Report from FCC-week in Washington
23-29 March 2015 Marriott Georgetown Hotel

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

A very large meeting (340 participants)

1st (introductions) and last day (summaries): plenary sessions

other days parallel 3X2 matrix

FCC-hh | particle Physics

FCC-ee | technology

| accelerator physics

2. FCC-ee related highlights

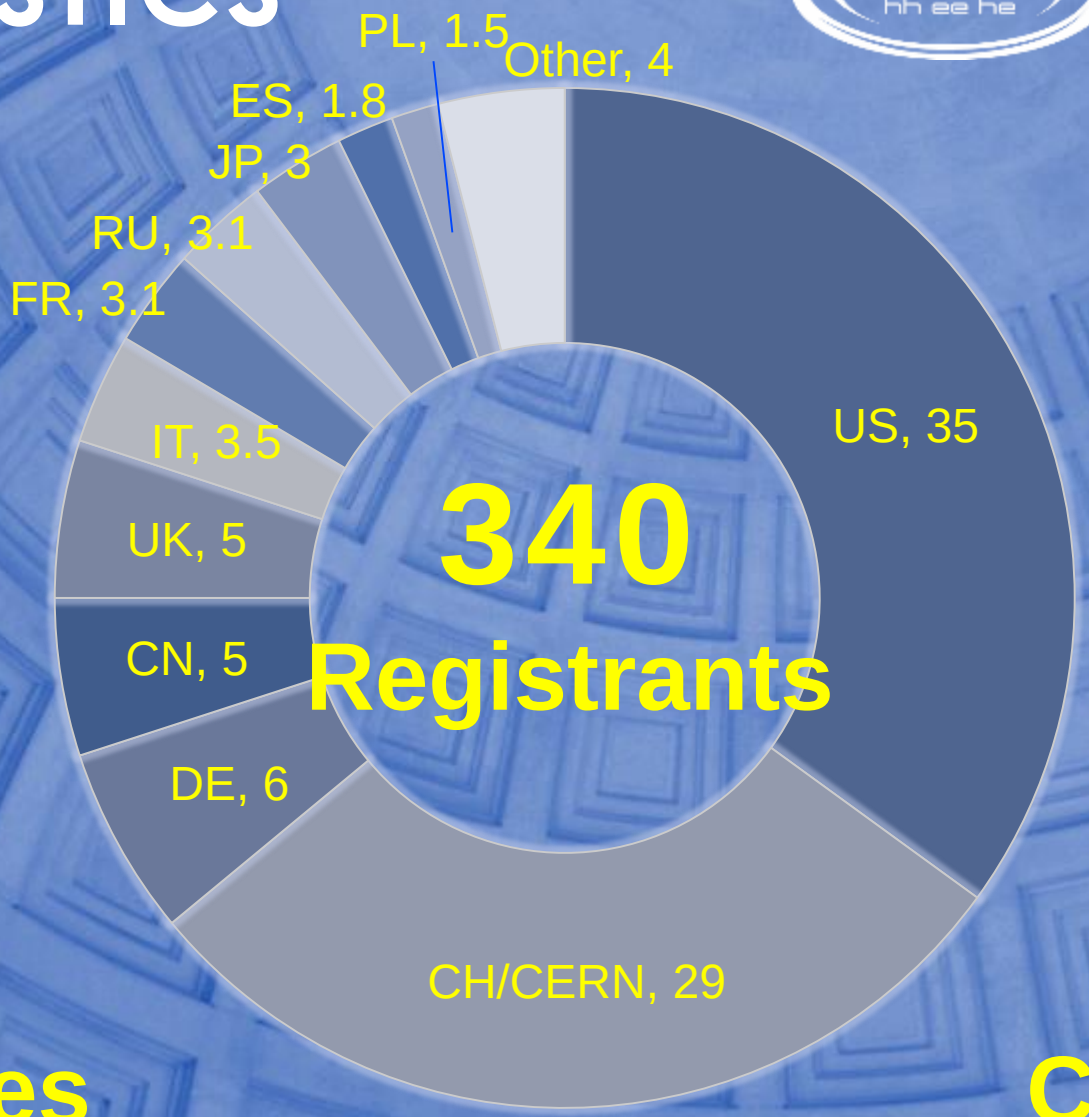
-- accelerator, RF

-- physics

-- phenomenology

3. Next steps

STATISTICS



128
Institutes

21
Countries

Collaboration Status

- 51 institutes
- 19 countries
- EC participation

Study Coordination Group

