70 YEARS / ANS CERN
1954-2024

FCC Accelerator Status

FCC Week, 10 June 2024

Frank Zimmermann, CERN

on behalf of FCC collaboration & FCCIS DS team

warm thanks to I. Agapov, K. Andre, W. Bartmann, H. Bartosik, M. Benedikt, A. Blondel, M. Boscolo, G. Broggi, R. Bruce, X. Buffat, C. Carli, F. Carlier, I. Chaikovska, A. Chance, P. Craievich, B. Dalena, A. Faus-Golfe, V. Gawas, A. Ghribi, C. Grojean, A. Grudiev, J. Gutleber, X. Huang, G. Iadarola, P. Janot, I. Karpov, J. Keintzel, P. Kicsiny, R. Kersevan, R. Kieffer, M. Koratzinos, A. Lechner, S. Liuzzo, S. Mazzoni, M. Migliorati, C. Milardi, K. Ohmi, K. Oide, F. Palla, Y. Papaphilippou, T. Pieloni, F. Poirier, P. Raimondi, T. Raubenheimer, M. Reissig, L. Sabato, S. Sai, J. Salvesen, J. Seeman, J. Steinmann, R. Tomas, F. Yaman, A. Vanel, L. Van Riesen-Haupt, S. White, G. Wilkinson, Y. Wu, …

FUTURE CIRCULAR COLLIDER Innovation Study · EuroCirCol A key to New Physics · EASITrain · iFAST · E-JADE · EAJADE · CHART Swiss Accelerator Research and Technology · http://cern.ch/fcc · CERN

*Work supported by the **European Commission** under the **HORIZON 2020 projects EuroCirCol**, grant agreement 654305; **EASITrain,** grant agreement no. 764879; **iFAST**, grant agreement 101004730, **FCCIS**, grant agreement 951754; **E-JADE,** contract no. 645479; **EAJADE**, contract number 101086276; and by the Swiss **CHART** program*

European Commission · Horizon 2020 European Union funding for Research & Innovation

photo: J. Wenninger

FUTURE CIRCULAR COLLIDER

FCC-ee main machine parameters

Parameter	Z	WW	H (ZH)	ttbar
beam energy [GeV]	45.6	80	120	182.5
beam current [mA]	1270	137	26.7	4.9
number bunches/beam	11200	1780	440	60
bunch intensity [10^{11}]	2.14	1.45	1.15	1.55
SR energy loss / turn [GeV]	0.0394	0.374	1.89	10.4
total RF voltage 400/800 MHz [GV]	0.120/0	1.0/0	2.1/0	2.1/9.4
long. damping time [turns]	1158	215	64	18
horizontal beta* [m]	0.11	0.2	0.24	1.0
vertical beta* [mm]	0.7	1.0	1.0	1.6
horizontal geometric emittance [nm]	0.71	2.17	0.71	1.59
vertical geom. emittance [pm]	1.9	2.2	1.4	1.6
horizontal rms IP spot size [μm]	9	21	13	40
vertical rms IP spot size [nm]	36	47	40	51
beam-beam parameter ξ_x / ξ_y	0.002/0.0973	0.013/0.128	0.010/0.088	0.073/0.134
rms bunch length with SR / BS [mm]	5.6 / 15.5	3.5 / 5.4	3.4 / 4.7	1.8 / 2.2
luminosity per IP [10^{34} $cm^{-2}s^{-1}$]	140	20	≥5.0	1.25
total integrated luminosity / IP / year [ab^{-1}/yr]	17	2.4	0.6	0.15
beam lifetime rad Bhabha + BS [min]	15	12	12	11
	4 years 5 x 10^{12} Z LEP x 10^5	2 years > 10^8 WW LEP x 10^4	3 years 2 x 10^6 H	5 years 2 x 10^6 tt pairs

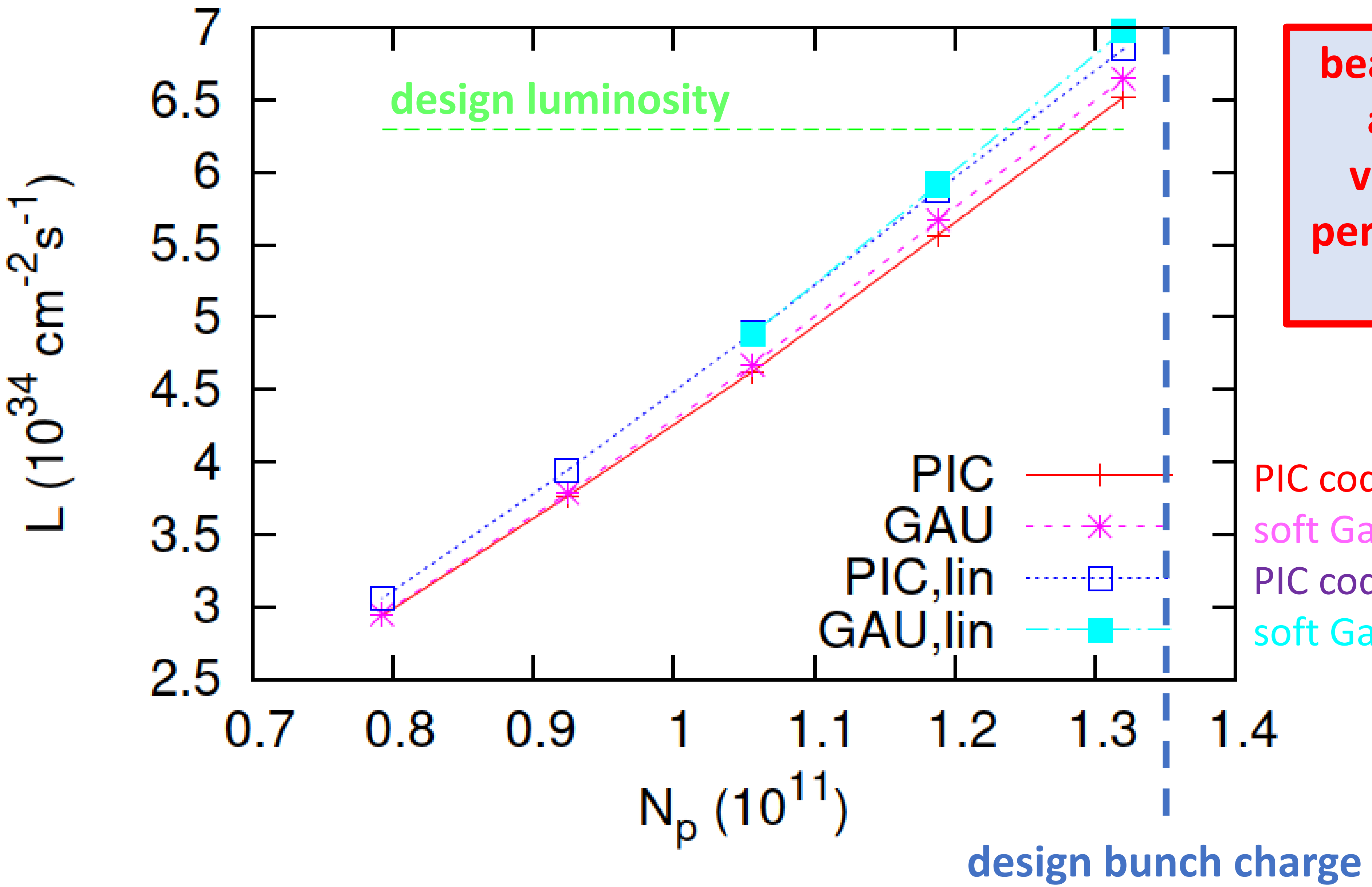
Design and parameters dominated by the choice to allow for 50 MW synchrotron radiation per beam.

- x 10-50 improvements on all EW observables
- up to x 10 improvement on Higgs coupling (model-indep.) measurements over HL-LHC
- x10 Belle II statistics for b, c, τ
- indirect discovery potential up to ~ 70 TeV
- direct discovery potential for feebly-interacting particles over 5-100 GeV mass range

Up to 4 interaction points → robustness, statistics, possibility of specialised detectors to maximise physics output

F. Gianotti

beam-beam performance @ HZ



beam-beam codes & approximations validated ; design performance reached & exceeded

PIC code, nonlinear lattice

soft Gaussian, nonlinear lattice

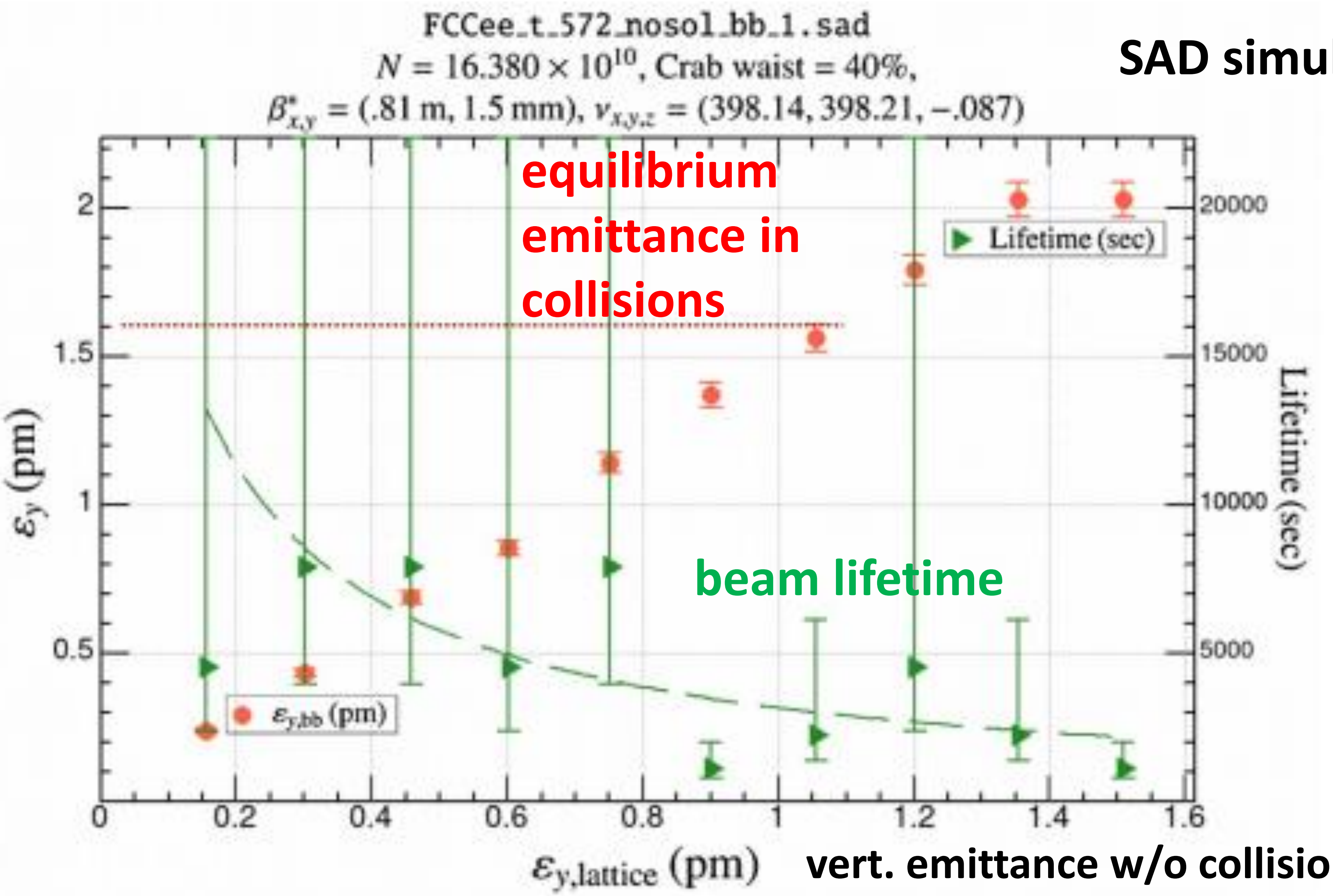
PIC code, linear optics

soft Gaussian, linear optics

K. Ohmi, KEK

beam-beam performance @ $t\bar{t}$

SAD simulation

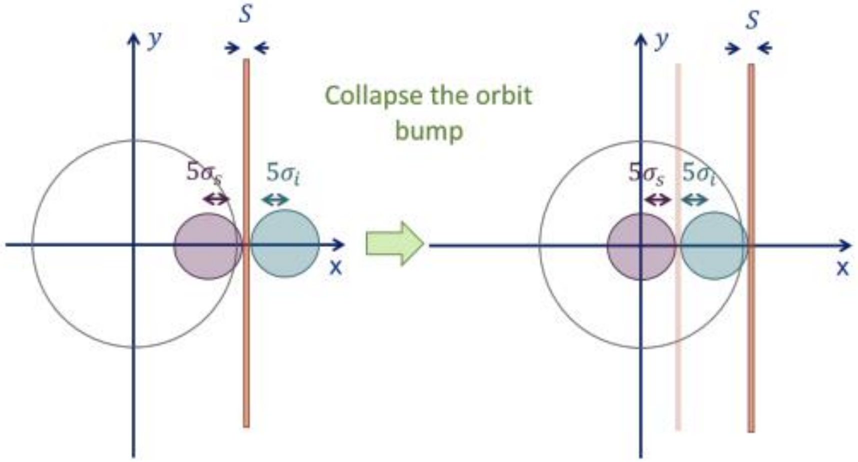


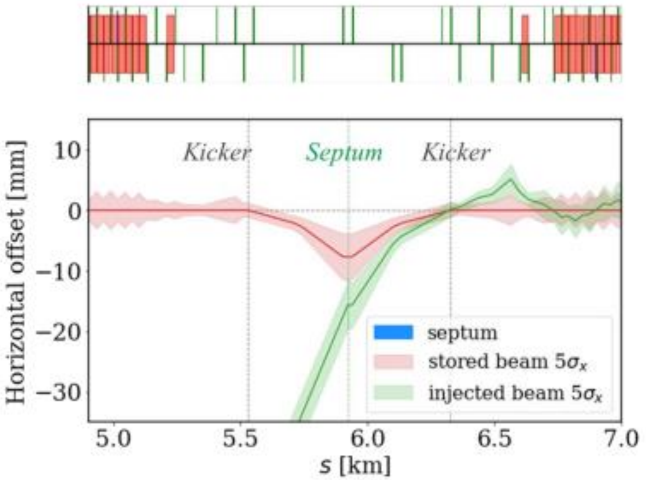
vert. emittance w/o collision

need for a small vertical "lattice emittance" ; ~50% blow up in collision; beam lifetime dominated by burn-off (not included here)

