EPPSU 2020

Goals of the Symposium, Halina Abramowicz

European Particle Physics Strategy Update 2020

Organisation of the Update Process

- Decision making body – CERN Council
- Drafting of the Strategy Update document – responsibility of the European Strategy Group (ESG)
- Scientific Input to the Strategy Update – responsibility of the Physics Preparatory Group (PPG)
- Coordinating body – the Strategy Update Secretariat (SUS)

EPPSU 2020

Strategy Secretariat

- H. Abramowicz (Chairperson)
- J. D'Hondt (ECFA Chairperson, *ECFA: European Committee for Future Accelerators*)
- K. Ellis (SPC Chairperson, *SPC: Science Policy Committee @ CERN*)
- L. Rivkin (European LDG Chairperson, *LDG: Lab Directors Group*)

Contact: EPPSU-Strategy-Secretariat@cern.ch

5/13 Plenary Session

9:00 Welcom address and inauguration of the Symposium

9:29 Goals of the Symposium, Halina Abramowicz

CERN council, sub-groups time line
160 submissions of EU documents
Open simposium with parallel sessions , plenty of discussions

9:37 Implementation of the 2013 European Strategy Update, Fabiola

LDG Laboratory director group
results for the 2013 updates
to make priority by this ESU
HL-LHC LS2 2019-2020 LS3 2024-2026
11T Nb3Sn magnets 5.5m long x2 with collimator 11m long in total
CLIC and FCC R&Ds
AWAKE as prasma acceleration by proton drive beam
1,701 young people educated in 2018
CERN's scientific Gateway will start in 2020 complete in 2022

10:04 Outstanding Questions in Particle Physics, Pilar Hernandez

there is not no-lose theorem for future colliders
Majot issue is the shape of scalar potential - vacuum instability

11:10 State of the art and challenges in accelerator technology - Past and present, A.Yamamoto

Now, 16T magnet costs more than an order of magnitude the current LHC 9T ones. It is difficult to accelerate the R&D by moneys and manpowers. Technological break through is needed.
But it require 20 years R&D which is matched to the FCChh plan.

11:50 Future – Path to very high energies, V.Shiltsev

plasma acceleration after 20-30 years R&D, we may say when this technique is available for colliders, some 1000 TeV colliders by end of this century. But only muons are accelerated.

matrices of colliders v.s. readiness/feasibility, power, cost

12:20 Technological challenges of particle physics experiments, Francesco Forti

70 - 20 - 10 Google model for now, next and horizon R&Ds

12:59 Computing challenges of the future, Simone Campana

HSF HEP Software Foundation

WLCG worldwide LHC Computing Grid

needs a strategy of the radical computing (industry standard?), e.g. using the GPUs

since C-language and root data base are old

quantum computing ? still far away from our computing

, where the problem is the stability,

10% investigation is needed for future.

Accelerator Sceince and Technology Session :

15:00 LHC future, Lucio Rossi

new type collimator, 11T dipole/Q for future accelerators

30 11T magnets are needed by 2024

Q/A cost of 16T magnet is assumed to be double of the present LHC for HE-LHC, FCChh

15:33 Future Circular Colliders , Michael Benedikt

the AC power comsumption < 2TWh/year, which is the most important parameter

Q/A budget ? the cost of FCCee is comparable to LHC

16:04 Future LC, Steinar

overviews of ILC and CLIC, staging, schedule, cost etc.

assume novel accelerator technologies (NAT) for future upgrades

see slides for the upgrades and the LC in an overall strategy

C : ILC250 10Hz operation is only possible after the ILC500

17:20 Technical Overview and Challenges of Proposed Higgs Factories, D.Schulte

C : Z, W factories by FCCee physics values

FCCee 4 BCHF machines + 7 BCHF for CFS common for FCChh

transeverse polarization is important for the precise energy measurement at Z pole in FCCee

C : LHC-ep collision the same yields of Higgs but different mechanism

Q : feasibilities are slightly diffferent from the matrices presented at the plenary session

A : the operational effort can compensate some issues in the circular machines

A : the differences can be represented by existence of TDR or CDR,

, that is TDR at ILC, no TDR at FCCee, CEPC

17:57 Higgs precision measurements at future colliders, Maria Cepeda

Comparison tables of various kinds of kappa parameters, rare decays, invisible width, Higgs width, Higgs CP, Higgs mass

5/14 BSM session

9:00 EWSB dynamics and resonances: what we can expect from experiments, Juan Alcaraz Maestre

Higgs composite overall factor C_H as a scale factor

Q/A Higgs is the longitudinal component, so W and Z are also composite

This talk is constrainted in FCChh for direct resonances. But there is no guarantee, The most demanding measurements are precise measurement of Higgs couplings.

