DIS2006 -> DIS2018

Tsukuba

Kobe

Progress in twelve years

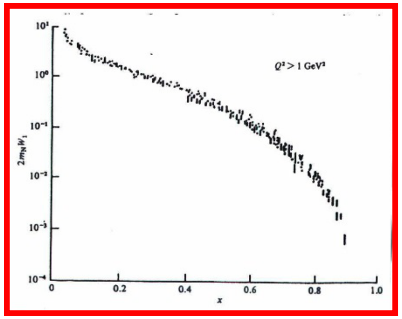
Katsuo Tokushuku (KEK)

Twelve year cycle is popular in Eastern Asia

- 2018: "The year of the dog"

- 2006:
  One year before the end of HERA

- 1994: DIS94: Eilat
  - Low-x rise, Large rapidity gap (1993)
  - HERA first collision (1992)
- 1982
  - HERA proposal (1981)
- 1970
  - DIS (1969), scaling (1969) ....
- 1958
  - Proton form factor (1956)

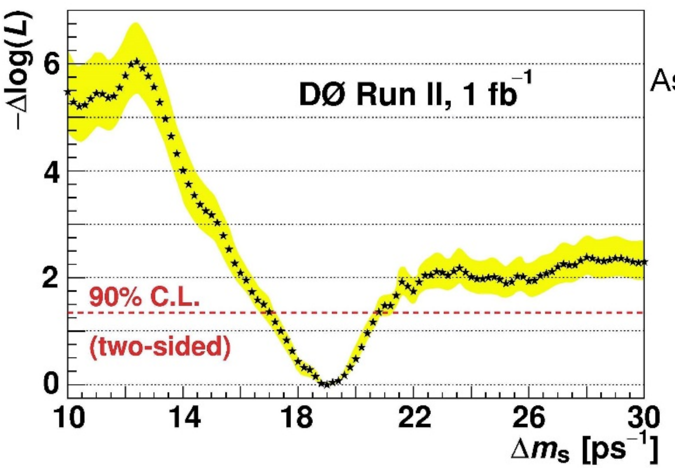


A hot topic in DIS2006

- D0 published the Bs mixing

Δm_s measurement

ΔLog(L) for different Δm_s and fixed A=1:



Asymmetry(t)= A•D•cos(Δm•t)

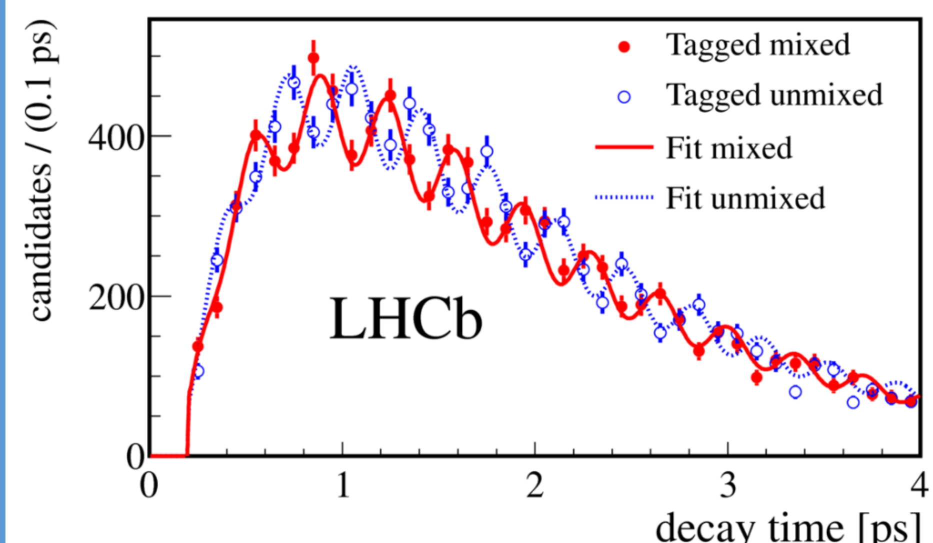
$17ps^{-1} < \Delta m_s < 21ps^{-1}$
(90% CL assuming
Gau

(arXiv:hep-ex/0603029 v1 15 Mar 2006)

April, 21th 2006 DIS2006 , Thorsten Kuhl

New dedicated detectors and
Higher cross section

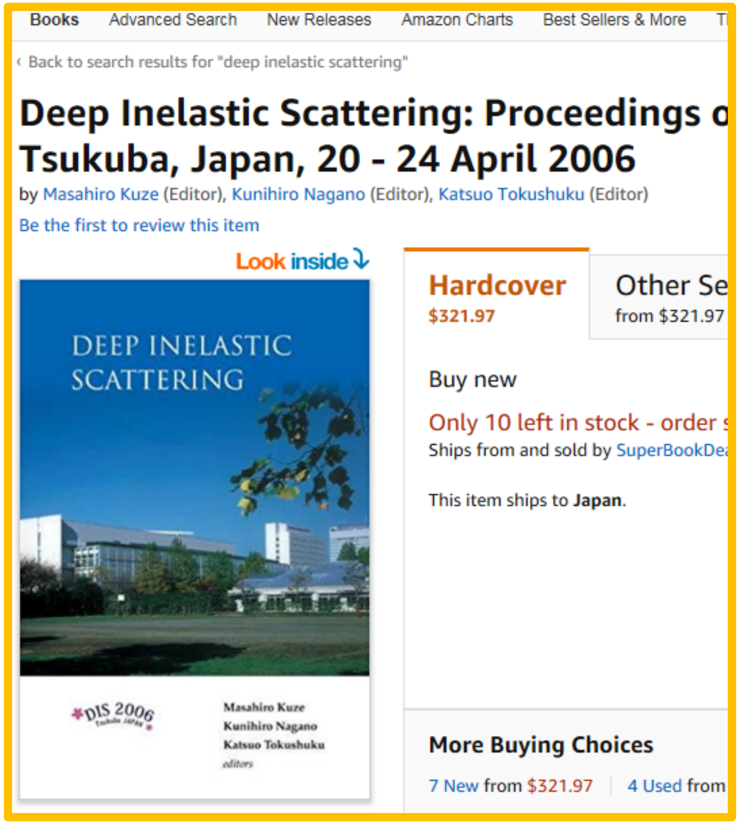
$\Delta m_s = 17.768 \pm 0.023$ (stat)
$\pm\ 0.006$ (syst) ps^{-1}



(New J. Phys 15 (2013) 053021)

Lost Technology

- In DIS06, there was one talk with OHP (over-head projector).



- Probably DIS06 was the last meeting with the proceedings without open access.

  -> You can still buy it from AMAZON!

  (no customer reviews so far)

Twelve year cycle is popular in Eastern Asia

- 2018: "The year of the dog"

Start of LHC and discovery of Higgs

- 2006:
  One year before the end of HERA

- 1994: DIS94: Eilat
  - Low-x rise, Large rapidity gap (1993)
  - HERA first collision (1992)
- 1982
  - HERA proposal (1981)
- 1970
  - DIS (1969), scaling (1969) ….
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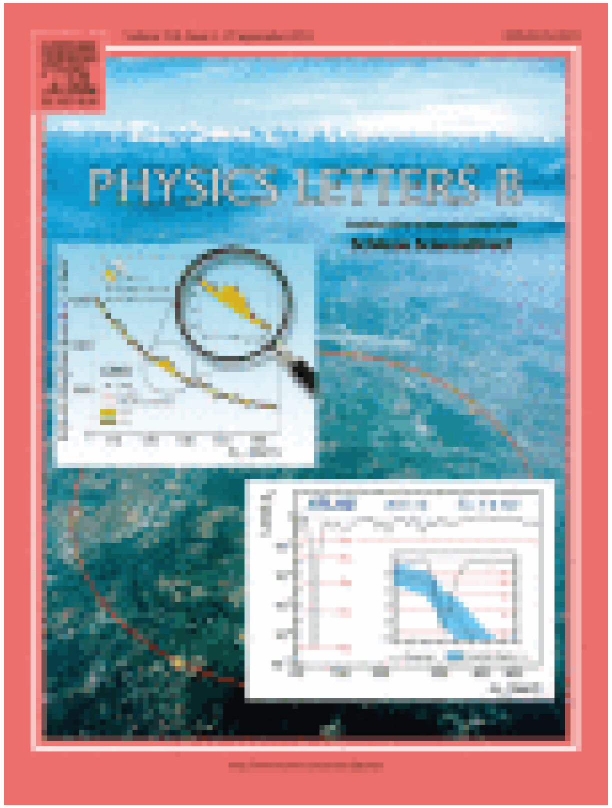


Preparation for LHC

- In 2006, more people were working for the LHC, preparation for discoveries, identifying the missing parts for the detailed studies.
  - LO -> NLO -> NNLO (+NLL….)
  - NLO MC generators
  - More PDFs, understanding of its uncertainty.
  - Multi parton interaction
  - Rapidity Gap, Jet veto.

Wish list

- Les Houches 2005: Wish list of NLO calculation

Table 42: The LHC "priority" wishlist for which a NLO computation seems now feasible.

arXiv:hep-ph/0604120v1

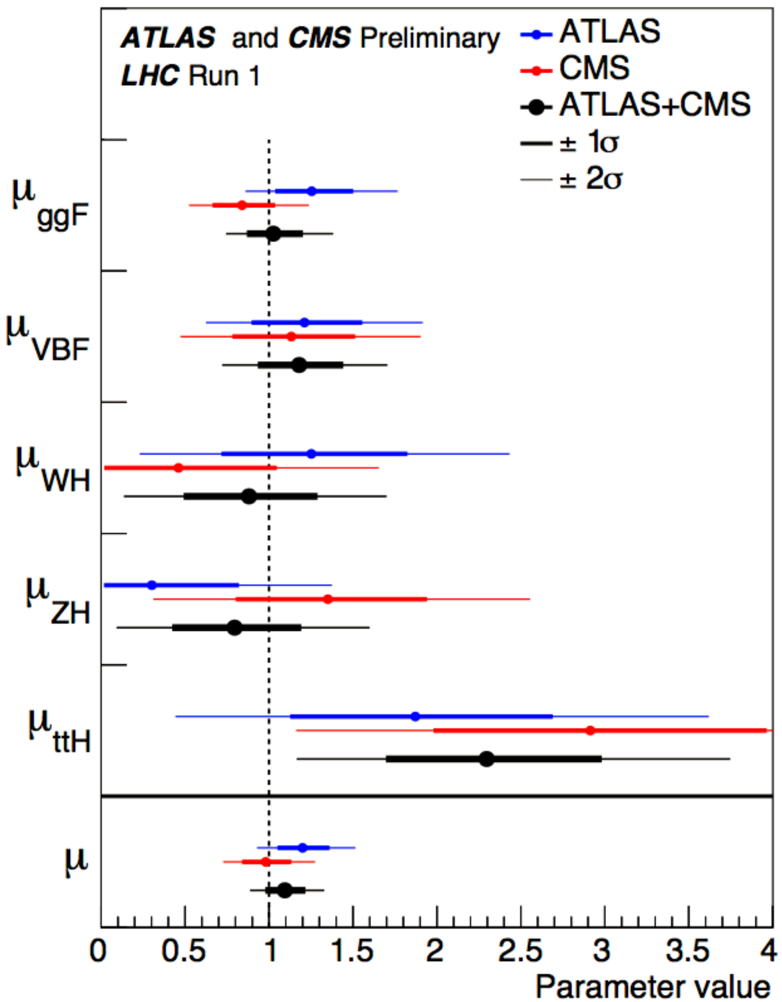
process ($V \in \{Z, W, \gamma\}$)	relevant for
1. $pp \to V\,V$ jet	$t\bar{t}H$, new physics
2. $pp \to t\bar{t}\,b\bar{b}$	$t\bar{t}H$
3. $pp \to t\bar{t} + 2$ jets	$t\bar{t}H$
4. $pp \to V\,V\,b\bar{b}$	VBF$\to H \to V\,V$, $t\bar{t}H$, new physics

Summary

- We're now well into LHC precision era with wealth of data and NNLO theory predictions
- PDF, α_s, m_W and m_t measurements laying solid foundation for Run II new physics searches
- New channels for exploration of Higgs potential and EW theory opening in Run II
- Deep understanding of jet mass and boosted topologies new tools for Run II and HL-LHC

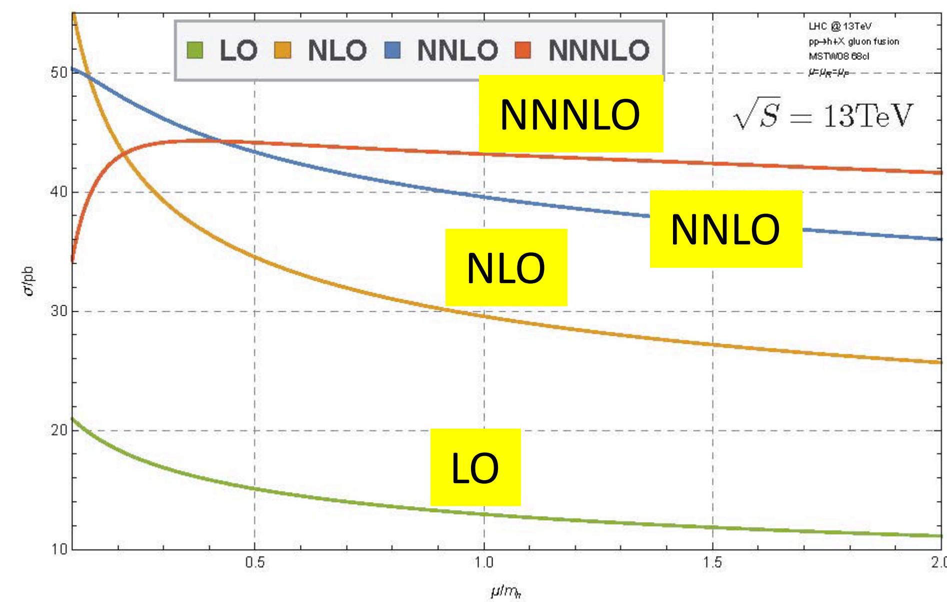
We now have better SM predictions.
I am happy to see the summary of WG4.

No fake mu's



$$\mu = 1.09^{+0.11}_{-0.10}$$

Great Success of the SM! $(\mu=\sigma/\sigma_{SM})$



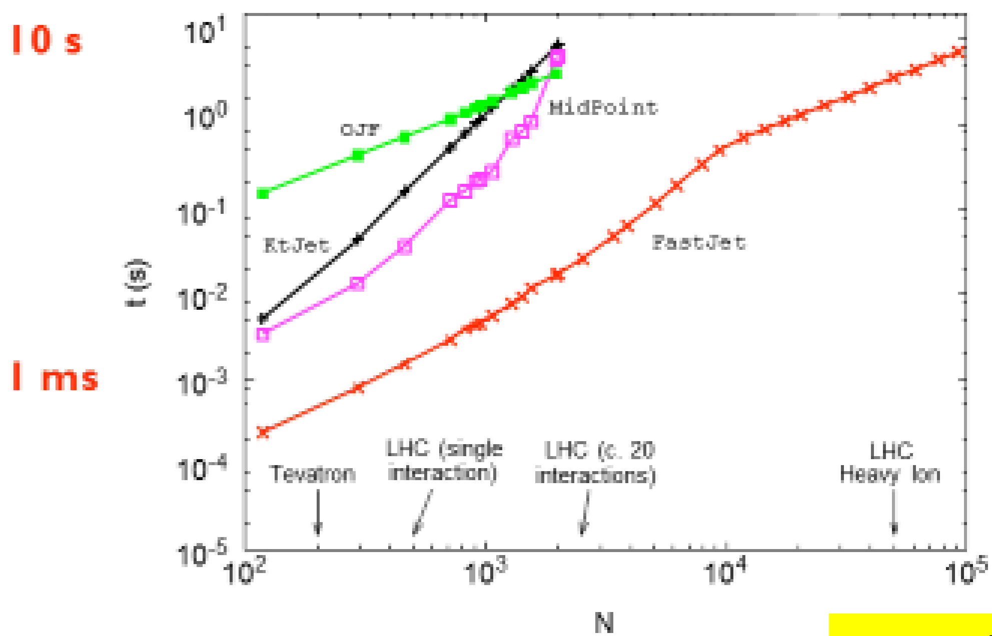
- If we knew only LO calculation for Higgs production, we would have had many papers for non SM Higgs!

