

# GENERAL INFORMATION & STUDY NEWS

Frank Zimmermann

FCC-ee Accelerator & Optics Design Meeting #198 & 69th FCCIS WP2.2 meeting, 27 November 2024

# SAC meeting #8, Peterhouse Cambridge, 18-20 November 2024



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- **On site:** Riccardo Bartolini (DESY), Michael Benedikt (CERN, FCC Study Leader), Christian Carli (CERN), Gerardo Ganis (CERN), Cédric Garion (CERN), Andre Henriques (CERN), Gudrun Hiller (U. Dortmund), Patrick Janot (CERN), Ivan Karpov (CERN), Philippe Lebrun (ESI), Peter McIntosh (STFC UKRI), Michiko Minty (BNL), Katsunobu Oide (UNIGE), Andy Parker (Cambridge University, Chair), Franck Peauger (CERN), Roberto Tenchini (University Pisa and INFN Pisa), Rogelio Toms (CERN), Tim Watson (CERN), Frank Zimmermann (CERN, Secretary)
- **Most SAC members present in person** (Kyo Shibata, Belen Gavela, Alain Chabert, Srinivas Krishnagopal, Heinz Ehrbar remote)
- **Most presenters attending in person** (Anton Lechner, Bernhard Auchmann, David d'Enterria remote)
- **Goal:** to tick off as many points from the mid-term report as possible

# SAC Program 1<sup>st</sup> half

MONDAY 18 NOVEMBER

**13:30** → 14:00 **Closed session**  
Convener: Andy Parker (University of Cambridge (GB))

**14:00** → 14:30 **FCC FS status and recent updates** ⌚ 30m  
Speaker: Michael Benedikt (CERN)  
241118\_FCC-genera... 241118\_FCC-genera...

**14:30** → 16:00 **Placement, Implementation, environmental studies**

**14:30** **Placement update, environmental studies and carbon footprint** ⌚ 50m  
Speaker: Michael Benedikt (CERN)  
241118\_placement-... 241118\_placement-...

**15:20** **Injector Implementation and update of site Investigations** ⌚ 40m  
Speaker: Timothy Paul Watson (CERN)  
241118\_SAC\_Revie... 241118\_SAC\_Revie...

**16:00** → 16:30 **Coffee break**

**16:30** → 17:40 **RF**

**16:30** **Double cell 400 MHz concept for Z, W, ZH RF including powering and beam dynamics** ⌚ 35m  
Speaker: Ivan Karpov (CERN)  
8th\_FCC\_SAC\_Cam...

**17:05** **RF integration and funneling/beam bypasses for Z, W, ZH operation** ⌚ 35m  
Speaker: Franck Peauger (CERN)  
2024\_11\_18\_SAC\_R... 2024\_11\_18\_SAC\_R...

**17:40** → 18:30 **Closed session**  
Convener: Andy Parker (University of Cambridge (GB))

TUESDAY 19 NOVEMBER

**08:30** → 10:30 **PED**

**08:30** **Computing resource** ⌚ 30m  
Speaker: Gerardo Ganis (CERN)  
FCC-SnC-Resources...

**09:00** **Physics case and schedule Implications of other possible energy stage** ⌚ 30m  
Speaker: David d'Enterria (CERN)  
dde\_schannel\_higg...

**09:30** **Discovery via precision measurements, Complementarity FCCee-FCC-hh** ⌚ 40m  
Speaker: Matthew Philip Mccullough (CERN)  
SAC.pdf

**10:10** **Human and financial resources** ⌚ 20m  
Speaker: Patrick Janot (CERN)  
SAC\_PEDHumanRe...

**10:30** → 11:00 **Coffee break** ⌚ 30m

**11:00** → 12:20 **CE and safety**

**11:00** **Status update on Civil Engineering** ⌚ 40m  
Speaker: Timothy Paul Watson (CERN)  
241118\_SAC\_Revie... 241118\_SAC\_Revie...