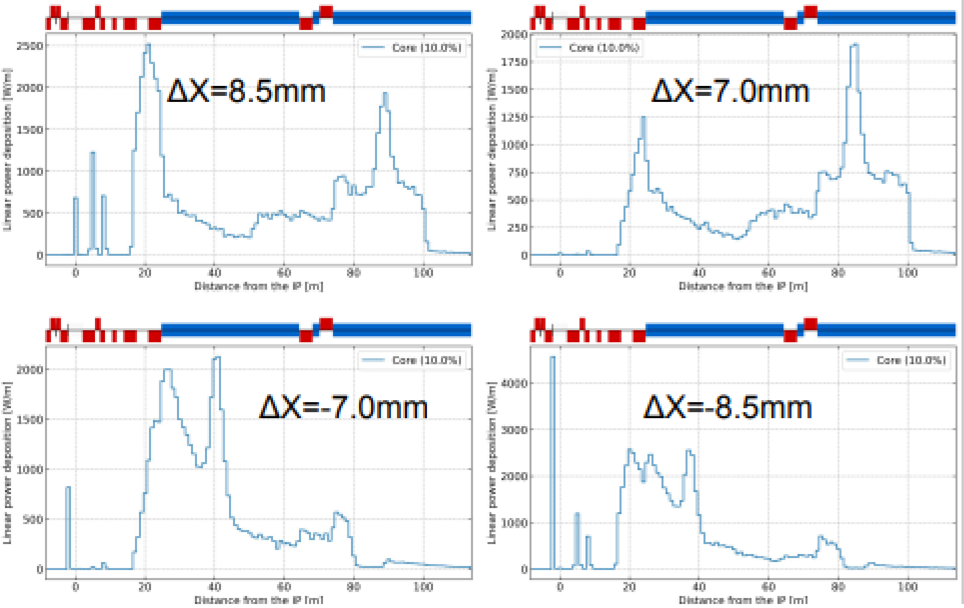
K. Oide, UNIGE

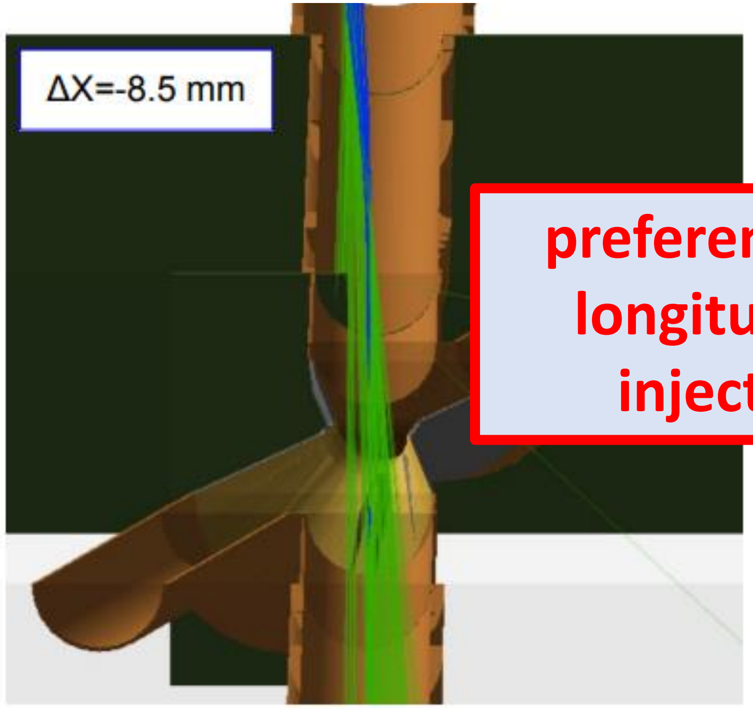
top-up injection



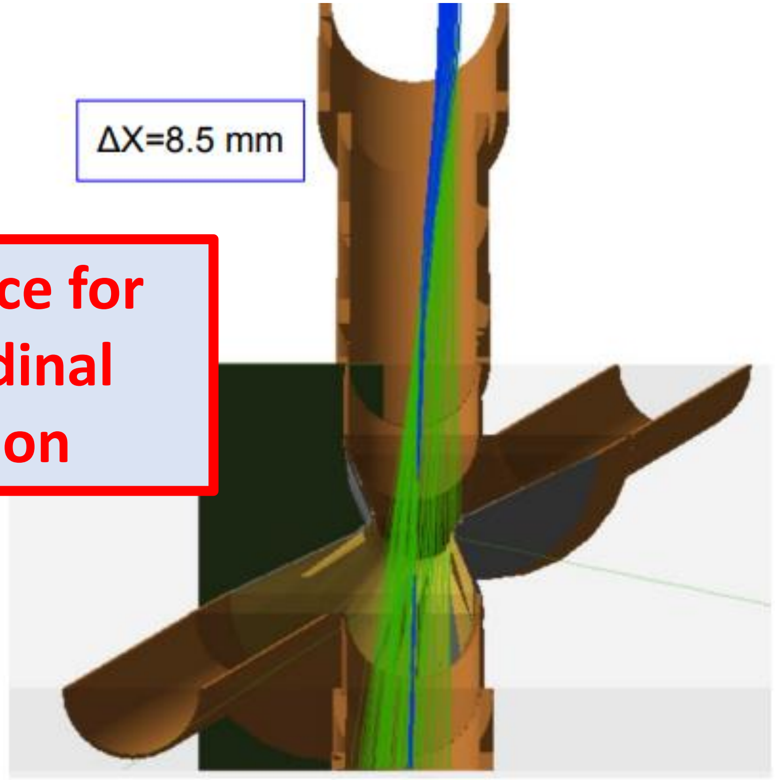


Off-axis top-up injection challenging at Z due to large orbit excursion and slow damping. **SR intercepted by the last mask ~0.2mJ/Xing** compared ~0.8μJ/Xing from colliding beam





preference for longitudinal injection

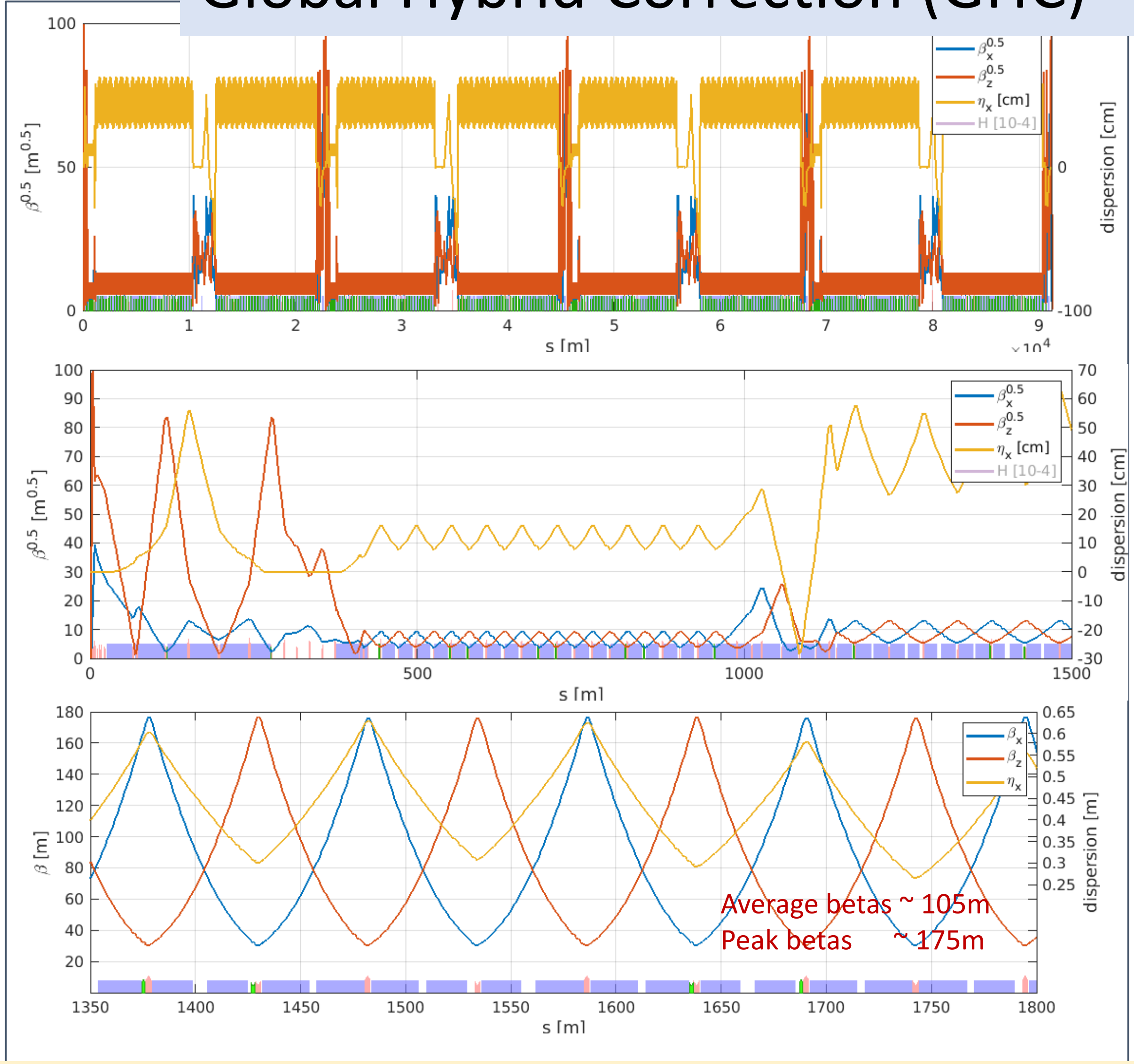


K. Andre, Y. Dutheil, M. Hofer R. Ramjiawan, CERN; P. Hunchak, CLS & U Saskatchewan

collider lattice design

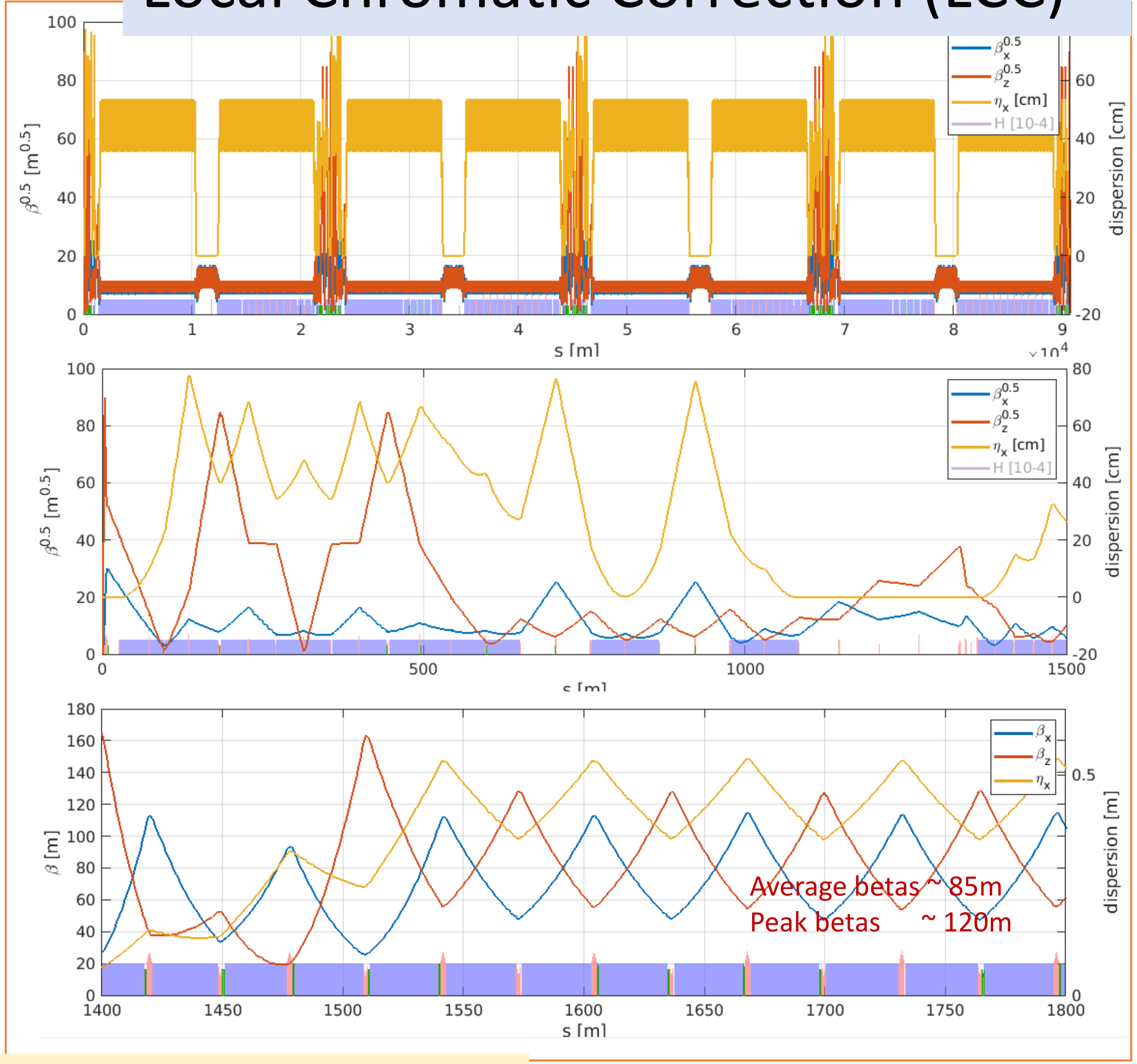
Global Hybrid Correction (GHC)

