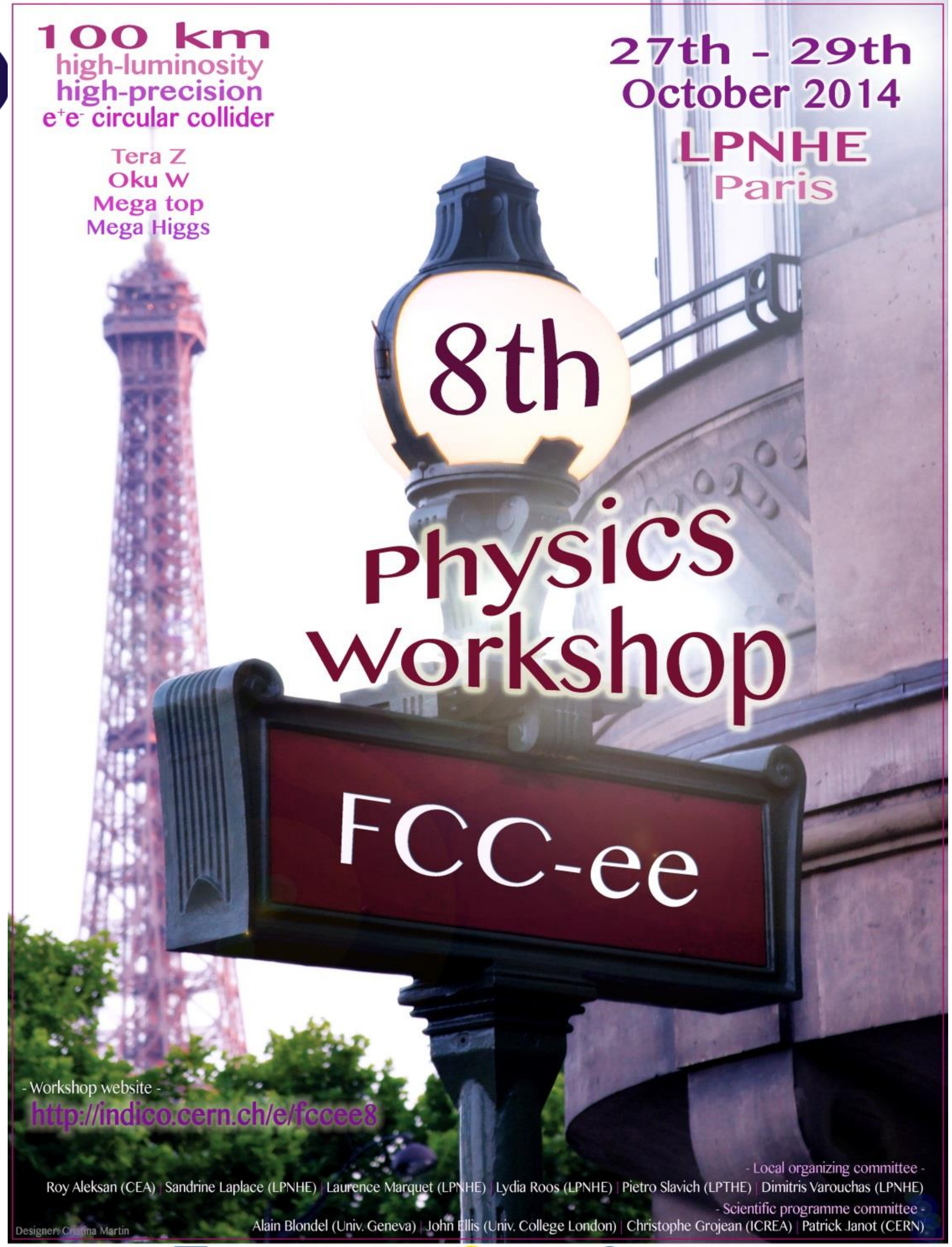


TLEP8 FCC-ee Phys. Workshop wrap-up
Alain Blondel

Initial parenthesis

THE DESIGN OF THE TUNNEL IS PROGRESSING WELL!

