



# Successes of FCC-ee Physics workshop

**-1- All top level conveners are nominated and engaged!**

congratulations to Patrick and to the conveners!

**-2- Software effort is underway**

big thanks to Benedikt Hegner et al!

**-3- Nice participation by e+e- Linear collider colleagues**

part of FCC-ee mandate. We all agree that the next machine should be an e+e- collider.

*(Thanks to Simon, Wilson, Sailer, Mele, Heinemeyer, Grojean, Brient, Haddad, etc...)*

***We re-invented the wheel (circle) but we do not need to re-invent the electron!***

**-4- Complementarity with hadron machine is not just words**

ttH coupling is a good example

**-5- Reaching out to dark matter, BAU and neutrinos**

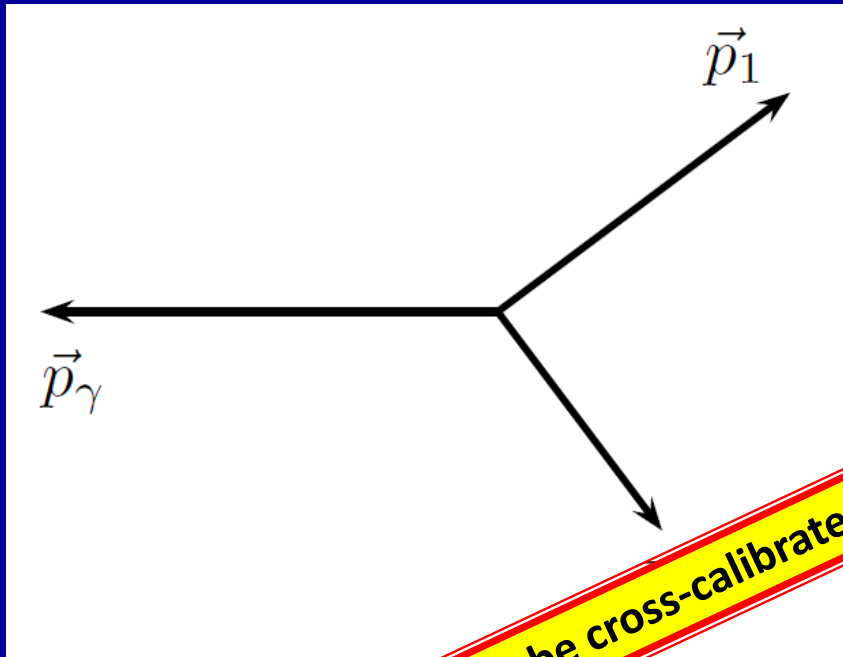
invisible widths, direct search for rare Z,H, W ... decays

**-6- We are discovering the immense potential offered by the high luminosity e+e-**

**Z,W,H,t factory**

# “New” In-Situ Beam Energy Method

$$e^+ e^- \rightarrow \mu^+ \mu^- (\gamma)$$



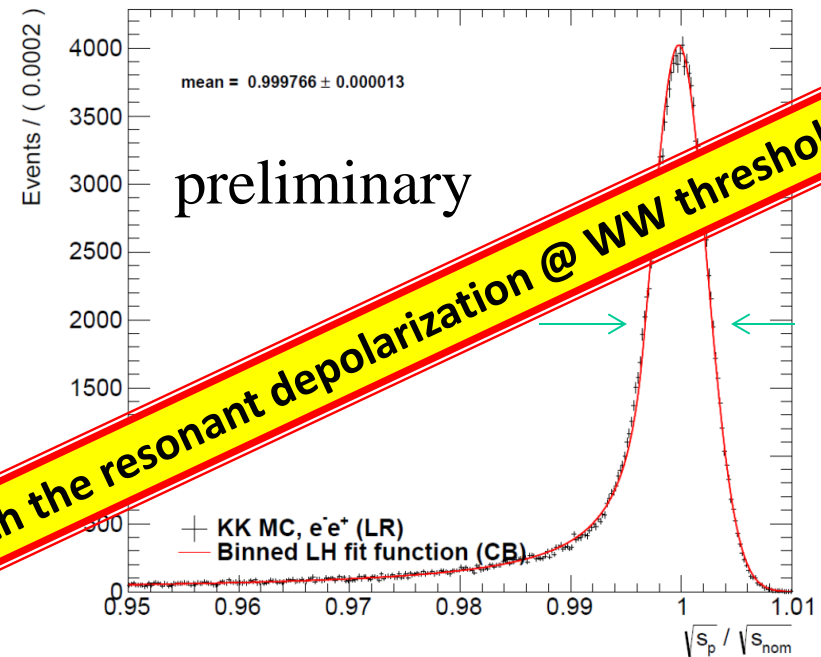
Use muon momenta  
 Measure  $E_1 + E_2 + |\mathbf{p}_{12}|$  as an  
 estimator of  $\sqrt{s}$   
 (no assumption that  $m_{12} \approx m_Z$ )