GHC https://jo



Local Chromatic Correction (LCC)

LCC https:



K. Oide, UNIGE; P. Raimondi, FNAL; S. Liuzzo, S. White, ESRF; K. Andre, M. Hofer, G. Roy, CERN

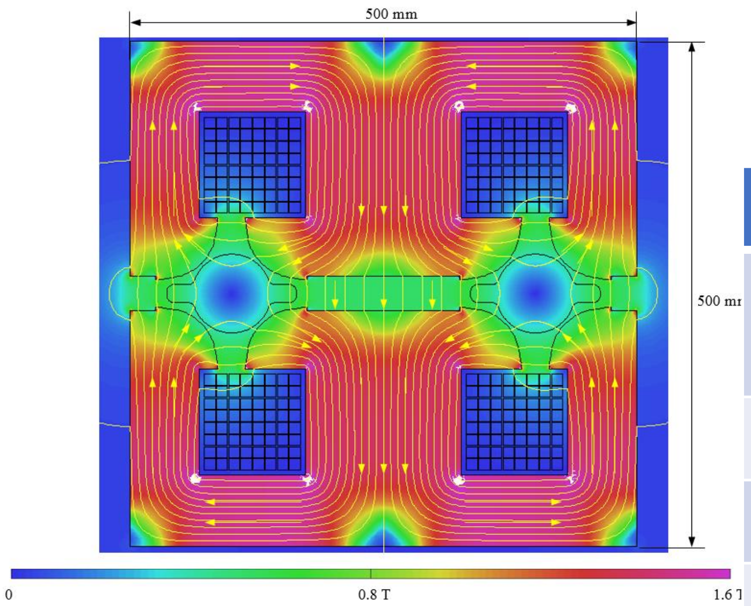
sensitivity to errors

K. Oide, UNIGE
P. Raimondi, FNAL
S. Liuzzo, S. White, ESRF
K. Andre, M. Hofer, CERN

Magnet Misalignments Leading to 1% rms Beta Beating or 1 mm rms Dispersion:

Optics	$\Delta\beta_x/\beta_x$	$\Delta\beta_y/\beta_y$	D_y
GHC quadr.	2.9 μm	0.7 μm	0.1 μm
LCC quadr.	6.1 μm	0.5 μm	0.26 μm
GHC sext.	17 μm	8.5 μm	2.6 μm
LCC sext.	>100 μm	46 μm	10 μm

the twin quadrupole question



LCC abandons twin quadrupoles

K. Oide, J. Keintzel

$t\bar{t}$	arc quadrupoles	arc sextupoles
	gradient^2 × length × number [T^2/m]	<gradient^2 >× length × number [T^2/m^3]
GHC	1.2×10^6	8.6×10^8
LCC	$2 \times 7.5 \times 10^5$	3.7×10^8
total power ratio LCC/GHC	**1.26**	**0.44**

A. Milanese

PRAB 19, 11204 (2016)

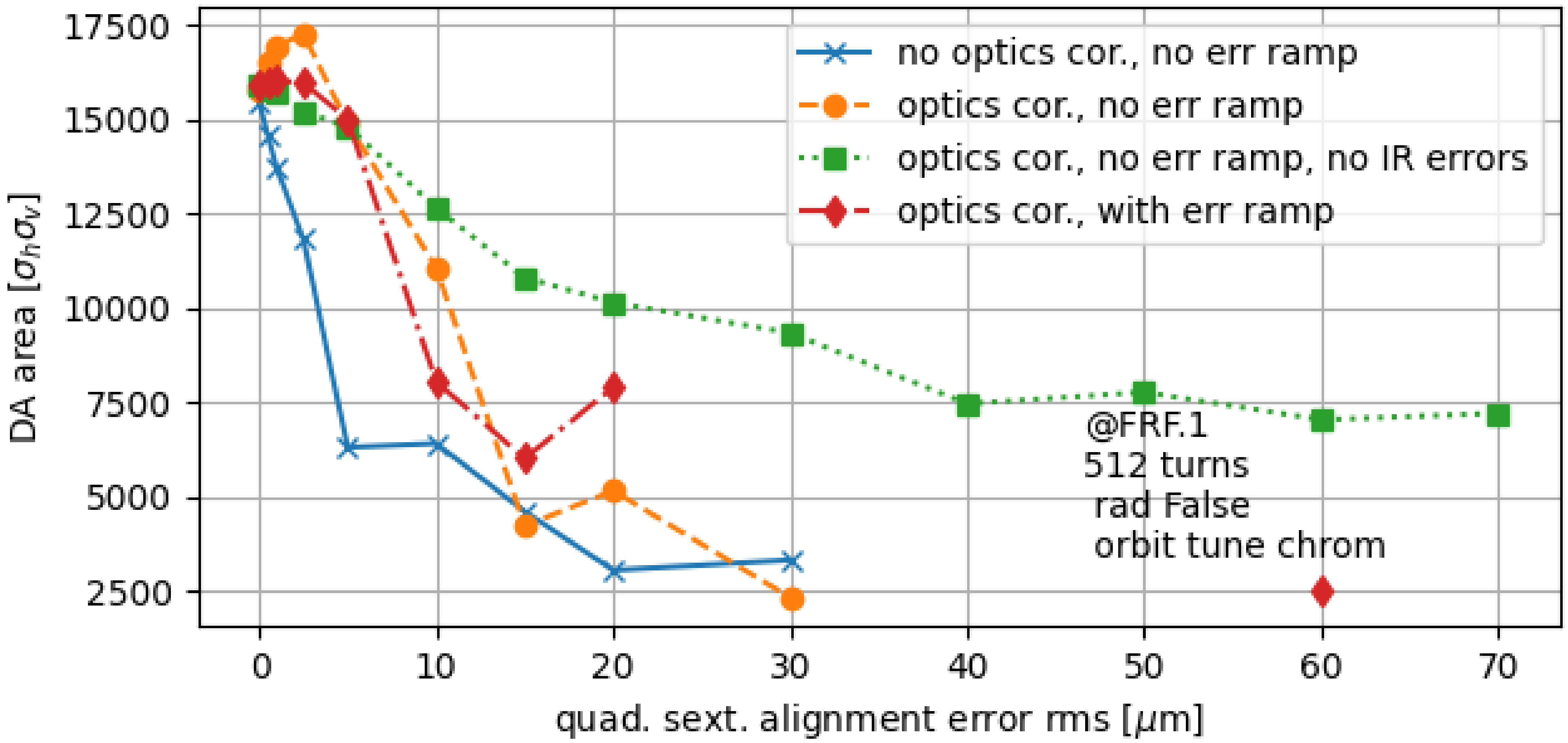
J.-P. Burnet, J. Bauche, for GHC

Storage Ring	Z	W	H	TT
Beam Energy (GeV)	45.6	80	120	182.5
Magnet current	25%	44%	66%	100%
Power ratio	6%	19%	43%	100%
Dipoles (MW)	0.8	2.6	5.8	13.3
Quadrupoles (MW)	1.4	4.3	9.8	22.6
Sextupoles (MW)	1.3	3.9	8.9	20.5
Power cables (MW)	1.2	3.8	8.6	20
Total magnet losses	4.8	14.7	33.0	76.4
Power demand (MW)	5.6	17.2	38.6	89

Even though without twin quadrupoles, overall arc magnet power consumption for LCC may be >10 MW lower than for GHC

dynamic aperture with errors

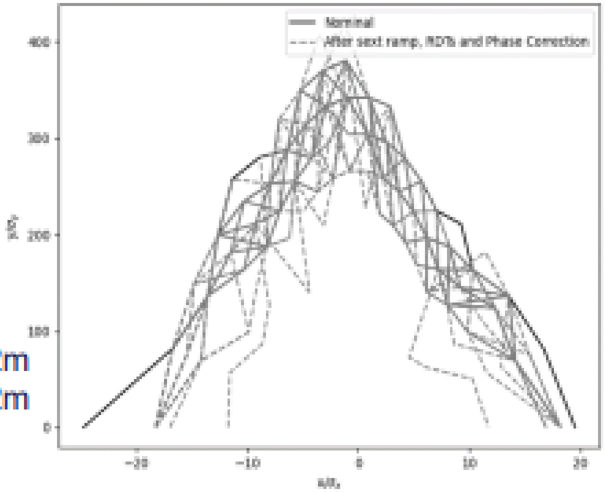
baseline optics at Z, with errors



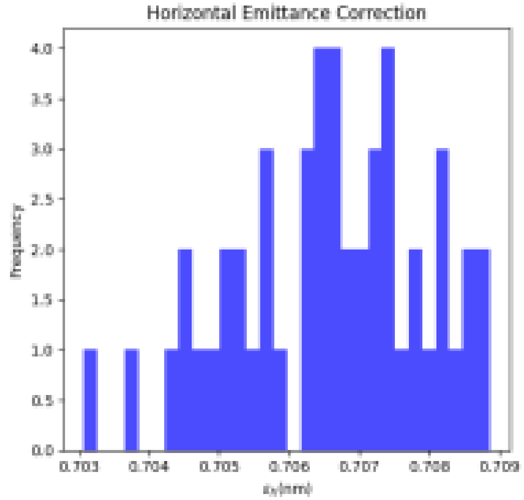
S. Liuzzo, ESRF

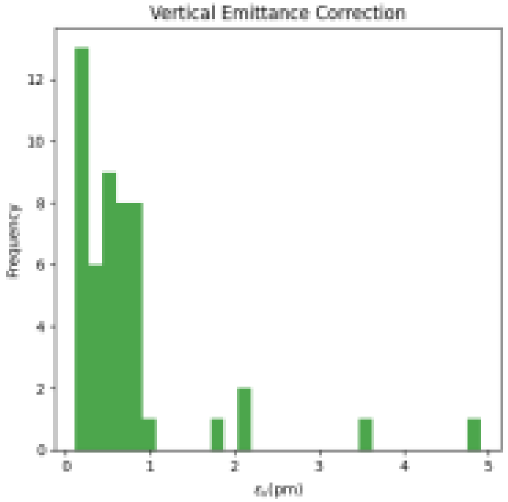
phase & RDTs/D_y correction for arc misalignments

50 seeds (mean values)		rms orbit x (µm)	rms orbit y (µm)	$\Delta\beta x/\beta x$ %	$\Delta\beta y/\beta y$ %	Δ ηx (mm)	Δ ηy (mm)	ε_h (nm)	ε_v (pm)
100 µm on arc quads & sexts	With err	6224.8	7276.7	1e-6	1e-4	11985	73458	-	-
	After Sext ramping	8.55	8.35	5.98	9.91	45.23	45.96	0.71	9.61
	RDTs & ηy Cor	8.58	8.42	6.01	9.94	45.09	4.49	0.71	2.32
	Phase Cor	8.55	8.35	0.35	0.79	2.94	4.36	0.70	0.88
	Final cor. result	8.55	8.35	0.35	0.89	2.94	4.37	0.70	0.73