-- 93 or 100 km?

tool in place to optimize feasibility (and cost to some extent)

All schemes pass under the lake and around the Salève.

(1a) 93km Quasi-circle

Alignment | **Shaft Tools**

Choose alignment option: 93km quasi-circular

Tunnel depth at centre: 259mASL

Gradient Parameters

- Azimuth (°): -15
- Slope Angle x-x(%): 5
- Slope Angle y-y(%): 0

CALCULATE

Alignment centre

X: 2499812 Y: 1106889

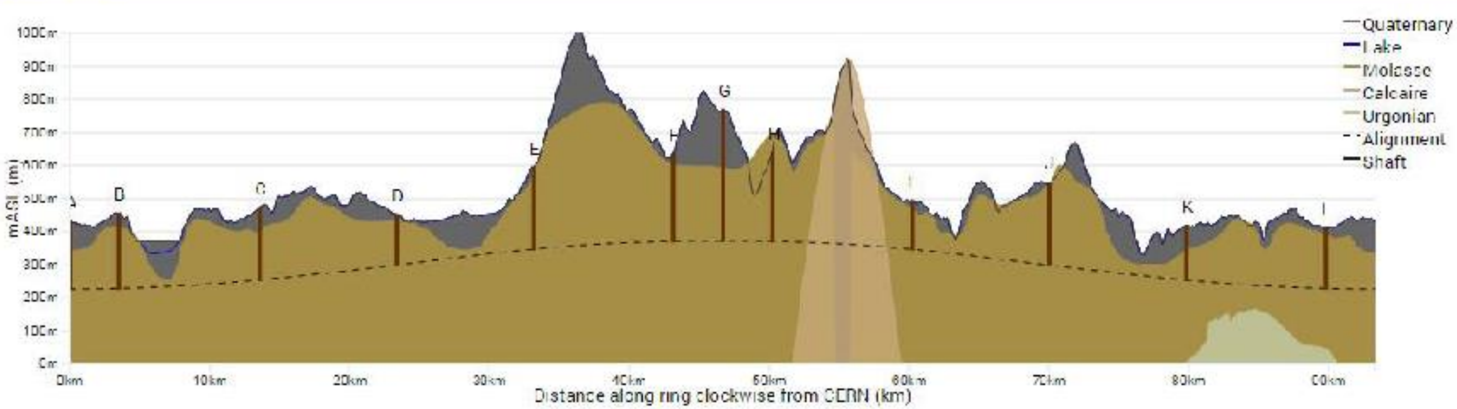
LHC Intersection	CP 1	CP 2
Angle		
Depth	585m	589m

Alignment Location

Geology Intersected by Shafts | **Shaft Depths**

	Shaft Depth (m)				Geology (m)			
Point	Actual	Min	Mean	Max	Quaternary	Molasse	Urgonian	Calcaire
A	203	200	204	212	93	111	0	0
B	227	219	226	231	41	186	0	0
C	218	208	217	226	75	143	0	0
D	153	150	154	158	19	134	0	0
E	247	239	249	261	24	223	0	0
F	262	251	269	304	32	230	0	0
G	396	392	393	396	177	220	0	0
H	266	231	274	322	0	325	0	0
I	146	141	144	149	26	120	0	0
J	248	247	251	258	6	242	0	0
K	163	160	159	164	76	87	0	0
L	182	182	184	187	17	165	0	0
Total	2711	2607	2724	2867	585	2185	0	0