Study Lead	Hadron Collider **Physics** & **Experiments**	Lepton Collider **Physics** & **Experiments**	ep **Physics**, **Experiment**, IP Integration
M. Benedikt F. Zimmermann	A. Ball, F. Gianotti, M. Mangano	A. Blondel, J. Ellis, C. Grojean, P. Janot	M. Klein, O. Bruning

Hadron **Injectors**	**Hadron Collider**	Lepton **Injectors**	**Lepton Collider**
B. Goddard	D. Schulte, M. Syphers	Y. Papaphilippou	F. Zimmermann, J. Wenninger, U. Wienands

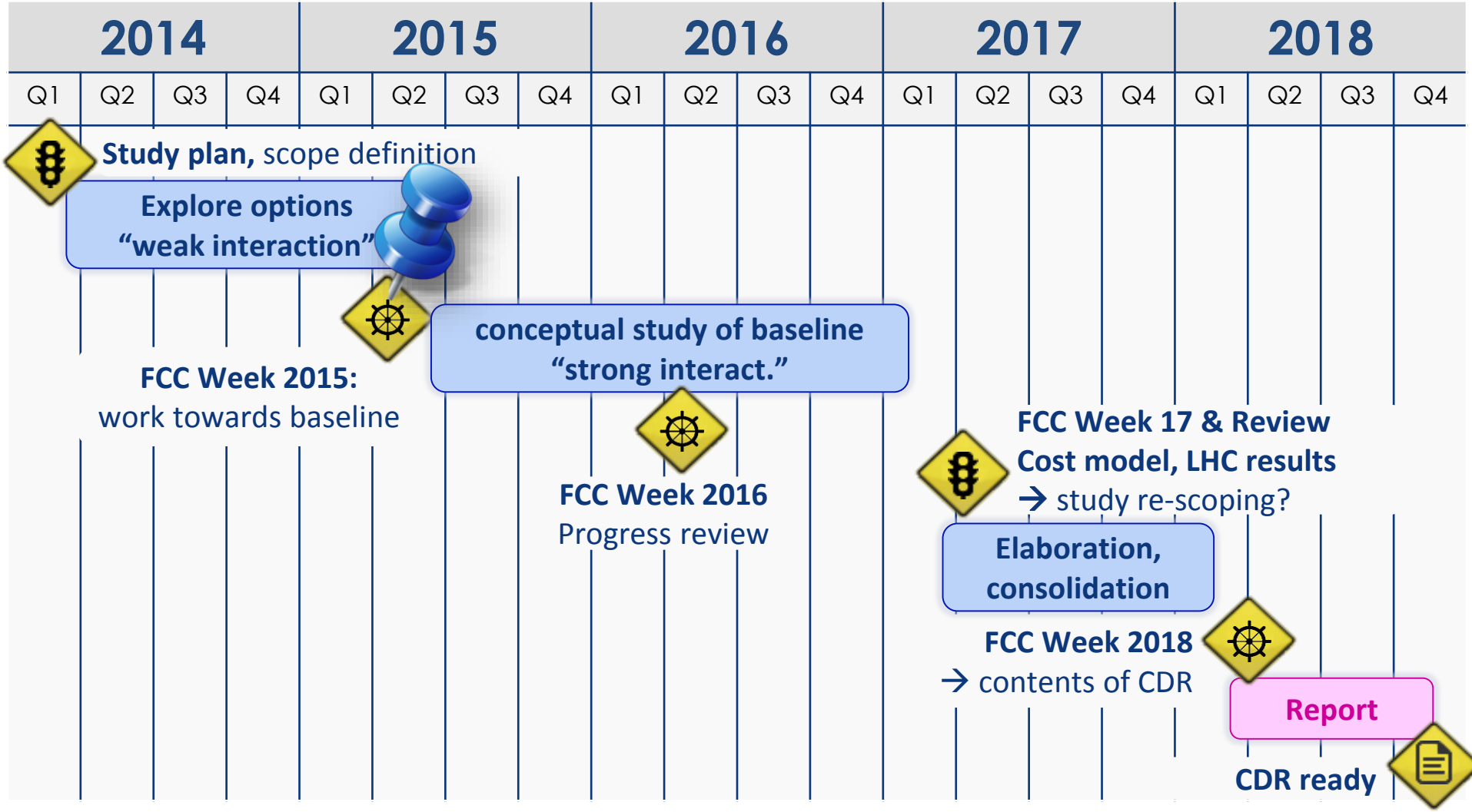
Accelerator Technologies **R&D**	**Special Technologies**	**Infrastructures** & **Operation**	**Costing** & **Planning**
L. Bottura, E. Jensen, L. Tavian	JM. Jimenez	P. Lebrun, P. Collier	P. Lebrun, F. Sonnemann

