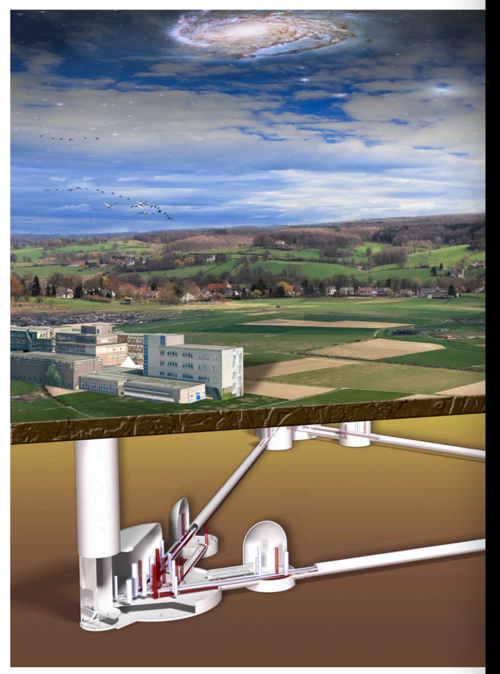
- Dedicated talk:
  Axion and ALP search with the Any Light Particle Search II experiment at DESY
  Isabella Oceano (ALPS (ALPS _ Any Light Particle Search))
  8/24/23, 9:45 AM, T03 Dark Matter

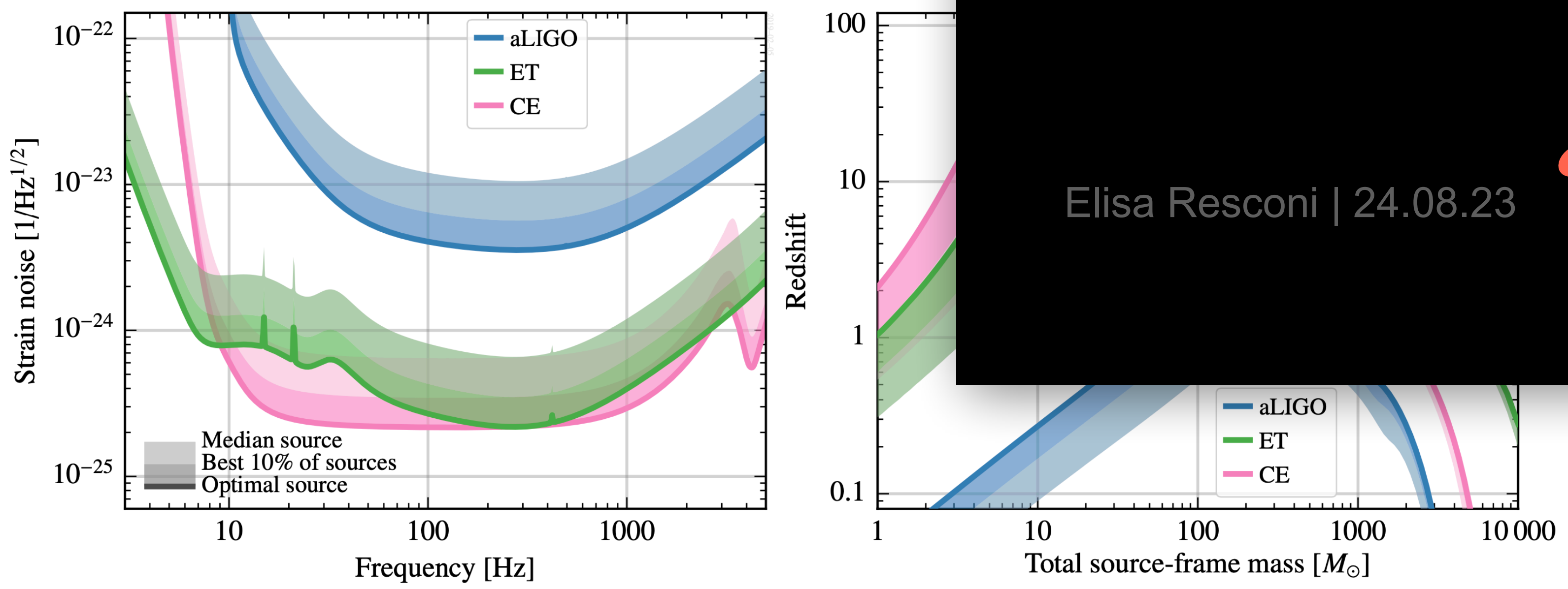


IAXO first data taking of babyIAXO in 2029 ?

THE NEXT GENERATION IN EUROPE: THE EINSTEIN TELESCOPE

- 10km-long arms in equilateral triangle design (underground for seismic isolation)
- two cryogenic detectors (LF and HF)
- site studies ongoing in EURegion Meuse-Rhin and Sardinia
- bid books by 2025 (at the earliest)
- ETPathfinder in Maastricht