@FRF.1
Sigma_x =0.000362m
Sigma_y =0.000012m

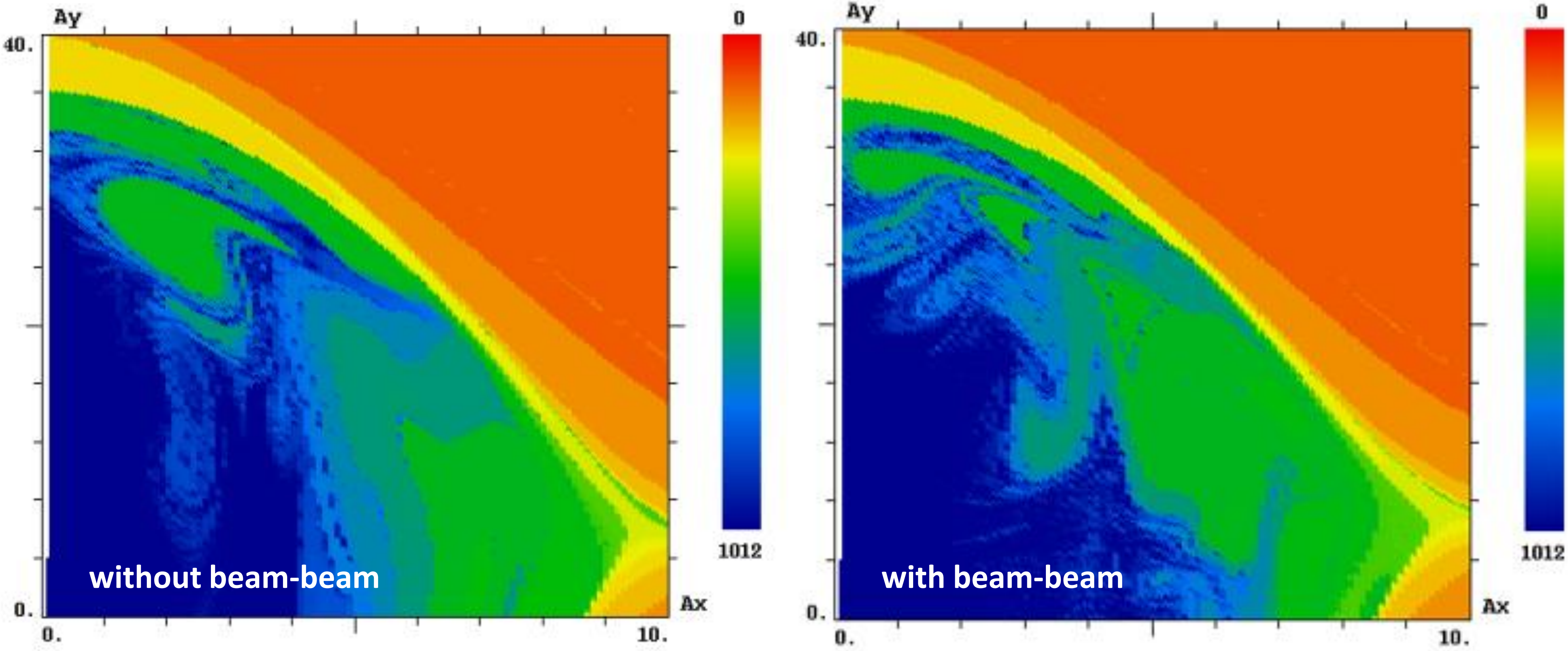




E. Musa, DESY

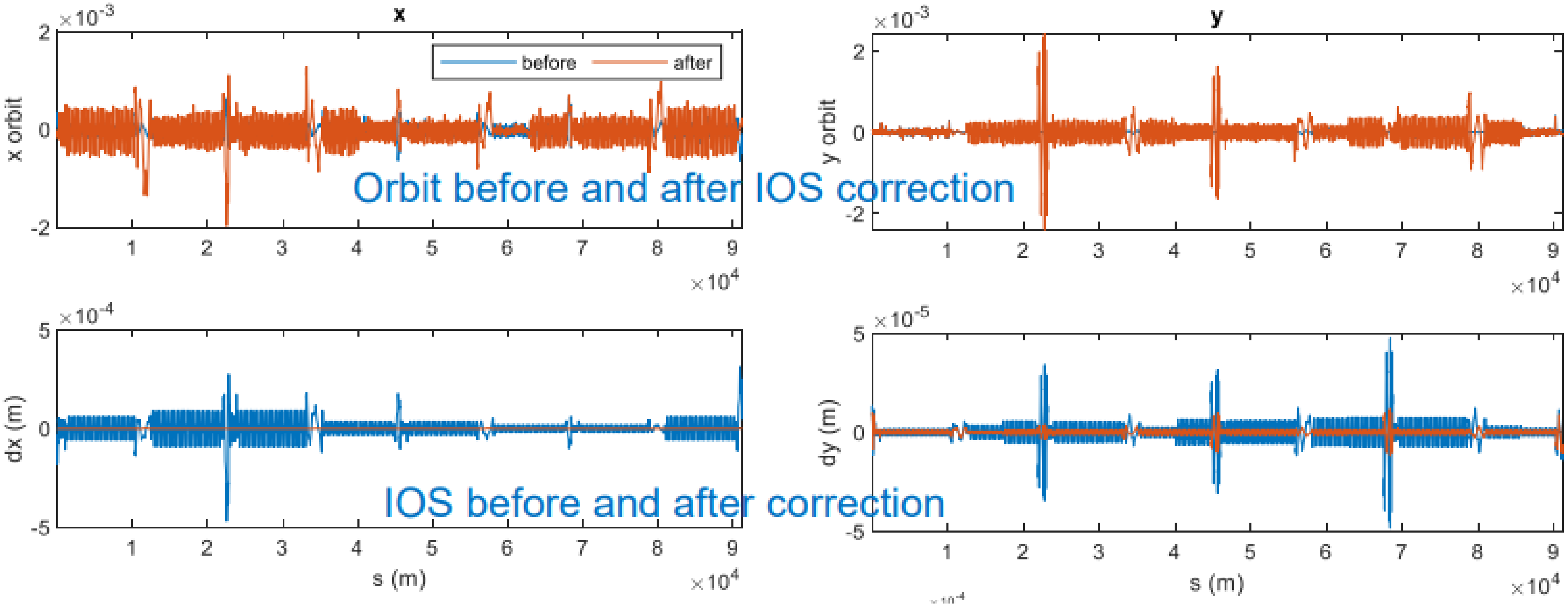
dynamic aperture with errors & w beam-beam

LCC, Z mode, CW 90%, δ=0.005



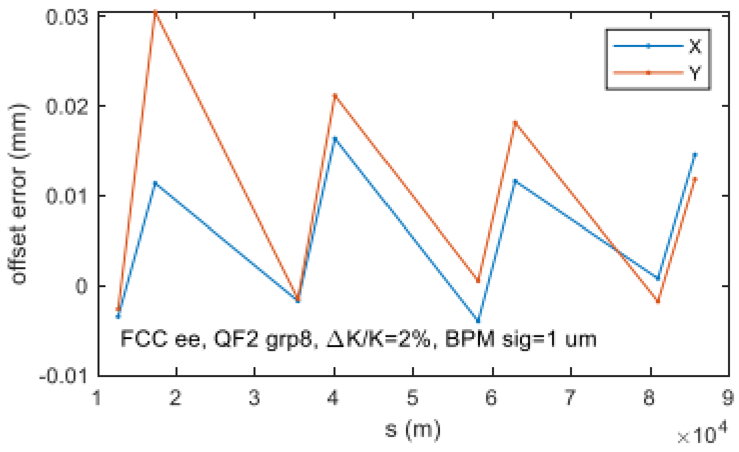
D. Shatilov, BINP

Beam-Based Alignment (BBA) for FCC-ee



"parallel BBA": method tested at SPEAR3

PRAB 25, 052802 (2022)

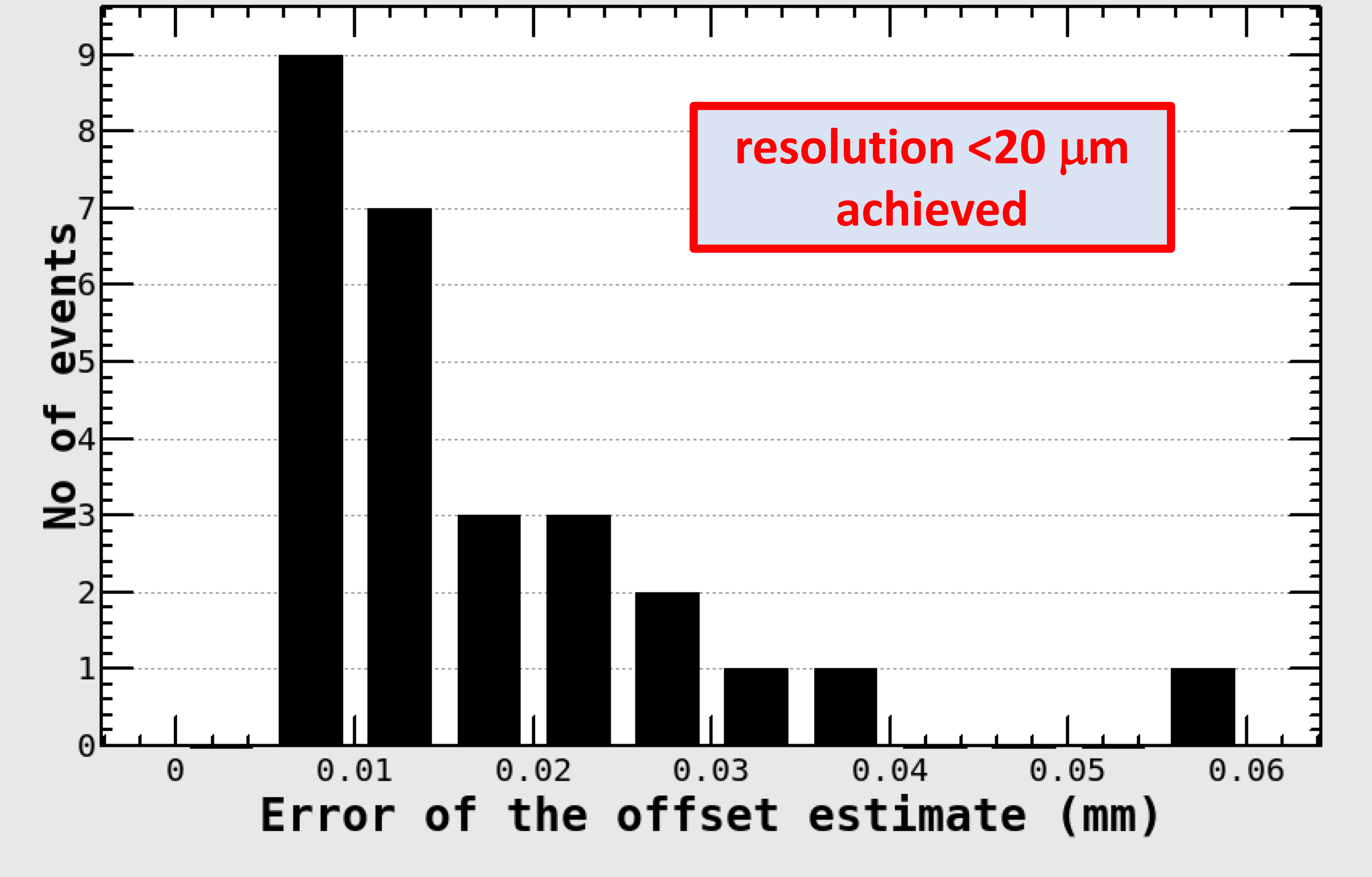


in FCC-ee simulation with 1 μm BPM noise: 10-30 μm resolution for parallel BBA of 8 quadrupoles

X. Huang, SLAC

Beam-Based Alignment (BBA) at KEKB

M. Masuzawa et al., EPAC2000



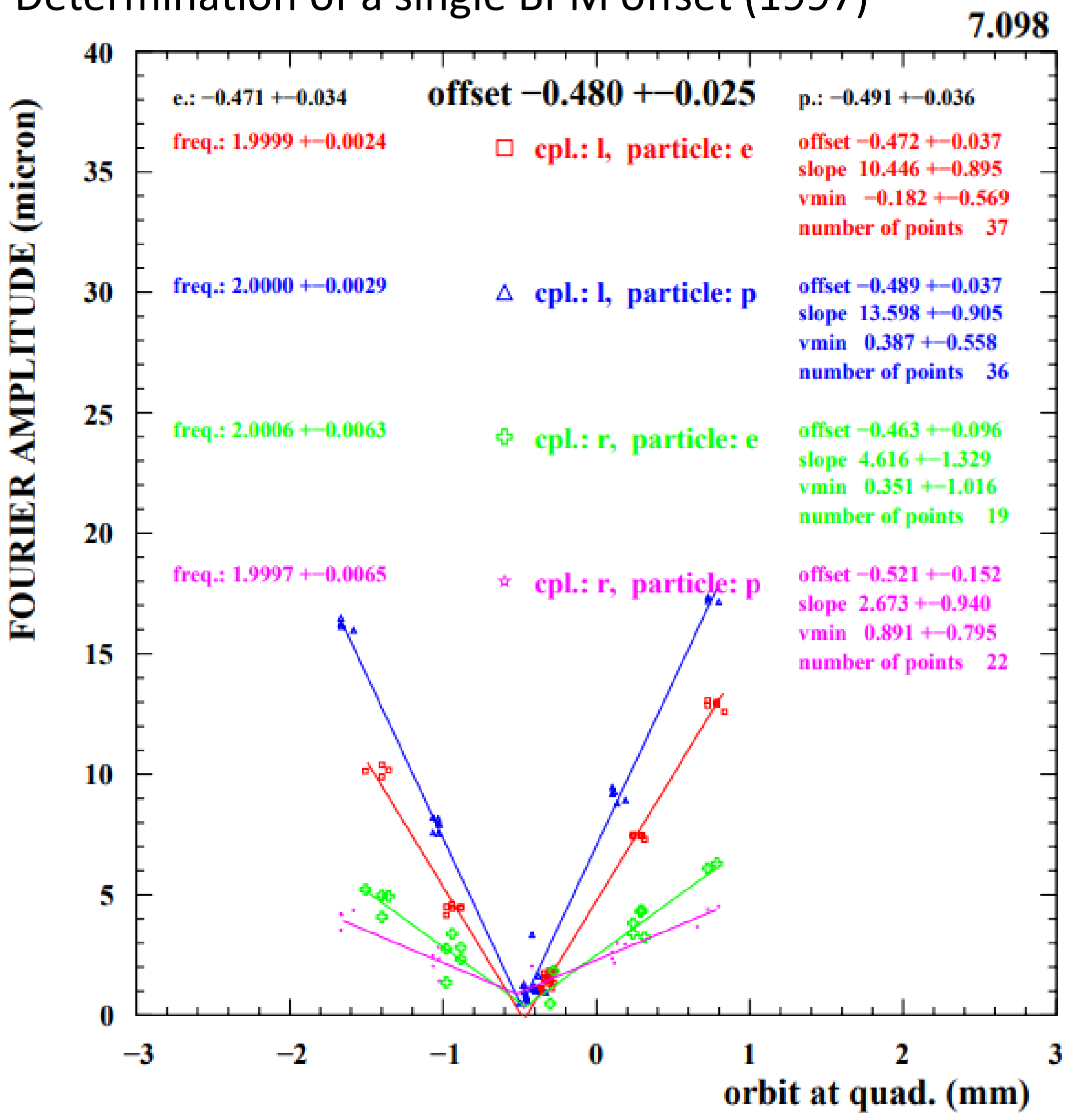
'reproducibility' needs further investigation