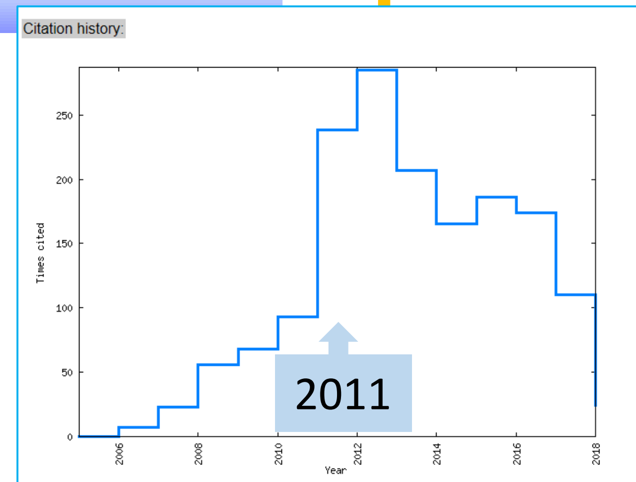
Jet

Cluster algorithm was very slow.
-> FastJet M. Cacciari and G. Salam hep-ph/0512210

Why FastJet

Time taken to cluster N particles:



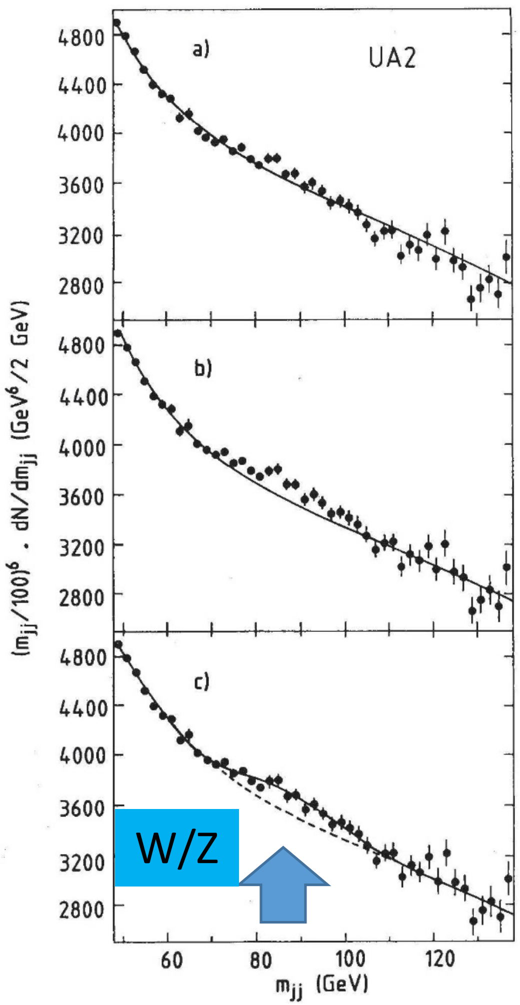


- Almost two orders of magnitude gain at small N ($O(N^2)$)
- Large-N region now reachable

- Applicable to Heavy Ion Jet
- Faster iteration -> More idea
  - Jet Area
  - Anti Kt
  - Subjet -> Boosted Jet

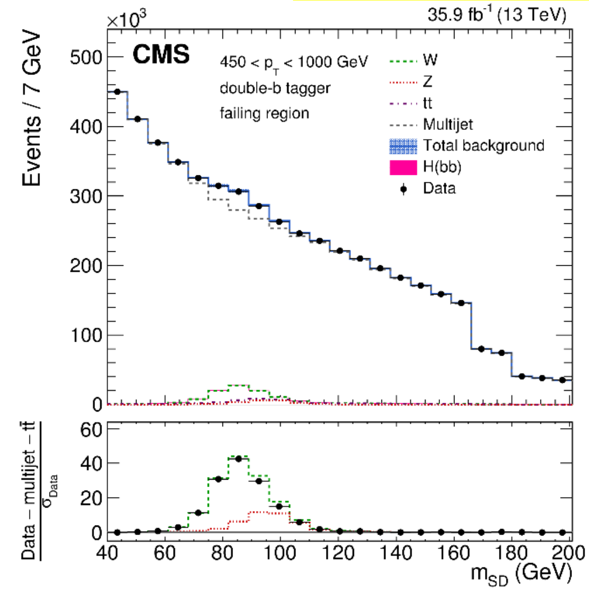
Jet

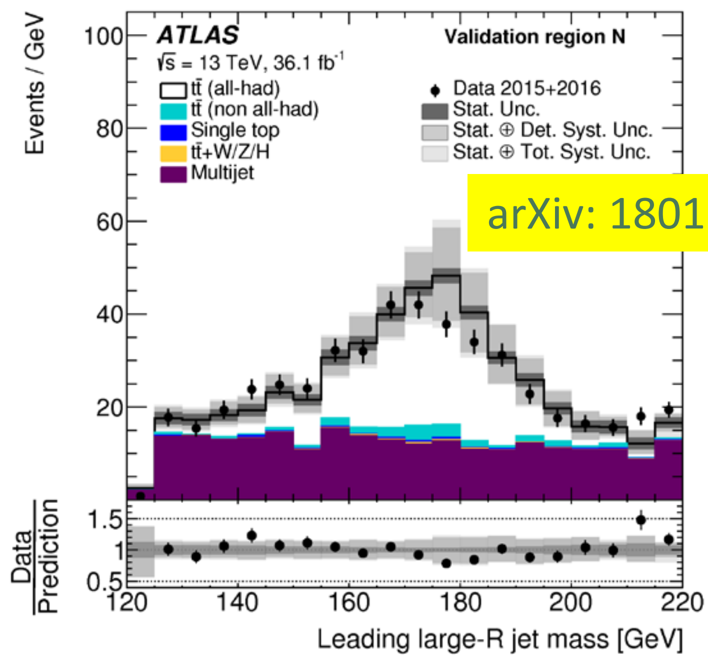
Mjj@UA2 Z.Phys. C49 (1991)



Boosted Jets

PRL120 (2018) 071802





arXiv: 1801.02052

Future @ DIS2006 (1)

- Very near term future: F_L measurements

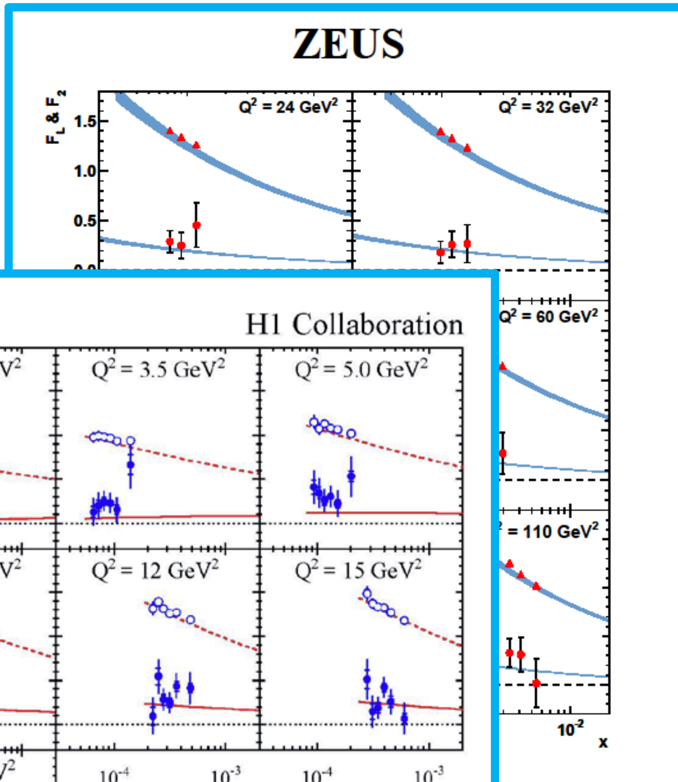
F_L Measurements at HERA

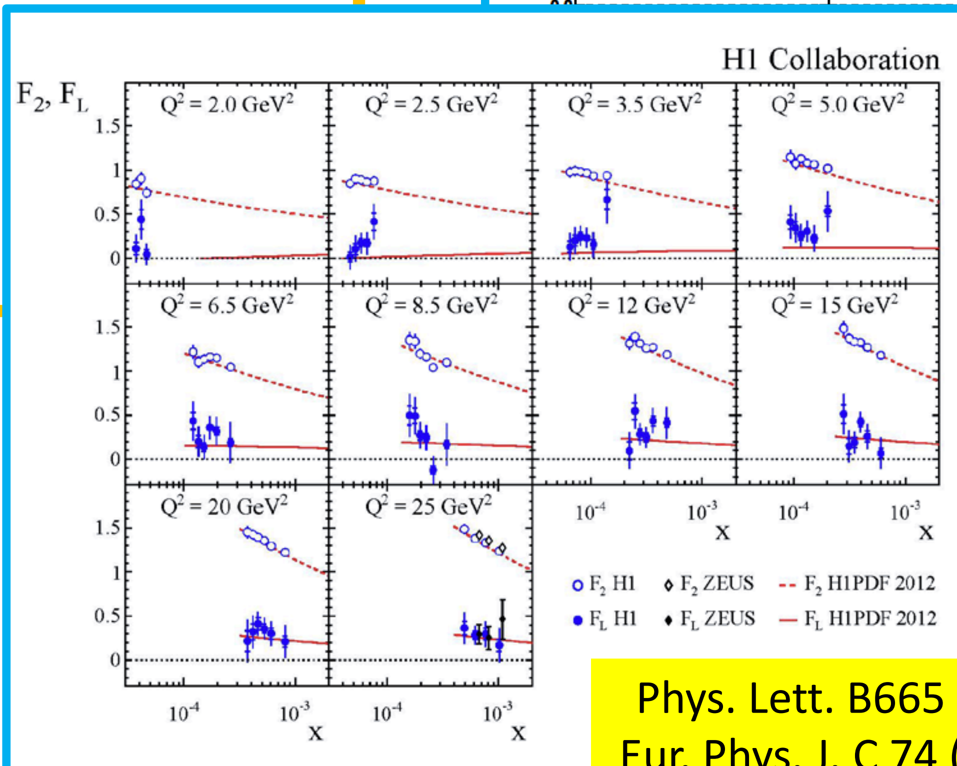
DIS06, Tsukuba, Japan

A. Caldwell

1. Motivation
2. Existing measurements
3. Predictions
4. Measuring F_L at HERA
5. How well we could do

Phys. Lett. B 682 (2009) 8



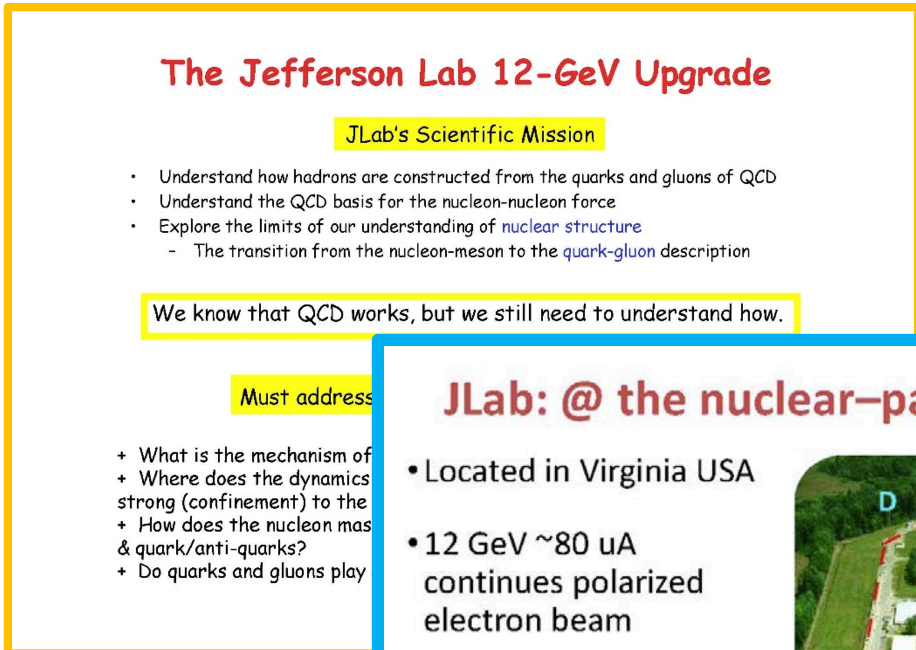


Phys. Lett. B665 (2008) 139

Eur. Phys. J. C 74 (2014) 2814

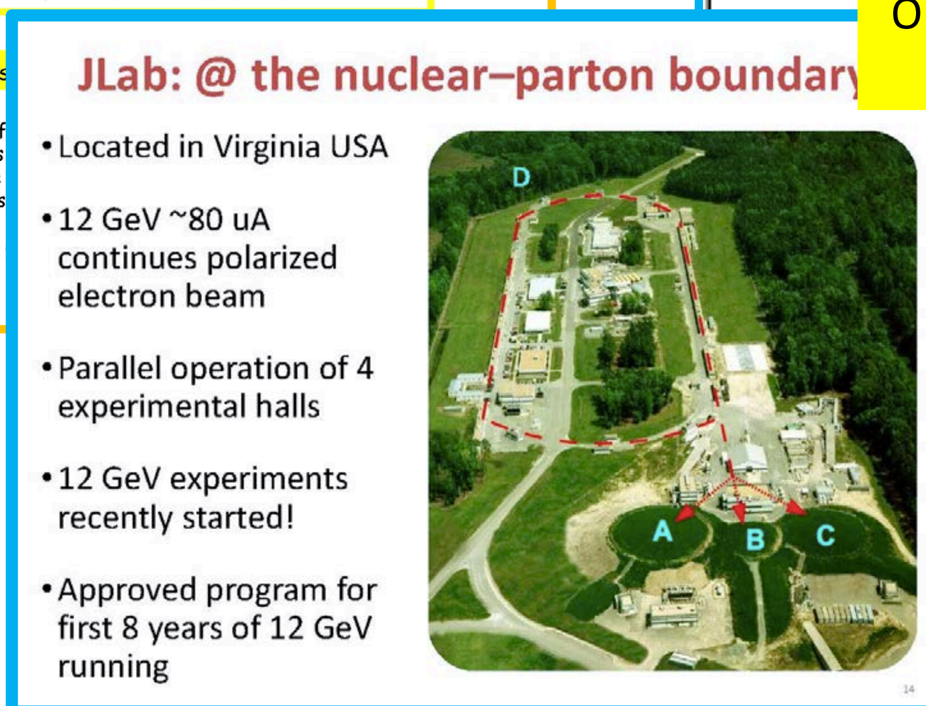
Future @ DIS2006 (2)

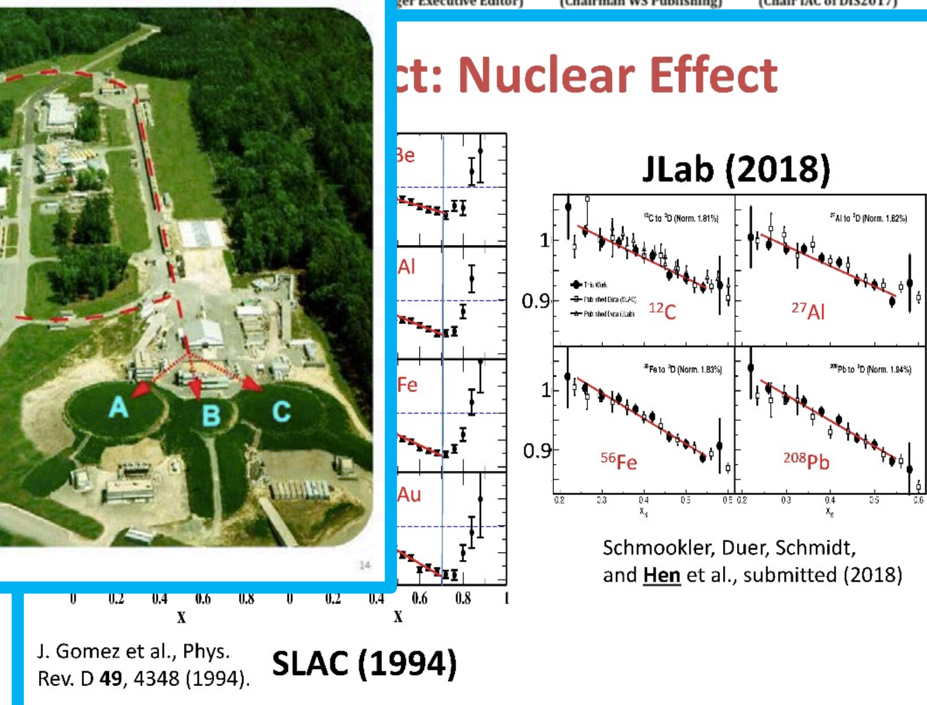
- Near term future: J-Lab 12 GeV upgrade