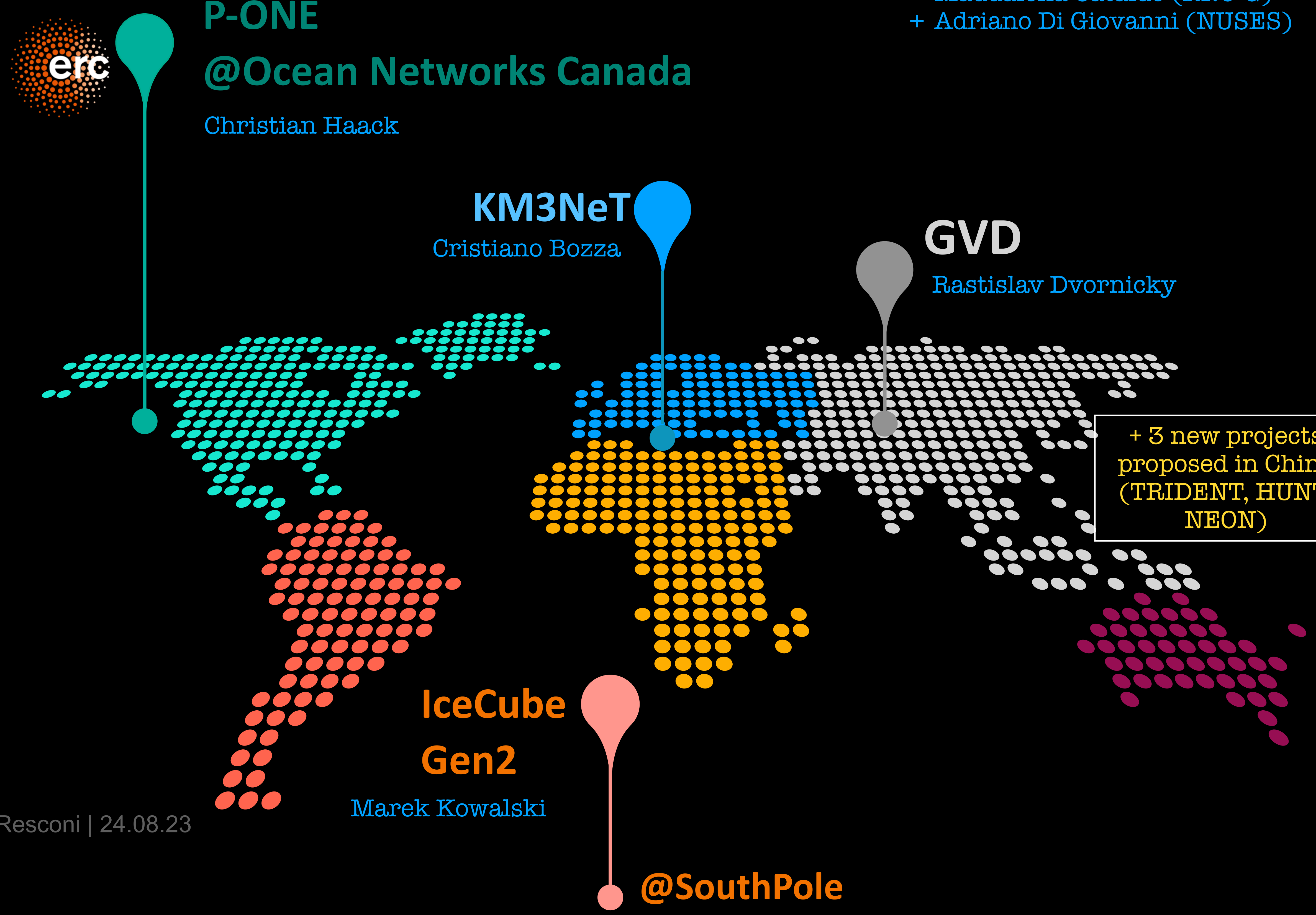




Kalogera et al. 2021: arXiv:2111.06990

The future neutrino telescopes

+ Maddalena Cataldo (RNO-G)
+ Adriano Di Giovanni (NUSES)

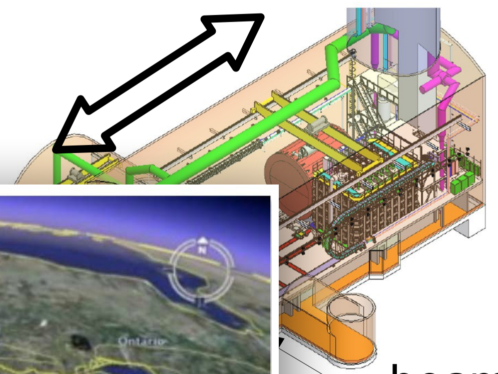


Elisa Resconi | 24.08.23

future neutrino experiments

To suppress the systematic uncertainties

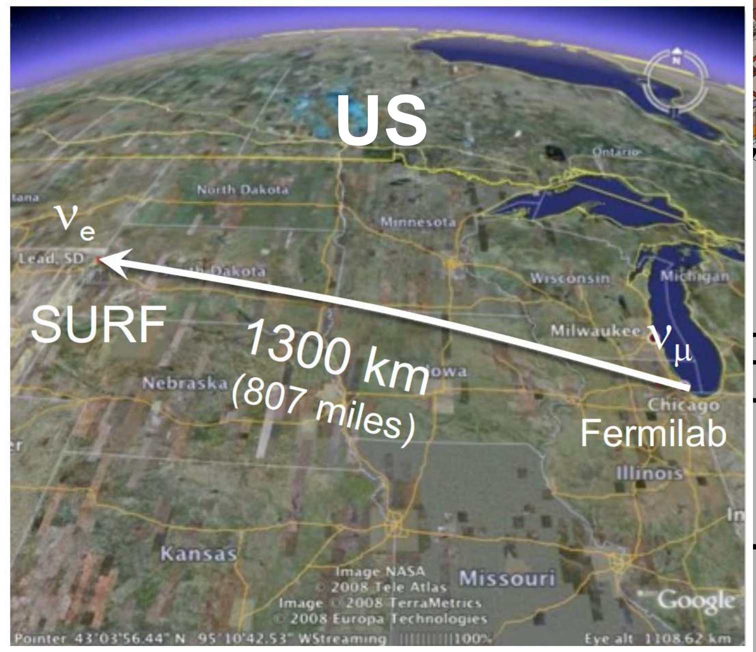
- cross-section measurements: LBL near detectors, MINERvA, MicroBooNE
  - need to improve knowledge of ν_e cross-section, nuclear initial state, final state interactions ← transverse kinematic imbalance variables → better interactions models PRC 94, 015503 (2016)
- movable near detectors in DUNE and HK



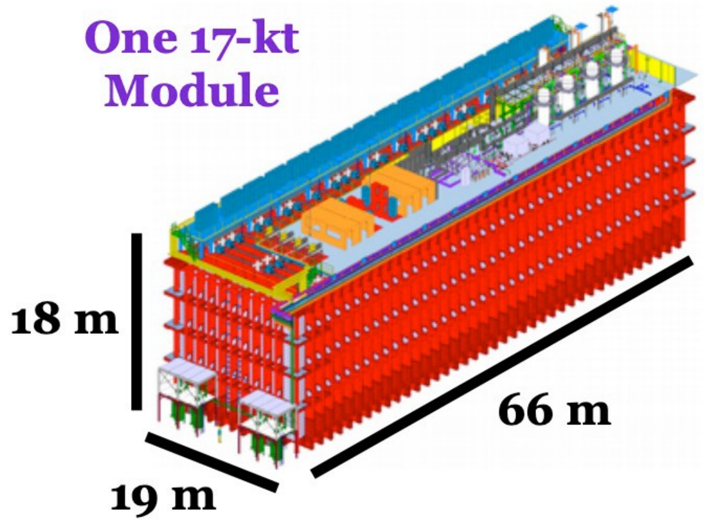
d beams: direct measurement
ne decay tunnel: ENUBET, Nu
EPJ C75 155 (2015)
arXiv:2308.09402
r neutrino beams: ESSnuSB,
EPJ. ST. 231 (2022) 37
: LiquidO, Theia
4 (2021) 273 EPJ C80 416 (2020)