hysteresis may shift the magnetic center due to the measurement itself

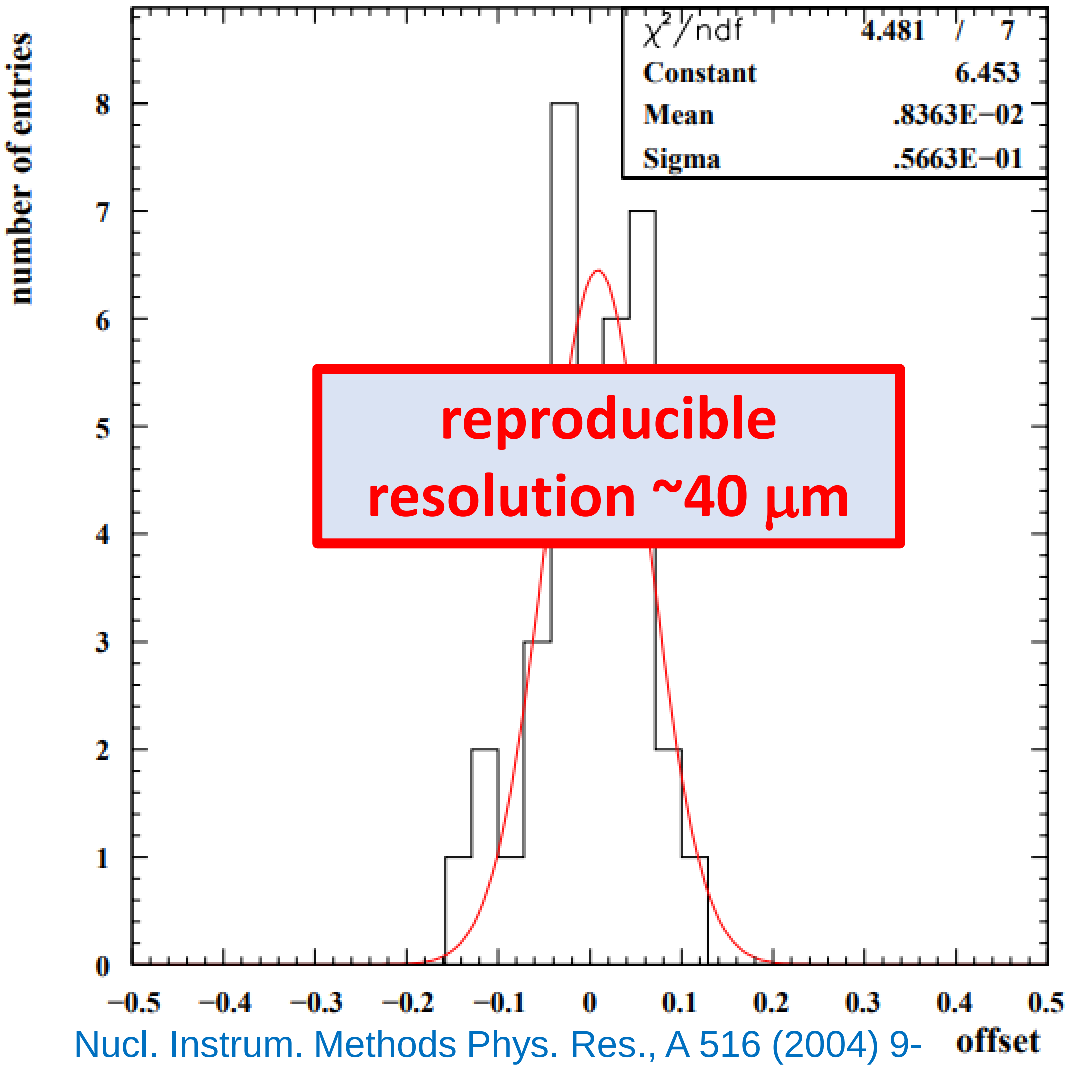
H. Koiso, KEK

Beam-Based Alignment (BBA) at LEP

Determination of a single BPM offset (1997)



Repetitive measurement of a single offset (1998)

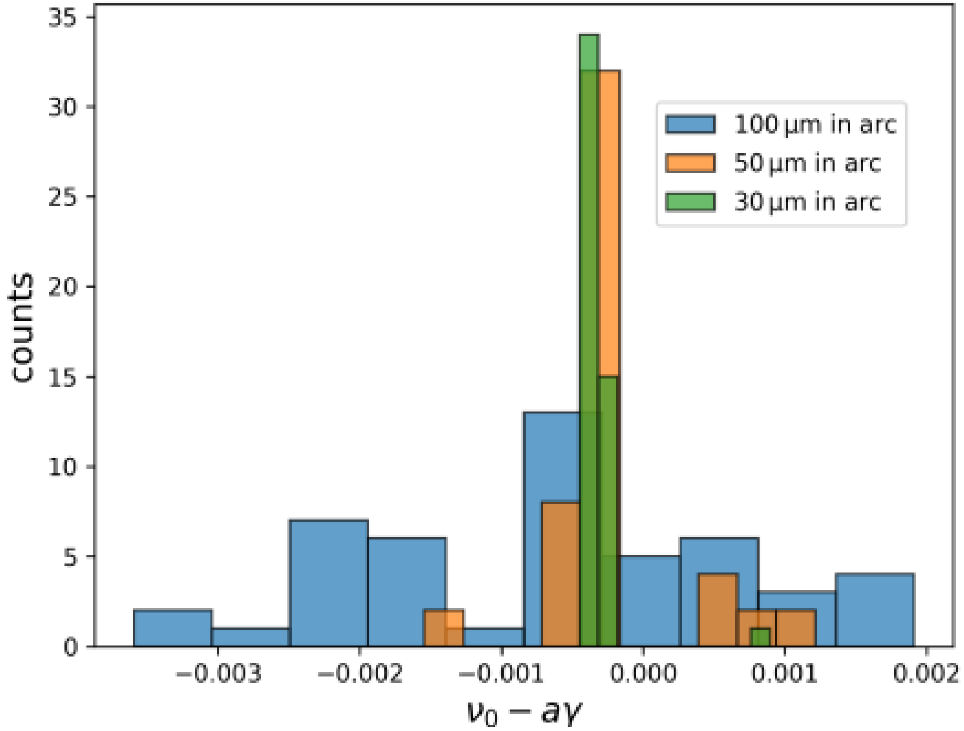


Nucl. Instrum. Methods Phys. Res., A 516 (2004) 9-20

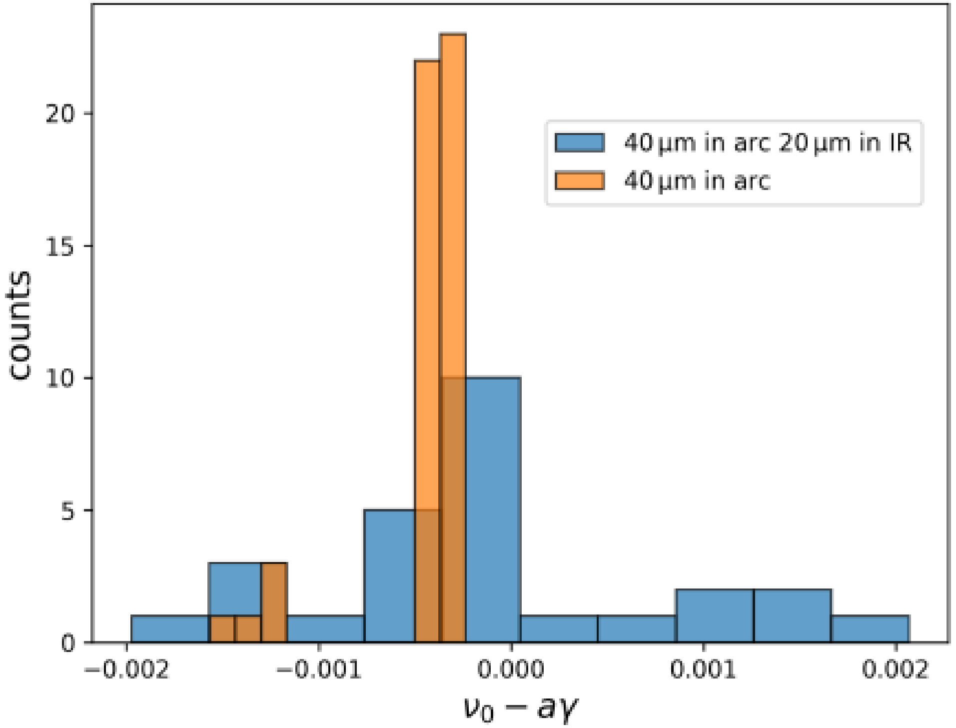
B. Dehning, J. Matheson, G. Mugnai, I. Reichel, R. Schmidt, F. Sonnemann, F. Tecker, CERN

misalignment impact on energy calibration

spin tune shifts away from *aγ* due to errors



different levels of arc misalignments



with and without IR misalignments

we need to achieve $|\nu_0 - a\gamma| \leq 10^{-4}$ – within reach

Y. Wu

FCC-ee SRF system

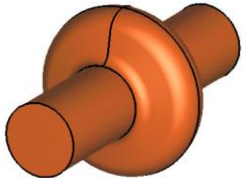
FUTURE CIRCULAR COLLIDER

Universität Rostock · Traditio et Innovatio · INFN LNL Istituto Nazionale di Fisica Nucleare Laboratori Nazionali di Legnaro · Jefferson Lab · Fermilab

F. Peauger, O. Brunner

Z

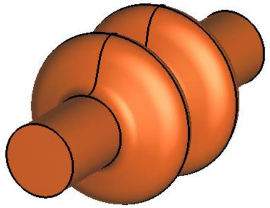
1-cell 400 MHz, Nb/Cu



low R/Q, HOM damping, powered by 1 MW RF coupler and high efficiency klystron

W, H

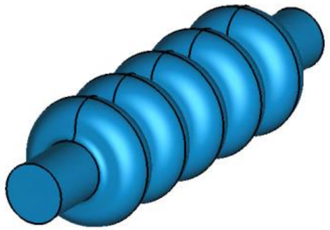
2-cell 400 MHz, Nb/Cu



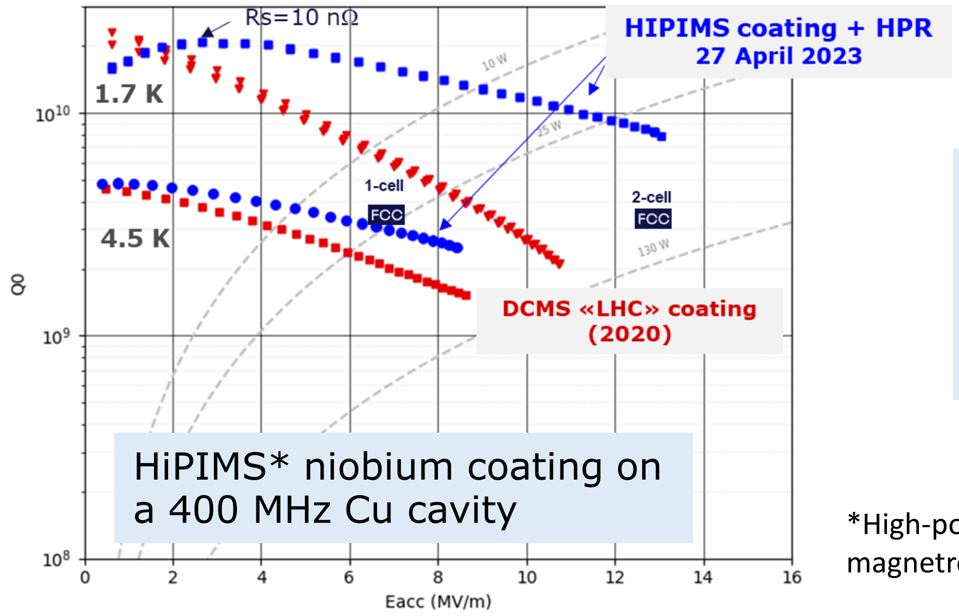
moderate gradient and HOM damping requirements; 500 kW / cavity, allowing reuse of klystrons already installed for Z

ttbar, booster

5-cell 800 MHz, bulk Nb



high RF voltage and limited footprint thanks to multicell cavities and higher RF frequency; 200 kW/ cavity