Rolf Ent

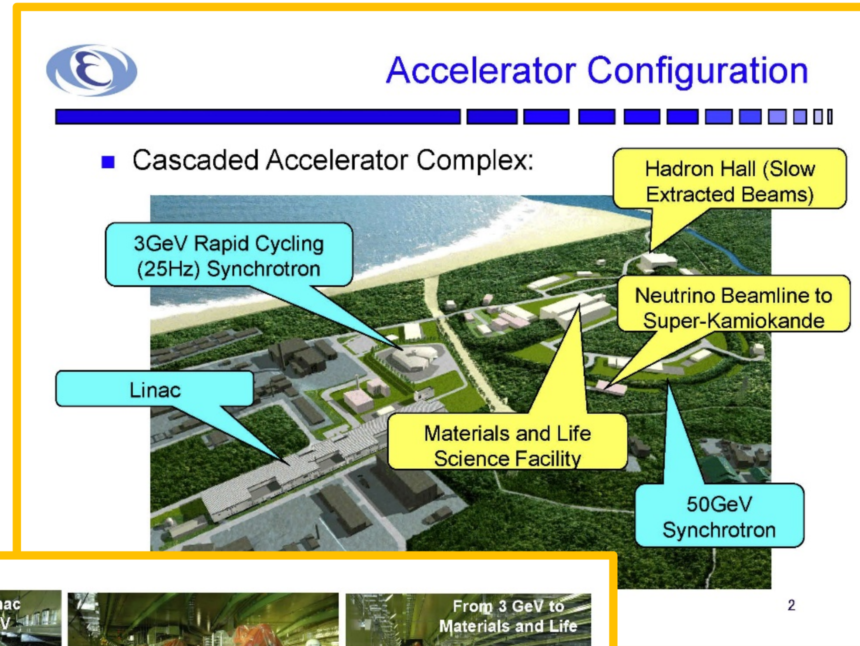
Or Hen : DIS18: Altareli Prize Talk

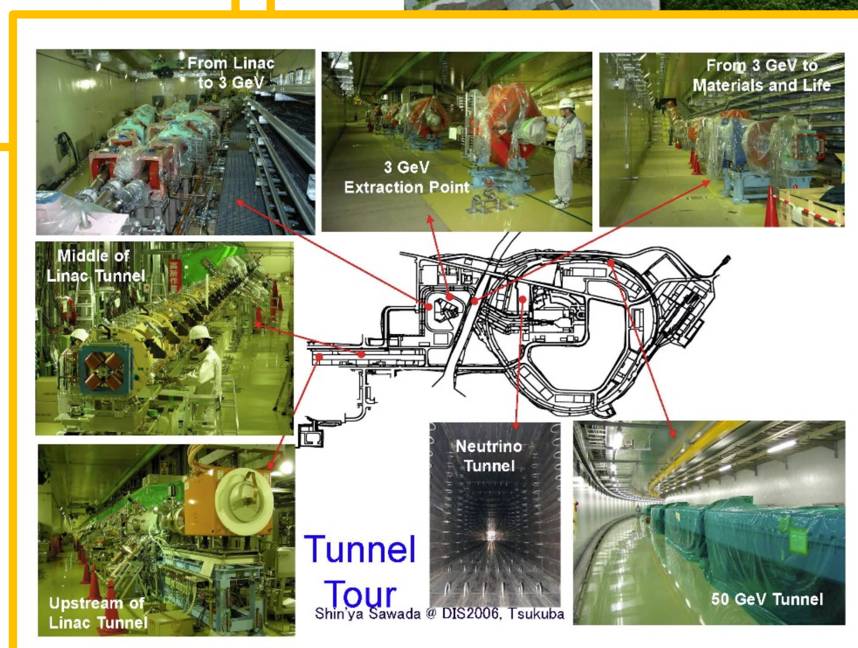




Future @ DIS2006 (3)

- Near term future: J-PARC

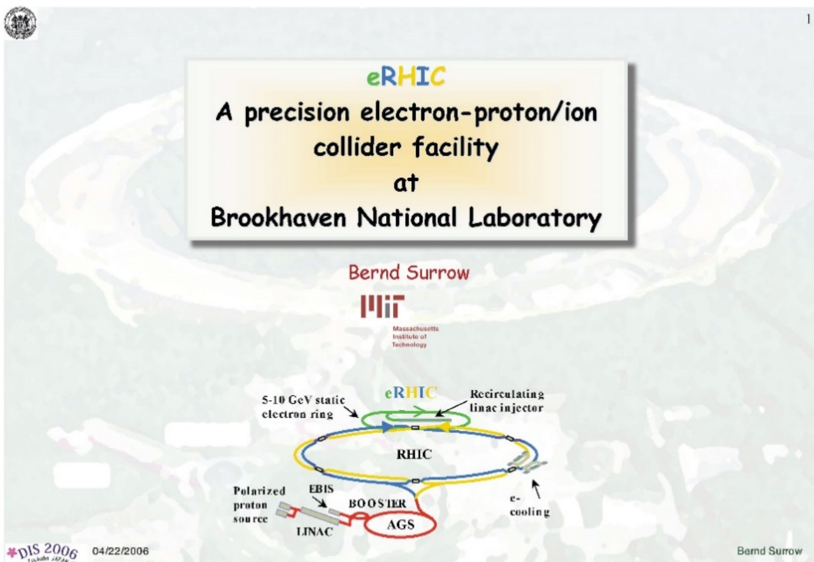


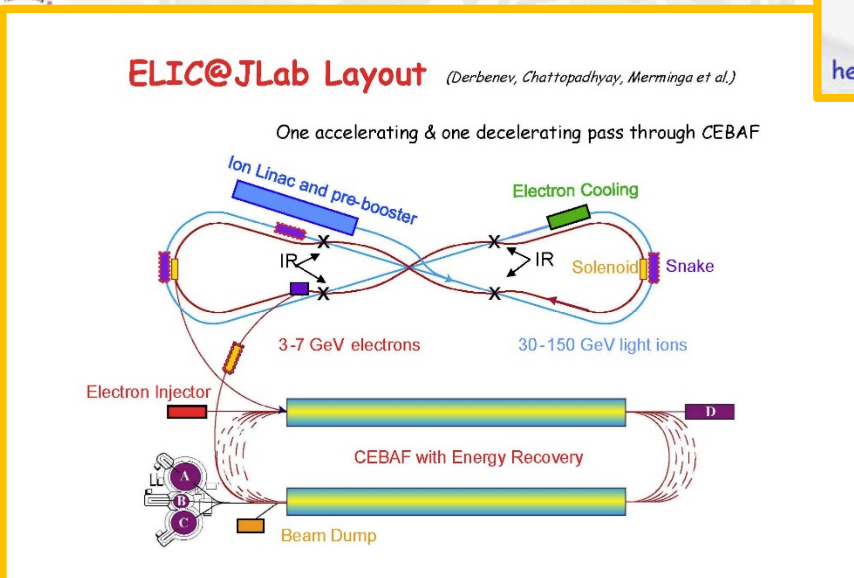


I will discuss the J-PARC status later.

Future @ DIS2006 (4)

- Future lepton-hadron colliders

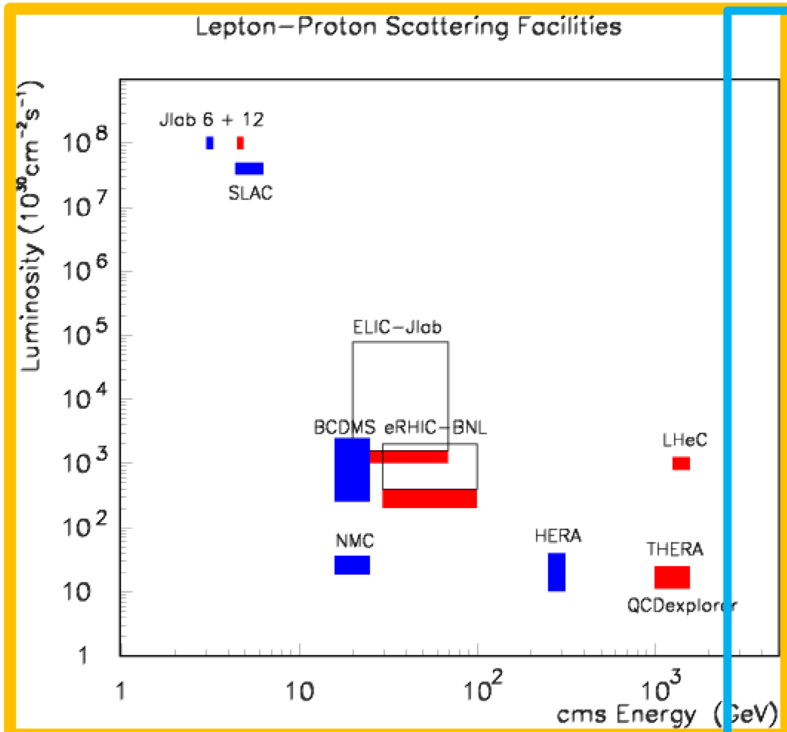


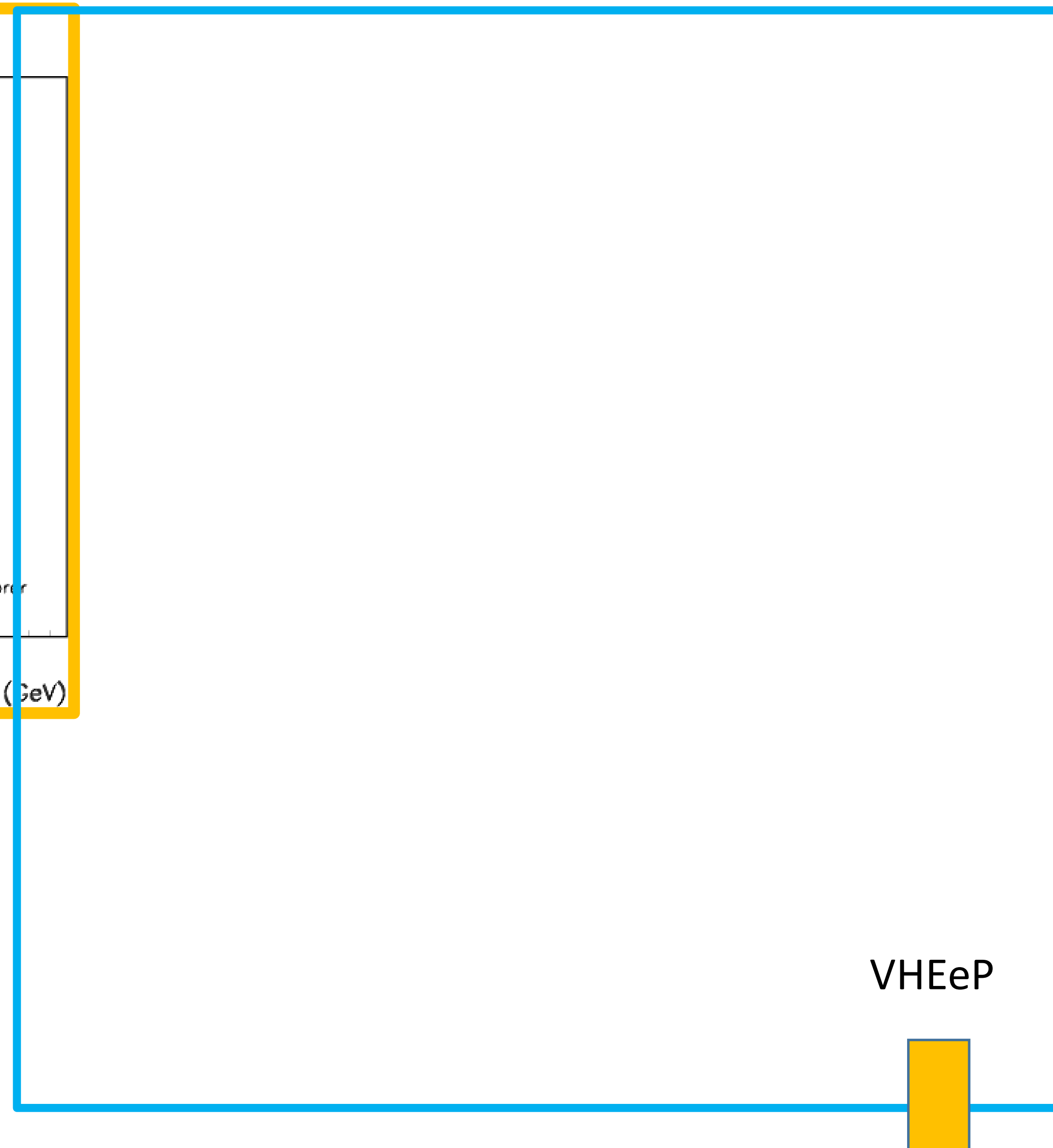


The LHeC proposal was submitted just before DIS 2006 Workshop.
hep-ex/0603016

Future @ DIS2006 (4) -> DIS2018

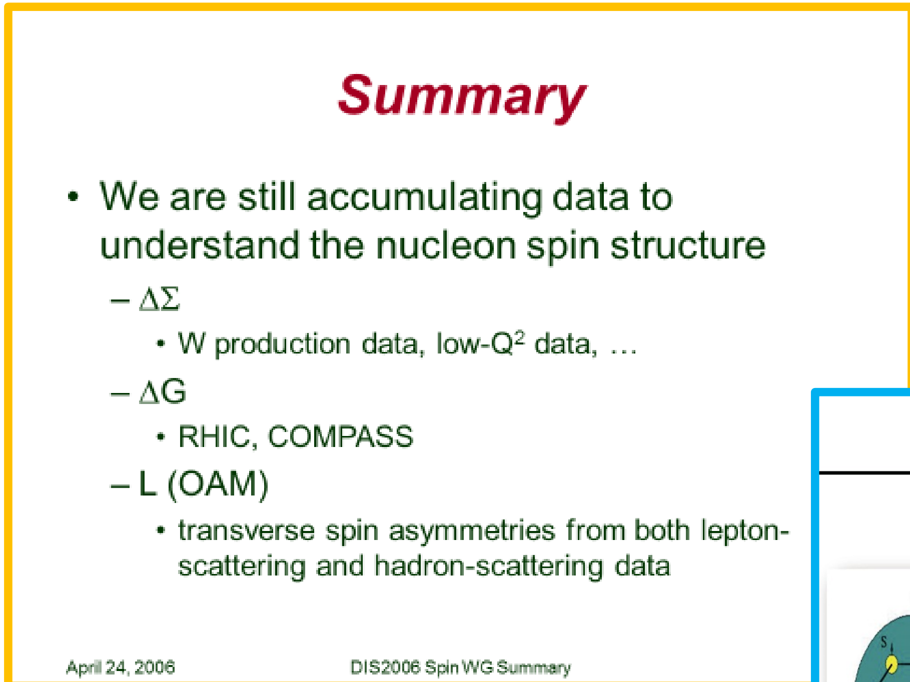
- Future lepton-hadron colliders



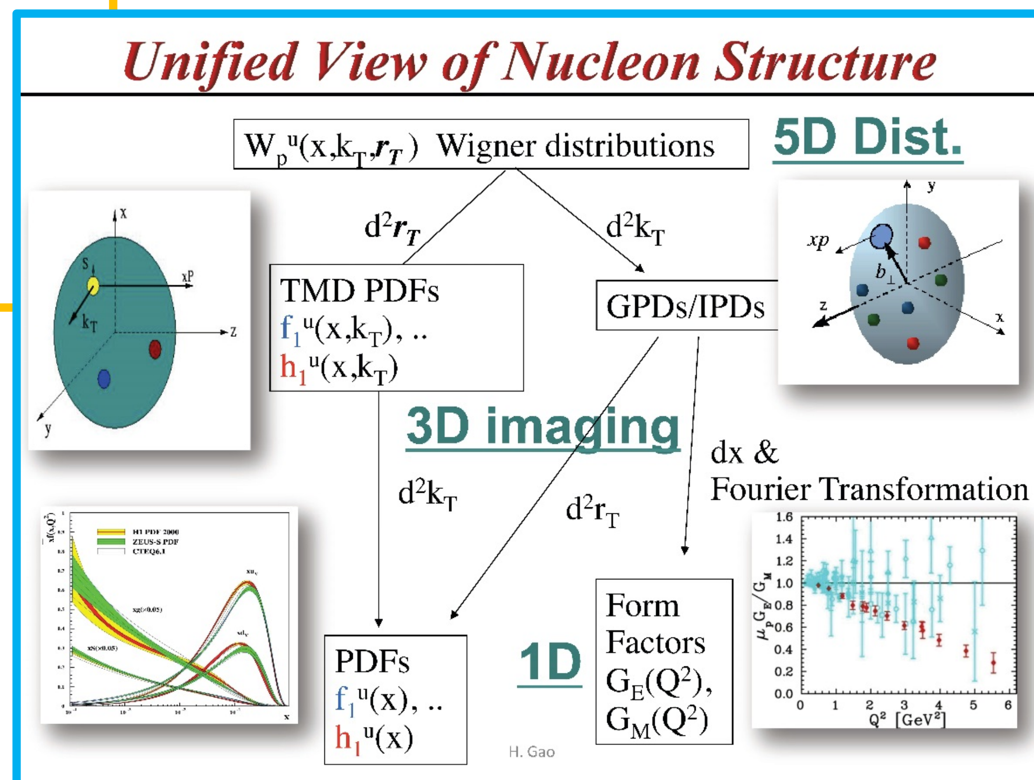


It is the time to realize the studies of last >12 years.
EIC, LHeC, FCC-he, VHEeP

SPIN @DIS2006



Yuji Goto



Since then there are many more data from HERMES, COMPASS, RHIC, J-LAB …. But not yet enough.

