

**Mini-workshop  
for the  
Machine Detector Interface design  
of the FCC-ee collider**

**Workshop Goals**

CERN, 16-27 January 2017

# Overview

- This mini-workshop for the Machine Detector Interface design of the FCC-ee collider aims at revisiting/validating several open issues.
- After this mini-workshop has made, or confirmed, the basic choices for the layout, a fully coherent study of all related systems and hardware will be performed in time for the CDR report.
- Further optimization work beyond the baseline should then take place either at an appropriate level in parallel to the baseline development, or in a second full iteration later on.

The MDI mini-workshop is organized with some presentations to open the discussion on the various inter-connected topics.

- I\* choice
- Incoming/outgoing layout
- Trapped mode analysis with symmetric vs asymmetric final focus quads
- Beam pipe apertures, material, thickness and masking
- IR quadrupoles design
- Detector Luminosity Calorimeter
- Integration of magnetic system and overall IR layout

# Program

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| <ul style="list-style-type: none"><li>• Monday 16/1<ul style="list-style-type: none"><li>– <b>OPTICS</b></li></ul></li><li>• Tuesday 17/1<ul style="list-style-type: none"><li>– <b>TRAPPED MODE ANALYSIS</b></li></ul></li><li>• Wednesday 18/1<ul style="list-style-type: none"><li>– <b>SYNCHROTRON RADIATION</b></li></ul></li><li>• Thursday 19/1<ul style="list-style-type: none"><li>– <b>LUMINOSITY MONITOR</b></li></ul></li><li>• Friday 20/1: [to be confirmed]<ul style="list-style-type: none"><li>– Magnetic Integration System</li><li>– and IR Mechanical Layout</li></ul></li></ul> | <ul style="list-style-type: none"><li>• Monday 23/1:<ul style="list-style-type: none"><li>– <b>IR QUADRUPOLE DESIGN</b></li></ul></li><li>• Tuesday 24/1:<ul style="list-style-type: none"><li>– <b>SuperKEKB IR SC magnets (N. Ohuchi)</b></li><li>– <b>additional presentations, discussion</b></li></ul></li><li>• Wednesday 25/1<ul style="list-style-type: none"><li>– <b>discussion &amp; write-up</b></li></ul></li><li>• Thursday 26/1<ul style="list-style-type: none"><li>– <b>discussion &amp; write-up</b></li></ul></li><li>• Friday 27/1<ul style="list-style-type: none"><li>– <b>Close-out with conclusions</b></li></ul></li></ul> |
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# This week

## **Monday 16/1**

The following talks at the 1<sup>st</sup> FCC Physics Workshop could be of interest:

09.10-09.40 Status of the FCC Project (M. Benedikt)

09.40-10.10 FCC accelerator parameters (F. Zimmermann)

The FCC-ee MDI mini-workshop starts at 2pm:

14:00-14:30 Introduction (M. Benedikt and F. Zimmermann)

14:30 -15:00 Workshop Plan (M. Boscolo)

15:00-16:00 Optics (K. Oide)

16:00-17:00 Optics discussion

# This Week

## **Tuesday 17/1**

09:30-10:00 Trapped Modes Analysis (A. Novokhatski)

10:00-11:00 Trapped modes and Electron Cloud in the Interaction Region of FCC-ee (E. Belli)

11:00-12:00 Optics Issues Discussion & Trapped Modes Discussion

Afternoon: Working session

## **Wednesday 18/1**

09:30-10:30 IR Layout with SR constraints (M. Sullivan)

10:30-11:00 SR with MDISim (H. Burkhardt)

11:00-11:30 SR with SYNRAD+ (R. Kersevan)

11:30-12:30 Discussion on SR related issues

Afternoon: Working session

## **Thursday 19/1**

09:30-10:30 LumiCal (M. Dam)

10:30-11:30 Discussion on LumiCal

11:30-12:20 Fast Luminosity monitor for SuperKEKB (D. Khechen)

Afternoon: Working session

## **Friday 20/1**

09:30 Magnetic Integration System and IR Mechanical Layout (H. Ten Kate) **[tbc]**

10:30-12:00 Discussion

# Next Week

## **Monday 23/1**

09:00-12:00 Working session

14:00-15:00 IR Quadrupole Design (P. Vobly) **[tbc]**

15:00-17:00 Discussion on IR Quadrupole Design

## **Tuesday 24/1**

10:00-10:20 SuperKEKB IR SC magnets (N. Ohuchi)

10:20-12:30 Discussion & additional presentations

## **Wednesday 25/1**

Discussion & write-up

## **Thursday 26/1**

Discussion & write-up

## **Friday 27/1**

09:00-13:00 Close-out with conclusions

# Proposal: working groups

to write up summary of discussion in a document as outcome of the workshop

- **Optics:** K. Oide , E. Levichev, A. Bogomyagkov, ...
- **Solenoid compensation scheme:** K. Oide , E. Levichev, S. Sinyatkin, ...
- **Synchrotron radiation:** M. Sullivan, H. Burkhardt, R. Kersevan, ...
- **Trapped Modes & Collective effects:** A. Novokhatski , E. Belli, ...
- **Lumical:** M. Dam, ...
- **IR Quadrupole Design:** P. Vobly, E. Levichev, ...
- **Magnets integration and overall IR integration:** H. Ten Kate, ...
- ....





# Parameters Table

K. Oide et al., PRAB 19, 111005 (2016)

Circumference [km]	99.984	
Bending radius of arc dipole [km]	11.190	
Number of IPs/ring	2	
Crossing angle at IP [mrad]	30	
Solenoid field at IP [T]	$\pm 2$	
$\ell^*$ [m]	2.2	
Local chrom. correction	y-plane with crab-sextupole effect	
Arc cell	FODO, $90^\circ/90^\circ$	
Momentum compaction $\alpha_p$ [ $10^{-6}$ ]	6.99	
$\beta$ -tron tunes $\nu_x/\nu_y$	387.08/387.14	
Arc sextupoles	292 pairs per half ring	
rf frequency [MHz]	400	
Beam energy [GeV]	45.6	175
SR energy loss/tum [GeV]	0.0346	7.47
Longitudinal damping time [ms]	440	8.0
Polarization time [s]	$9.2 \times 10^5$	1080
Current/beam [mA]	1450	6.6
Bunches/ring	30180 (91500)	81
Minimum bunch separation [ns]	10 (2.5)	2000
Total SR power [MW]	100.3	98.6
Horizontal emittance $e_x$ [nm]	0.86	1.26
$e_y/e_x$ with beam-beam [%]	0.6	0.2
$\beta_x^*$ [m]	0.5 (1)	1 (0.5)
$\beta_y^*$ [mm]	1 (2)	2 (1)
Energy spread by SR [%]	0.038	0.141
Bunch length by SR [mm]	2.6 <sup>a</sup>	2.4 <sup>b</sup>
Synchrotron tune $\nu_z$	$-0.0163^a$	$-0.0657^b$
rf bucket height [%]	2.3 <sup>a</sup>	11.6 <sup>b</sup>
Luminosity/IP [ $10^{34}/\text{cm}^2 \text{ s}$ ]	210 (90)	1.3 (1.5)

<sup>a</sup>for rf voltage  $V_c = 88 \text{ MV}$ .

<sup>b</sup>for rf voltage  $V_c = 9.04 \text{ GV}$ .