Alignment Profile



Geology Intersected by Tunnel

92.8% | 1.3 | 5.9%

(2b) 100km Quasi-circle

Alignment | Shaft Tools

Choose alignment option

100km quasi-circular ▼

Tunnel depth at centre 299mASL

Gradient Parameters

Azimuth (°): -20

Slope Angle x-x(%): 0

Slope Angle y-y(%): 0

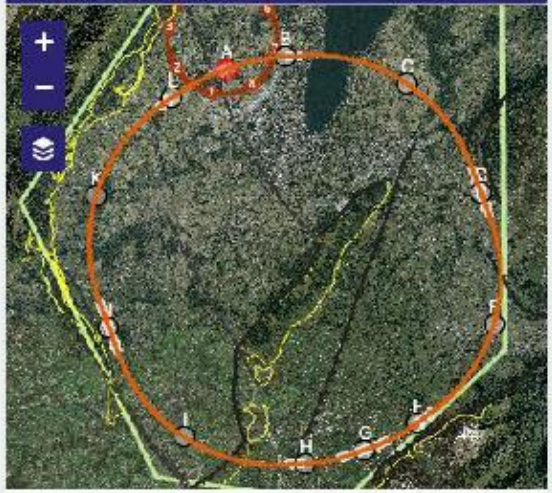
CALCULATE

Alignment centre

X: 2499808 Y: 1108469

LHC Intersection	CP 1	CP 2
Angle	-65°	66°
Depth	36m	22m

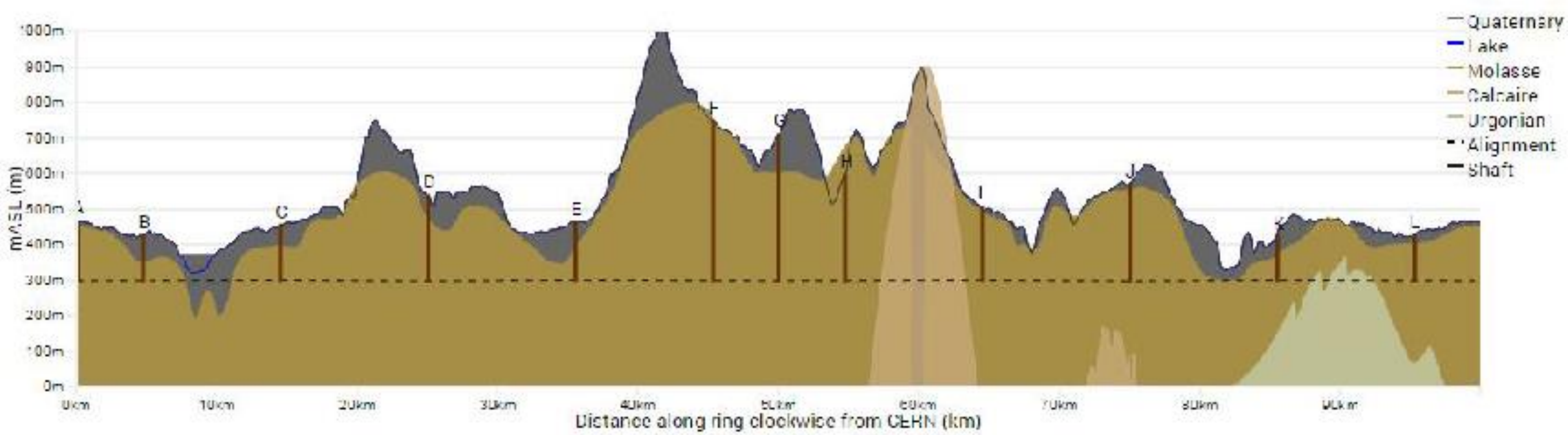
Alignment Location



Geology Intersected by Shafts | Shaft Depths

Point	Shaft Depth (m)				Geology (m)			
	Actual	Min	Mean	Max	Quaternary	Molasse	Urgonian	Calcaire
A	156	165	166	167	13	152	0	0
B	127	122	128	132	77	50	0	0
C	154	147	162	167	67	97	0	0
D	239	218	238	249	60	179	0	0
E	162	159	162	164	72	90	0	0
F	446	441	449	458	0	458	0	0
G	410	391	410	433	109	301	0	0
H	296	266	293	341	0	373	0	0
I	206	196	204	214	12	193	0	0
J	272	268	275	285	18	254	0	0
K	122	104	129	166	54	68	0	0
L	128	124	129	137	24	103	0	0
Total	2729	2502	2740	2895	497	2319	0	0

Alignment Profile



Geology Intersected by Tunnel

Back to physics studies

We are in the exploratory «wow» period

NOW we have a lot to do!