→ Importance of high Lumi EIC

Twelve year cycle is popular in Eastern Asia

- 2018: "The year of the dog"

J-lab 12GeV first beam (2015)

- 2006:

RHIC polarised proton (2003-)

  One year before the end of HERA

- 1994: DIS94: Eilat
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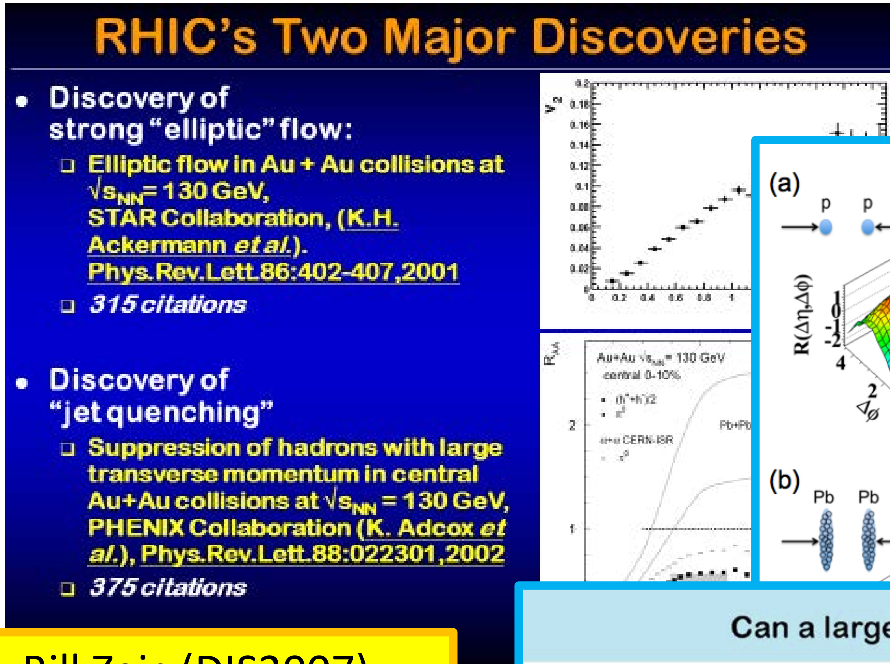
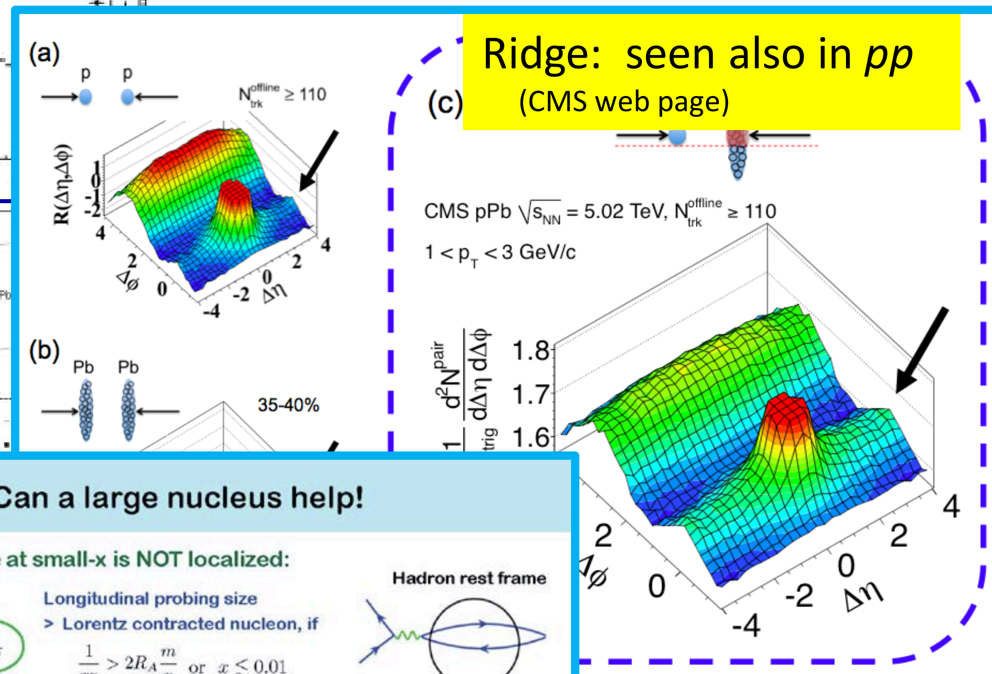
  - HERA first collision (1992)
- 1982
  - HERA proposal (1981)
- 1970
  - DIS (1969), scaling (1969) ….
- 1958
  - Proton form factor (1956)

From eN to eA

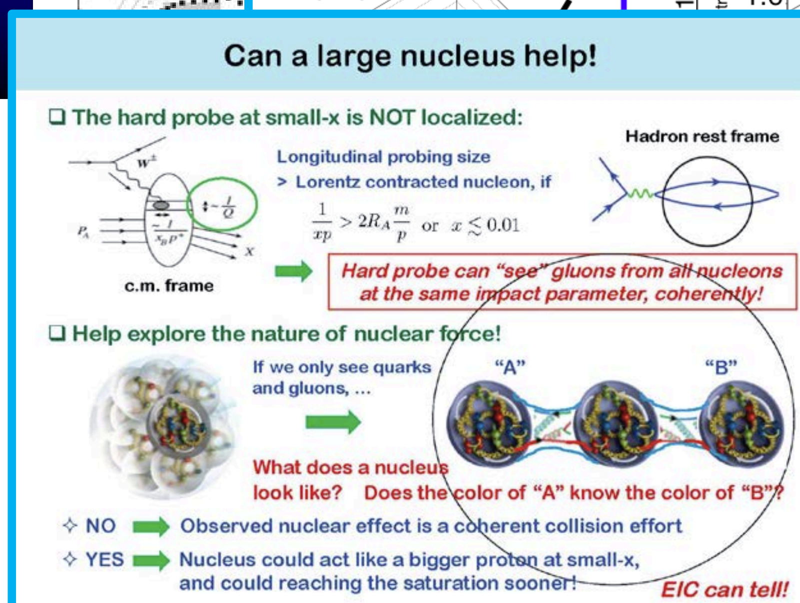
There were little discussion on Heavy Ion results in DIS2006 but many interesting observations from heavy ion collisions



Bill Zajc (DIS2007)

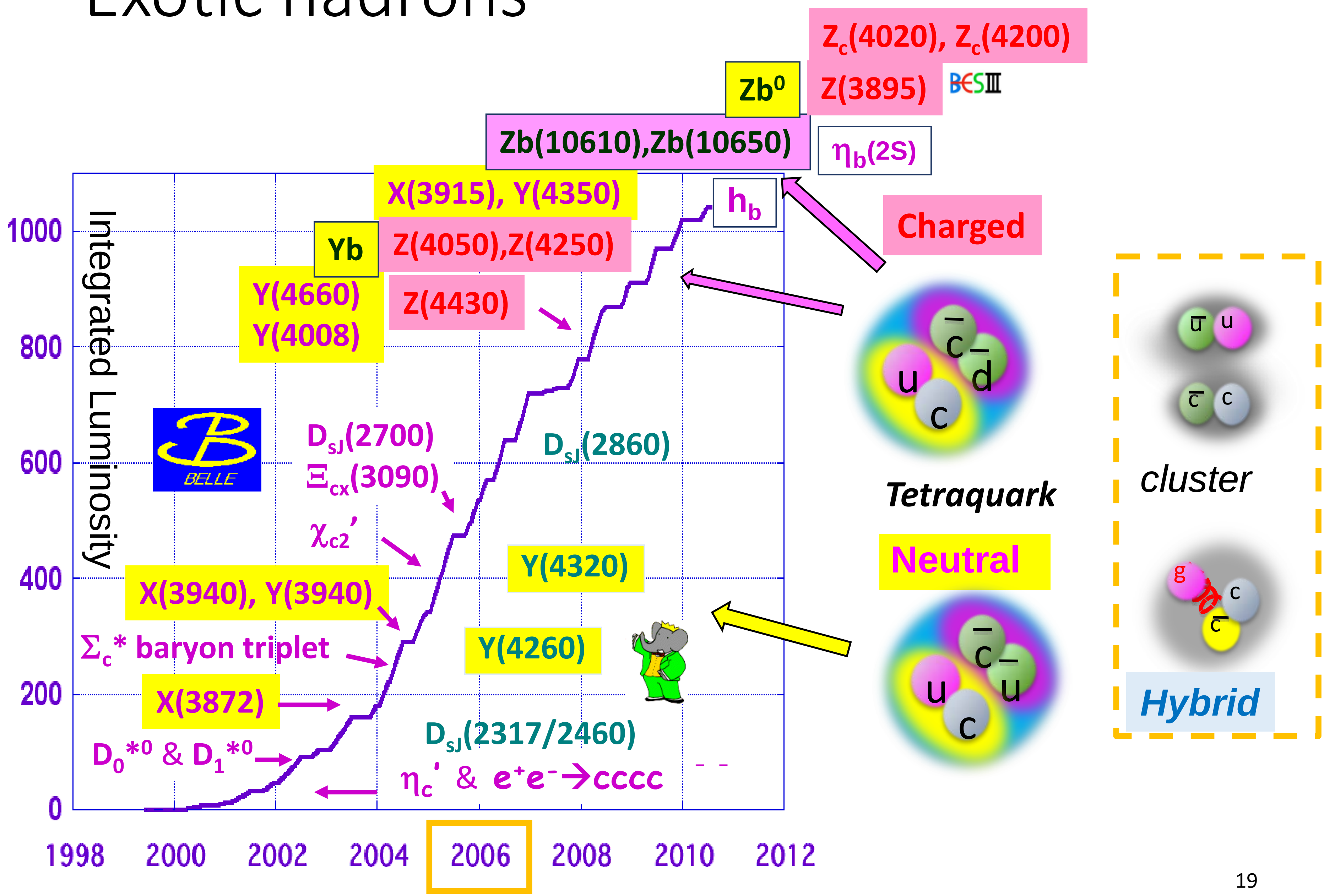


Ridge: seen also in *pp*
(CMS web page)



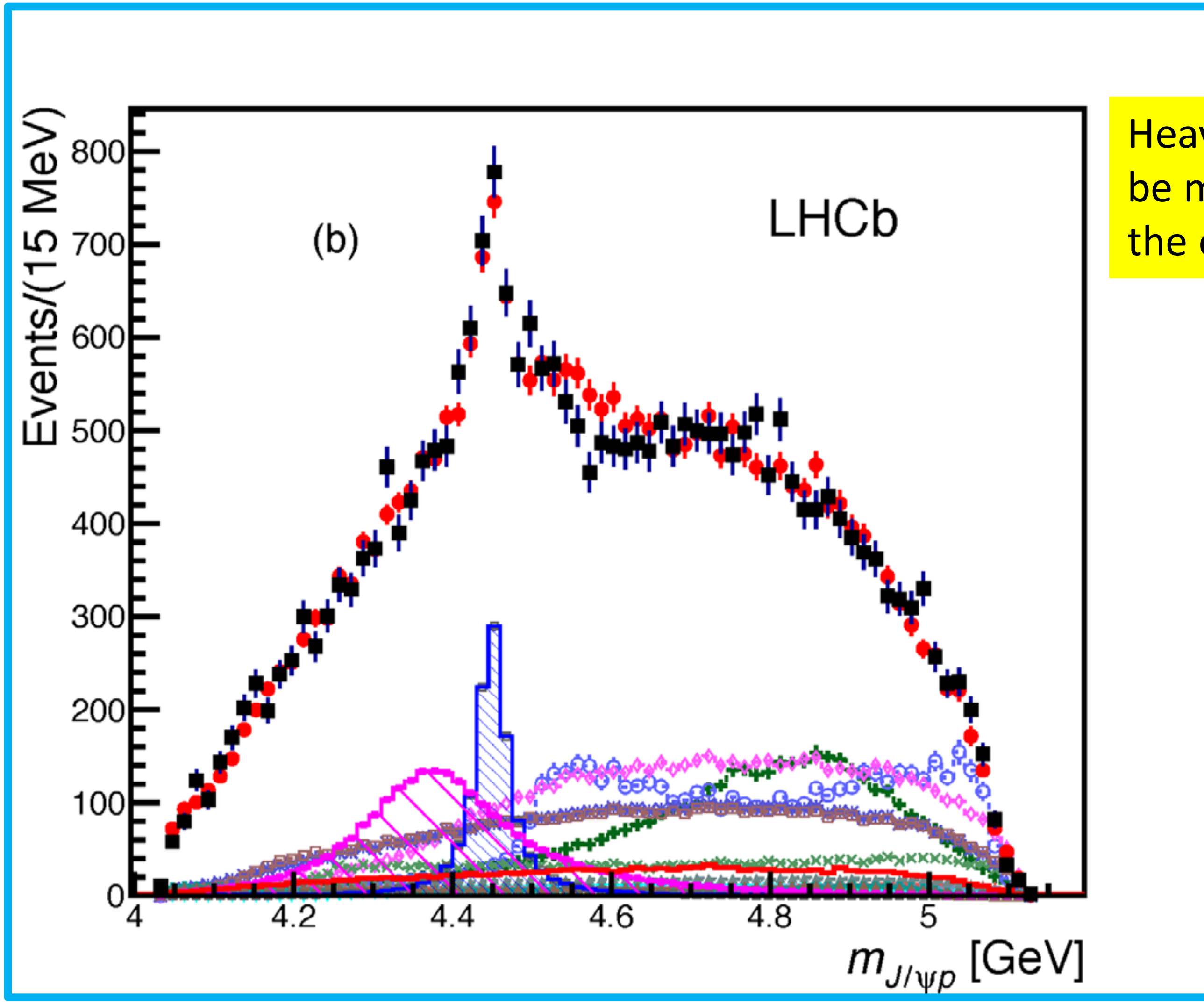
Collaborative works of HEP and NP are essential.

Exotic hadrons



And Pentaquark!