**11:40** **General safety concept for operation phase** ⌚ 40m  
Speaker: Andre Henriques (CERN)  
FCC\_Safety\_Concep... FCC\_Safety\_Concep... videos\_slm

**12:20** → 13:00 **Closed session**  
Convener: Andy Parker (University of Cambridge (GB))

# SAC Program 2<sup>nd</sup> half

**14:00** → 16:00 **Injector, filling schemes, other science**

**14:00** **Injector concept and parameters**  
**Speaker:** Paolo Craievich  
[20241119\\_SAC\\_me...](#) [20241119\\_SAC\\_me...](#)

**14:40** **New filling scheme from source to collider for all operation points, flexibility**  
**Speaker:** Christian Carli (CERN)  
[24\\_11\\_19\\_SAC\\_Filli...](#) [24\\_11\\_19\\_SAC\\_Filli...](#)

**15:20** **Report on study of other science applications**  
**Speaker:** Frank Zimmermann (CERN)  
[Other FCC Science ...](#) [Other FCC Science ...](#)

**16:00** → 16:30 **Coffee break**

**16:30** → 17:50 **FCC-ee optics and tolerances**

**16:30** **Lattice progress and main parameters update**  
**Speakers:** Katsunobu Oide, Dr Katsunobu Oide (Universite de Geneve (CH))  
[Lattice\\_Oide\\_24111...](#)

**17:10** **Tolerances, corrections, tuning, alignment**  
**Speaker:** Rogelio Tomas Garcia (CERN)  
[Slides](#) [Slides](#)

**17:50** → 18:30 **Closed session**  
**Convener:** Andy Parker (University of Cambridge (GB))

**19:30** → 22:00 **Dinner** ⌚ 2h 30m

WEDNESDAY 20 NOVEMBER

**08:30** → 10:30 **FCC-ee shielding & vacuum, FCC-hh cryo magnet system**

**08:30** **Shielding concept collider** ⌚ 40m  
**Speaker:** Anton Lechner (CERN)  
[FCCee\\_radshielding...](#)

**09:10** **Vacuum concept collider and booster** ⌚ 40m  
**Speaker:** Cedric Garion (CERN)  
[FCC\\_Vacuum\\_CG.pdf](#) [FCC\\_Vacuum\\_CG.p...](#)

**09:50** **FCC-hh cryo magnet system and Integration** ⌚ 40m  
**Speaker:** Bernhard Auchmann (PSI/CERN)  
[241120\\_HFM\\_updat...](#)

**10:30** → 11:00 **Coffee break** ⌚ 30m

**11:00** → 12:00 **Closed session**  
**Convener:** Andy Parker (University of Cambridge (GB))

**12:00** → 14:00 **Close out** ⌚ 2h

**Restriction**

# SAC #8: regarding FCC-ee optics & tolerances (K. Oide, R. Tomas)

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## discussion points:

choice of baseline optics

filling time from scratch

→ monochromatization optics

→ 100 micron initial quad-BPM alignment questioned

→ a4 tolerance for sextupoles (30 units) flagged red

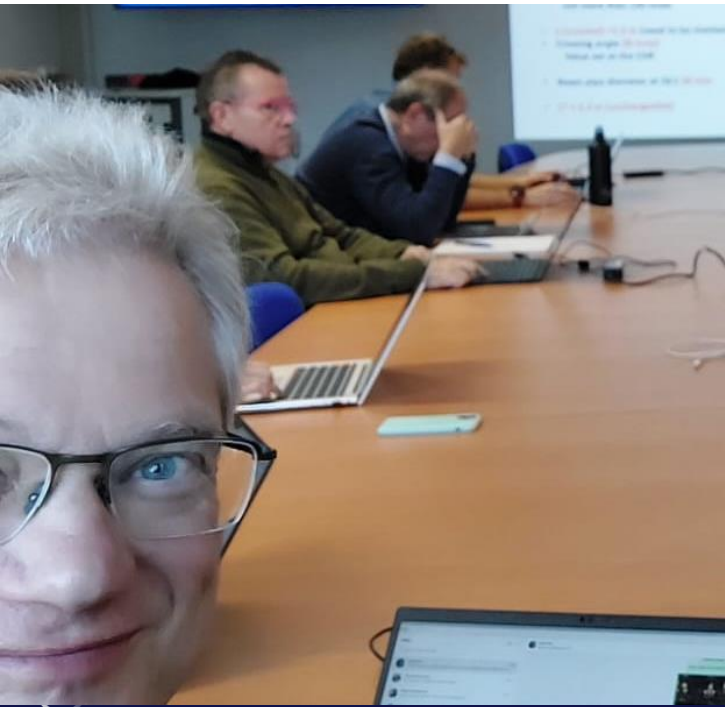
→ study error effects on injection efficiency