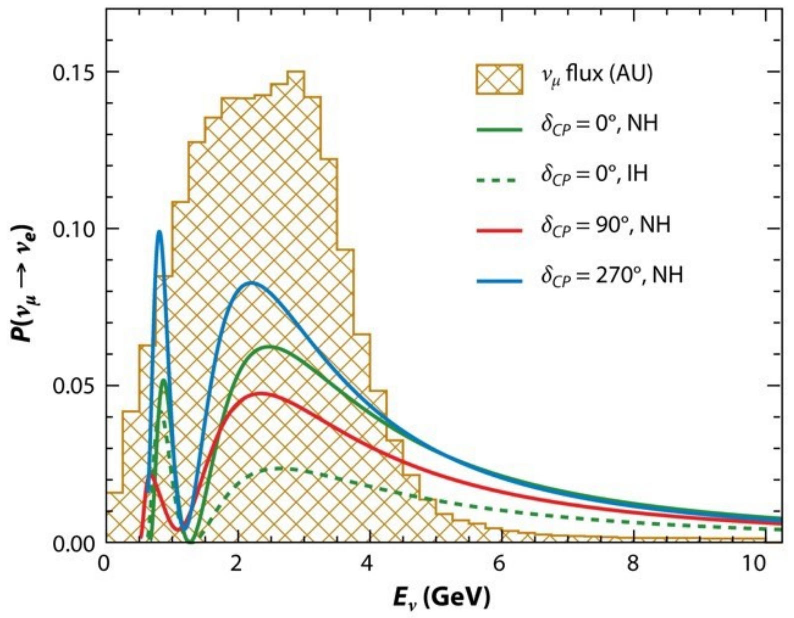
DUNE

DUNE DEEP UNDERGROUND NEUTRINO EXPERIMENT



- **very long** baseline → large mass effects, removing of degeneracy
- **broad band** beam → covering full oscillation period
- large **LAr** detectors → imaging and calorimetry
- movable and on-axis near detectors to constrain systematic uncertainties
- phase 1: 1.2MW beam, 2x17kt (2x10kt fiducial mass) Far Detector modules
- phase 2: two more modules, >2MW beam, ND upgrades





Far site excavation 75% complete, civil construction to be completed in 2024, detector construction underway

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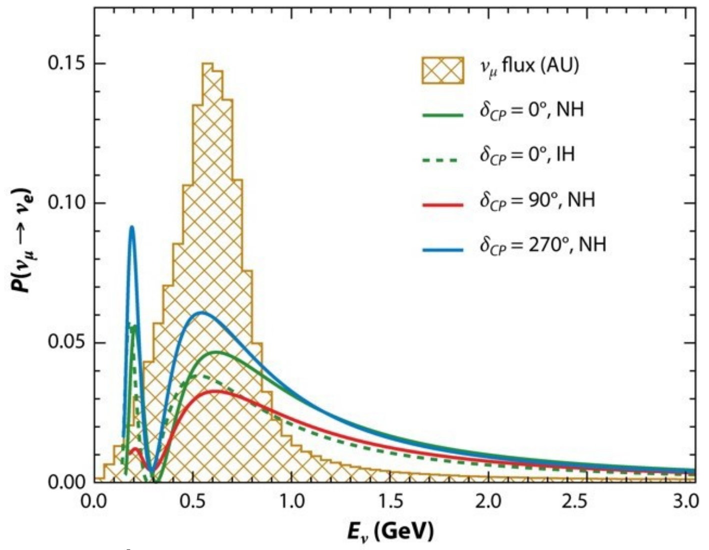
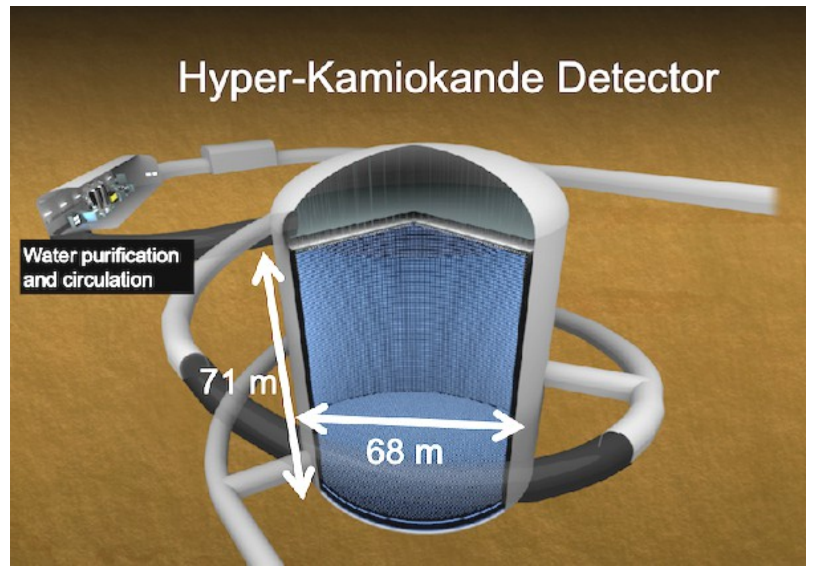
Hyper-Kamiokande

Hyper-Kamiokande

- baseline of **295** km → small matter effect
- **narrow band** beam and **off-axis** technique → CC QE events, most events close to oscillation maximum





- far detector: 258-kt **Water Cherenkov** (fiducial mass 186 kton)
- near detectors: upgraded ND280
  - new 1kton scale Water Cherenkov (IWCD) with off-axis angle spanning orientation (site investigation and facility design on-going)