PRL 115 (2015) 072001

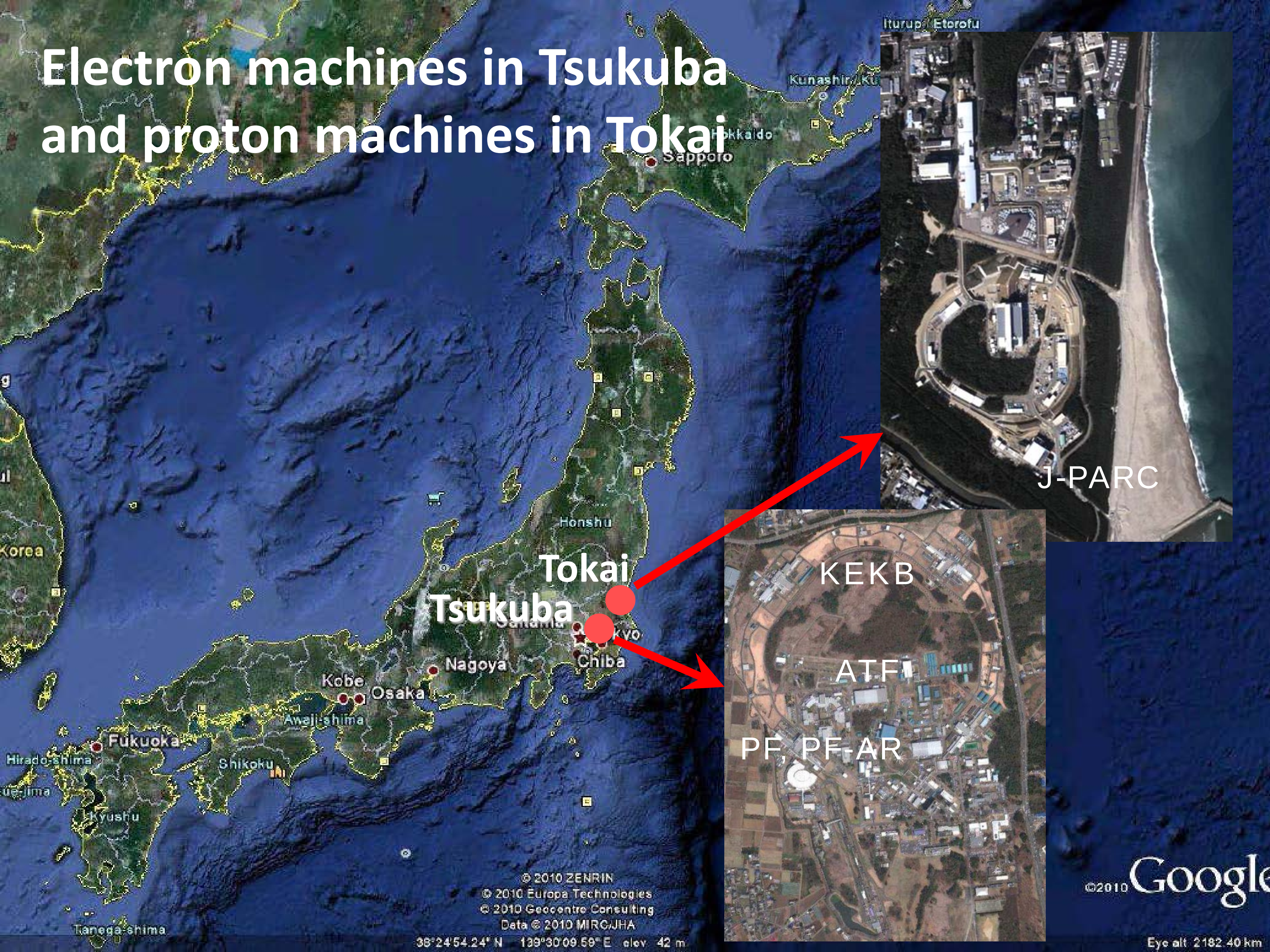


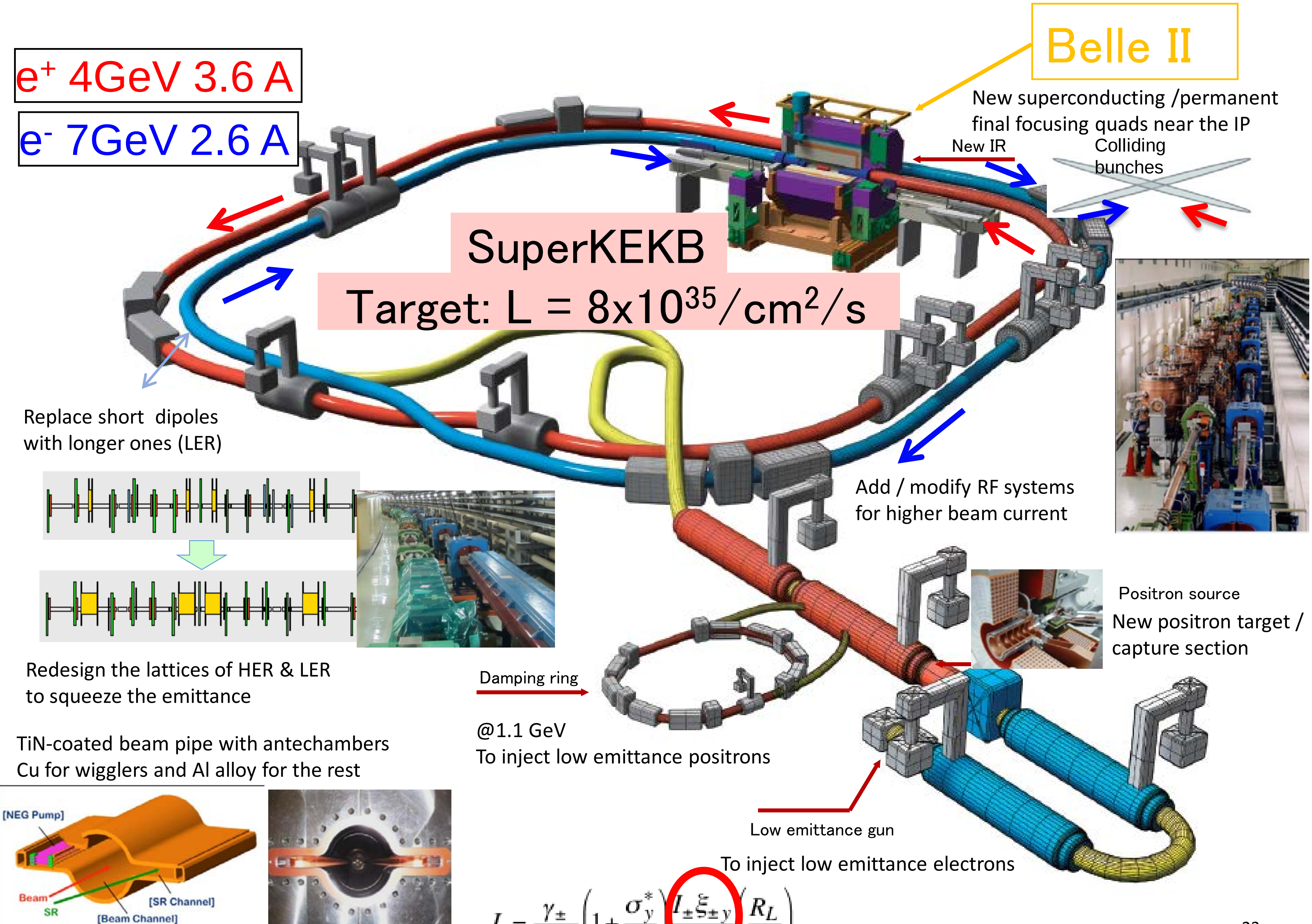
Heavy quarks seems to be more open-minded to the exotics!

New accelerators in Japan since 2006

- J-PARC (2010)
- SuperKEK (2018)
- and Future

Electron machines in Tsukuba and proton machines in Tokai

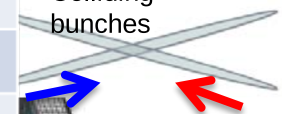




$$L = \frac{\gamma_\pm}{2er_e}\left(1+\frac{\sigma_y^*}{\sigma_x^*}\right)\left(\frac{I_\pm \xi_{\pm y}}{\beta_y^*}\right)\left(\frac{R_L}{R_y}\right)$$

elle II

conducting /permanent
ng quads near the IP



Parameter	Units	KEKB		SuperKEKB	
		HER (e^-)	LER (e^+)	HER (e^-)	LER (e^+)
Circumference	m	3016.3		3016.3	
Energy	GeV	8	3.5	7	4
Crossing angle	mrad	22		83	
β_x at IP	cm			2.5	3.2
β_y at IP	mm	5.9	5.9	0.30	0.27
ε_x (emittance)	10^{-9} m	24	18	5.3	3.2
Emittance ratio	%			0.35	0.40
σ_z	mm	6	6	5	6
Beam current	mA	1190	1640	2620	3600
σ_x at IP	10^{-6} m			7.75	10.2
σ_y at IP	10^{-9} m	940	940	59	59
ξ_x (tune shift)				0.0028	0.0028
ξ_y		0.090	0.129	0.0875	0.09
Luminosity	$cm^{-2}\ s^{-1}$	2×10^{34}		8×10^{35}	

e^+ 4

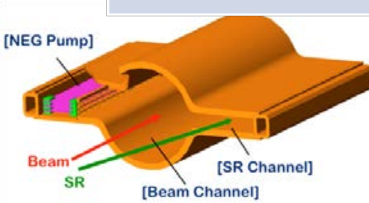
e^- 7

Repla
with l

Redes
to squ

TiN-co
Cu for

Positron source
New positron target /
capture section

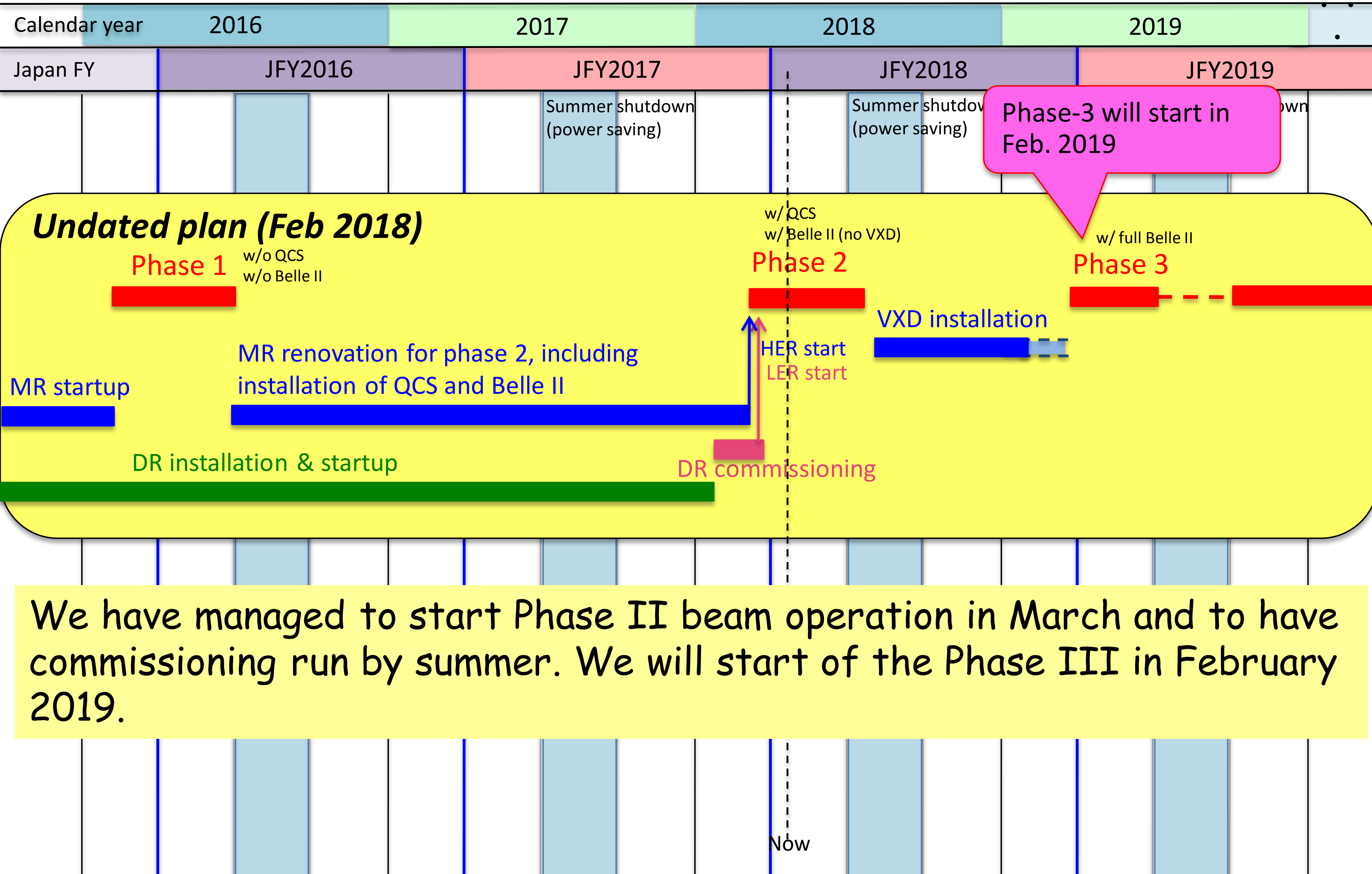


$$L = \frac{\gamma_\pm}{2er_e}\left(1+\frac{\sigma_y^*}{\sigma_x^*}\right)\left(\frac{I_\pm \xi_{\pm y}}{\beta_y^*}\right)\left(\frac{R_L}{R_y}\right)$$

Nano beam scheme:
Modest (x2) current increase.
Ambitious challenge to reduce
the beam size (x 1/20)

KEK
High Energy Accelerator
Research Organization

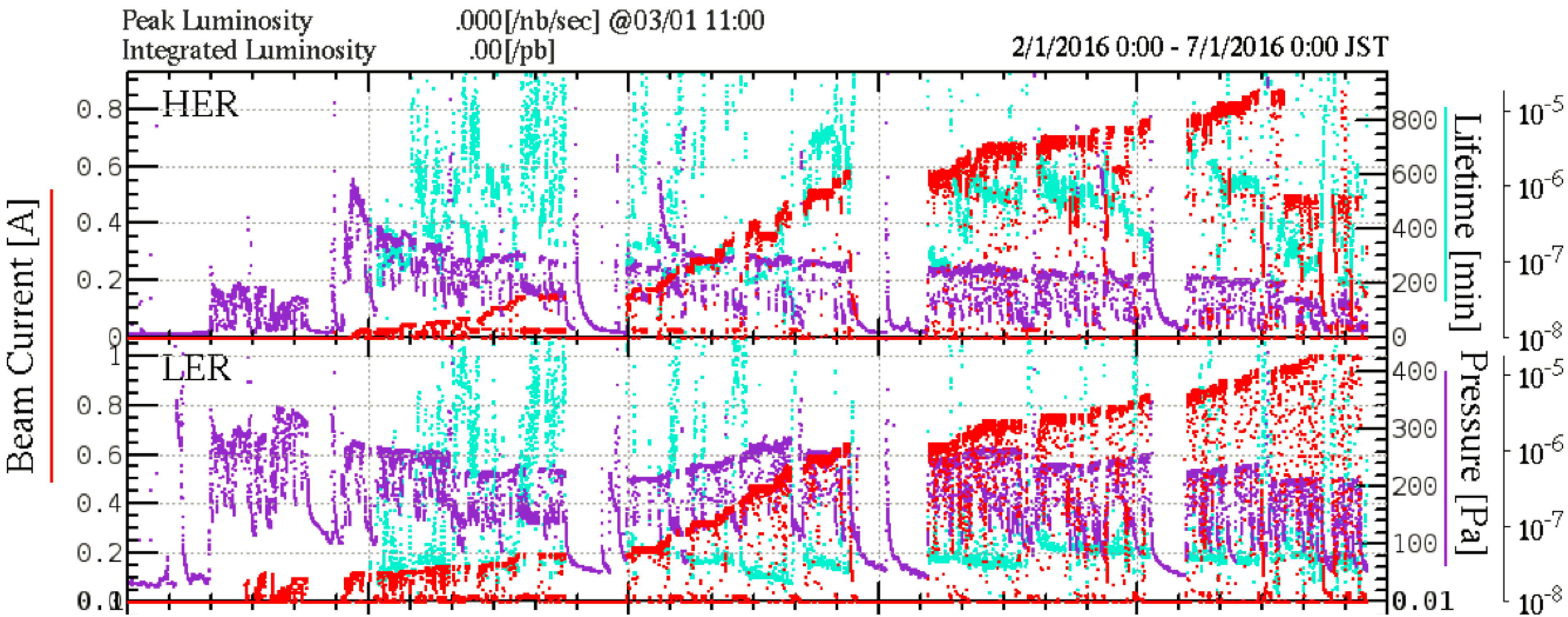
Commissioning schedule



We have managed to start Phase II beam operation in March and to have commissioning run by summer. We will start of the Phase III in February 2019.

Success of Phase-1 Commissioning

- First beam on 6/Feb/2016
- 5 month (almost) continuous commissioning (Feb-Jun).
- The pressure is kept at reasonable level: success of the scrubbing effect.