→ effect of beam-beam on tolerances

# FCC-ee MDI Mini-workshop, 22 November 2024









## Participants:

Ilya Agapov (DESY), Patricia Borges de Sousa (CERN), Manuela Boscolo (INFN-LNF), Jean-Paul Burnet (CERN), Francesco Franesini (INFN-LNF), Mike Koratzinos (PSI), Katsunobu Oide (U. Geneva), Brett Parker (BNL), Vittorio Parma (CERN), John Seeman (SLAC), Laurent Tavian (CERN), Vikas Teotia (BNL), Frank Zimmermann (CERN)





# Program

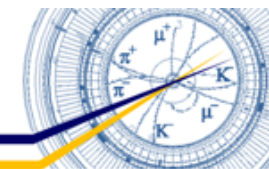
<b>08:30</b>	→ 08:45	<b>IR Overview and present clearances</b>	🕒 15m	📄
		<b>Speaker:</b> Manuela BOSCOLO (INFN e Laboratori Nazionali di Frascati (IT))		
		 241122_Mboscolo_...		
<b>08:45</b>	→ 09:15	<b>IR vacuum chambers, LumiCal, backgrounds</b>	🕒 30m	📄
		<b>Speaker:</b> Francesco Franesini (INFN e Laboratori Nazionali di Frascati (IT))		
		 FCC-MDI-Mini_Work...  FCC-MDI-Mini_Work...		
<b>09:15</b>	→ 09:45	<b>Present design of IR magnets (LTC and HTC)</b>	🕒 30m	📄
		<b>Speaker:</b> m Koratzinos (Paul Scherrer Institute (CH))		
<b>09:45</b>	→ 10:00	<b>Coffee break</b>	🕒 15m	
<b>10:00</b>	→ 10:30	<b>Cryogens/cryostats Issues</b>	🕒 30m	📄
		<b>Speaker:</b> Dr Patricia Tavares Coutinho Borges De Sousa (CERN)		
		 FCC-ee_MDI_CryoC...  FCC-ee_MDI_CryoC...		
<b>10:30</b>	→ 11:00	<b>Direct wind magnets and IR Issues</b>	🕒 30m	📄
		<b>Speaker:</b> Brett Parker (Brookhaven National Laboratory (US))		
<b>11:00</b>	→ 11:30	<b>Concerns of cryostat layout, clearances, mitigations</b>	🕒 30m	📄
		<b>Speakers:</b> John Seeman, John Theodore Seeman (SLAC National Accelerator Laboratory)		
		 Seeman FCC IR Me...  Seeman FCC IR Me...  Seeman FCC IR Me...		
<b>11:30</b>	→ 12:00	<b>FCC-ee magnet design activities at BNL</b>	🕒 30m	📄
		<b>Speaker:</b> Vikas Teotia (Brookhaven National Laboratory)		
<b>12:00</b>	→ 12:30	<b>Summary and discussion</b>	🕒 30m	📄

## MDI General Issues

- Start work soon on future improvements to IR: MDI after the December document date.
- Check if adding 1) non-local solenoid compensation with Pantaleo's lattice plus 2) a modest increased IP crossing angle compensates the beam in-tunnel locations.
- See if any tungsten shielding can double as another chamber wall (say vacuum, heat shield)?