Further enlargement of coordination group and study teams with international partners

Outlook 2015

- **Freeze baselines parameters** and concepts
  - Colliders, injectors and infrastructures
- Put **Nb_3Sn/16 T magnet program** on solid feet
- Define and **launch selected** technology **R&D programmes**
- Reinforce **physics and detector simulations**
- Pursue **MDI and experiment studies**
- Further **enlarge our global FCC collaboration**

Study time line towards CDR



FCC Week 2016

Rome, 11 – 15 April 2016

See you in Rome next year!

Highlights: FCC-ee accelerator

-- Main technology challenge /cost is RF (see session + Rimmer)

-- many solutions!

-- HOM extraction at high beam intensity (Tera-Z running)

-- staging scenario with 12MW → 100 MW----------

--- 1-5 GV /beam --- → 11 GV/beam

--- Z,W,H --- → top

-- big progress in SC RF quality factor and RF efficiencies (90%!)

-- Main accelerator design challenge is «4 different machines»

from Z peak (lots of bunches, power, low GV)

all the way to above tt thrshold (few bunches, max GV)

-- several optics solutions studied none complete yet.

Issues: chromaticity, dynamic and mom. aperture, IR design

(solenoid compensation!) Review in the fall?

→ keep watching FCC-ee accelerator meetings!

A. Butterworth

Dynamic range: energy vs. intensity

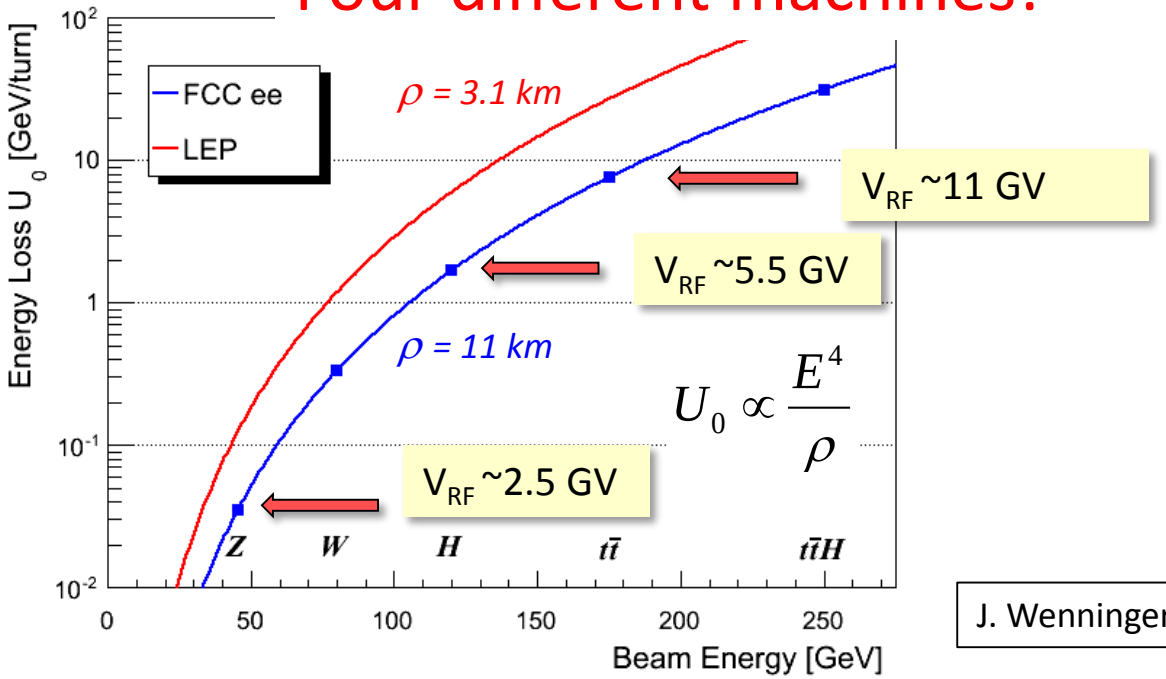
parameter	FCC-ee baseline			
	Z	W	H	t
E_{beam} [GeV]	45	80	120	175
RF voltage [GV]	2.5	4	5.5	11
current [mA]	1450	152	30	6.6
$P_{SR,tot}$ [MW]	50	50	50	50