A great idea, especially if it can be cross-calibrated with the resonant depolarization @ WW threshold

GWW

$\sqrt{s} = 161 \text{ GeV}$ , Luminosity =  $8.2 \text{ fb}^{-1}$

with J. Sekaric



ILC detector momentum resolution (0.15%), gives beam energy to better than 5 ppm statistical. Momentum scale to 10 ppm  $\Rightarrow$  0.8 MeV beam energy error projected on  $m_W$  (J/psi)

Beam Energy Uncertainty should be controlled for  $\sqrt{s} \leq 500 \text{ GeV}$

# Some comments

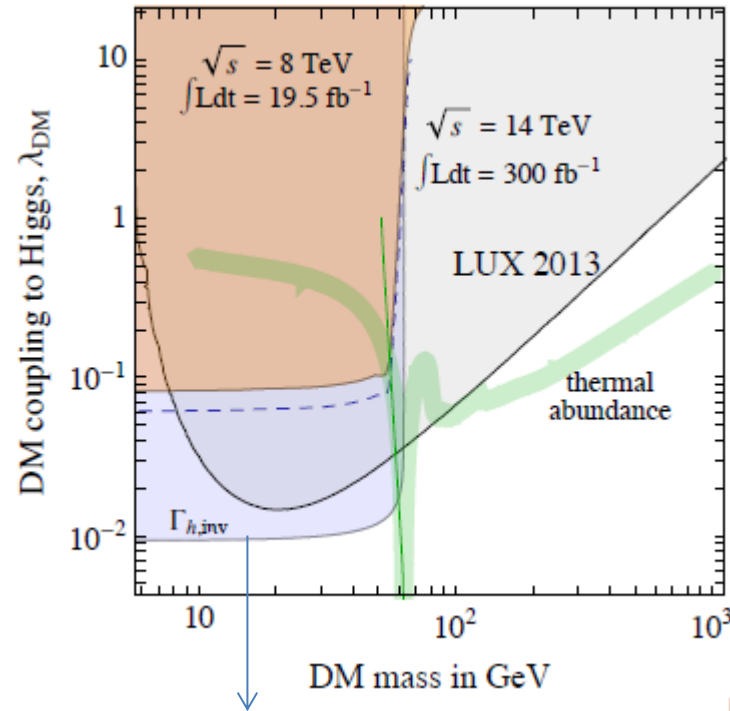
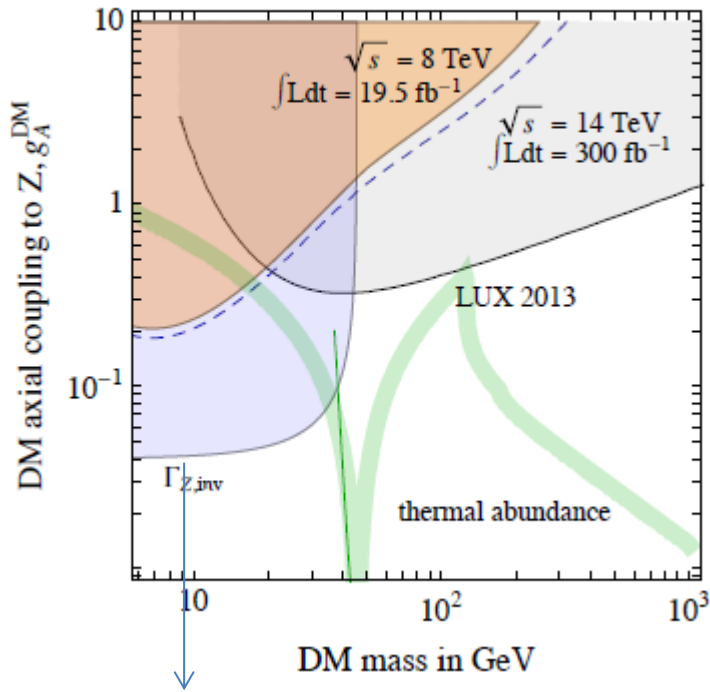
- Many people have been working on a future linear collider for a long time. I would like to see a high energy  $e^+e^-$  collider in our not too distant future.
- Let's make sure that there is at least one such  $e^+e^-$  machine and work towards actually realizing it and making it the best scientific facility.