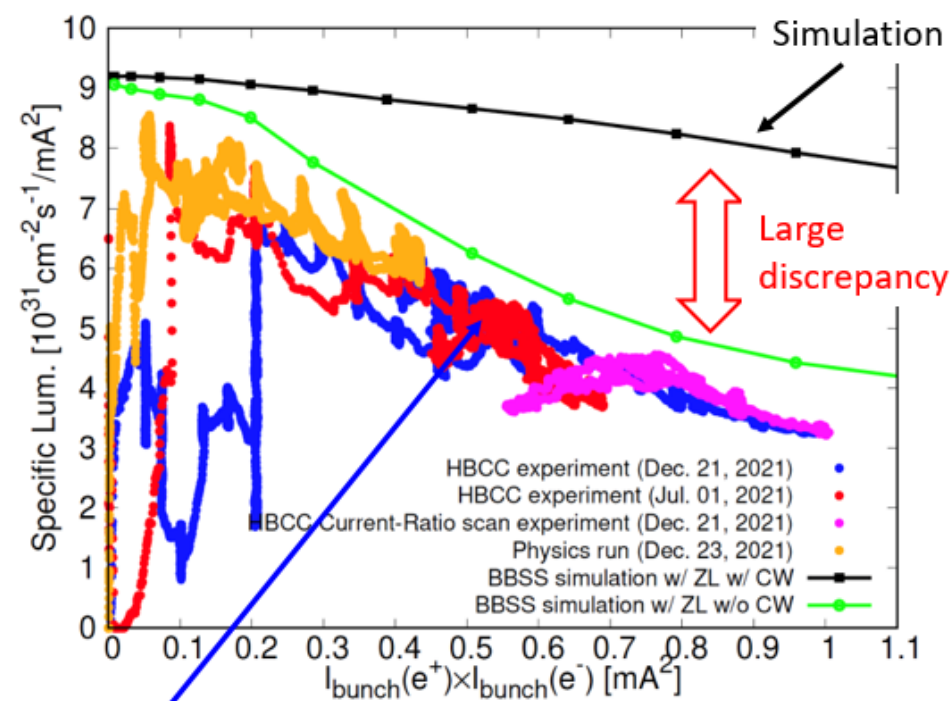


## Collaboration proposal

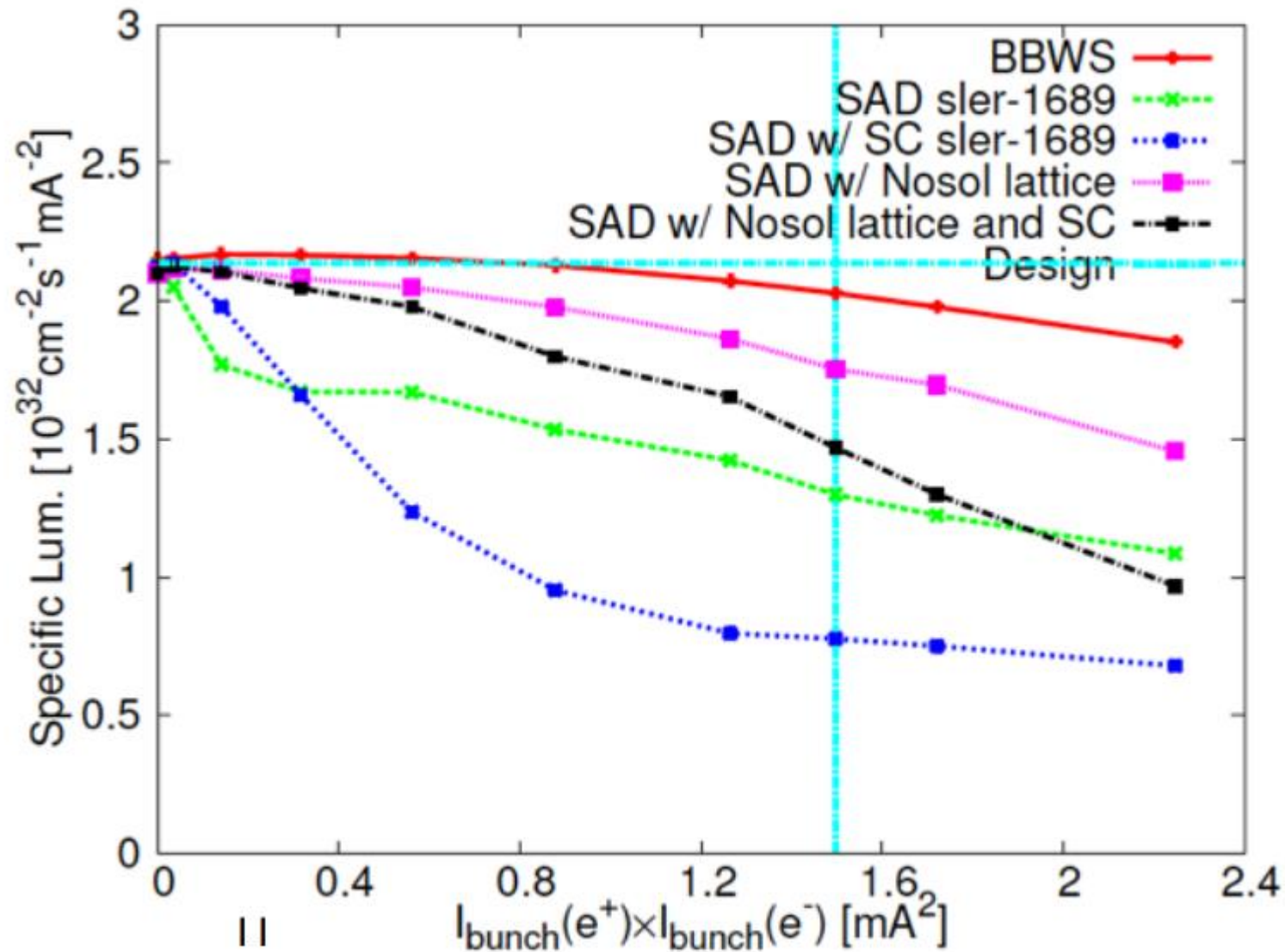


- Beam-Beam simulation shows much higher specific luminosity
  - It is still unclear why experimental results are much smaller than the simulation.
    - Can simulation miss some important factors?
  - There should be hints to increase luminosity of SuperKEKB.
    - If we identify the cause of the reduction in the luminosity, measures can be taken to improve luminosity.