Far site:
Access tunnels completed →
← Cavern excavation in progress

Huge activity geared to near, medium-term & distant future

Session

T09 Higgs Physics

Aug 21, 2023, 9:00 AM

Hörsaal B (Historic ma

Higgs physics with ILC
Hörsaal B, Historic main buildi

Higgs self-coupling measure
Hörsaal B, Historic main buildi

Determination of CP-violatin
Hörsaal B, Historic main buildi

Probing CPV mixing in the H
Hörsaal B, Historic main buildi

Higgs physics opportunities
Hörsaal B, Historic main buildi

Higgs self-coupling measure
Hörsaal B, Historic main buildi

Higgs precision physics in e
Hörsaal B, Historic main buildi

Higgs physics prospects at I
Hörsaal B, Historic main building 10:36 - 10:54

Overview of ATLAS Upgr
Audimax, Universität Ham

ATLAS ITk Pixel Detecto
Audimax, Universität Ham

The ATLAS ITk Strip Dete
Audimax, Universität Ham

The Silicon Vertex Detec
Audimax, Universität Ham

Development of the time
Audimax, Universität Ham

Overview of the ATLAS H
Audimax, Universität Ham

The LHCb VELO detecto
Audimax, Universität Ham

Upgrade of the CMS luminosity instrumentation and the Fast Beam Condition Monitor for HL-LHC — *Alexey Shevelev*
Audimax, Universität Hamburg 18:45 - 19:00

ALICE 3: a next-generation heavy-ion detector for LHC Run 5 and beyond — *Nicola Nicassio*
Audimax, Universität Hamburg 16:00 - 16:20

Characterization of a 180nm CMOS pixel sensor prototypes for the CEPC vertex detector — *Xinhui Huang*
Audimax, Universität Hamburg 16:20 - 16:40

ALICE ITS3: the first truly cylindrical inner tracker — *Artem Kotliarov*
Audimax, Universität Hamburg 16:40 - 17:00

The LHCb Mighty Tracker — *Karol Hennessy*
Audimax, Universität Hamburg 17:00 - 17:20

Including radiation damage effects in ATLAS Monte Carlo simulations: status and perspectives — *Marco Bomben*
Audimax, Universität Hamburg 17:20 - 17:40

Precision Timing at HL-LHC with the CMS MTD Endcap Timing Layer — *Zhenyu Ye*
Audimax, Universität Hamburg 17:40 - 18:00

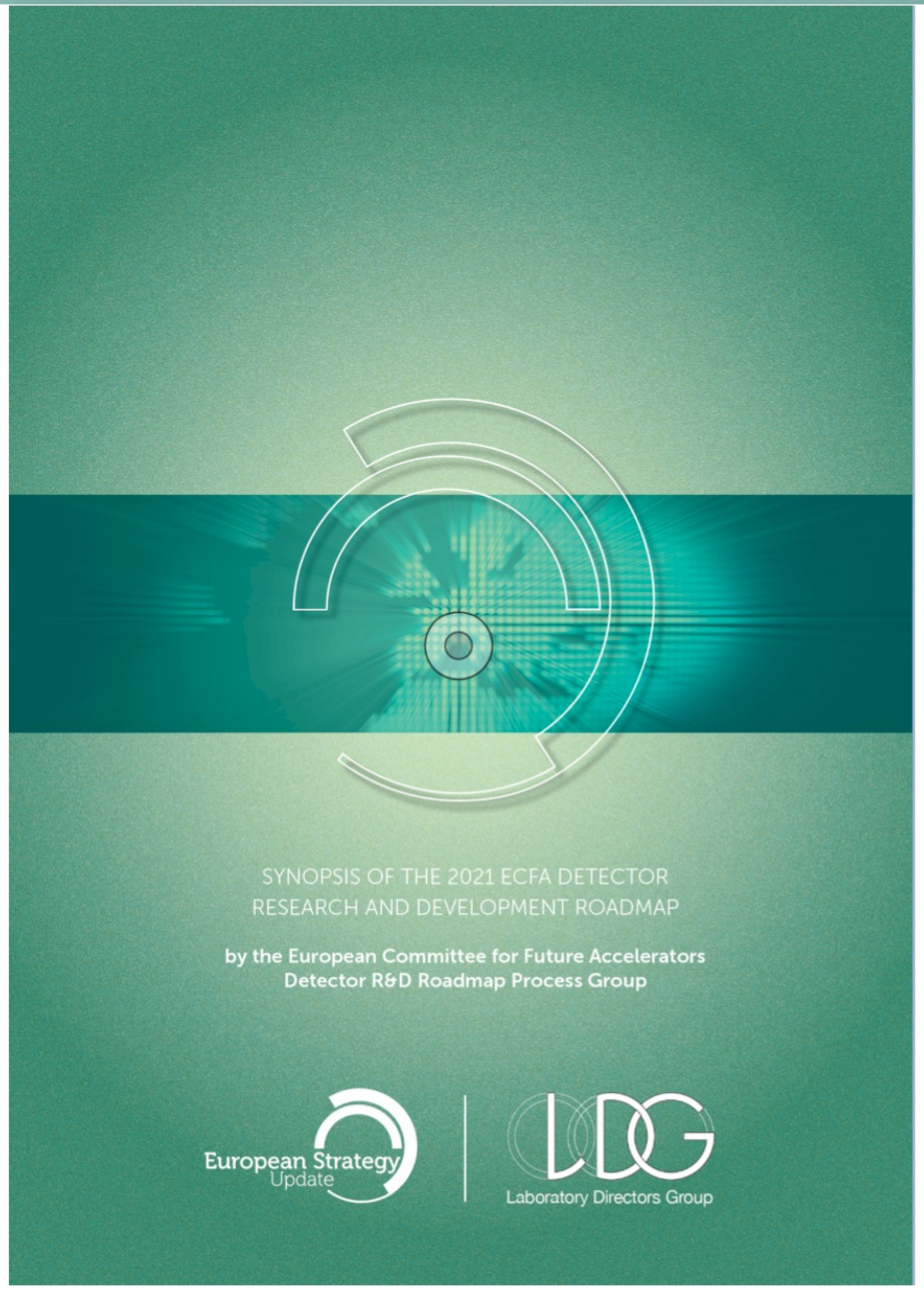
Towards the validation and assembly of the CMS MTD Barrel Timing Layer — *Simona Palluotto*
Audimax, Universität Hamburg 18:00 - 18:15