*Graham Wilson, «the slide he did not show...»*

# $\Gamma_Z$ and $\Gamma_h$ invisible are the most efficient way to explore SM-mediated DM at colliders

(Giudice)

Fermion DM coupled to the Z

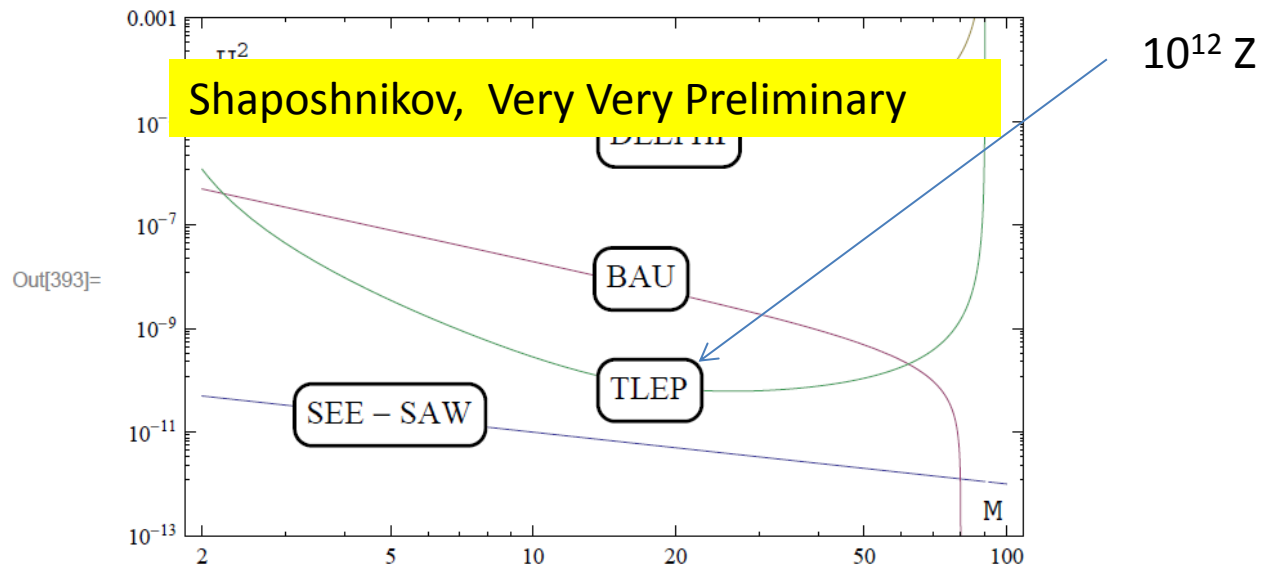


Aim to improve these by factor 10-20

## Workshop! Searching for Right-Handed neutrinos in Z decays

MS, 20.06.2014

NB: if that heavy neutrino is really there, we will want to study it to see if it violates CP!



How many times more Z's needed to close the window? 50?  
Crab waist → x10 and run 5 years.