-- **write-up** the nice talks for ICHEP and other places
[put on arxiv and refer to your closest FCC-ee management
(NB I am supposed to authorize FCC-ee physics documents)
➔ upload on FCC-ee web page and submit to fcc-cds@cern.ch]

-- need physics speakers for upcoming conferences
-- please respond positively

-- continue to get working groups working, identify issues and define needed **tools**
USE tools for doing **WORK**

-- Prepare first report for Q1 2015. (Patrick has prepared template)

Some questions need to be answered to define the accelerator better

-- the physics program

how many years at which energies?

I believe we have enough *fantastic* physics case for ~20 years

-- careful that at some point someone might be waiting behind...

-- Staging scenario (can we do something useful with 1MW, etc...)

-- Which is the desirable highest /lowest energy of the machine

-- enough to measure top quark chiral couplings ?

-- what is the physics behind this? (is it unique)

-- Is there / What is a physics case for longitudinally polarized beams ?

-- unique or 'better' or 'practical' ?

-- at the Z (for A_{LR} , A_{FB}^{pol})

-- other energies

-- case of new physics?

Top couplings as a NP discriminator

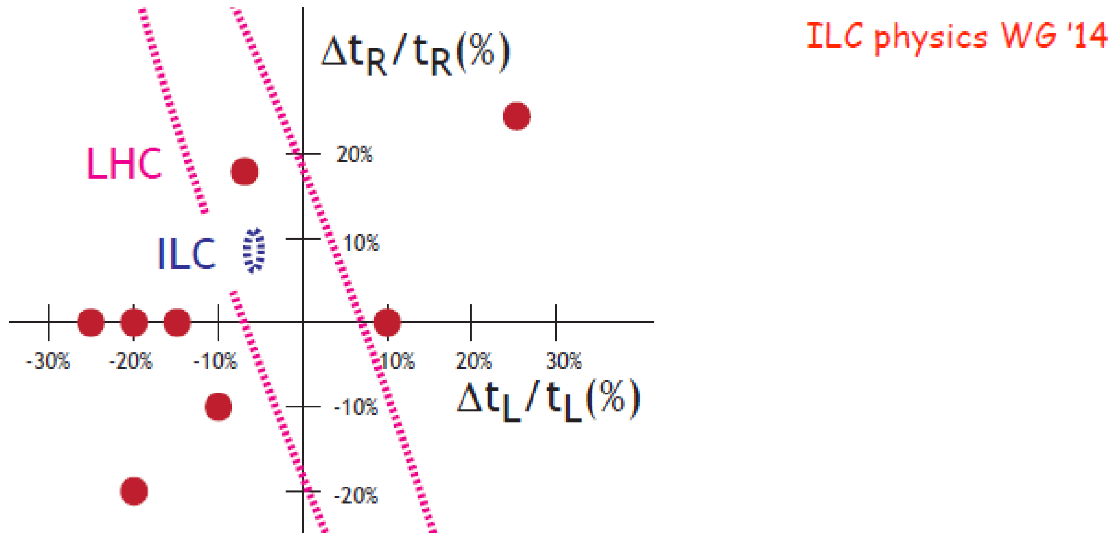


Figure 9: The heavy dots display the shifts in the left- and right-handed top quark couplings to the Z boson predicted in a variety of models with composite Higgs bosons, from Ref. [31]. The ellipses show the 68% confidence regions for these couplings expected from the LHC [26] and the ILC [30].

Need to estimate the sensitivity in the ttZ couplings
@ 350GeV and 500GeV

The polarization of the initial beams is a big asset!

Questions for top group: What energy is really needed? What does Polarization really buys?