RD53A Quad Modules Production and QC for the ATLAS Inner Tracker Outer Barrel (OB) Demonstrator — *Yahya Khwaira*
Audimax, Universität Hamburg 18:15 - 18:30

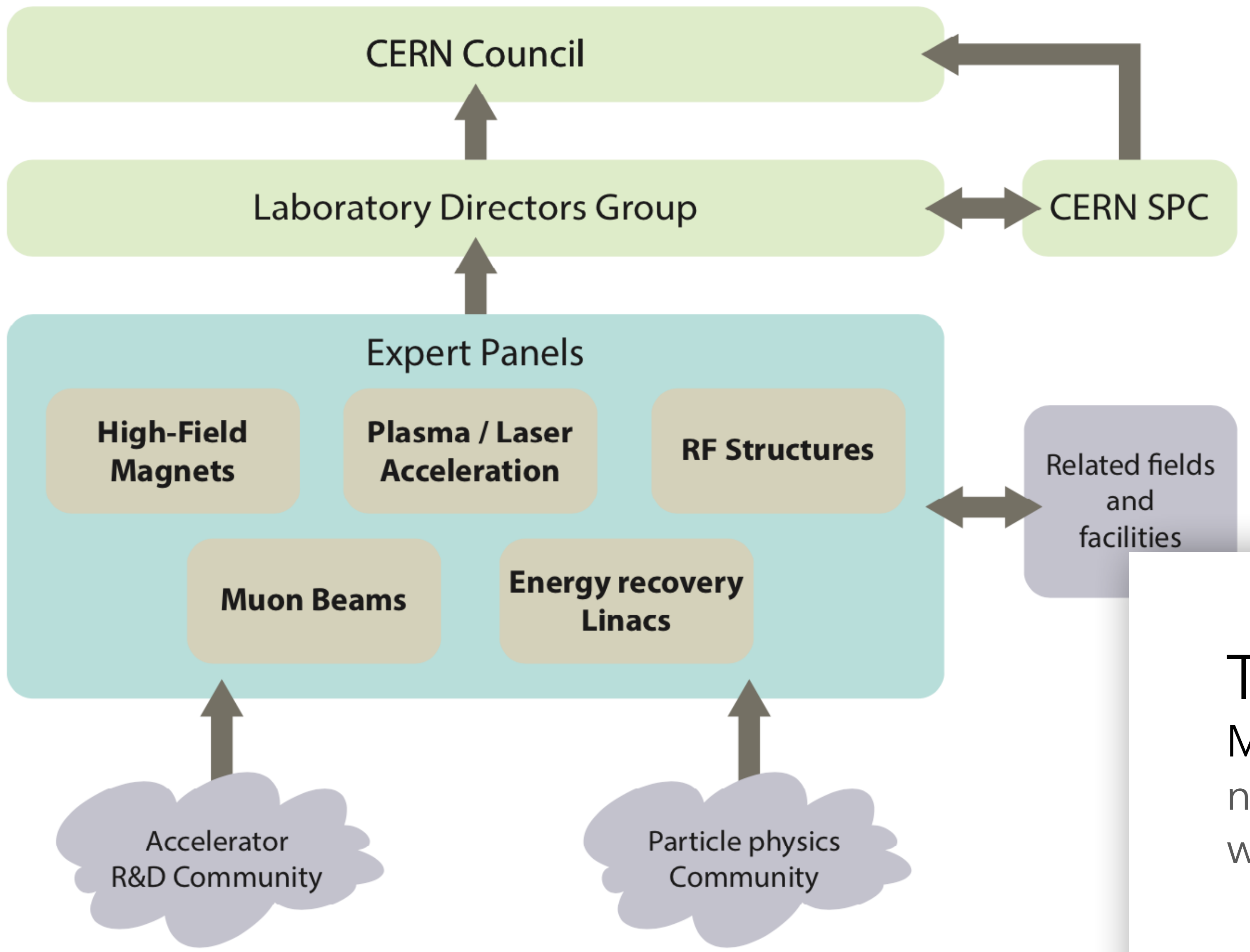
ETC.

these screenshots only a tiny fraction of the week's talks about the future

Detector & accelerator structures & roadmaps [Garutti, Contardo]



https://cds.cern.ch/record/2800190/files/146-138-PB.pdf



Steinar Stapnes - Accelerator R&D

TF8 in ECFA roadmap: Integration

Mechanical support and structures, cooling, magnets and management of radiation environment