Also this may allow to measure  $H \rightarrow ee$  ???

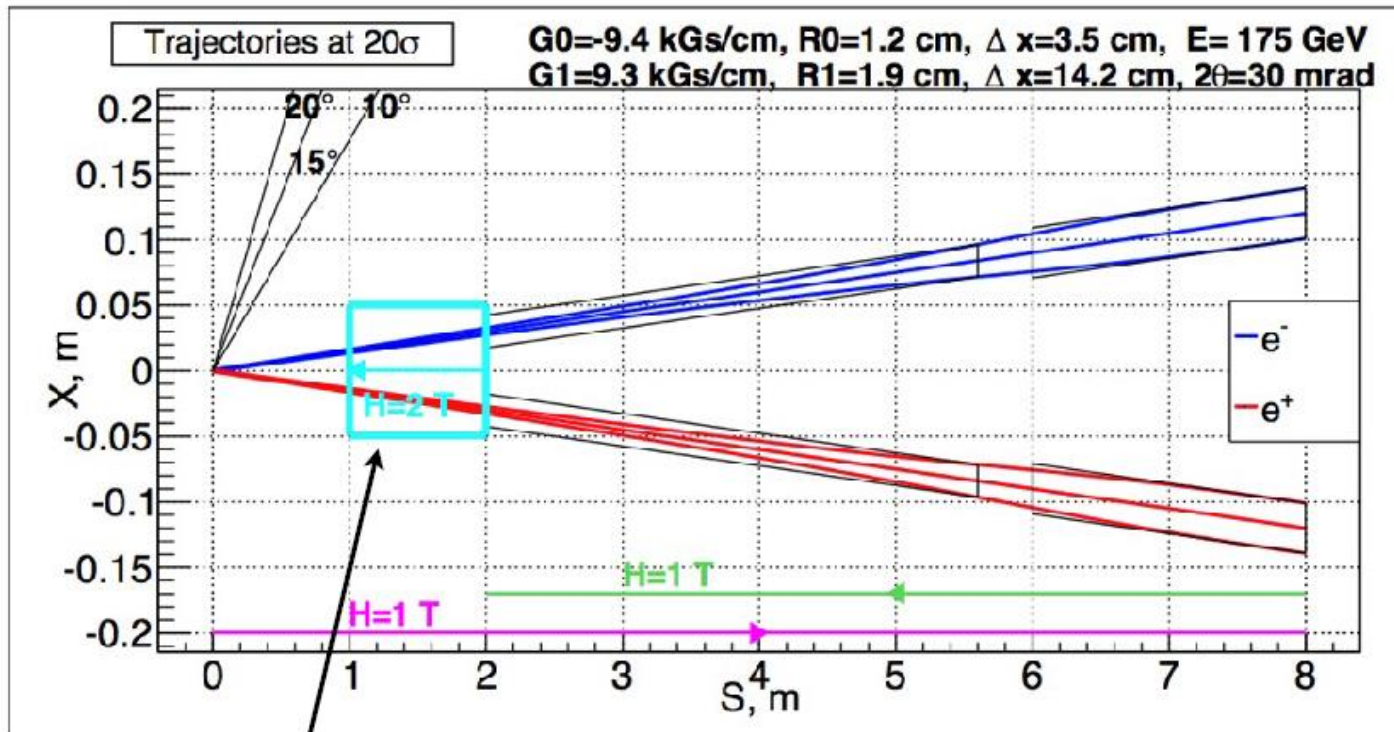
parameter	LEP2	FCC-ee					CepC
		Z	Z (c.w.)	W	H	t	H
$E_{\text{beam}}$ [GeV]	104	45	45	80	120	175	120
circumference [km]	26.7	100	100	100	100	100	54
current [mA]	3.0	1450	1431	152	30	6.6	16.6
$P_{\text{SR,tot}}$ [MW]	22	100	100	100	100	100	100
no. bunches	4	16700	29791	4490	1360	98	50
$N_b$ [ $10^{11}$ ]	4.2	1.8	1.0	0.7	0.46	1.4	3.7
$\epsilon_x$ [nm]	22	29	0.14	3.3	0.94	2	6.8
$\epsilon_y$ [pm]	250	60	1	1	2	2	20
$\beta_x^*$ [m]	1.2	0.5	0.5	0.5	0.5	1.0	0.8
$\beta_y^*$ [mm]	50	1	1	1	1	1	1.2
$\sigma_y^*$ [nm]	3500	250	32	130	44	45	160
$\sigma_{z,\text{SR}}$ [mm]	11.5	1.64	2.7	1.01	0.81	1.16	2.3
$\sigma_{z,\text{tot}}$ [mm] (w beamstr.)	11.5	2.56	5.9	1.49	1.17	1.49	2.7
hourglass factor $F_{hg}$	0.99	0.64	0.94	0.79	0.80	0.73	0.61
$L/IP$ [ $10^{34} \text{ cm}^{-2}\text{s}^{-1}$ ]	0.01	28	212	12	6	1.7	1.8
$\tau_{\text{beam}}$ [min]	300	287	39	72	30	23	40