Four different machines!

Total beam power limited to 50 MW (design choice)

SR loss/turn (+ beamstrahlung + ...)

Defines maximum beam current at each energy



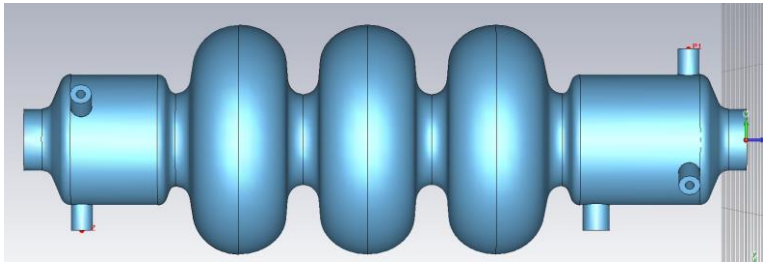
J. Wenninger

Staging can partly address this

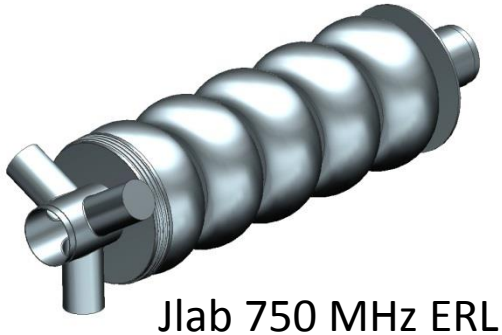
S. Belomestnykh

Lots of cavity options!