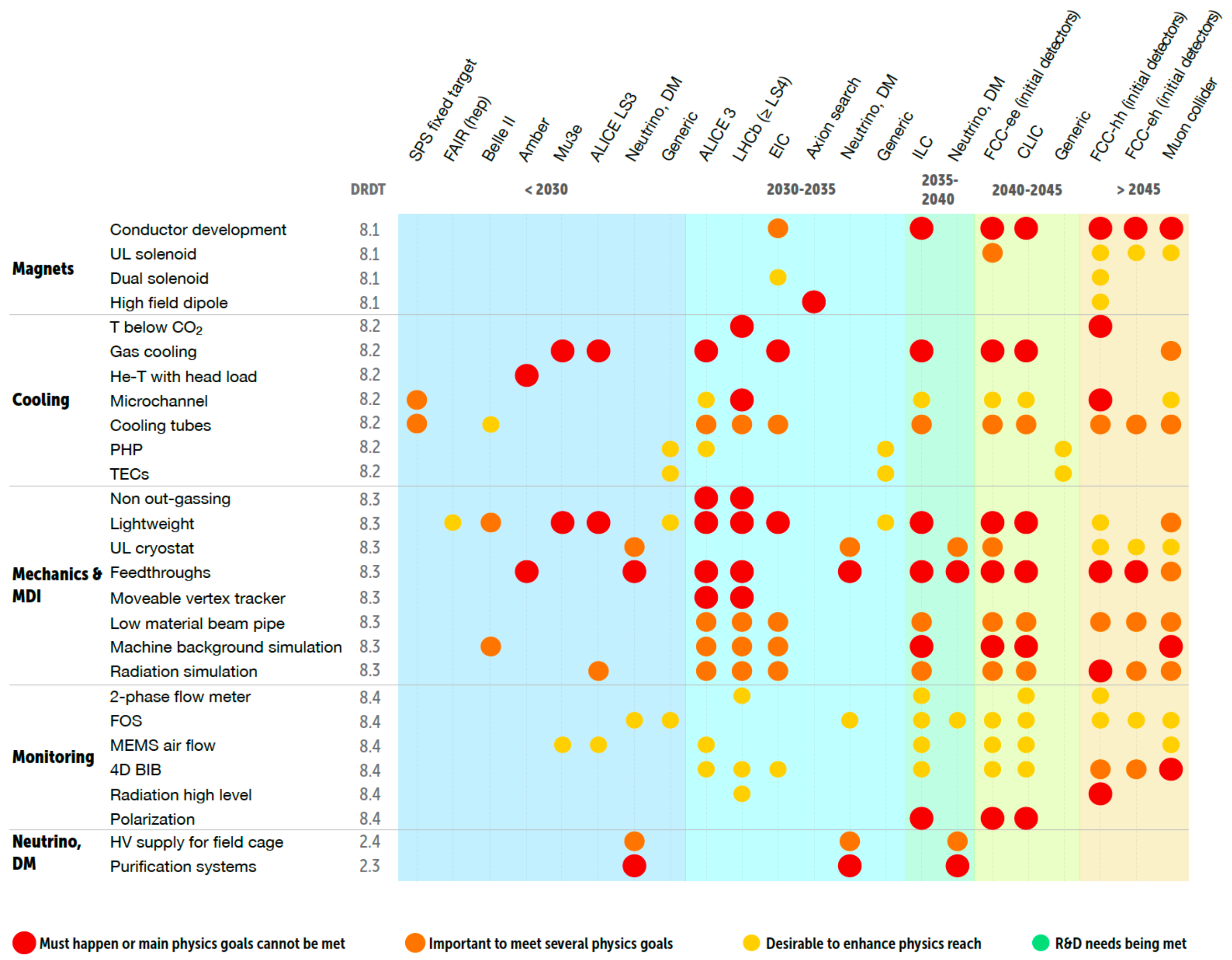
no DRD collaboration proposed at this stage - relatively different topics and communities with existing kernel at CERN and/or forums

DRDT 8.1 Develop novel magnet systems

DRDT 8.2 Develop improved technologies and systems for cooling

DRDT 8.3 Adapt novel materials to achieve ultralight, stable and high precision mechanical structures. Develop Machine Detector Interfaces.

DRDT 8.4 Adapt and advance state-of-the-art systems in monitoring including environmental, radiation and beam aspects



DRDT 8.3 relatively specific to systems

- needs are at this stage considered in specific DRD proposals

➢ nevertheless a community survey is on-going to investigate opportunities for a joint effort on common aspects, such as materials, assembly techniques… and also DRDT8.2 on cooling

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ECFA Early-Career Researchers Panel [Ilg]

Concluding words

Young panel with young people

- Panel has self-organised and is active with several working groups
- Just had our first large member renewal

Keep in touch with us

Future Colliders for ECRs event

- Our webpage to find your country ECR representative
- ecfa-ecr-organisers@cern.ch
- Subscribe to ecfa-ecr-announcements e-group to get notified about our activities!

Consider joining us when a panel slot becomes free in your country!

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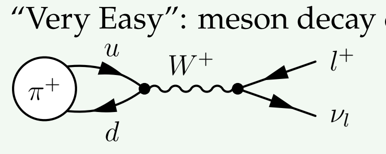
Theory is an essential part of the future too!

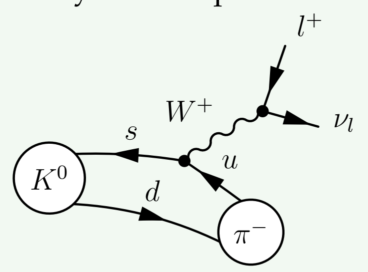
Conclusions

No justice to the field!

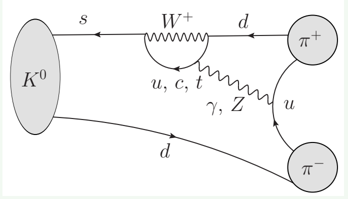
- Key input for flavor physics. FLAG is your friend! [http://flag.unibe.ch/2021/]
- "Very Easy": meson decay constants