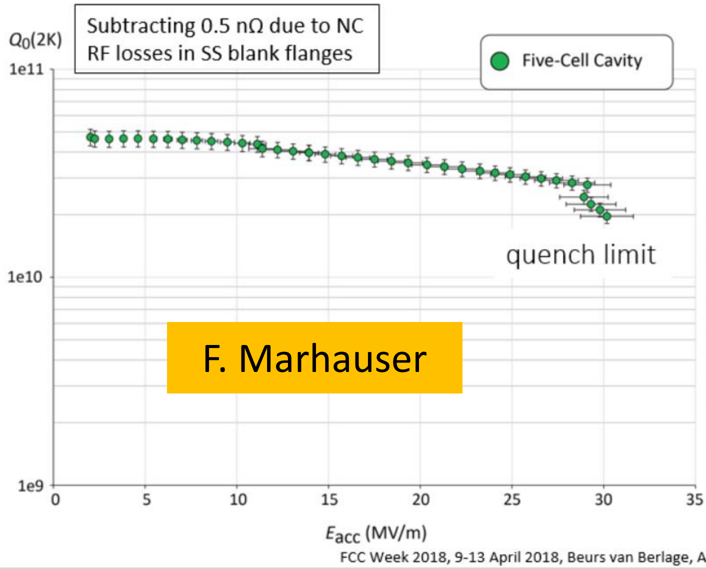


HiPIMS* niobium coating on a 400 MHz Cu cavity

*High-power impulse magnetron sputtering

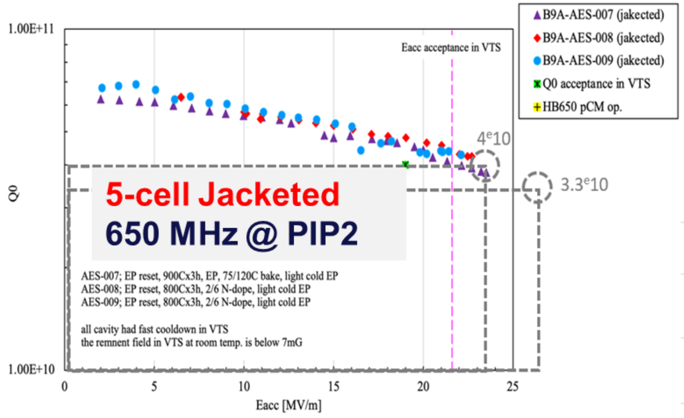
Promising R&D towards ultra-high Q_0. Collaboration with FNAL

5-cell cavity development (2018), successful collaboration with JLAB

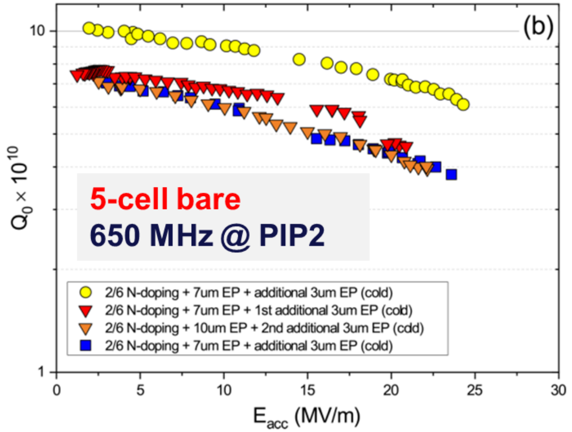


Main post-processing steps

	Unit	CRN5
Bulk BCP	µm	216
High-T heat treatment	°C, hrs.	800, 3
Final EP	µm	30
HPR cycles		4
Low-T bake-out	°C, hrs.	120, 12



Q0 = 3.5e10 @ 25 MV/m with 2/6 N-doping or midT bake + EP

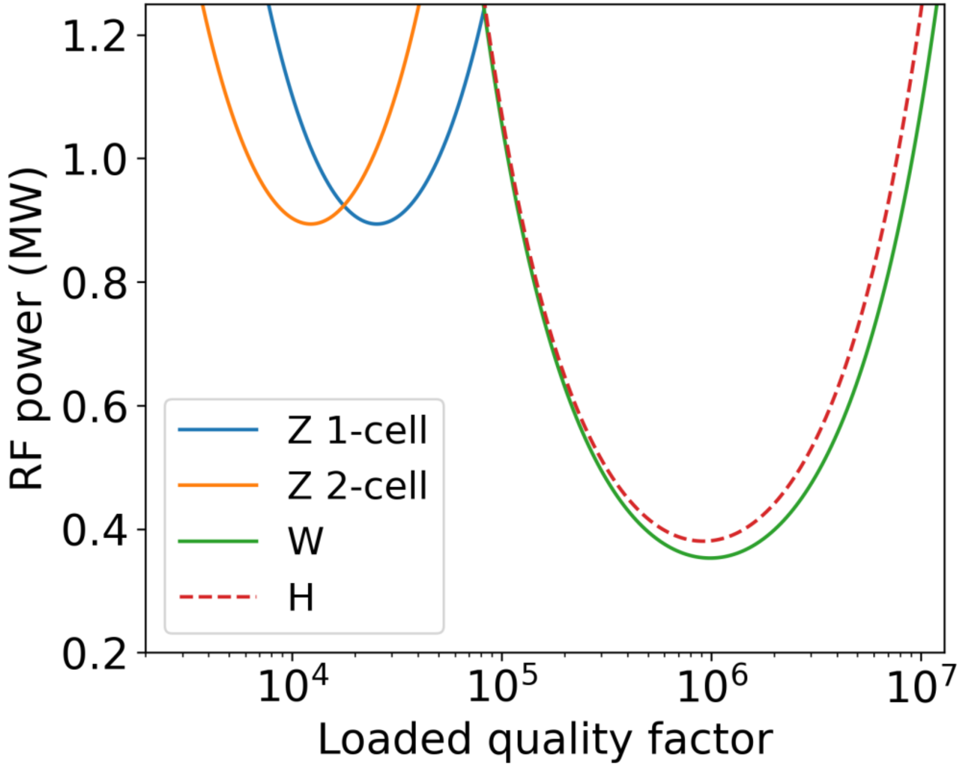


Q0 = 6e10 @ 25 MV/m with 2/6 N-doping + EP + cold EP

FUTURE CIRCULAR COLLIDER

a 2-cell 400 MHz SRF cavity for all energies ?

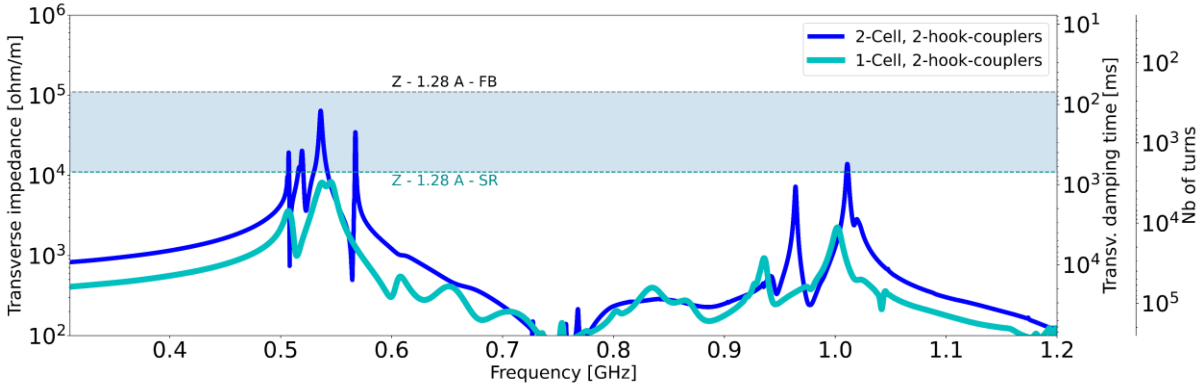
Input RF power for optimum detuning



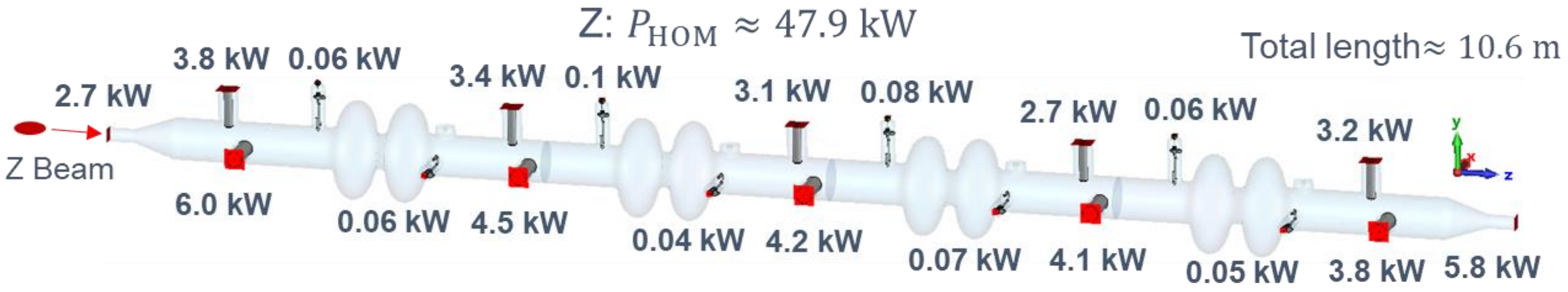
I. Karpov, R. Calaga, E. Montesinos, S. Zadeh, F. Peauger, O. Brunner

- Need for **adjustable/variable fundamental power coupler with wide range of coupling** (2 orders of magnitude)
- Presence of 0-mode requires additional longitudinal feedback

Transverse feedback needed

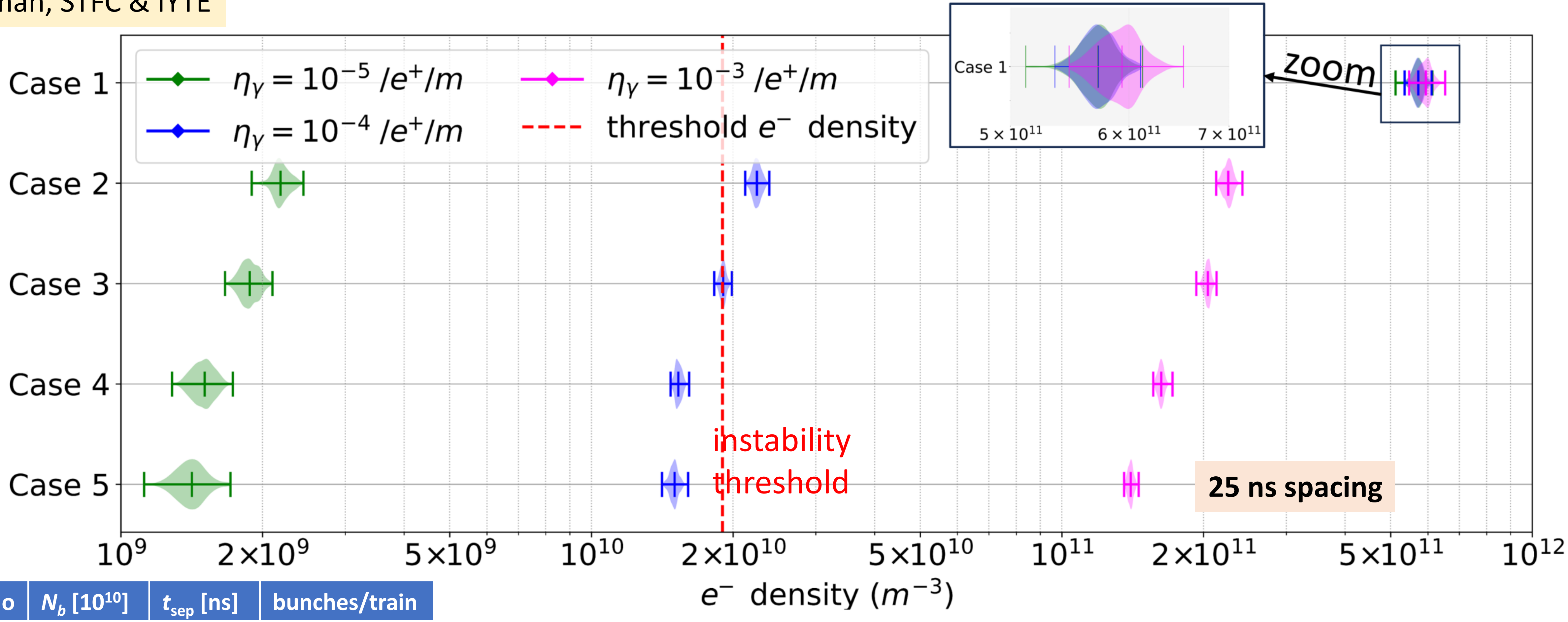


- 40%-increase of **HOM power** per cryomodule is not a showstopper if the **"2-coax concept"** is demonstrated



e-cloud @ Z : photoemission

F. Yaman, STFC & IYTE

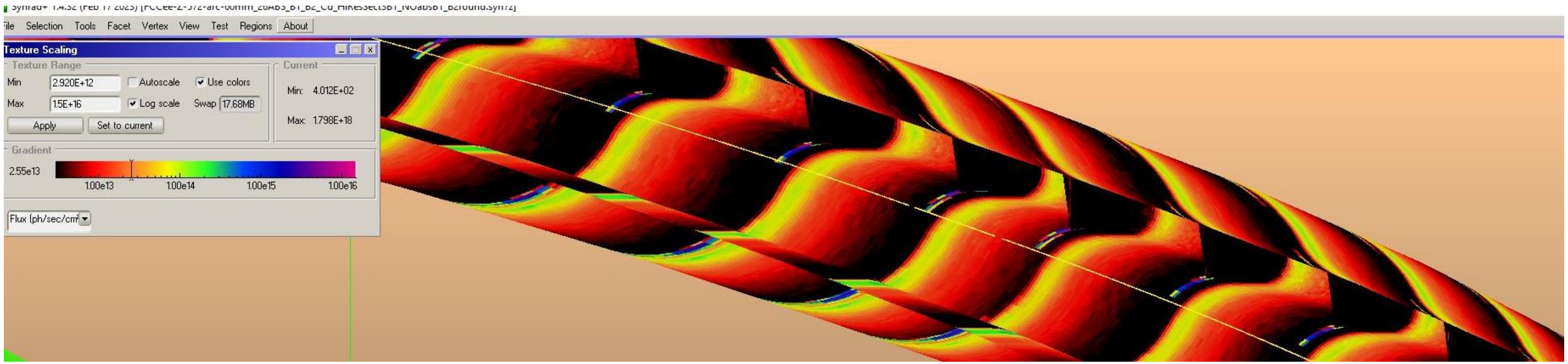


Scenario	N_b [10^{10}]	t_{sep} [ns]	bunches/train
Case 1	15	25	320
Case 2	21.5	25	280
Case 3	21.5	25	560
Case 4	24.3	25	255
Case 5	43.0	50	280