- Important issue not just for SuperKEKB, but for future colliders with nano-beam collision scheme.
- SuperKEKB would like to collaboration with FCCee on Beam-Beam simulations.
  - Beam-Beam with impedance
  - Beam-Beam with machine errors
  - Beam-Beam with lattice

Strong-Strong Beam-Beam simulation (D. Zhou)



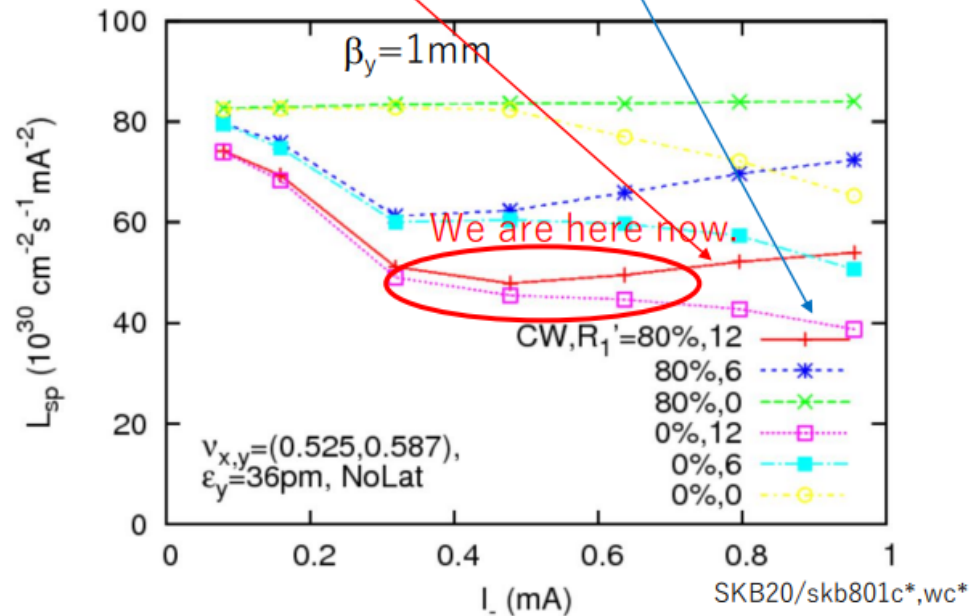
# is luminosity drop unexpected ? - SKEKB ARC, February 2015