9:37 EWSB dynamics and resonances: implications for theory, Andrea Wulzer

new gauge force Z'

massive U(1), fully equivalent to a heavy dark photon

coupling is a free parameter

10:25 Supersymmetry: what we can expect from experiments, Monica D'Onofrio

SUSY search, needs determinations of quantum numbers e.g. spin , where lepton colliders are needed.

11:30 Supersymmetry: implications for theory, Andreas Weiler

naturalness with tuning parameter of Δ

conclusions : Post HL-LHC: e+e- colliders (ILC,CLIC, FCCee) will provide some limited improvement in direct coverage and A high-energy pp machine would bring significant improvement in direct coverage

Q/A 100TeV collider ? Is there any reason ?

A : we do not know the energy scale.

C : linear colliders are needed for the compressed SUSY region

C/Q : Kappa_g has effect of stop mixing and their masses

12:15 Extended Higgs sectors and High-energy flavor dynamics: what we can expect from experiments, Philipp Roloff

conclusions : Substantial improvement with respect to HL-LHC possible for all discussed physics topics

・Large amount of complementarity:

- Direct and indirect sensitivity

(e.g. SM + heavy singlet, heavy MSSM Higgs bosons)

- Hadron and lepton collisions (e.g. doubly charged Higgs)

- Different energy stages of a lepton collider (e.g. top-quark FCNC effects)

12:45 Extended Higgs sectors and High-energy flavor dynamics: implications for theory, Veronica Sanz Gonzalez

C_H is proportional to $\sin^2 \gamma$ mixing parameter Higgs doublet

top FCNC decays

Flavor anomalies new vector LQ, U1

R_{D^*} - R_D

R_K

Outlook : If not minimal, could the EW phase transition be strong 1st order? Scalars need to be light (< TeV) and typically modify the properties of the Higgs. Colliders have an excellent coverage to these scenarios.

Exceptional opportunity to connect with GWs and theoretical approaches to fluid dynamics

15:00 muon collider, Daniel Schulte

Not ready to draft a CDR

muon source by positron beam annihilating into muon pairs, which require no DR.

15:30 Accelerator-based Neutrino beams, Vladimir Shiltsev

Femilab proton complex , JPARC and new proposals (Protvino/ORKA, ESSνSB, ENUBET, vSTORM)

16:00 Energy efficiency of HEP infrastructures, Erk Jensen

Sustainability, energy and heat recovery, figure of merit as luminosity per power consumption

17:00 Current plasma acceleration projects, Edda Gschwendtner

FACET at SLAC, USA - positron acceleration

BELA, Berkeley, lab, USA

AWAKE at CERN

SPARCLAB, Frascati, Italy

Laser-Driven Plasma Acceleration Facilities

Beam-Driven Plasma Acceleration Facilities

17:30 Challenges of plasma acceleration, Wim Leemans

18:00 Beyond colliders, Mike Lamont

fixed target experiments and facilities

5/15

9:00 Feebly interacting particles: theory landscape (FIP theory), Gilad Perez

9:40 Feebly interacting particles: what we can expect from experiments, Gaia Lanfranchi

10:20 Global discussion on DM and FIPs

11:30 Global discussion on EWSB, resonances, SUSY, extended scalars and HE flavor

EWSB dynamics and resonances

1st point : Which is the best way to find new interactions/particles around or above the electroweak scale using high-energy probes? (direct or indirect ?)

HE-LHC vs circular colliders (FCCee , CEPC) , FCChh vs linear colliders in M(TeV) v.s. g_Z'

C : definitely need e^-e^+ collider for the precise measurements of Higgs couplings

C : ILC results will be put on the final slide

C : luminosity and polarization are needed

2nd point : How can we tell whether the Higgs is composite (or not)?

FCChh vs CLIC m* and g*

C_ϕ, C_W C_{2W} by CLIC

Expected O_H=O_ϕ: $\frac{c_\phi}{\Lambda^2} = \frac{g_*^2}{m_*^2}$ Expected O_W: $\frac{c_W}{\Lambda^2} = \frac{1}{m_*^2}$

Expected O_{2W}: $\frac{c_{2W}}{\Lambda^2} = \frac{1}{g_*^2 m_*^2}$

C : muon collider as very hig energy lepton collider

tuning parameter Δ = 200 @VHEL14 and 1200@VHEL30

New Gauge force : Y-Universal Z', 2σ

SUSY mass values? unification of couplings ? dark matter ? naturalness ?

gluino 17TeV@FCChh

stop

wino-like LSP for the higher mass limit of 2.9 TeV...

complementarity : lepton and hadron colliders

e.g. compressed case , however mono jet + specific particle analysis can be applied at LHC

BSM summary

Higgs exists and No indications for new phenomena
precise measurements a clear priority
How can it be done best/most efficienly/realistically ?

the Higgs naturalness puzzle much shaper
scientific priority
LHC to FCC probe by a factor 30-50

unexplored experimental avenues e.g. FIPs, DM

after LHC Higgsino-like from Bino like and to TeV scale from 50GeV scale

FIPs small couplings, small masses as unexplored particles

Naturalness a robust guidance

Questions
Should CERN take any role in being a hub for technology/experiment/theory/computing towards DM searches?
e.g. novel rare liguid gas detector etc.