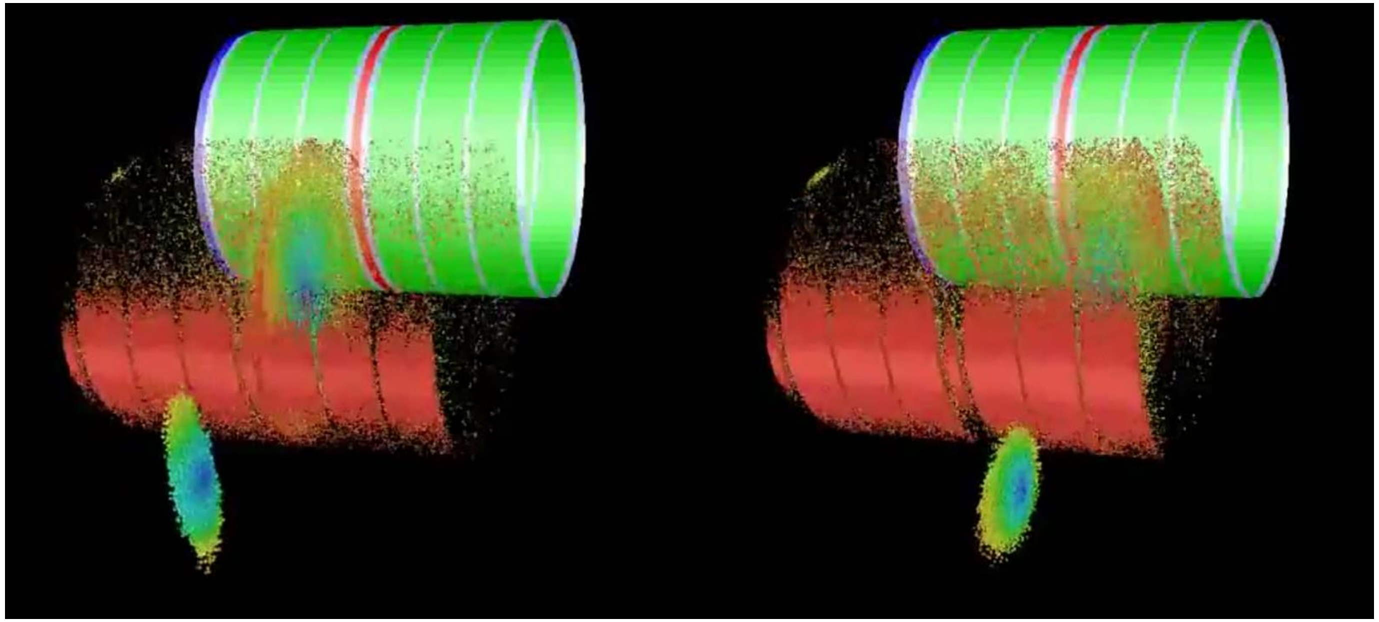
In order to reach a primary photoelectron rate η_γ as low as $10^{-4}/e^+/m$, the **antechamber with its photon stops must absorb 99% of the photons** without reflection into the circular part of the vacuum chamber

effect of non-uniform photoemission?

color-coded SR flux revealing "zebra"-like photon absorption profile along the beampipe with absorbers



R. Kersevan

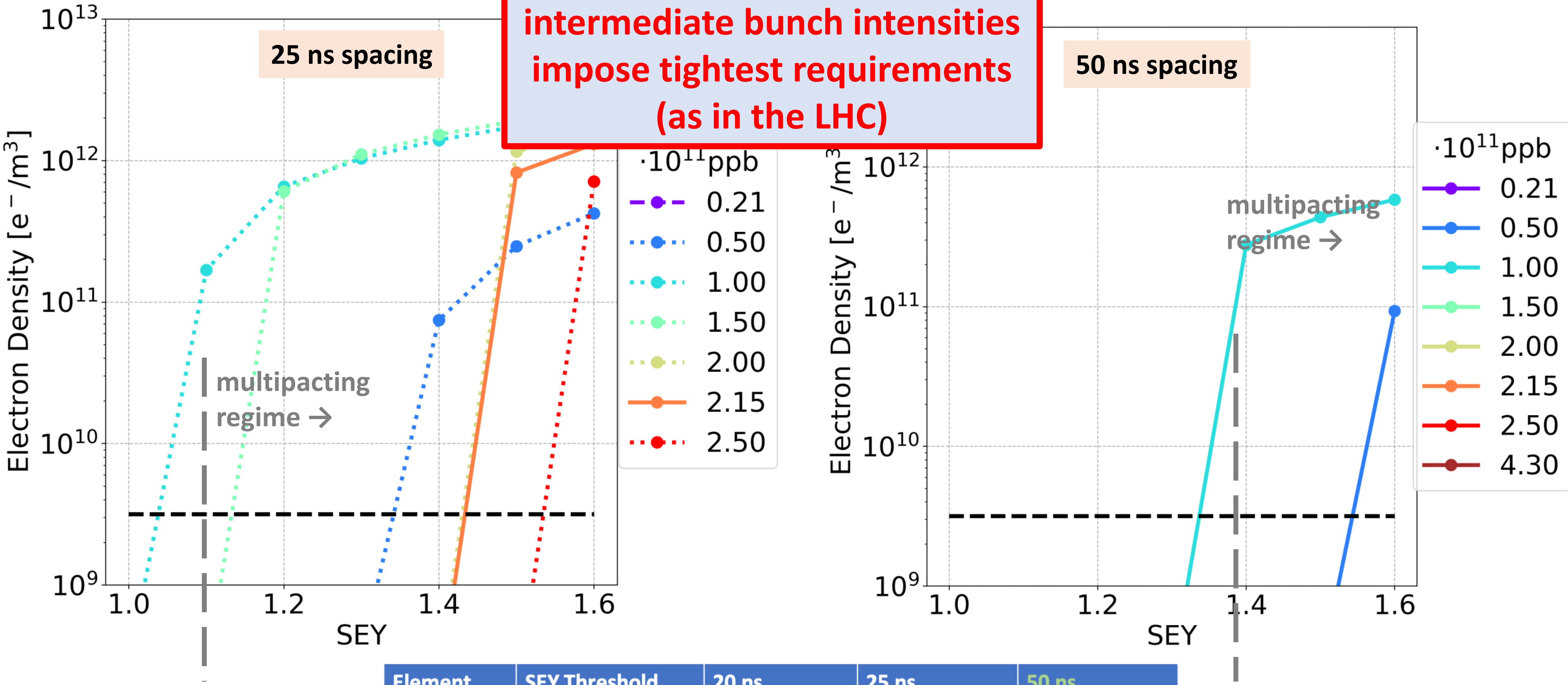


3D WARP + POSINST simulation (example for LHC)

C. Carli, CERNi

J.-L. Vay, LBNL

e-cloud @ Z : multipacting challenge



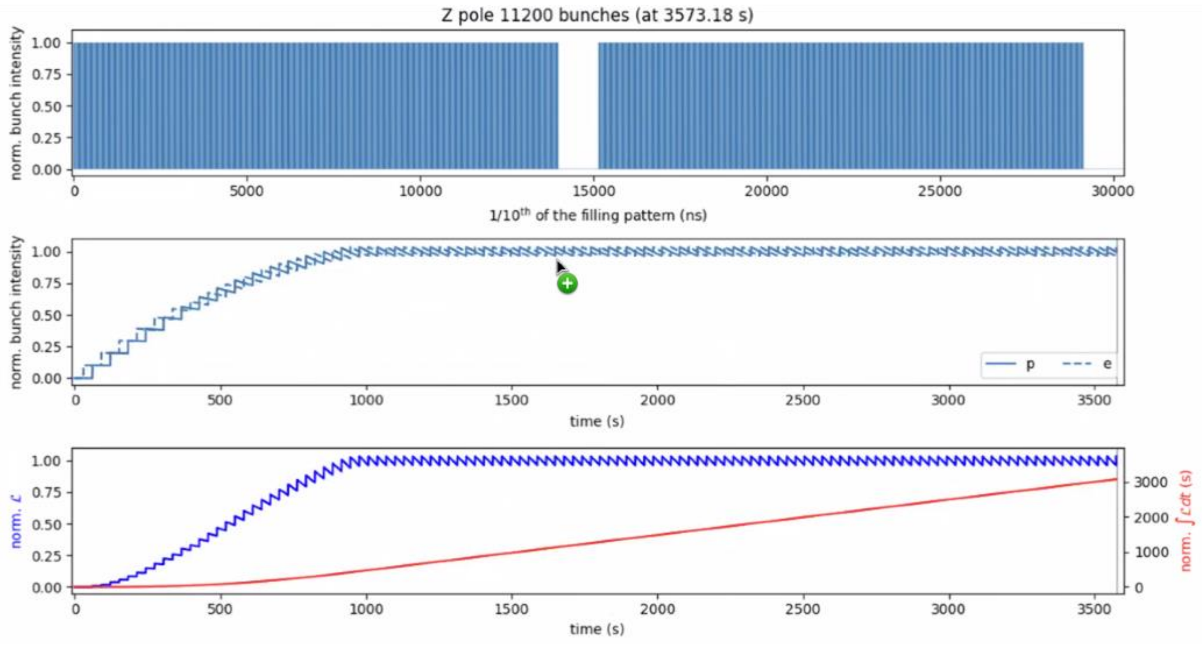
intermediate bunch intensities impose tightest requirements (as in the LHC)

Element	SEY Threshold	20 ns	25 ns	50 ns
Dipole (15.2 mT)	nominal intensity	1.3	1.4	> 1.6
	all intensity below nominal one	1.0	1.0	1.3

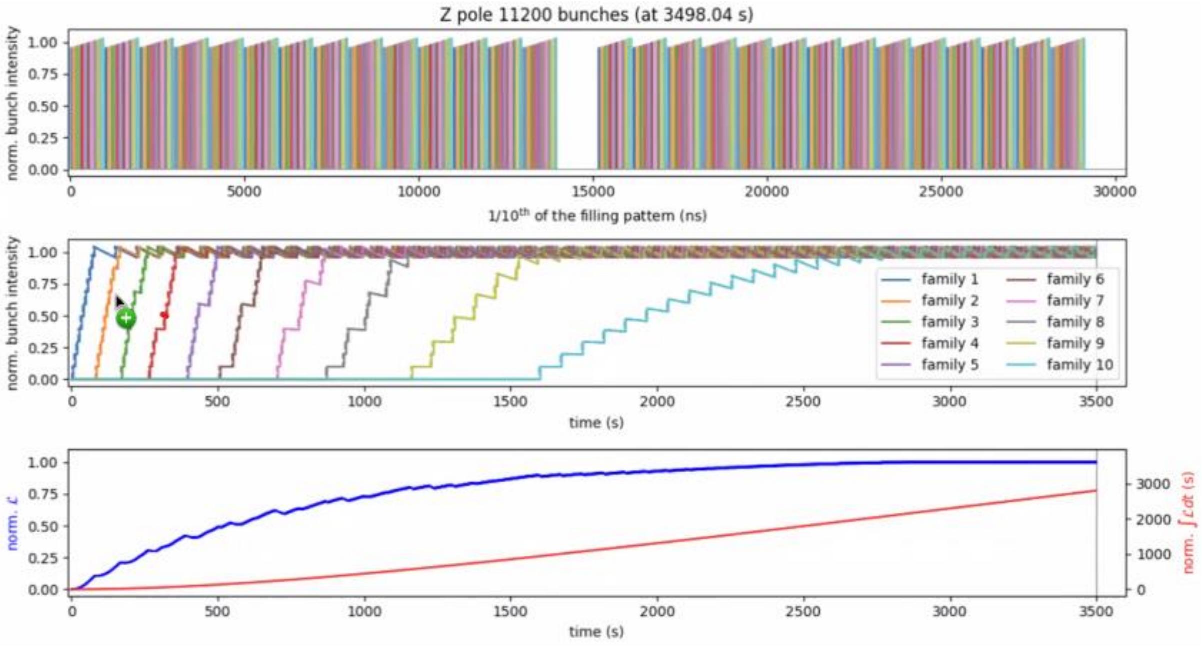
L. Sabato, EPFL

a way out: revised filling scheme

“CDR scheme”



“Carli-Bartosik scheme”



only 1/10 of intensity per booster cycle

- vacuum pressure-tolerant

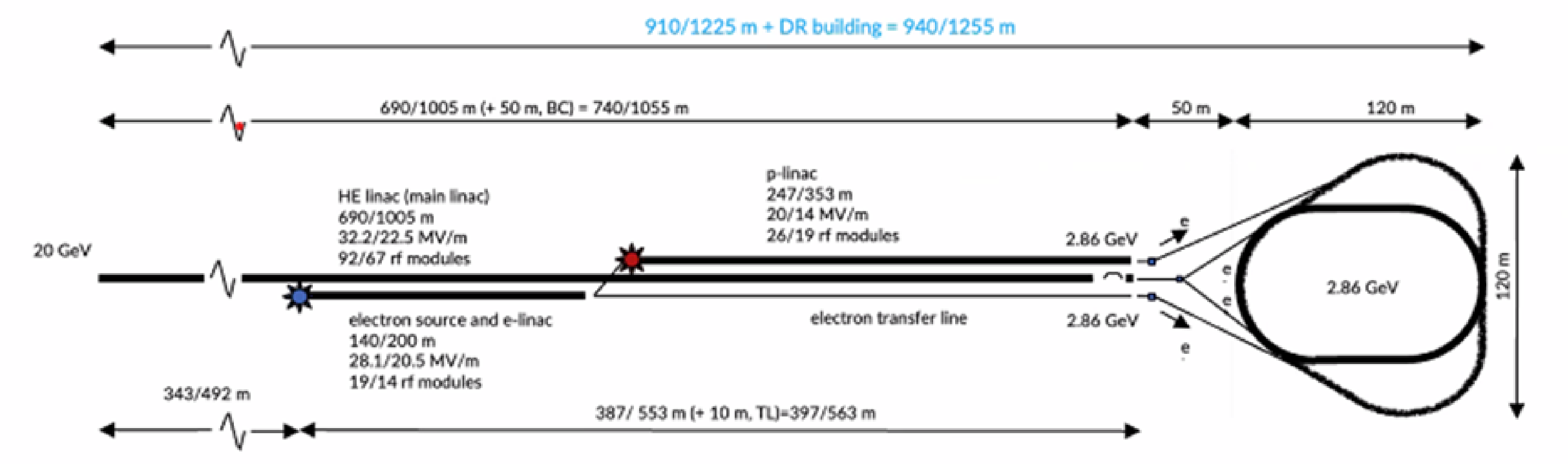
only 1/10 of collider bunches at intermediate intensity

- anti e-cloud build up

yet same integrated luminosity as for CDR scheme !