Experiments A. Blondel, P. Janot

- WG1: Electroweak physics at the Z pole (R. Tenchini, F. Piccinini)
- WG2: Di-boson production and W mass measurement (R. Tenchini)
- WG3: H(126) properties (M. Klute, K. Peters)
- WG4: Top quark physics (P. Azzi)
- WG5: QCD and $\gamma\gamma$ physics (D. d'Enterria, P. Skands)
- WG6: Flavour physics (S. Monteil, J. Kamenik)
- WG7: Experimental signatures of new physics (M. Pierini, C. Rogan)
- WG8: Experimental environment , MDI (N. Bacchetta)
- WG9: Offline software and computing (B. Hegner, C. Bernet)
- WG10: Online software (C. Leonidopoulos, E. Perez)
- WG11: Detector designs (A. Cattai, G. Rolandi) ➔ *come to the PISA meeting!*

Phenomenology J. Ellis, C. Grojean

- Model Building and New Physics (A. Weyler)
- Precision EW calculations (S. Heinemeyer)
- QCD and $\gamma\gamma$ Physics (see above)
- Flavour Physics (see above)
- Global Analysis, Combination, Complementarity (J. Ellis)

Perhaps a first assignment for physics groups

➔ Defining needed tools -- Work Packages

Precision EW: Z physics

-- Z mass and width and line shape related issues:

-- statistics of 10^10 Z decays (1%) is enough to reach 100 keV statistical precision

-- understand systematics related to energy calibration, wigglers, sidebands etc...
(see Koratzinos talk) UNIGE, BINP .... 100 keV!

-- understand limitations due to line shape QED effects (Jadach et al, Krakow, ...)

-- limitations due to luminosity measurements (Dam, Copenhage, Belgrade..)

this work is common with W and top mass measurement

-- Rb,c B, c tagging

-- not addressed yet, but b-tagging is clearly an important issue.

-- proximity to beam pipe

-- simulation of SR and beam-strahlung backgrouns (Belgrade -- MDI)

this work is common with Higgs & top Working groups

-- what is the impact on detector design?

R_ℓ : measurement of hadrons to leptons at precision limited by lepton statistics (i.e. ~ 10^{11} lepton pairs) (0.3 10^{-5}...)
(we can already get to 0.3 10^{-4} with 1MW)

-- hadron selection

-- low angle region and losses

-- lepton identification

-- e/mu/tau separation this is common to LFV searches

Asymmetries $A_{FB}^{\ell} \rightarrow \sin^2\theta_W^{eff}(M_z^2) \rightarrow$ new physics

Very much the same as above.

What are the limitations of A_{FB}^{ℓ} ?

-- What are the QED theoretical limitations?

-- measurement of alpha_QED -- ideas most welcome.

-- need m_{top}

Physics with Z factory 10^{13} **Z**

-- rare processes

FCNC Flavour violation in Z decays

LFV

right-handed neutrinos → displaced vertices!

also need: event display!

Physics with W pairs, ZH, $t\bar{t}$ process, etc...

-- kinematic fit using jets and jet + leptons, missing neutrino etc..