Is the example of a universal Z' really representative? Does it miss important information about flavour?

SUSY benchmarks simplified models

14:50 Perspective on the European Strategy from the Americas (US,Canada, Laten America), Young-Kee Kim

C : FCCee Higgs/EW factory,

15:15 Perspective on the European Strategy from Asia, Geoffrey Taylor

Q : MEXT recognizes the energy upgrade plan ?

Q : 8 Billion dollars, 1/2 by Japan ?

A : it includes 2 detectors, (also salary (manpower) for the construction)

17:09 Programs of Large European and National Labs (LENL), Pierluigi Campana

17:50 Overview of National Inputs to the Strategy Update, Siegfried Bethke

slide -6 highest score in ILC ! 13.67/15 for 15 MS(member states)

C ; it is a snap shot, before December 2018
FCCee CDR is available, which was published in January 2019.

C : it is difficult to put scores in the table by Itarian

C : France is not properly scored.

C : Finland LC and also FCC

C : more work is needed so the table is not proper to put in the briefling report

C : Germany we must have important information as previously prepared as the national interests.

C : UK does not have priority ee and hh , it must be cautious , focus on CERN

C : Germany support the table since they held many workshops to prepare the inputs.

18:23 education, communication and outreach, Perrine Royole-Degieux

18:40 Summary : Accelerator Science and Technology, Caterina Biscari and Lenny Rivkin

C : Alan synergy FCCee to FCChh , where 7 BCHS is a common

C : Lyn FCCee to FCChh dismantle all magnets and install 16T magnets for 20 -25 years is expected from the LHC experiences (LEP to LHC)., 2 times the LHC while tunnel length is 4 times.

C : Benno build LC now to investigate the next energy for hadron machine (energy frontier, new particle discovery) including plasma acceleration.

C : CLIC 600MW@3TeV the plasma acceleration needs the same power at least. So 6000MW for 30TeV

C : gradient in the plasma acc. must be higher by an order of magnitude than the CLIC.

C : Alan to reply Lyn's comment, we learned from the LHC ones, e.g. large cross section of the tunnel for the expensive cost
FCCee not only Higgs but also EW factory

Q/A : technology for far future collider plasma?

C : plasma is important better keep manpowers for the collider application
investigation to the technology, 100 people, 10million euro

C : high field magnet R&D must be executed at CERN
C : it benihits also for other fields

5/16 8:30 Neutrino Physics (accelerator and non-accelerator), Marco Zito and Stan Bentvelsen

mass by Majorana term , and new neutral fermions window to new physics

Dirac or Majorana

mixing, CP violation, mass ordering

Q : CP violation joint analysis ?

A : yes, global fit, but a new facility is needed

Q/C : precision of nuclear interaction at percent level for collabolation with theorists

Q: Dirac or Majorana , plan ?

A : count rate is very low, 1/year background detector R&D

Q : "Europe should explore the possibility of major participation in leading long-baseline neutrino projects in the US and Japan" should be removed

A : we like to focus on the current programs, maybe next to next generation

9:10 Flavour Physics and CP violation (quarks, charged leptons and rare processes), Antonio Zoccoli and Belen Gavela

EDMs 2 loop by SM, 1loop by BSM

to 10^{-31}

B anomalies $R_{K(*)}$, $R_{D(*)}$

C : tau charm factory

C : new scale, anomaly for BSM

C : theoretical effort to continue

Q : Tera Z vs Giga Z w and w/o polarization

10:00 Dark matter and Dark Sector (accelerator and non-accelerator dark matter, dark photons, hidden sector, axions), Marcela Silvia Carena Lopez and Shoji Asai

Long-Lived Particle (LLP) by SHIP and FASER of the SPS and LHC beam dump experiments, respectively

C : Dark sector, other than DM, which can solve other thing, e.g. heavy neutral leptons for neutrino mass, leptogenesis -- CP-violation for EDM

11:00 Beyond the Standard Model at colliders (present and future), Gian Giudice and Paris Sphicas

Deviations ~1% in Higgs couplings for mass/coupling ~2 TeV

C : holes in SUSY, small but theoretical weights are large

C : Higgsino is difficult for hadron colliders

11:45 Strong Interactions (perturbative and non-perturbative QCD, DIS, heavy ions), Jorgen D'Hondt and Krzysztof Redlich