- "Easy": semileptonic decays



- "Very hard": $K \to \pi\pi$ and ϵ'/ϵ



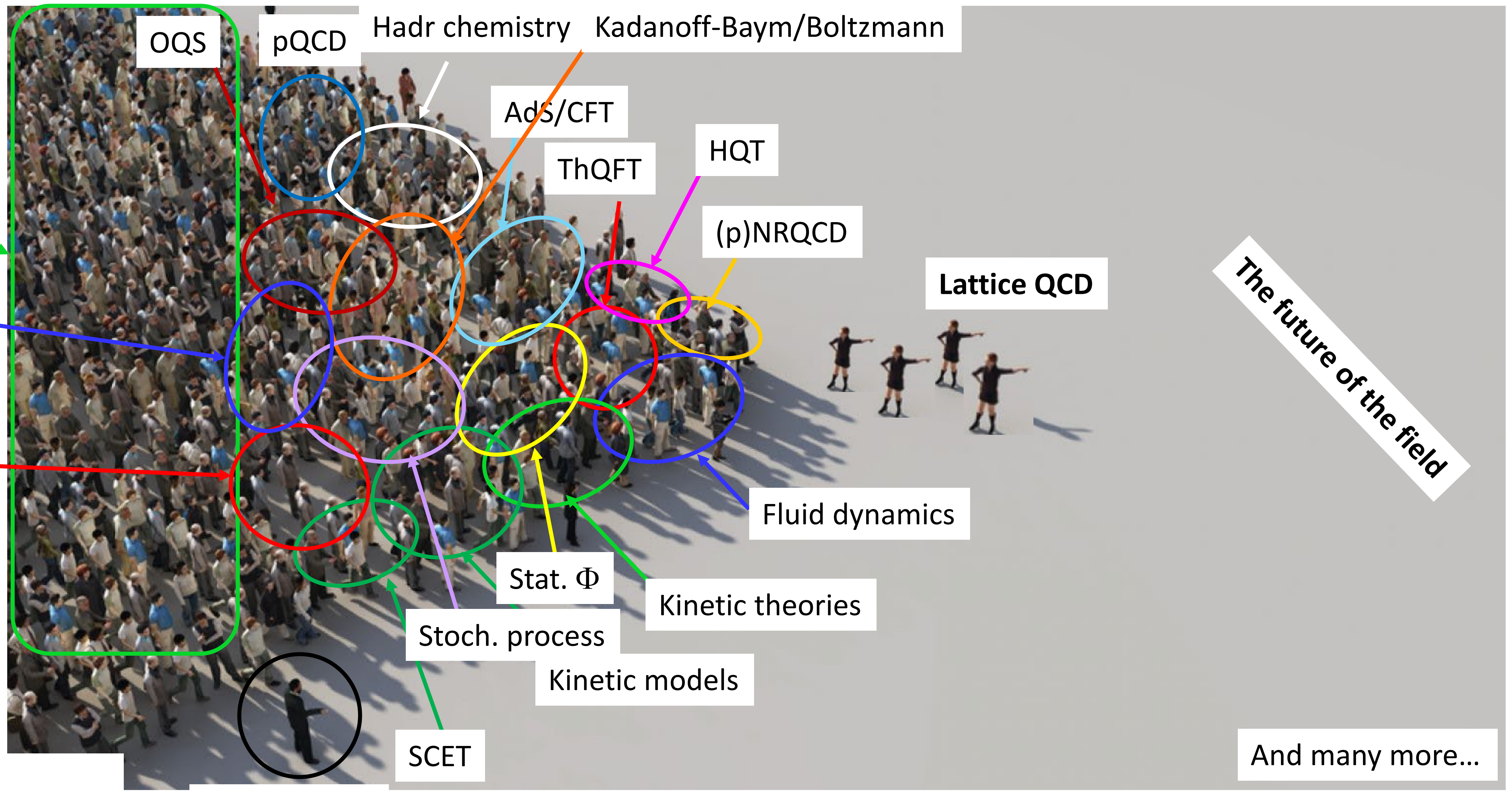
- Still need to understand how to many things!: QED corrections to hadronic processes!
- Enormous progress in determination of PDF's: Soon useful information for some kinematics!
- Large activities understanding multi-particle systems and resonances

The structure of Hot QCD matter theory (in a broad acceptance)

"Trying to catch up" models

Renorm. group

Little room for your own model (hurry up)



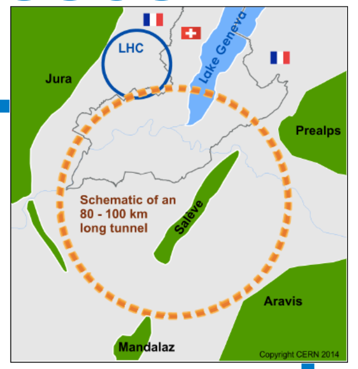
proud outlier

- But… Reaching new bottlenecks for large multiplicities
  - 2-loop amplitudes beyond $2 \to 3$
  - Real radiation far from trivial (numerical infrared treatment)
  - N^{3}LO beyond Drell-Yan like processes require significant developments
- Higgs Pair Production will be fundamental : more work needed

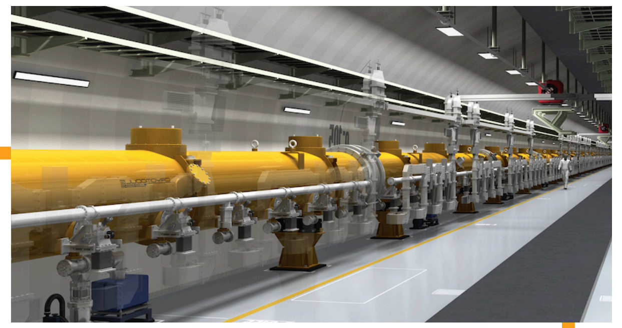
Need a more rigorous treatment of TH uncertainties

Future e⁺e⁻ colliders [Benedikt, List, Marchiori, Foster, and many other talks]

They fall into two classes
Each have their advantages



Circular e+e- Colliders
- FCCee, CEPC
- length 250 GeV: 90…100km
- high luminosity & power efficiency at **low energies**
- **multiple interaction regions**
- very clean: little beamstrahlung etc



Linear Colliders
- ILC, CLIC, C³, …
- length 250 GeV: 4…11…20 km
- high luminosity & power efficiency at **high energies**
- **longitudinally spin-polarised beam(s)**

Long-term vision: re-use of tunnel for pp collider
- technical and financial feasibility of required magnets still a challenge

Long-term upgrades: energy extendability
- same technology: by increasing length
- **or by replacing accelerating structures with advanced technologies**
  - RF cavities with high grad…
  - plasma acc…

DESY. | Status of e+e- Higgs Factory Projects | Jenny List, 24 Aug 2023

FUTURE CIRCULAR COLLIDER — FCC Feasibility Study – status summary

The first half of the FCC Feasibility Study will soon be completed with the mid-term review

Topics addressed: **Infrastructure & placement, Technical Infrastructure, Accelerator design FCC-ee and FCC-hh, Physics, experiments, detectors, Organisation and financing, Environmental impact, socio-economic impact**
- End October 2023: Review committee reports available to Scientific Policy Committee and Finance Committee
- 20 – 22 November 2023: SPC and FC review meetings on mid-term review
- 2 February 2024: CERN Council meeting on mid-term review

Focus so far: identifying best placement & layout … o new placement
- 3D underground civil engineering m… …re-injector on CERN Prevessin site
- FCC-ee 4 IP … …cs solutions, major … …etc.

… network operator RTE.

… …tific & technical actors and in close cooperation with … …erned; at departmental/cantonal and local level. Direct exchange … concerned by surface sites. Environmental studies ongoing.