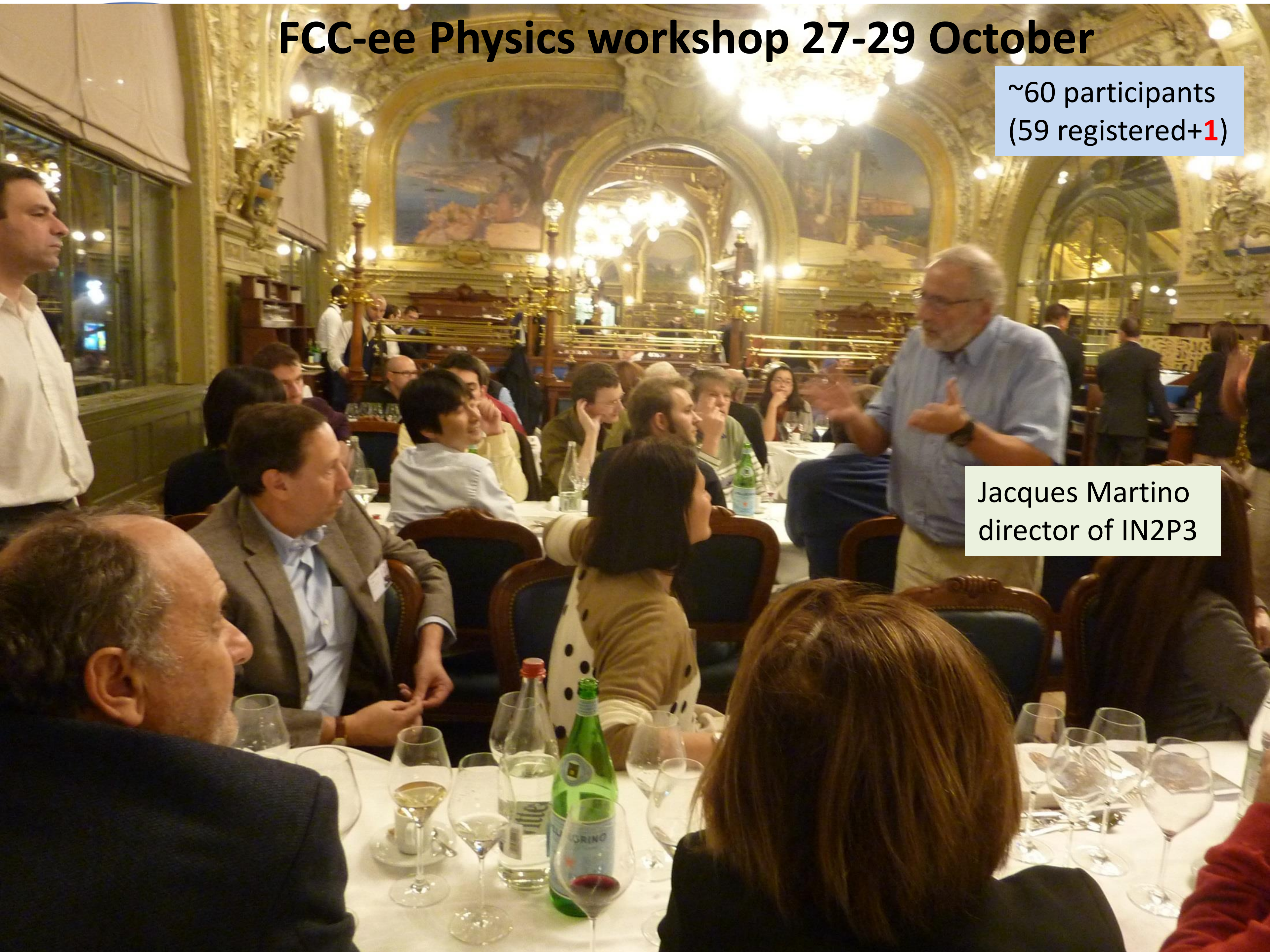
➔ **PLEASE HELP US DEFINE**

-- and create --

THE TOOLS NEEDED FOR

PHYSICS STUDIES

FCC-ee Physics workshop 27-29 October



~60 participants
(59 registered+1)

Jacques Martino
director of IN2P3

Meanwhile N. Lockyer was speaking at the ICFA seminar in Beijing

Higgs discovery has dramatically changed the landscape…

- Higgs discovery motivates a precision Higgs factory…not going to make three….what is the right direction?

- China wants to build a Higgs factory
- Europe wants to build a Higgs factory

Note that this is not based on physics comparisons but values FCC-ee as launching pad for FCC-hh

- ILC higher energy (500 GeV), both beams polarized, mature design & machine ready to go technically e.g., Euro-XFEL~500 cavities built…together 3 regions can build ILC
  - (significant energy increase possible with further R&D on Nb3Sn)
- Strategy for FCC and CECP is however attractive
- Neither FCC or CECP as high energy as Linear Collider(s) but have an attractive growth path just as LEP grew into LHC.

FCC-ee IS MUCH MORE THAN A 'HIGGS FACTORY'

IT IS A DISCOVERY MACHINE !

-- precision measurements (is there anything more contributing to loops?)
-- rare Z, W, Higgs, top decays   Right-handed neutrinos, LFV process, FCNC, ...

especially with 10^{13}Z!

First FCC Week

Conference

Washington DC
23-27 March 2015

http://cern.ch/fccw2015

hoping to see you there!