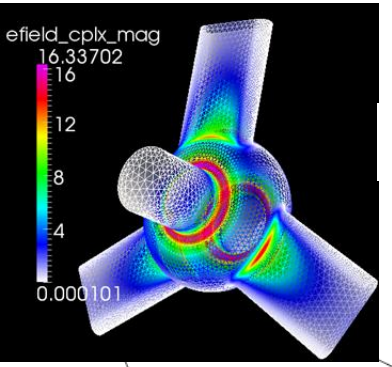
Jlab 400 MHz



BNL 422 MHz

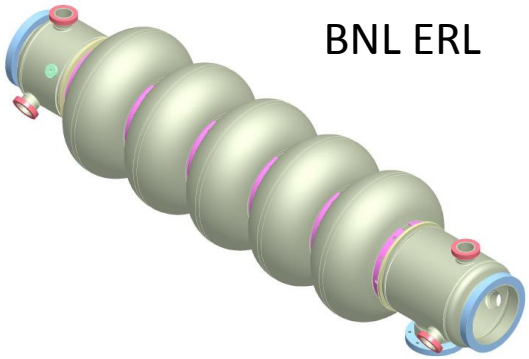


Jlab 750 MHz ERL

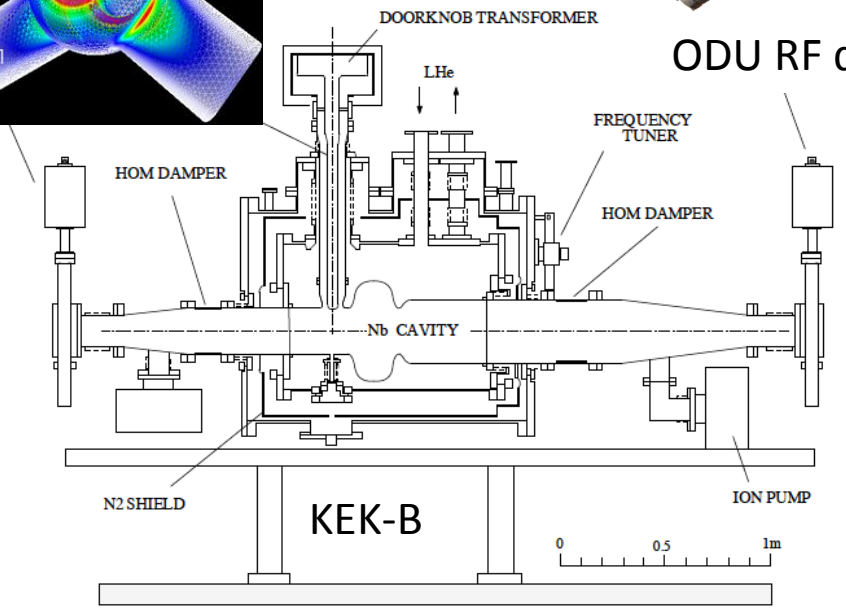


Jlab MEIC

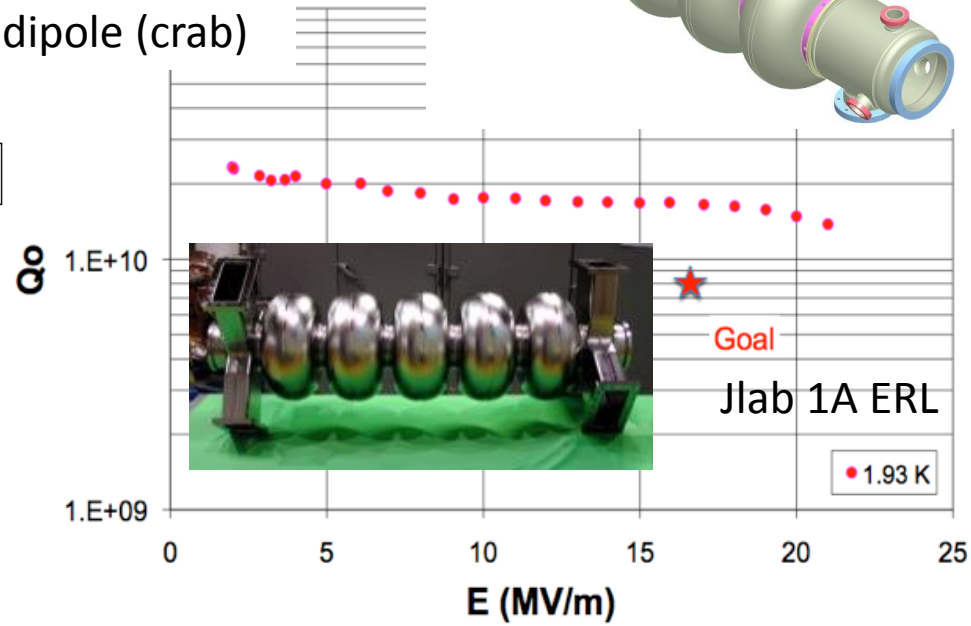
ODU RF dipole (crab)