WOW! Just what we need!

Luminosity comes at a cost -- still needs to be measured!  
 MDI essential. Needs to **understand** each other, not just set constraints.

## TLEP - Interaction Region

❖ As presented by Anton Bogomyagkov



❖  $L^* = 2 \text{ m}$

◆ But what is this - Is there any room at all for luminosity monitors...?



## NOW we have a lot to do!

- prepare nice talks for ICHEP and other places
  - speakers and posters:
    - please send around talks and posters for comments no later than  
Thursday 26 June (one week before)
  - **need 2 physics speakers for HF2014 (8-11 Oct.'14 in Beijing)**  
and a few other conferences. Dont be shy, volunteer.
- Get working groups working, first identify issues and needed tools
- Prepare first report for Q1 2015.
- IP region design issues need to be identified and understood  
(we saw a lot this morning)
  - work for now is to list issues comprehensively
  - dont jump on solutions!
- This is a FANTASTIC machine, but lots of new things to do.
  - ➔ Form technical and institutional collaboration !





# Forming the collaboration:

This goes further than a mailing list!

**We have mission from the FCC study director to collect expressions of interest, agree on FCC-ee workpackage of interest and prepare MOUs**

**WHY?** This allows

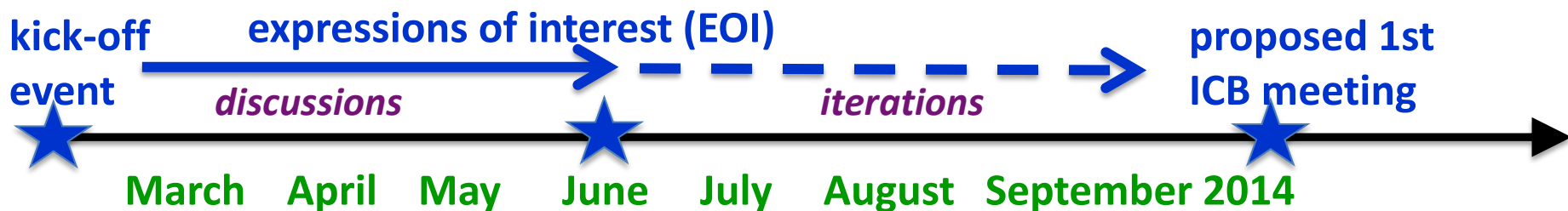
1. to structure the study and help cover the whole **WBS structure**.
2. to have access to CERN, access card, computing resources etc. etc.  
like any member of a **CERN approved experiment**
3. to **prepare funding requests** for
  - PhD students, post-docs etc..
  - travel
  - others such as detector prototype project etc...within an official CERN approved activity and with CERN support!
4. to be represented in the **Institutional Board**

**Small and large institutes are welcome. Who signs is country-dependent**



# Establish an international collaboration

- **Invitation to institutes to join collaboration**
- Aiming at **expressions of interest by end May 2014** to form nucleus of collaboration by September 2014
- Enlargement of the study preparation team
- **First international collaboration board meeting:**  
**9-10 September at CERN**