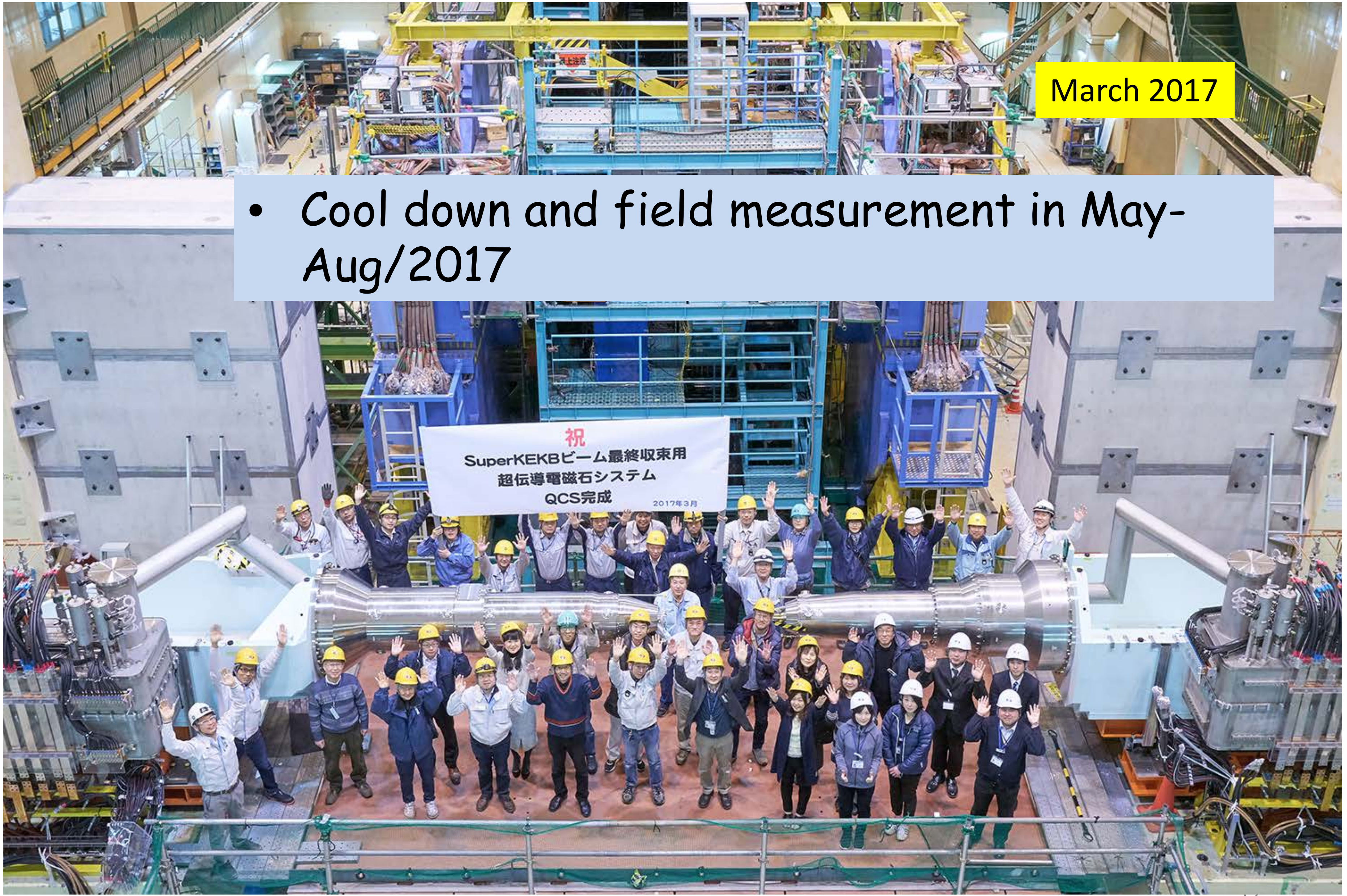


LER: 1010 mA, HER 870 mA

Red: total beam current
Purple: vacuum pressure

KEK
High Energy Accelerator Research Organization

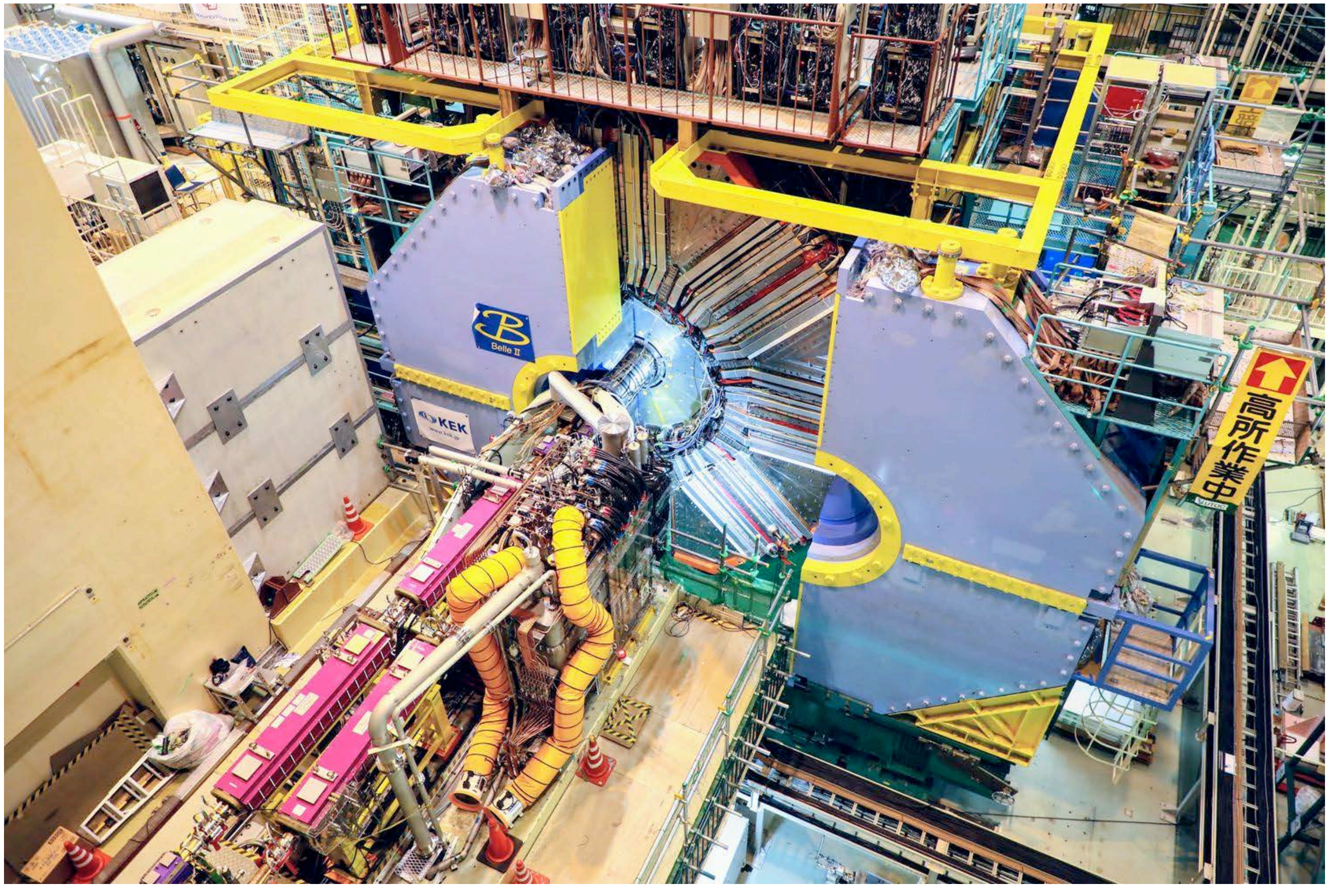
Preparation for the Phase 2 (QCS)



March 2017

- Cool down and field measurement in May-Aug/2017

January 15th, 2018: both sides of the complex superconducting final focus system and RVC (Remote Vacuum Connection) are fully integrated with Belle II.



Phase 2

Kudos to the KEK (K. Kanazawa et al) and DESY (K. Gadow et al) installation teams.

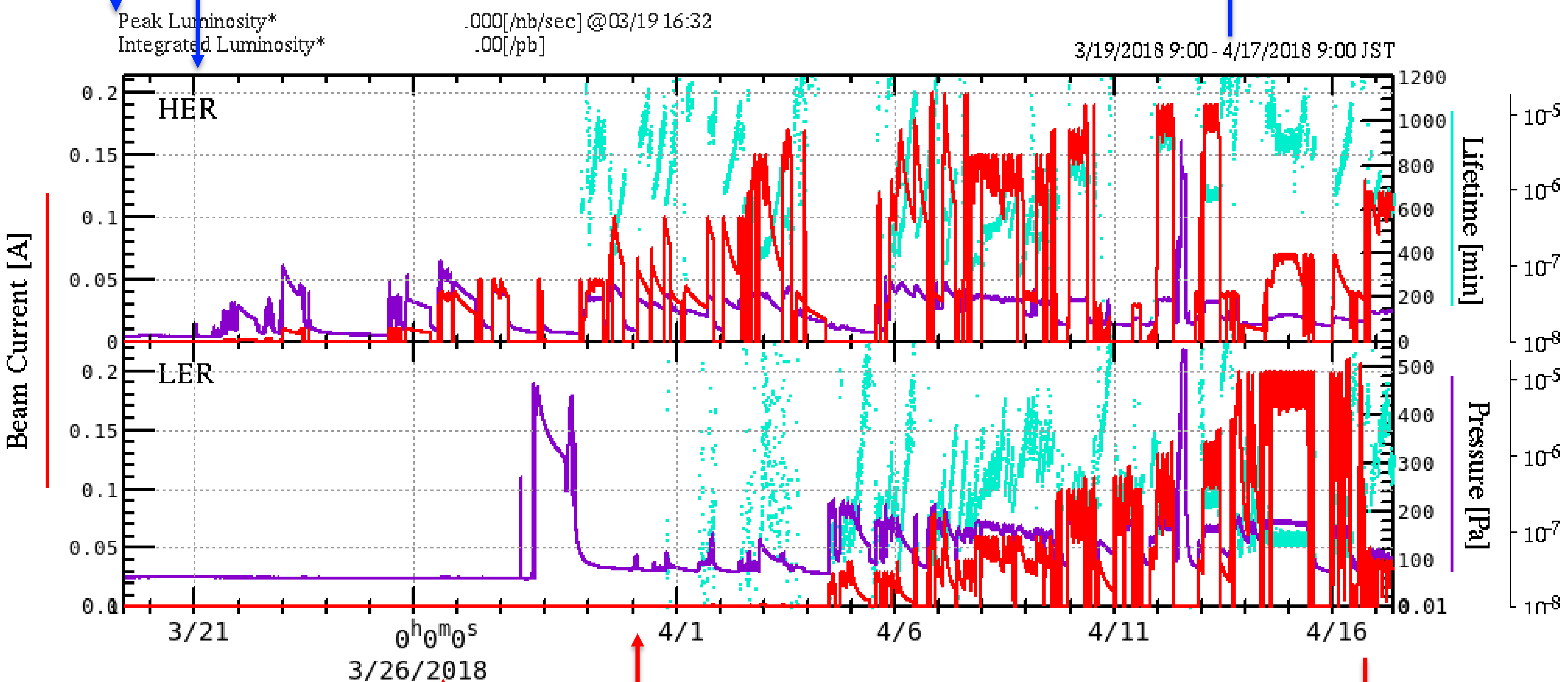
SuperKEKB phase 2 status

as of Apr. 17, 2018

3/19 HER beam tuning start

3/21 HER beam storage

HER collision optics: phase 2.1
($\beta_x^* = 200$mm, $\beta_y^* = 8$mm)



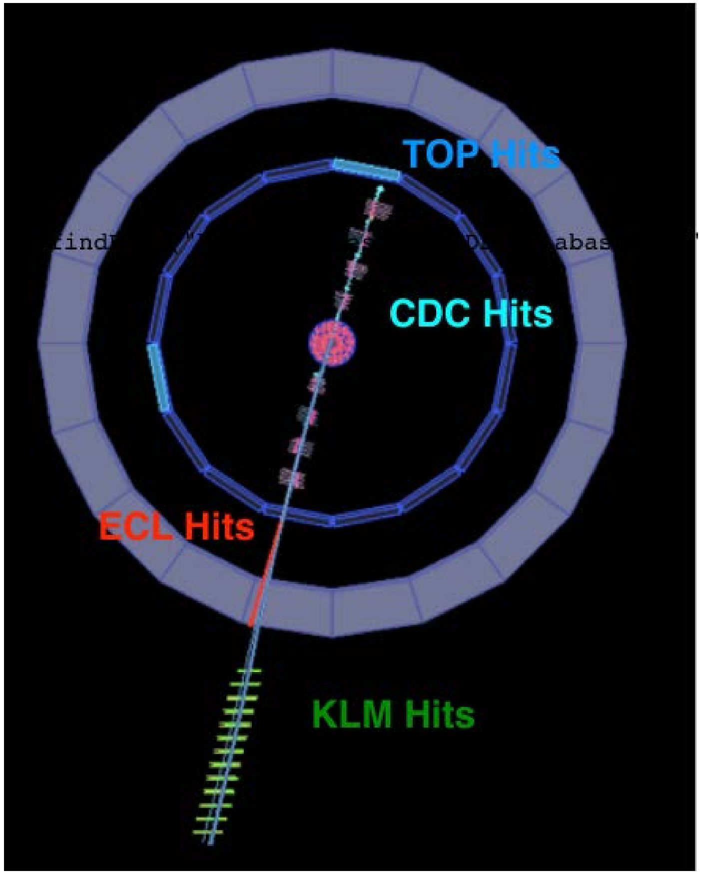
3/31 LER beam storage

3/26 LER beam tuning start

LER collision optics: phase 2.1
($\beta_x^* = 200$mm, $\beta_y^* = 8$mm)

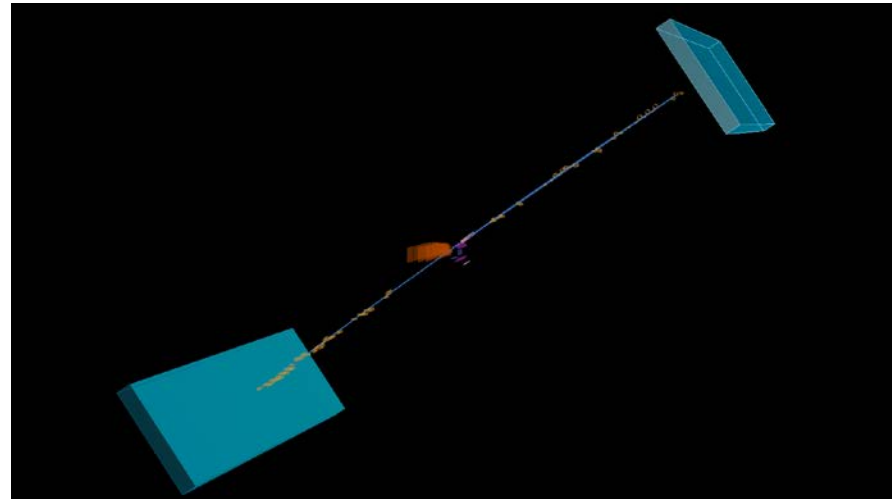
Cosmic Ray Muon Event Displays

Outer detector (barrel)

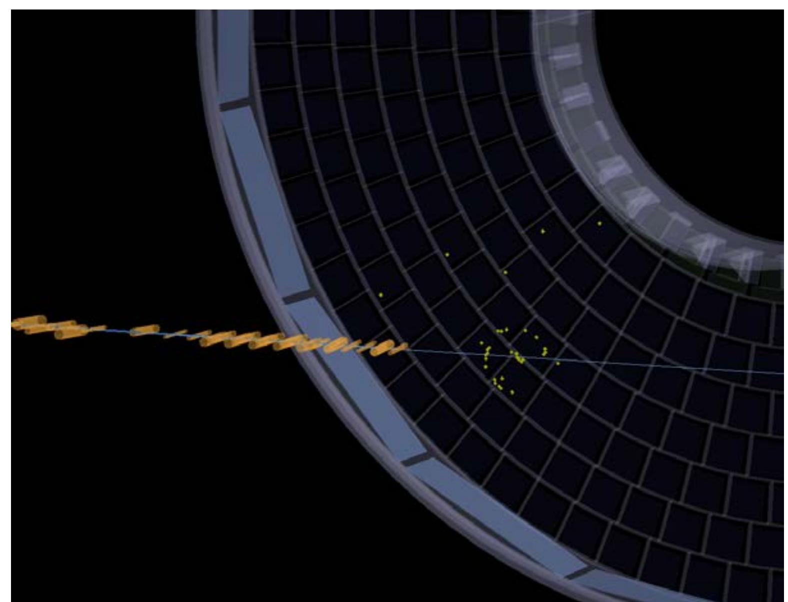


Barrel Outer Detector Integrated and recording cosmics. (KLM RPCs ok, but no scintillator KLM hits yet).