BNL ERL



KEK-B

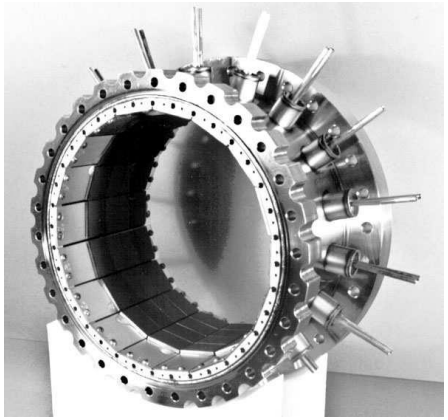


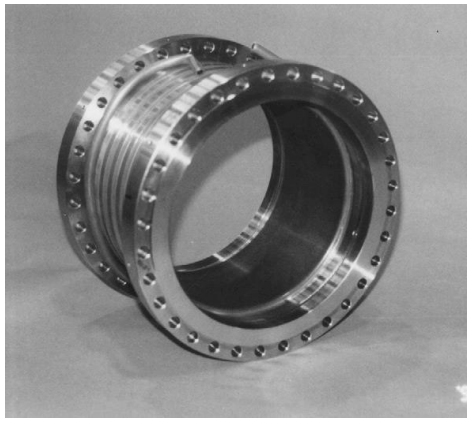
Jlab 1A ERL

S. Belomestnykh

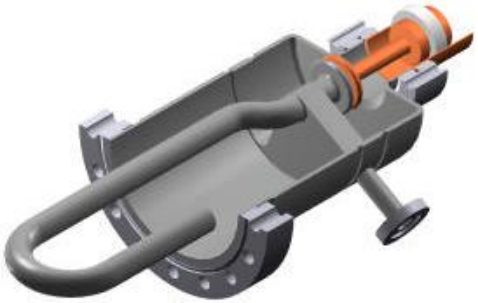
HOM power extraction

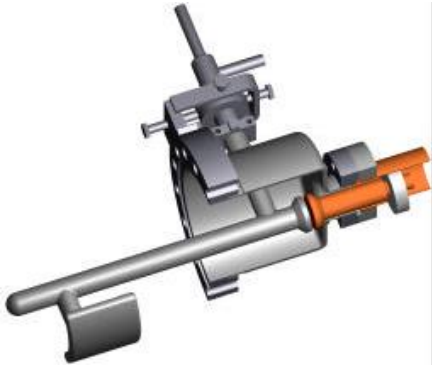
Cornell/KEKB like ferrites, 300K
~20 kW (approx 8^0C/kW temp rise)