PED study's …

… …ng groups):

WG3 Detector (R&D) — … **Analysis Methods**

- … harmonise work of different … specific efforts
- Interplay between (HL)-LHC and future Higgs factory (e.g. include LHC potential on high-pT measurements and EFT interpretations)
- Identify specific topics where concrete work should be organised
- Requirements on accuracy in theoretical calculations and parametric uncertainties
- …

Created June 2021

Conveners: Jorge de Blas, Patrick Koppenburg (Juan Alcaraz) Jenny List, Fabio Maltoni,

- Monte Carlo generators for e+e- precision EW/top Higgs factory
- Software framework
- Fast simulation (and its limitations)
- Reconstruction
- …

Created June 2021

Conveners: Patrizia Azzi, Fulvio Piccinini, Dirk Zerwas

- Inform/provide guidance to detector R&D community on needs of future ee factories
- Foster interaction between detector R&D groups and future collider PED studies, minimising duplication and injecting technological realism into conceptual studies

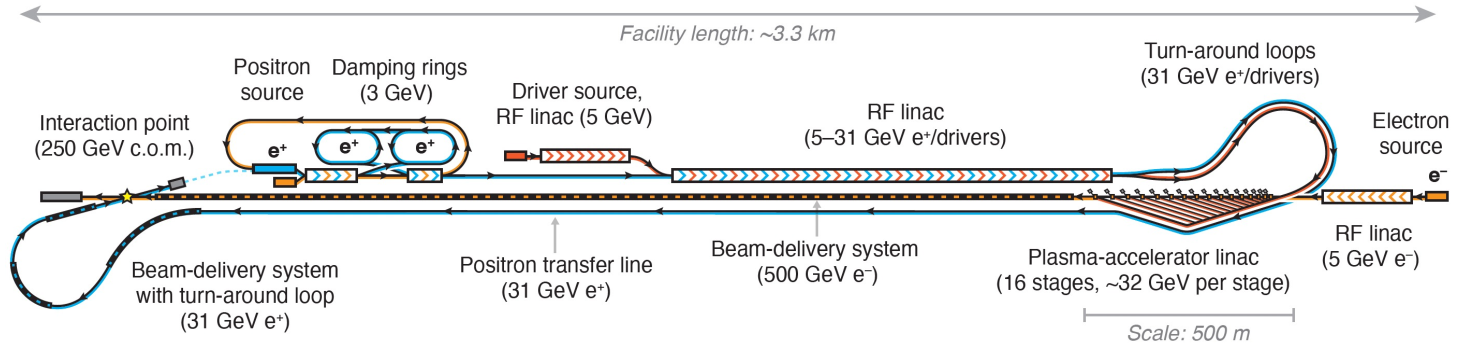
Created May 2022 (after conclusion of works of ECFA Detector Roadmap Task Force)

Conveners: Mary Cruz Fouz, Giovanni Marchiori, Felix Sefkow

Giovanni Marchiori — The ECFA study on future e⁺e⁻ factories - 24/08/2023 — 5

Hybrid Asymmetric Linear Higgs Factory (HALHF)

B. Foster, R. D'Arcy & C.A. Lindstrøm



B. Foster, EPS, 8/23 — https://arxiv.org/2303.10150

Focus needs to be on getting at least one of these approved

EU citizens' interest in new scientific discoveries is high*

Interest and knowledge

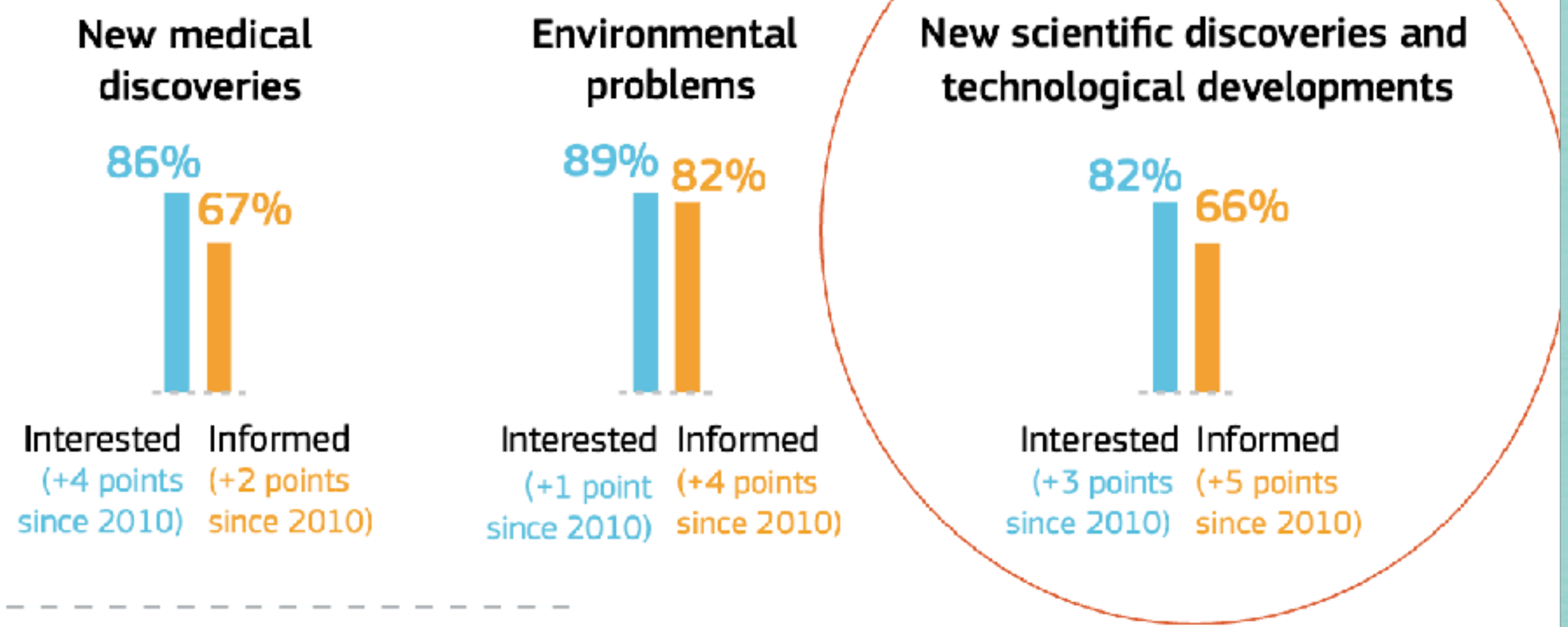
Being interested in and feeling informed about science and technology

Others areas

Culture & Arts - 77% (66%)

Politics - 71% (75%)

Sports news - 59% (60%)



Q: In everyday life, we have to deal with many different issues, where we feel more or less interested. For each of the following, please indicate whether you are...

Eurobarometer (2021)

looking forward to EPS-HEP 2025