## Collaboration based on general MoU and specific addenda:

Draft 23 May 2014 11:30

### Memorandum of Understanding for the Future Circular Collider (FCC) Study hosted by CERN

THE INSTITUTES, LABORATORIES, UNIVERSITIES AND THEIR FUNDING AGENCIES AND OTHER SIGNATORIES OF THIS MEMORANDUM OF UNDERSTANDING AND CERN AS THE HOST LABORATORY (“the Participants”)

#### Whereas

At a dedicated session of the CERN Council held on 30 May 2013, the Council adopted the Update of the European Strategy for Particle Physics which included *inter alia* the following statement:

*“...Europe needs to be in a position to propose an ambitious post-LHC accelerator project at CERN by the time of the next Strategy update, when physics results from the LHC running at 14TeV will be available. CERN should undertake design studies for accelerator projects in a global context, with emphasis on proton-proton and electron-positron high-energy frontier machines. These design studies should be coupled to a vigorous accelerator R&D programme, including high-field magnets and high-gradient accelerating structures, in collaboration with national institutes, laboratories and universities worldwide.”*

The conceptual design study (the “FCC Study”) must be available in time for the next update of the European Strategy for Particle Physics, foreseen to take

DOCUMENT ID / Doc. Mgmt. Sys. ID      VERSION      DATE

#### ADDENDUM {IDENTIFIER}

<b>{Name of Participant} (“Participant”)</b>	
This Addendum defines a contribution by one or more Participants under Article 6 of the Memorandum of Understanding for the FCC Study <a href="#">{MoU Identifier and date}</a>	
<b>SCOPE OF WORK</b>	
<a href="#">{General description of scope of work}</a>	
<b>PROJECT CONTACTS</b>	
The following contacts may, on behalf of the Participant and of CERN as the Host Organization, update the contents of this Addendum by issuing a revised Addendum that will cancel and replace all previous versions.	
<b>Participant Project Contact:</b>	<a href="#">{FIRST NAME} {LAST NAME} {e-mail} {phone}</a>
<b>CERN Project Contact:</b>	<a href="#">{FIRST NAME} {LAST NAME} {e-mail} {phone}</a>

#### DETAILED WORK DESCRIPTION

**Note:** The following table is repeated for each individual Work Unit constituting the Scope of Work (i.e. each deliverable, identifier, title, description and planned delivery date). The identifier should have the form {3-letter institute letter code}-{work unit code}-{deliverable code}.

<b>WORK UNIT</b>	
<b>Title:</b>	<a href="#">{Name of the unit of work to be carried out}</a>
<b>Identifier:</b>	<a href="#">{Identifier used in communication between Participant and CERN}</a>
<b>Reference:</b>	<a href="#">{Associated FCC Work Breakdown Structure items}</a>
<b>Objectives:</b>	<a href="#">{Description of objectives}</a>



**Next VIDYO meeting:**

**28 July 2014 15:00**



# Next FCC-ee Physics Workshop

27-29 October 2014 in Paris

Roy Aleksan and Sandrine Laplace, organizers.

Will include  
parallel discussion  
afternoon  
(28 October)



collaboration meeting in January: volunteers?





**The 7th FCC-ee  
Physics Workshop**

Thank you all for the wonderful  
FCC-ee physics workshop!

Right on target!

We also need a  
Zpm-counter  
(in log scale)  
for the next meeting

We have a  
GeV-counter

10km Tunnel for Luminosity, Energy and Precision

19 - 21 June 2014

TH Auditorium (CERN)

Register at  
[indico.cern.ch/event/313708/](http://indico.cern.ch/event/313708/)

Organizing committee  
Alain Blondel - U. Geneva  
John Ellis - U. College London  
Christophe Grojean - ICREA  
Patrick Janot - CERN

Designer:  
Cristina Martin Perez

FCC  
International Design Study  
of Future Circular Colliders

European Organization  
for Nuclear Research

90 100 150 200 250 300 350 400

FCC