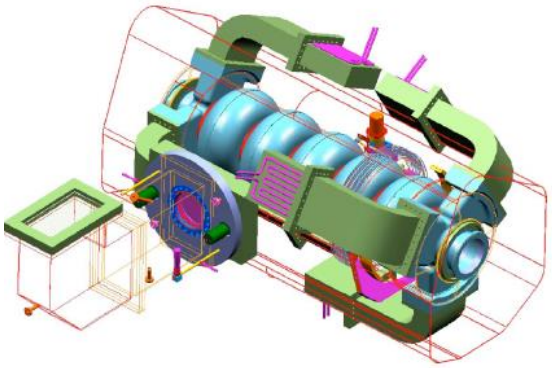


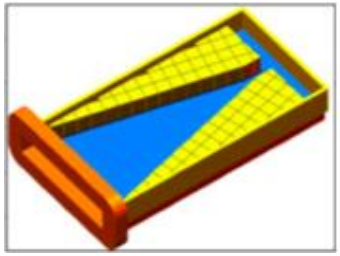


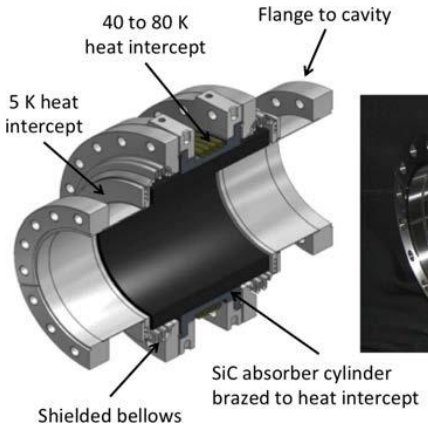
LEP/LHC like loops, 4.5K
~1 kW maximum











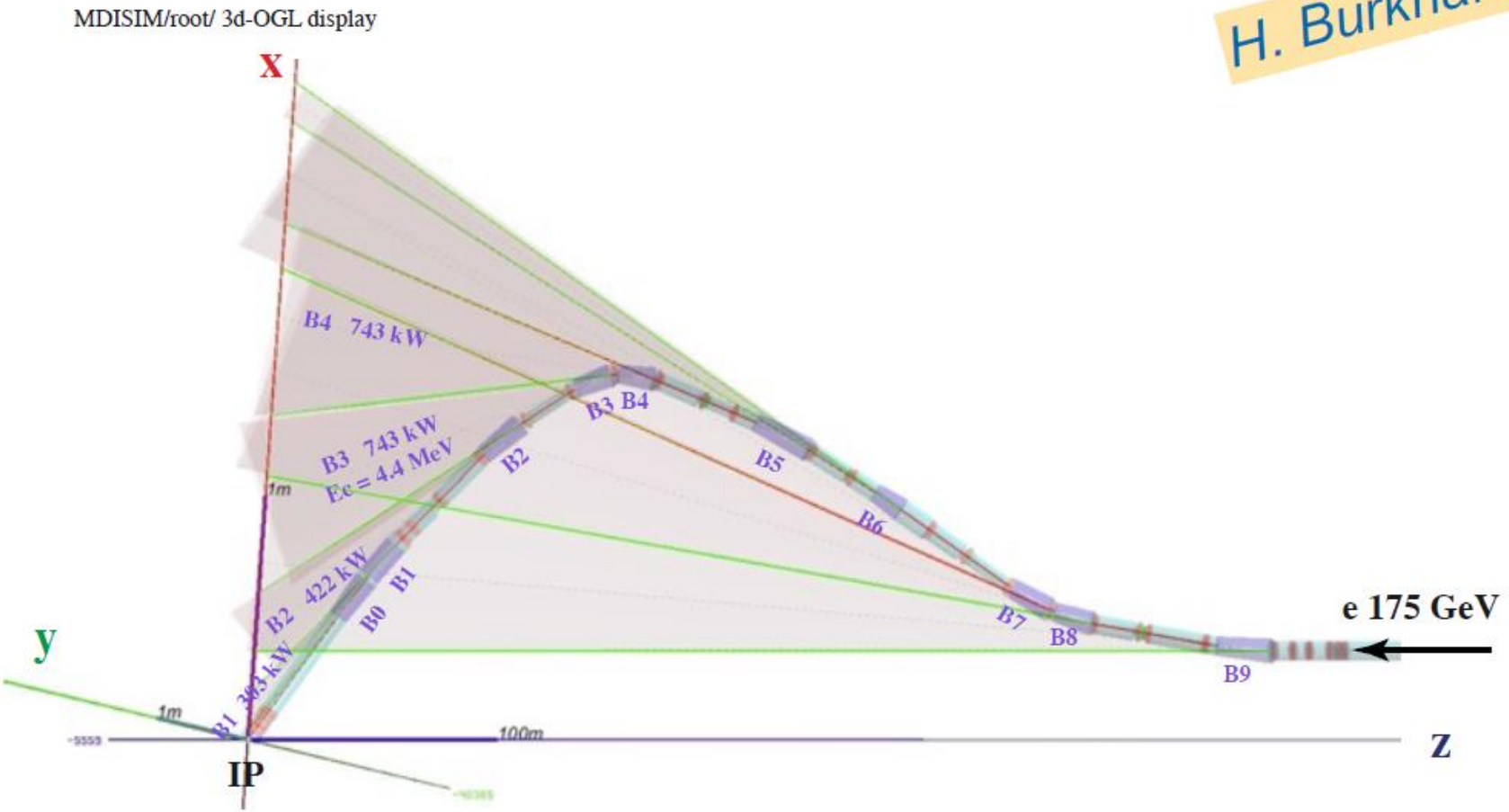
Cornell ERL

Jlab WG HOMs
~30 kW

FCC-ee IR MDI

SynRad bend cones for TLEP_V14_IR_6-13-2 BINP IR

H. Burkhardt



Synchrotron radiation into IR major challenge : **2.3 MW** / beam of MeV γ's into detector region

NB these bends are for high lumi at Z peak, but cause problem at top energy. reconfigure?

Physics:

see many interesting talks

-- phenomenology:

complementarity FCC-ee /FCC-hh (and eh)

-- experimental novelties

-- improvements in H invisible width from Z→ qq tagging at ILC/CEPC (we should see what it does to us!)