α_s precision 0.1% is needed,

QGP, the proton radius, spin, muon g-2 (low energy hadronic int.) , precision lattice QCD

12:25 Electroweak Physics (physics of the W, Z, H bosons, of the top quark, and QED), Beate Heinemann and Richard Keith Ellis

C :

14:30 Instrumentation and Computing, Brigitte Vachon and Xinchou Lou

14:55 Discussion and Closeout

C : Spiro　Next CERN collider must be large circular collider

C :　LC in Asia,　pp circular collider　FCChh　at CERN ,　LHC type magnets can be installed in a 100km tunnel.

C : LC in Japan, CEPC in China,

C : proceed to prepare the TDR of CLIC

C : find　money for 100km tunnel　to continue the energy frontier machine

　　,but CLIC has no future as such machine

C : physics requires e^+e^- collider , next hadron collider should not be the gangatic machine

C : Steinar, CLIC should be next and also open novel technology,　after the LC,　hadron machine could be constructed.

C : involving other countries,　CERN contributes to LC　and FCChh.

C : Claude,　global strategy is needed

C : For physics of FIP, ...　FCCee,　FCCeh, FCChh are the best machine

C : huge budget for FCCee, FCChh　limits novel idea ,　It is dangelous to investigate

C :　Higgs and top physics, Higgs self coupling,　support Steinar's opinion

C :　Murayama,　worldwide thinking,　Higgs factory,　FCChh

C : Next is　e^+e^- collider　so support CLIC　which has potentail to increase luminosity

C : DESY next is a e^+e^- collider,　FCCee　to FCChh is not good idea

C : For future hadron collider,　tunnel is important

差出人: **T. Tauchi** toshiaki.tauchi@kek.jp
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Dear Prof. Halina Abramowicz, Chairperson of the Strategy Secretariat

I am Toshiaki Tauchi, a participant in the Open Symposium from KEK, Japan.

Fist of all, I congratulate you the very successful symposium clarifying all the issues in the elementary particle physics democratically. They were concisely presented at the summary session.

At the last discussion session, I was very impressed by young lady physicists appealing from the hearts, that is, their strong desire to execute the precision measurement experiments of Higgs and Top physics by CLIC as the most affordable collider at CERN. I applauded involuntarily and I lost my words.

Coming back to Japan and spent for a few days, I remember my words.
Could you listen me ?

We greatly appreciate European contributions in the high energy physics by providing the large scientific infrastructures, CERN, especially opportunity of participation in the experiments to non-European countries for many years. In return, we would like to contribute by hosting such a large infrastructure, International Linear Collider (ILC), in Japan. The ILC has been prepared by the world effort under the ICFA leadership since the Global Design Effort (GDE) establishment in 2005. We must respect such world effort to realize the large infrastructures for requirements of large budget and human resources anywhere in the world. The ILC can achieve the young physicists' will, too.

In the European Particle Physics Strategy Updates (EPPSU2020), we would like to ask you for expression of your prospect of Japanese hosting ILC with your enthusiasm about the precision experiments operating concurrently with the HL-LHC in order to determine the next energy scale for future hadron collider. It is essential since Japanese government "officially" expressed the interest of hosting ILC and is carefully watching the ILC status in the EPPSU2020 for the final decision.

Most sincerely,
Toshiaki Tauchi

差出人: **Halina Abramowicz** halina@tauex.tau.ac.il
件名: Re: Opinion at the Open Symposium, EPPSU2020
日付: 2019年5月21日 3:57
宛先: T. Tauchi toshiaki.tauchi@kek.jp

HA

Dear Prof. Tauchi,

Thank you very much for your kind words. Many of us were disappointed by the "no-news" from Japan. It would have made the whole strategy update process so much easier.

The previous Strategy statement about the ILC was very strong. I am afraid it will be very difficult to reiterate it again. I hope that the strong message from the community about the necessity to build a Higgs factory as the next big investment in particle physics, if we get it through in the final document, will be sufficient for the Japanese Government to understand how important the ILC project could become.

Best regards, HA

Prof. Halina Abramowicz, Tel Aviv University
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Dear Halina,

Thank you very much for your attentive reply.

We hope that Japanese government will show the green sign soon after the EPPSU2020 and the SCJ (Science Council of Japan) master plan 2020 in February 2020. The ILC is expected to be selected in the important large research projects of the SCJ master plan. Then, the government's decision will be made on the international and domestic circumstances.

Also, we hope that the conclusions in the EPPSU document will be available concurrently with the SCJ master plan 2020 at least.

Best regards,

Toshiaki