FCC meeting in Washington 23-27 March 2015

http://indico.cern.ch/event/340703/

Do attend/Register/participate

important as first international meeting of FCC as such

<u>Program committee nominated</u>

-- will include the FCC coordination group + a number of americans

-- e.g. Klute , Van Kooten and Barklow (TBC) for FCC-ee physics

Wienands

Sunday	Monday (23.3)	Tuesday (24.3)			Wednesday (25.3)			Thursda	
	Registration Welcome Plenary: study overview	FCC-hh Lattice Design & Optics	FCC-ee Detectors	Novel SRF cavity concepts & cryomodules	Machine Configuration & Magnet Specs	*FCC-hh Experiments*	FCC-ee Lattice Design & Optics	Civil Engineering handling & transport	Magnet Design Options
	Coffee Break	Coffee Break			Coffee Break			Coffee	
	Plenary: Physics motivation and overview Plenary: Machine overview (hh, ee)	FCC-hh Beam phyiscs and technology	FCC-ee Physics studies & Simulations	Novel SRF cavity concepts & cryomodules	Conductor R&D	*FCC-hh Experiments*	FCC-ee EIR Design & MDI	Reliability, Energy, Controls, IT	Magnet Design Options
	Lunch	Lunch			Lunch			Lun	
	Plenary: Infrastructure and Civil Engineering Overview Plenary: Magnet and RF overview	FCC-hh EIR Design & MDI	FCC-ee MDI	Coating technologies for SRF cavities	Conductor R&D	*FCC-hh Experiments*	FCC-ee Beam-beam & Energy Calib.	Cryogenics, Safety	Magnet Design Options
Registration	Coffee Break	Coffee Break			Coffee Break			Coffee	
	Plenary: Special Technologies Overview	FCC-hh Injector Options & Design	FCC-he Parameters, EIR & Detector Design	Higher Efficiency RF Power Generation	*TBD*	FCC-he Physics Highlights	FCC-ee Injector & Booster Design	*TBD*	Magnet Cost Model
	Teatime	Teatime			Teatime			Teat	
	Plenary: Study organisation, governance, quality, documentation	Gender Equality working group	EuroCirCol schedule working group	Industry Fast Track	Communications working group	FCC-hh and FCC-ee parameter working group	Technologies R&D working group	*Plenary: US C*	
	Welcome reception				Workshop Banquet				

4.3)		Wednesday (25.3)			Thursday (26.3)				Friday (27.3)
s	Novel SRF cavity concepts & cryomodules	Machine Configuration & Magnet Specs	*FCC-hh Experiments*	FCC-ee Lattice Design & Optics	Civil Engineering handling & transport	Magnet Design Options	Cryogenic Beam Vacuum System	*Physics & Phenomenology*	Summary FCC-hh collider Summary FCC-ee collider Summary infrastructure
eak		Coffee Break			Coffee Break				Coffee Break
ies & ns	Novel SRF cavity concepts & cryomodules	Conductor R&D	*FCC-hh Experiments*	FCC-ee EIR Design & MDI	Reliability, Energy, Controls, IT	Magnet Design Options	Beam Transfer Systems & Instrumentation	*Physics & Phenomenology*	Summary technologies Summary FCC-hh experiments Summary FCC-ee experiments Conclusions and outlook
		Lunch			Lunch				Lunch
	Coating technologies for SRF cavities	Conductor R&D	*FCC-hh Experiments*	FCC-ee Beam-beam & Energy Calib.	Cryogenics, Safety	Magnet Design Options	Materials & Engineering Breakthroughs	*Physics & Phenomenology*	International Collaboration Board
eak		Coffee Break			Coffee Break				Coffee Break
EIR & esign	Higher Efficiency RF Power Generation	*TBD*	FCC-he Physics Highlights	FCC-ee Injector & Booster Design	*TBD*	Magnet Cost Model	Magnet & Machine Protection	*Physics & Phenomenology*	EuroCirCol Coordination Committee
e		Teatime			Teatime				Break
nedule oup	Industry Fast Track	Communications working group	FCC-hh and FCC-ee parameter working group	Technologies R&D working group	*Plenary: US Contributions*				FCC International Steering Committee