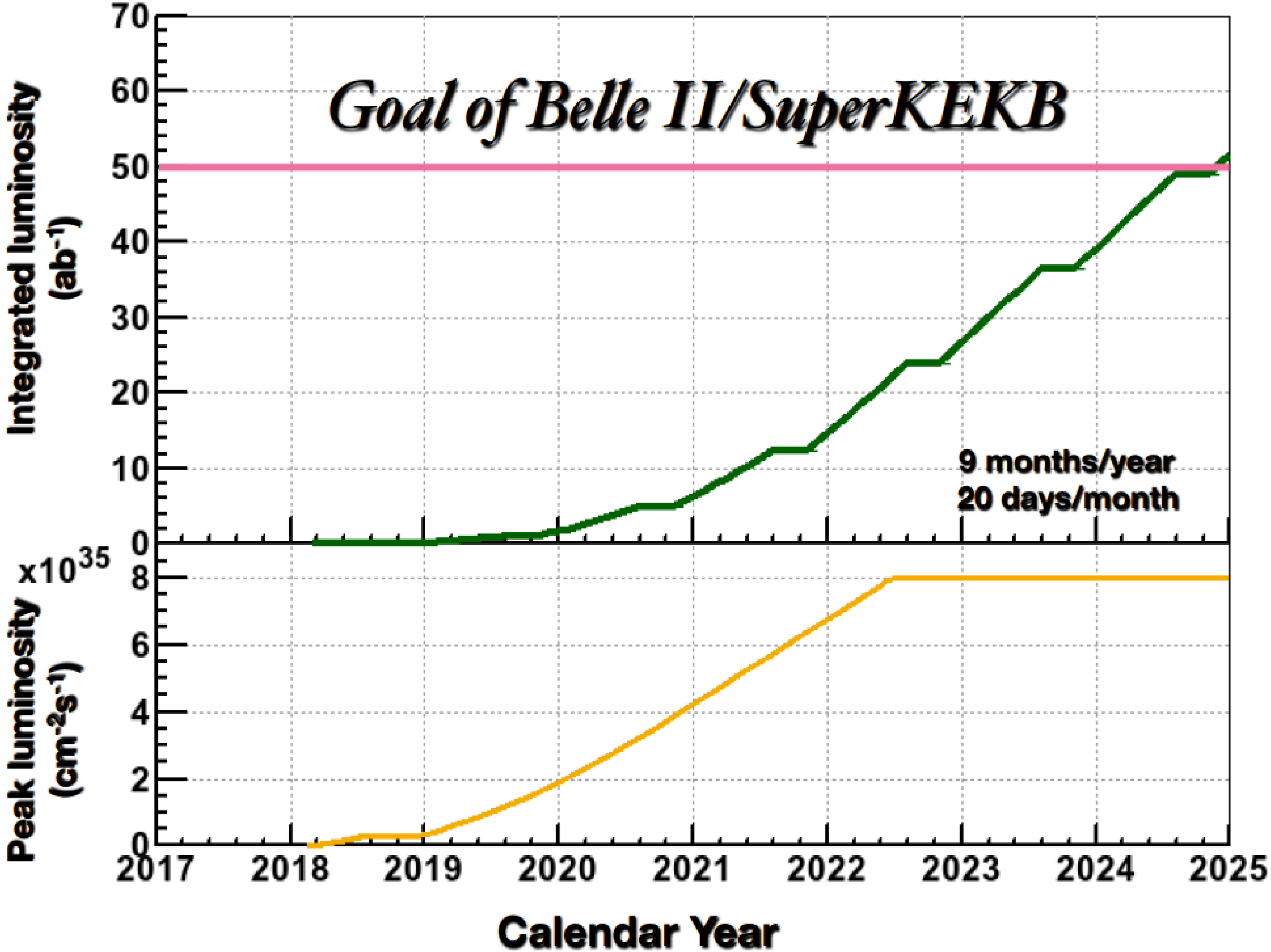
VXD First Cosmics



First ARICH ring with cosmics



SuperKEKB luminosity projection



Belle II Collaboration

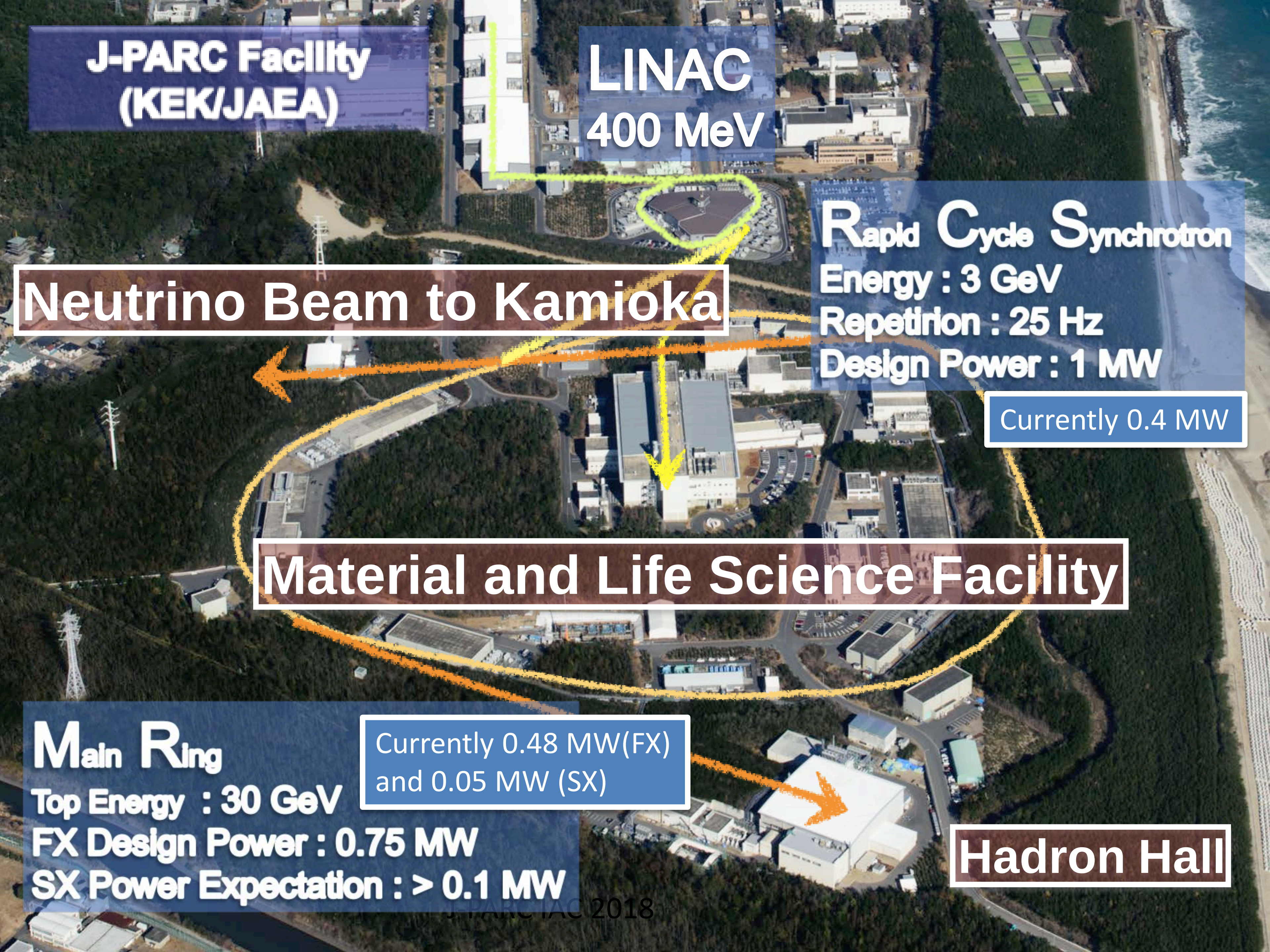
As of Apr. 2018

25 countries/regions
108 institutions
756 researchers

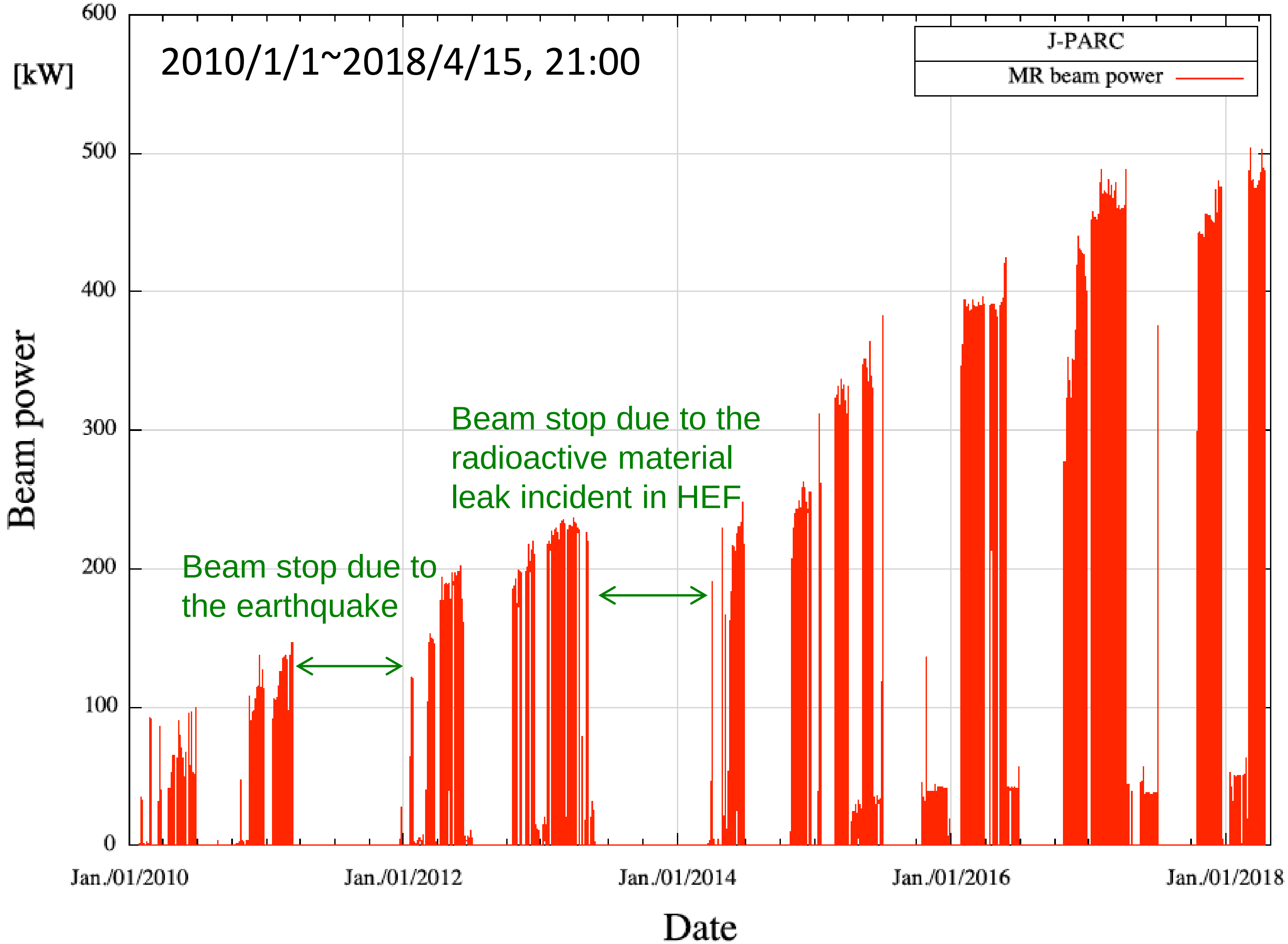
Europe	320
Austria	10
Czechia	7
France	22
Germany	138
Israel	5
Italy	65
Poland	12
Russia	38
Slovenia	14
Spain	5
Ukraine	4

Asia			313
Saudi Arabia	1	Korea	40
Australia	33	Malaysia	5
China	37	Vietnam	2
India	31	Taiwan	27
Japan	133	Thailand	1
		Turkey	3

America	123
Canada	26
Mexico	13
USA	84


J-PARC Facility
(KEK/JAEA)
LINAC
400 MeV
Rapid Cycle Synchrotron
Energy : 3 GeV
Repetirion : 25 Hz
Design Power : 1 MW
Currently 0.4 MW
Neutrino Beam to Kamioka
Material and Life Science Facility
Main Ring
Top Energy : 30 GeV
FX Design Power : 0.75 MW
SX Power Expectation : > 0.1 MW
Currently 0.48 MW(FX)
and 0.05 MW (SX)
Hadron Hall

History of MR beam power



Achieved beam power for users :

Fast extraction : 485 kW (2.5 x10^{14} ppp)

Slow extraction : 51 kW (5.5 x10^{13} ppp)

Neutrino experiments

T2K results: see Yoshinari Hayato's Talk

T2K2 (E11 -> E65 (stage-1): ND upgrade + more POTs

https://home.cern/about/updates/2017/10/baby-mind-born-cern-now-ready-move-japan

Baby MIND born at CERN now ready to move to Japan

by Stefania Pandolfi

tefania Pandolfi
017. Last
Oct 2017,
ais
is archived on
ocument Server

Baby MIND under test on the T9 beamline at the Proton Synchrotron experimental hall in the East Area, summer 2017 (Image: Alain Blondel/University of Geneva)

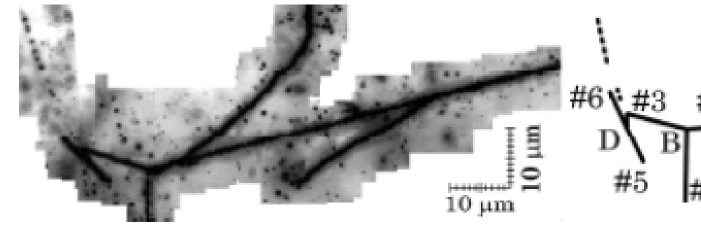
A member of the CERN Neutrino Platform family of neutrino detectors, Baby MIND, is now ready to be shipped from CERN to Japan in 4 containers to start the experimental endeavour it has been designed and built for. The containers are being loaded on 17 and 18 October and scheduled to arrive by mid-December.

Baby MIND is a 75-tonne neutrino detector prototype for a Magnetised Iron

Many proposals on orecision measurements of neutrino-nucleus cross sections, for reducing systematics of the oscillation parameters

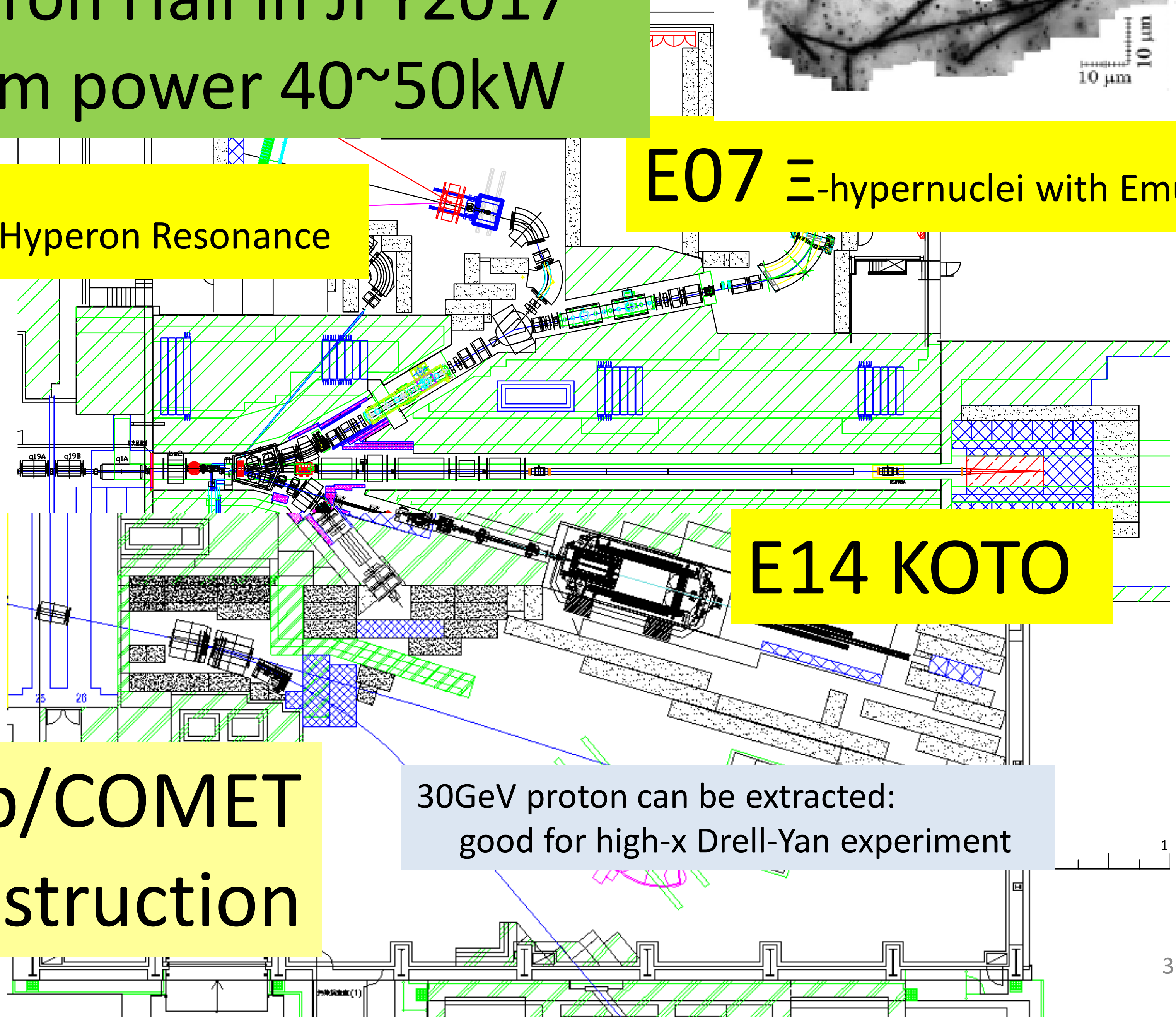
- E13/E65 T2K(2)
- E61 (NuPRISM+TITUS),
- E69 (WAGASCI+BabyMIND),
- E71 (NINJA):

Hadron Hall in JFY2017
Beam power 40~50kW



E07 Ξ-hypernuclei with Emulsion

E31: Hyperon Resonance



E14 KOTO

Hi-p/COMET construction

30GeV proton can be extracted:
good for high-x Drell-Yan experiment

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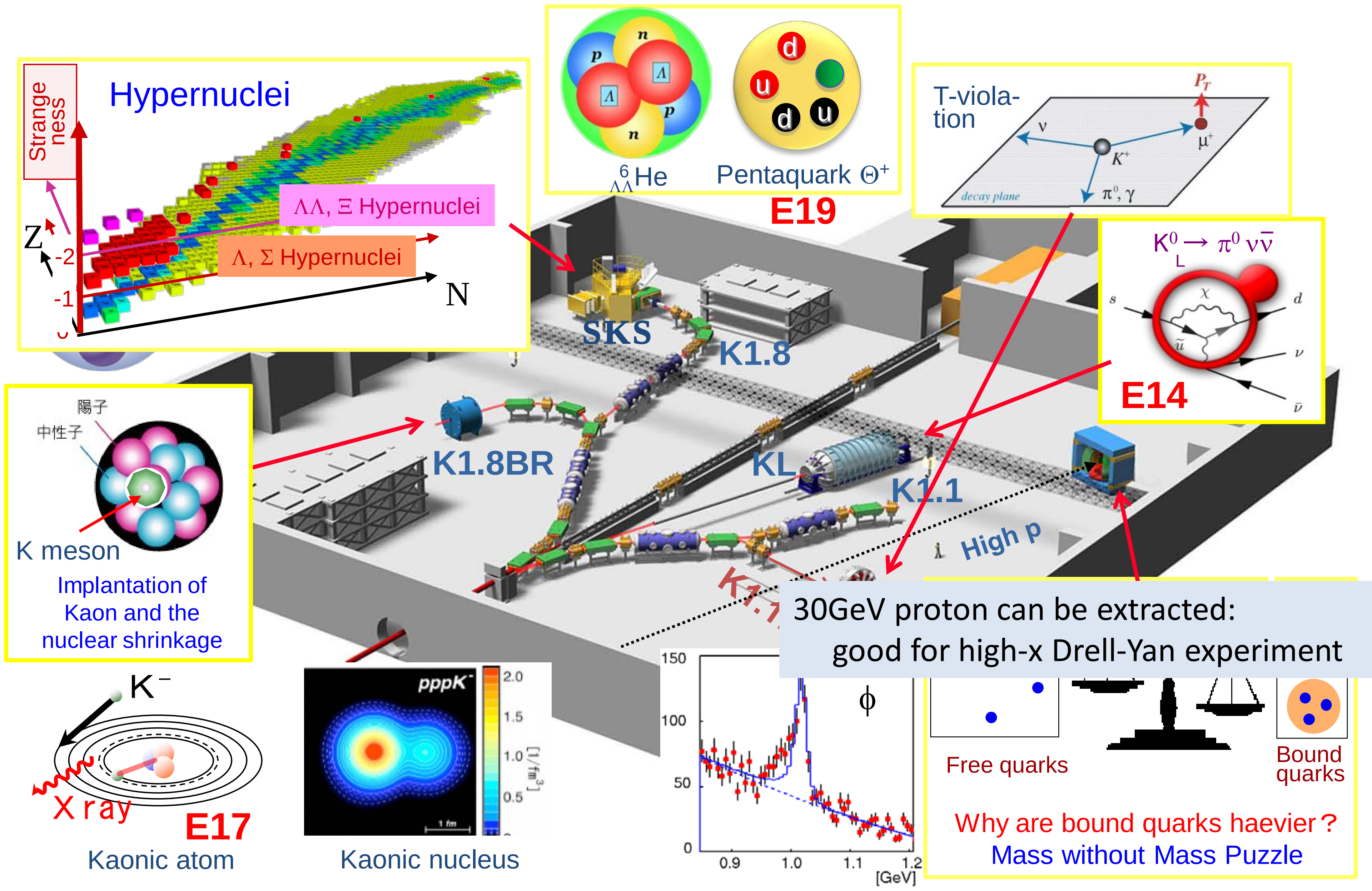
Nuclear and Particle Physics at J-PARC