# is luminosity drop unexpected ? - SKEKB ARC, July 2020

Weak-strong simulation for crab waist with chromatic coupling

- $L_{sp}$  worsens in the low bunch current ( $<0.3\text{mA}$ ) and then changes slowly for a large  $R_1'=6, 12$ .
- $L_{sp}$  somewhat increase/decrease for Crab waist ON/OFF for  $I > 0.5\text{mA}$ .



# recent big achievement 😊

F.Z.

we waited ~18 years for this 😞 since Akio Morita's stay at CERN in 2006/2007

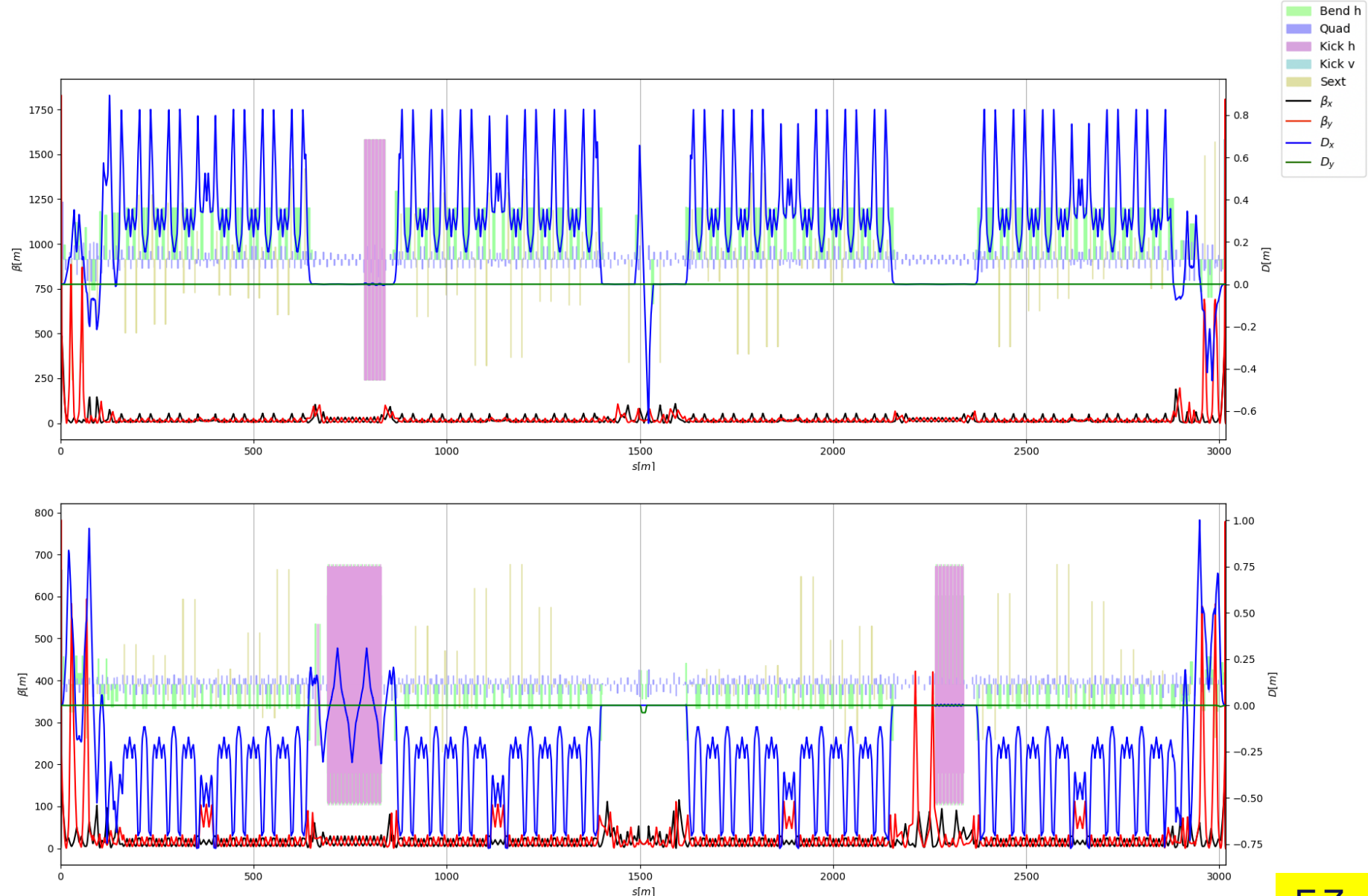
Now, thanks to

J. Salvesen, G. Iadarola, G. Broggi, H. Sugimoto, and K. Oide :  
complete model of SuperKEKB LER and HER, including IR with tilted solenoid and overlapping elements available in CERN simulation framework xsuite since last week !

With this CERN FCC team could carry out many studies for SuperKEKB:

Optics, beam-beam, collimation, SR background, injection, ..

- strong collaboration between CERN and KEK
- alternative modelling strategy for IR
- many additional features & improvements to Xsuite have come about as a result of this effort



*J. Salvesen, G. Iadarola,  
G. Broggi, H. Sugimoto,  
K. Oide*

# Other FCC-ee science applications under study

→ Workshop on “Other Science Opportunities at the FCC-ee”  
28-29 November at CERN, <https://indico.cern.ch/event/1454873/>

for example:

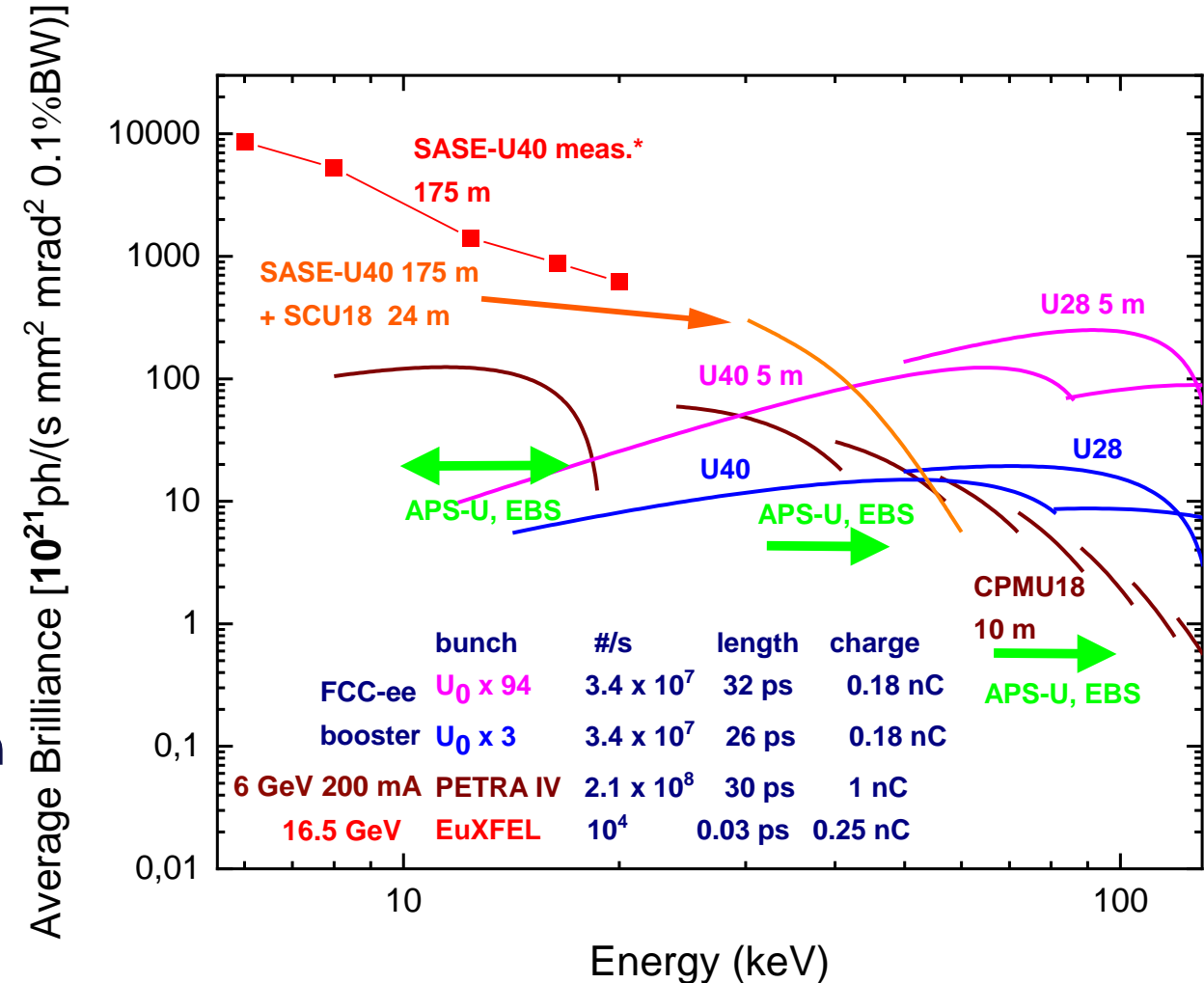
**FCC-ee booster as diffraction limited storage ring** with coherent synchrotron radiation down to 0.1 Å

FCC-ee injector as the world’s **ultimate positron source** for material studies and paving a path towards the first **Bose-Einstein condensation of Ps** (511-keV gamma-ray laser)

using beamstrahlung for **radionuclide production**

$e^-$  beam driven **neutron source**

etc.





# FSR status

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contributions are coming in ! 😊

4 more weeks till Xmas

some teams write separate documents to integrate them later  
- be careful with references (avoid duplications) !

# timeline for pre-TDR phase

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“new” collider baseline optics by early 2026

- possibly LCC optics
- must have integrated collimation, RF, inj./extr. straights
- non-local solenoid compensation

should define milestones in 2025 to get there

work needed for booster optics

- strengthen CEA team ?

explore polarized injector for pilot bunches

- TL optics with spin rotators, polarizer ring

# welcome Takashi Mori from KEK !

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topic: dynamics after injection with beam-beam

# Today's agenda

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**10:00 AM**

→ 10:15 AM

**General Information**

**Speaker:** Frank Zimmermann (CERN)

🕒 15m

**10:20 AM**

→ 10:40 AM

**Updates from the Optics Tuning Working Group**

**Speakers:** Jacqueline Keintzel (CERN), Rogelio Tomas Garcia (CERN)

🕒 20m

**10:45 AM**

→ 11:05 AM

**Low center-of-mass FCC-ee Runs**

**Speaker:** David d'Enterria (CERN)

🕒 20m

**11:10 AM**

→ 11:30 AM

**Parasitic Interactions In the Crossing of the Technical Insertions**

**Speakers:** Ghislain Roy (CERN), Xavier Buffat (CERN)

🕒 20m

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