-- rare decays are of great interest (light quark couplings)

-- CP violation from H→ $\tau\tau$

-- better understanding of complementarity with FCC-hh (gives ttH and HHH)

-- determination of top couplings from top polarization (Azzi, Janot)

Input from Physics to the accelerator design

0. Nobody complains that the luminosity is too high (the more you get, the more you want)

1. Do we need polarized beams?

-1- transverse polarization:

continuous beam Energy calibration with resonant depolarization

central to the precision measurements of m_Z , m_W , Γ_Z

requires 'single bunches'

a priori doable up to W energies -- workarounds exist above (e.g. γZ events)

large ring with small emittance offers *a priori* excellent prospects

need wigglers; simulations ongoing (E. Gianfelice, M. Koratzinos)

-2- longitudinal polarization requires spin rotators and is very difficult at high energies

-- We recently found that it is not necessary to extract top couplings (Janot, Azzi)

-- improves Z peak measurements *if loss in luminosity is not too strong*

but brings no information that is not otherwise accessible

2. What energies are necessary?

-- in addition to Z, W, H and top listed the following are being considered

-- e+e- → H(125.2) (requires monochromatization A. Faus) (under study)

-- e+e- at ~70 GeV (Z-γ interference)

-- e+e- at top threshold + <~20 GeV for top couplings (E_max up to 180 -185 GeV)

-- no obvious case for going to 500 GeV

4. At the end of my presentation there were two questions.

-- one from Fabiola asking how long would the FCC-ee physics program take. My answer was, as in Aspen, "15 years" although, given the choice 5,10 or 20 as in Aspen I would have said 20 to be on a safer side.

I could also have answered that to do the equivalent physics as the ILC, one year of commissioning and one year of measurements with FCC-ee would be more than enough. (yes!)

I could have also said that our goal is to provide precision/discovery reach that matches the energy range of the FCC-hh, and this requires running for the time that we have estimated.

Nevertheless the question whether FCC-ee will delay FCC-hh requires attention: on this issue the whole project can go very sour, and I dont believe this is necessary.

Personally I think that the best and safest way to get to 100 TeV as soon as possible is to start FCC-ee as soon as possible.
Its also the method that gets most physics out per GigaEURO!.

Meanwhile (as I answered to Fabiola) we must work out carefully the interface/transition between the two machines (maybe the 'exclusion principle' is not the best solution?).

I also believe physicists are not 'hadron' or 'lepton‘ physicists. Finding a way to 1) avoid gaps as much as possible; and 2) produce as much physics as possible; will be very attractive and give us the best chance to find the funding.

I would suggest a dedicated working party to meet with the aim of finding out the facts in the most positive way.

-- Nima asked why we run so much at the Z while they (CEPC) find that they are limited by systematics with 10^10 of them. **Similar question was asked by Philippe Lebrun a year ago. We can provide a more detailed answer but here are a few elements:**

-- I noted that CEPC often took as given the theory systematics from the ILC, this is a natural consequence of having to deliver a report very soon. Our approach, with more time in front of us is to call to arms the theorists and organize a theory workshop to get the Th community engaged with the new challenge posed by FCC-ee.

-- yes, some measurements will reach experimental systematic limits quite fast (m_Z in particular), and this provides a set of very significant achievement for the first step in the staging scenario. As I replied to Nima, others precision measurements need full statistics (asymmetries, W mass, strong coupling constant)

-- and definitely fascinating discoveries are made possible for the high statistics machine in rare decays.

On our horizon:

-- we have regular VIDYO conferences on Monday 15:00 -- 17:00 (both acc. and phys.)

-- regular meetings of heavy flavour (leptons or quarks) and software group
-- more coming.

-- regular physics coordination meetings
https://indico.cern.ch/event/384939/material/minutes/minutes.html

-- workshop on precision calculations for Future Colliders
13-14 July, CERN

-- workshop on interpretation of precision SM tests
in the fall : -- to what new physics are these sensitive
-- extracting info from a series of different measurements

-- Workshop on detectors technologies for future e+e- colliders being set-up

-- working on a 1st phase report on the scoping exercize, delineating phisics potential and work needed to achieve it (first one was published in 2013

Summer conferences

It is very useful to present our results to conferences

-- otherwise very limited publicity is made to physics at FCC

-- Please volunteer to find or give talks

-- HEP EPS in Vienna (we had 5 talks last year)

-- other summer meetings