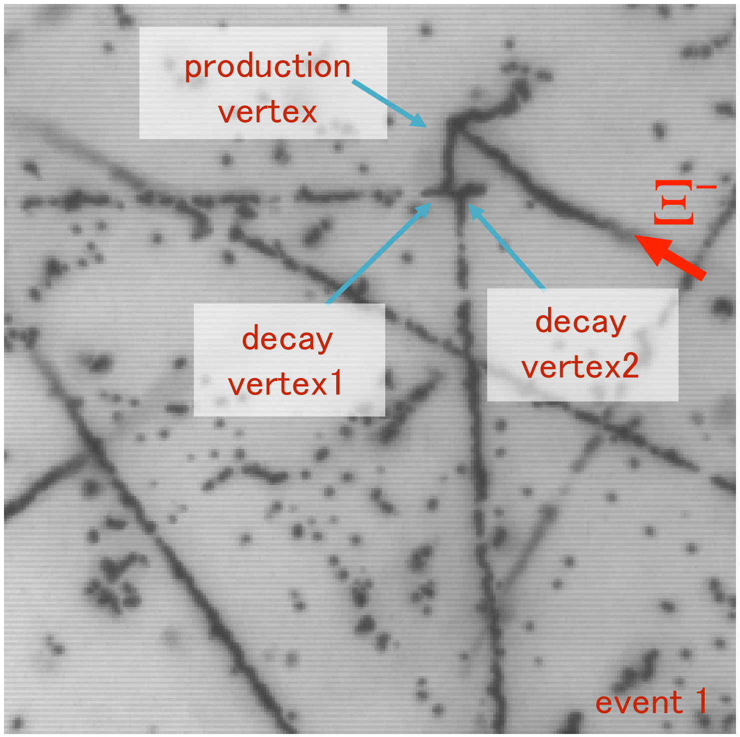


E07: Emulsion Photo Xi +A -> ?

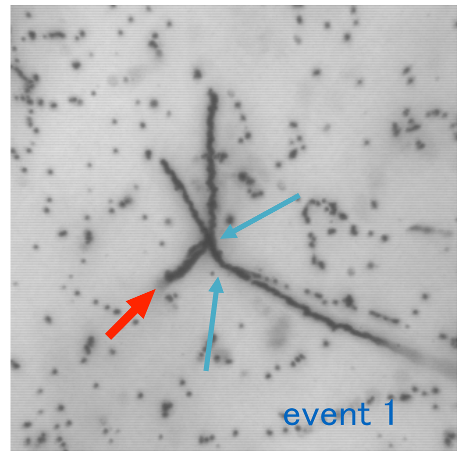
Ξ^- stop -> Formation of double hyper nuclei

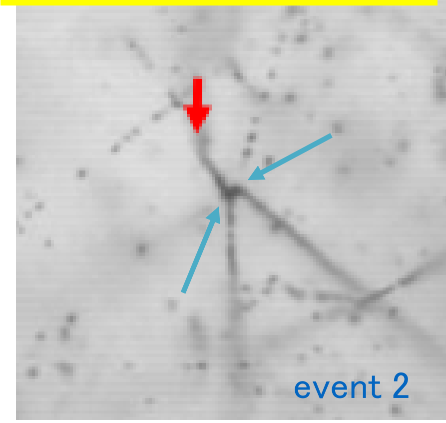
Old method with advanced tools.

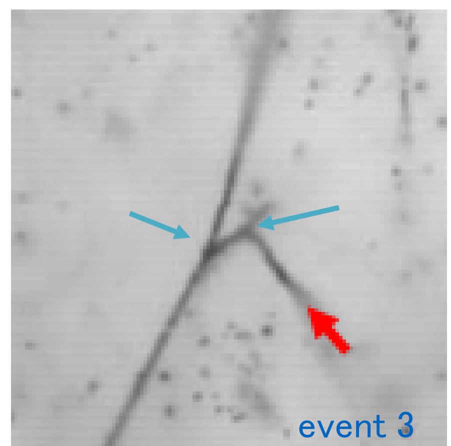
3 vertex event

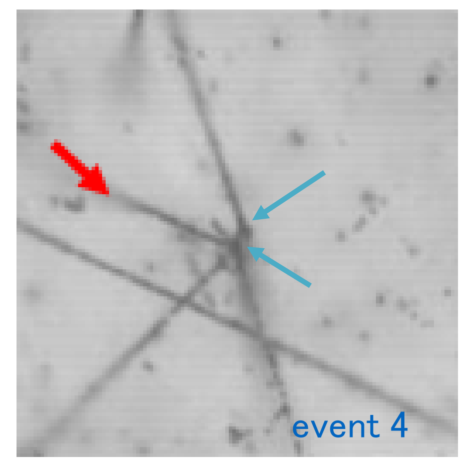


2 vertex events







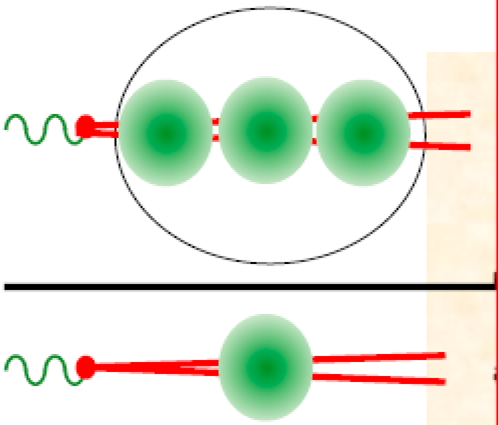


Several Hyper-fragments have been observed.

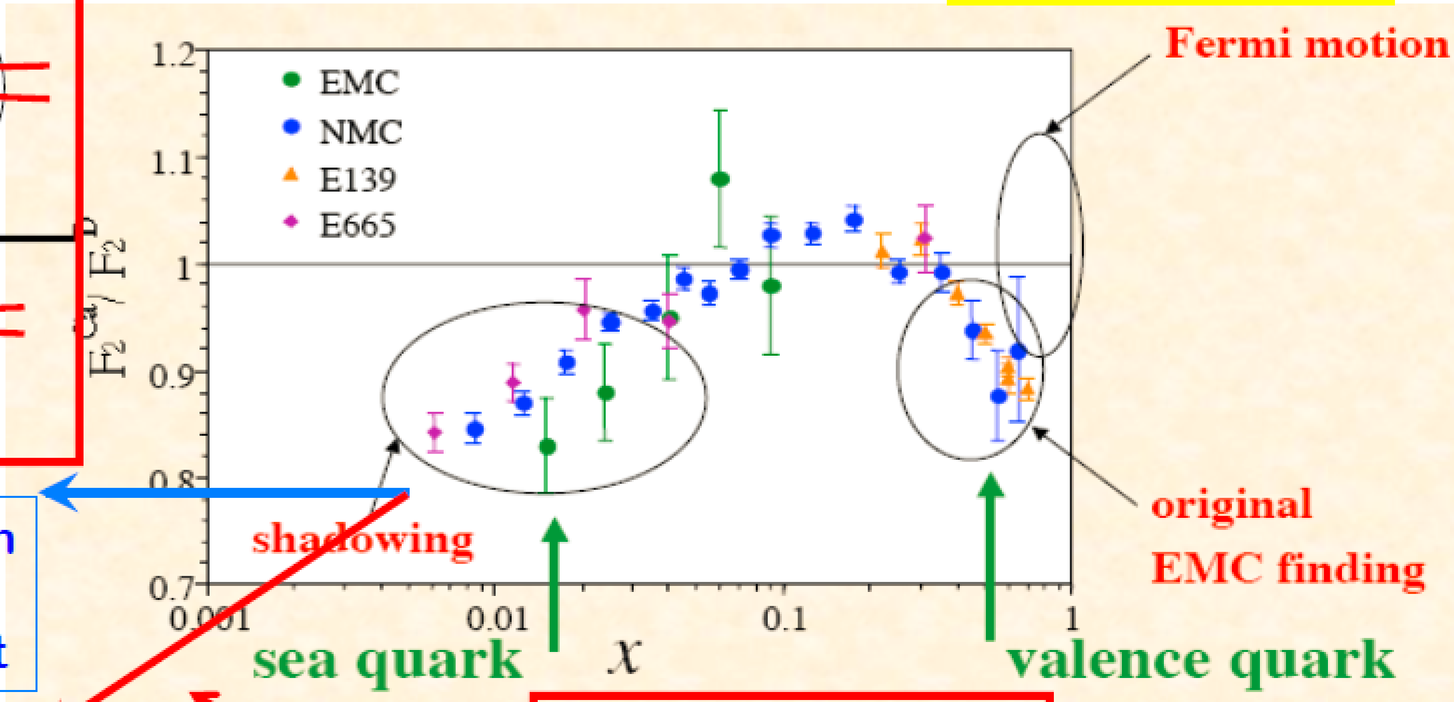
1 year for fast scanning of all the emulsions.

Role of color for nuclear force?

Jianwei Qiu : DIS18

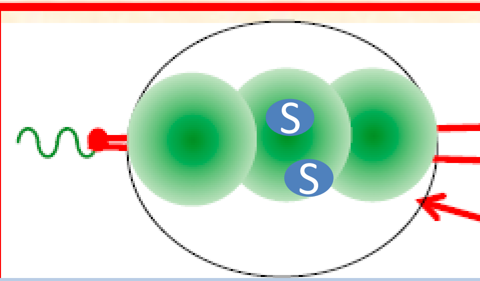


Color localized



No saturation in nucleon
Collision effect

Nucleus as a bigger proton



Color leaks outside nucleons
Soft gluon radius is larger

- A simple question:

  Will the suppression/shadowing continue to fall as x decreases?

Quarks may leaks: Xi – double lambda hyper spectroscopy can give extra information

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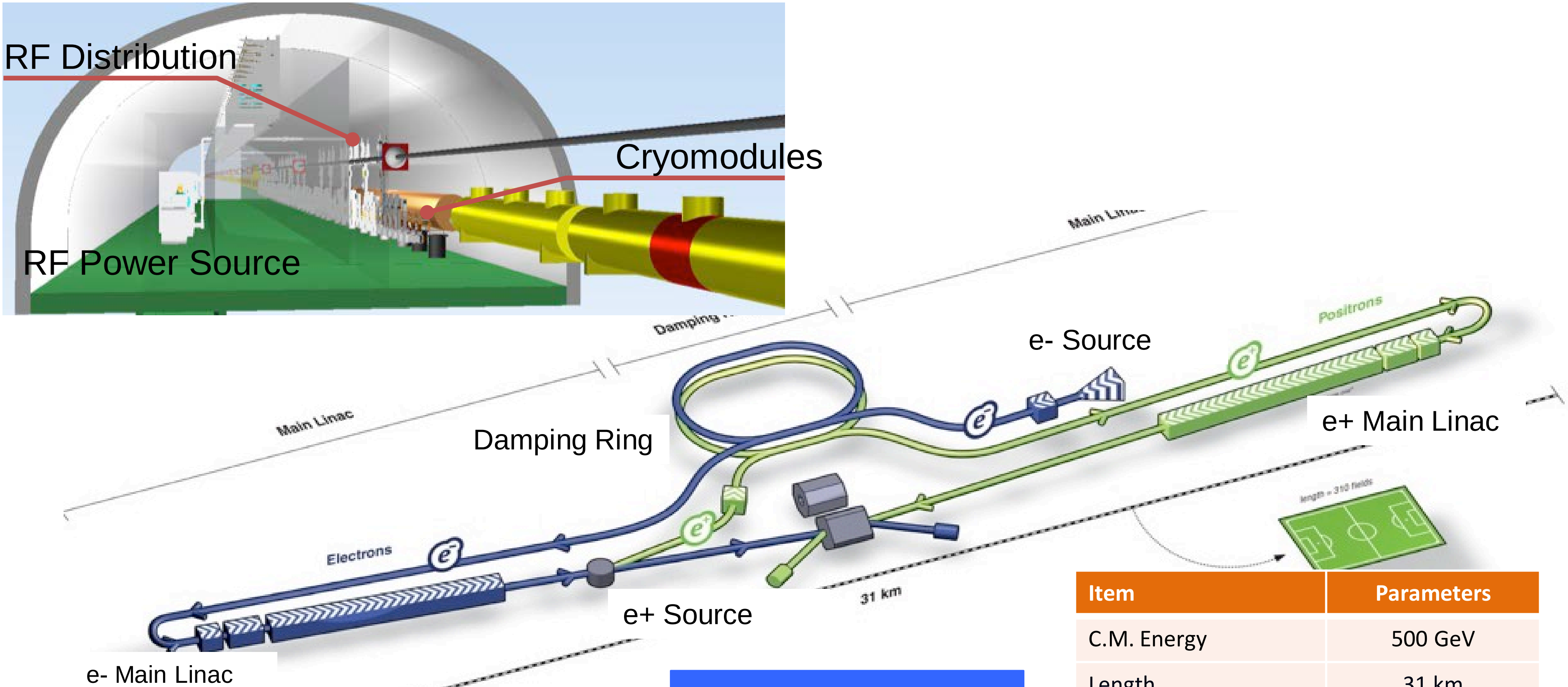
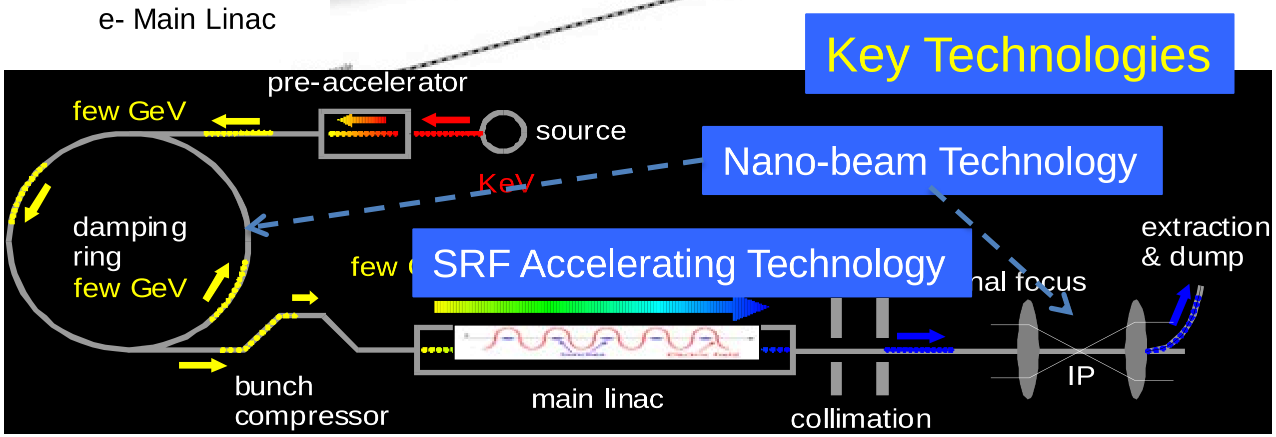
ILC accelerator à la TDR





Item	Parameters
C.M. Energy	500 GeV
Length	31 km
Luminosity	1.8 x10^{34} $cm^{-2}s^{-1}$
Repetition	5 Hz
Beam Pulse Period	0.73 ms
Beam Current	5.8 mA (in pulse)
Beam size (y) at FF	5.9 nm
SRF Cavity G. Q_0	31.5 MV/m Q_0 = 1x10^{10}

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High Energy Accelerator Research Organization

ILC250 as an international project with Japanese initiative

- Japanese HEP community proposed to start ILC as a Higgs factory with 250GeV collision energy, which was supported by LCB and ICFA at the Ottawa meeting in November 2017.

- Following the LCB/ICFA statement on ILC250, the proposal was discussed at the ILC Advisory Panel meeting at MEXT in December.

- The panel agreed to re-start physics and TDR working groups to evaluate physics potential, cost and technical issues of the new ILC250 proposal.

- It is expected that the conclusion of the Advisory Panel will be given in summer 2018 after hearing conclusions of the working groups, and the outcome will be sent to the Science Council of Japan for the final evaluation of the project.

Summary

- A lot of progress in last years.
- Preparation for the LHC and huge real data from the LHC accelerate the progress.
- Many new data from fixed target experiments and RHIC. -> more diverse meaning of the DIS-WS

- It is the time to prepare for the future.