H. Bartosik, C. Carli, L. Mether, F. Zimmermann

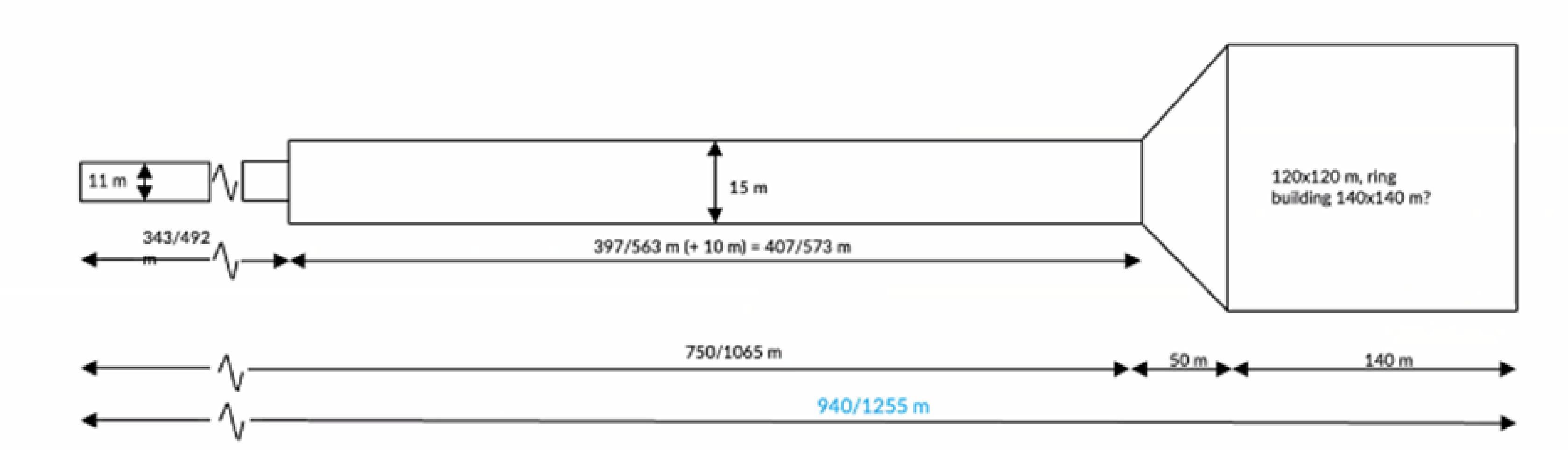
post-MTR: revised injector layout



linac:

- 100 Hz 4 bunches / pulse
- 4 structures / rf module

→ much reduced power consumption (factor 3)



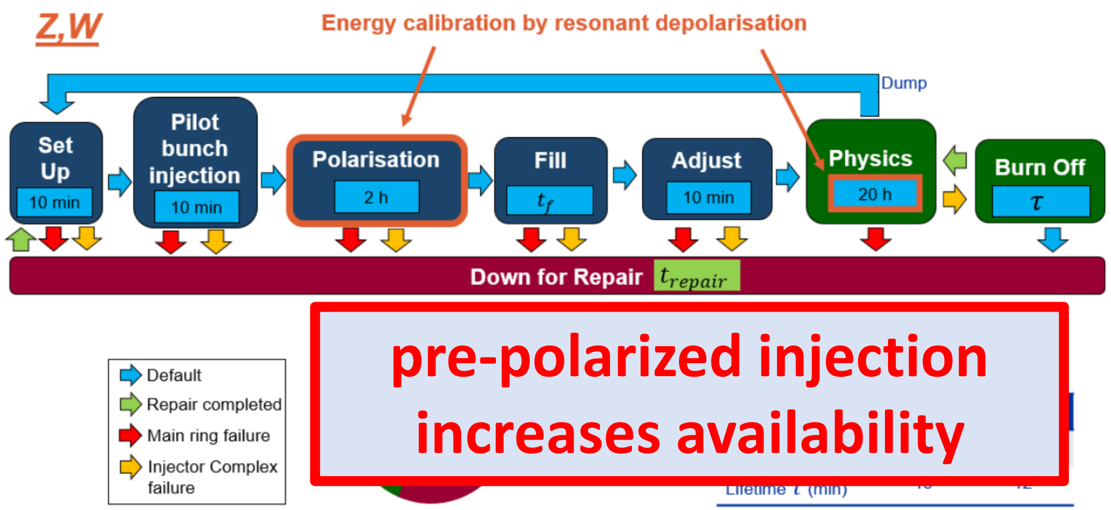
damping ring:

- triangular or racetrack
- SC or permanent magnet wigglers

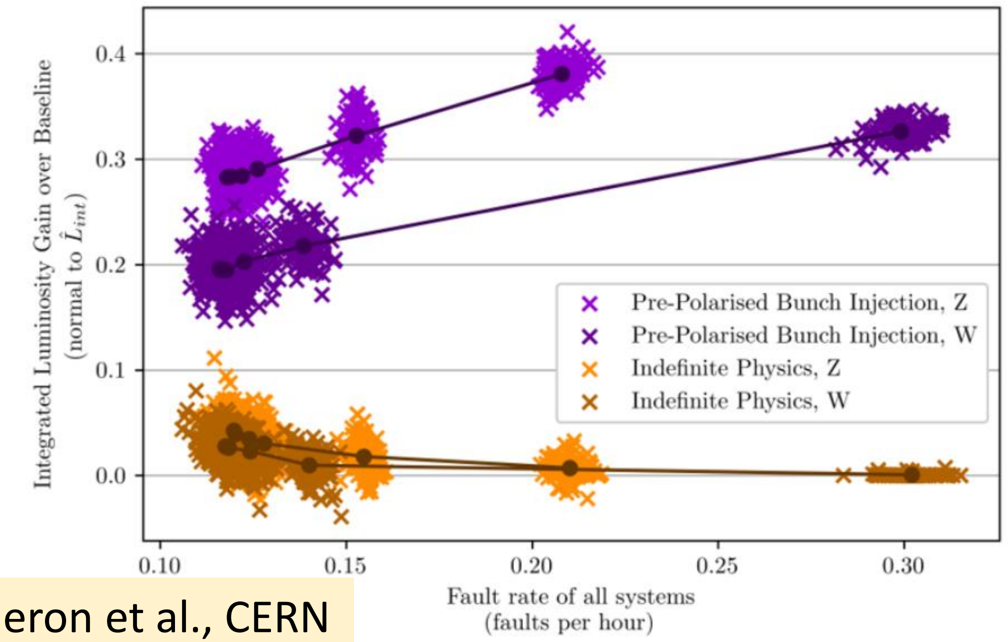
H. Bartosik, P. Craievich, A. De Santis, O. Etisken, A. Grudiev, A. Latina, C. Milardi, I. Papaphilippou,…

injecting polarized pilot bunches ?

FCC-ee Operation Cycle



pre-polarized injection increases availability



booster errors assumed

Courtesy: B. Dalena

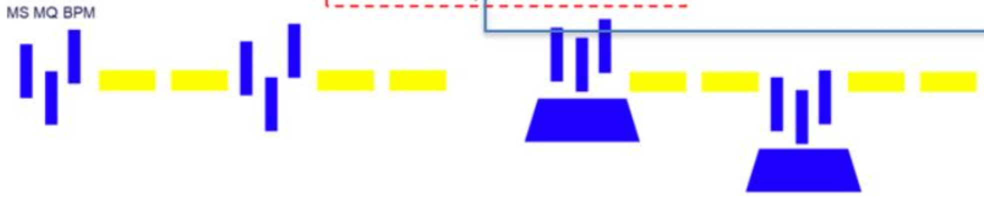
old w/o girders

Error type	σ value
Dipole relative field error	$10^{-4}, 10^{-3}$,
Main dipole roll error	300 μrad
Offset quadrupoles (MQ)	150 μm
Offset BPMs	150 μm
Offset sextupoles (MS)	150 μm
BPMs resolution error	50 μm

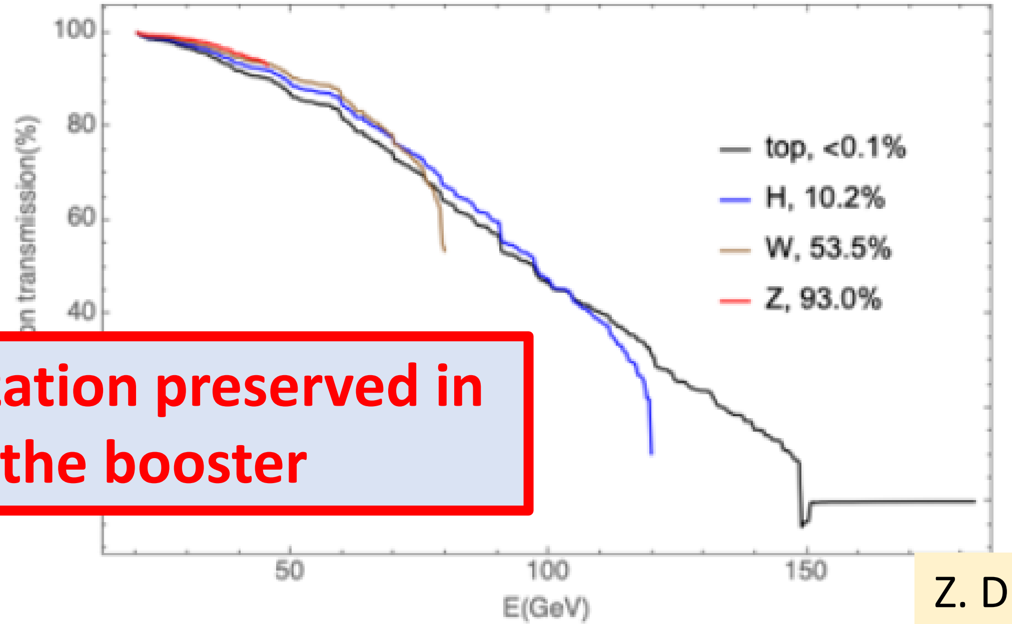
new w girders

Error type	σ value
Dipole relative field error	$10^{-4}, 10^{-3}$,
Main dipole roll error	300 μrad
Offset quadrupoles	200 + 50 μm
Offset BPMs	200 + 50 μm
Offset sextupoles	200 + 50 μm
BPMs resolution error	50 μm

All errors are randomly distributed with ± 3 Gaussian rms.



polarization transmission ~90% (Z), ~60%(W), ~15%(H) and ~0 (top) for different error seeds and lattices



polarization preserved in the booster

J. Heron et al., CERN

Z. Duan, IHEP

IP collision feedback: offset signatures

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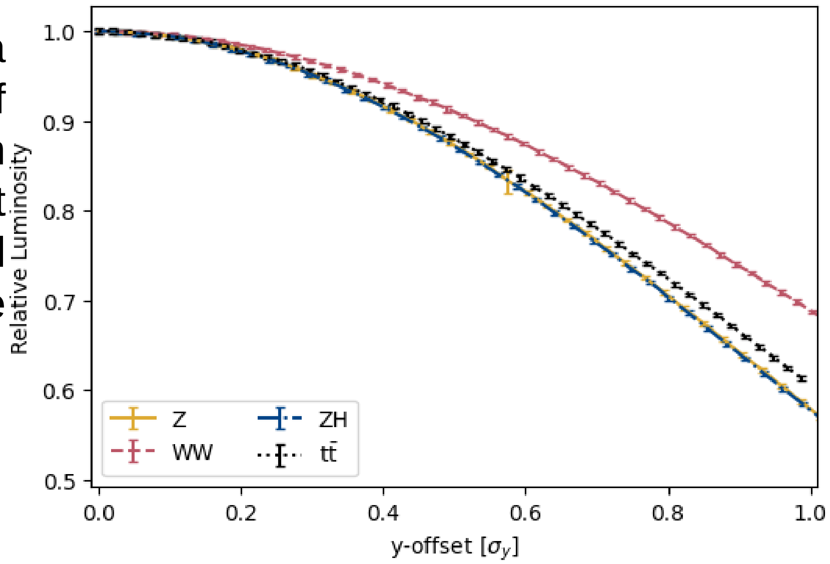
UNIVERSITY OF OXFORD

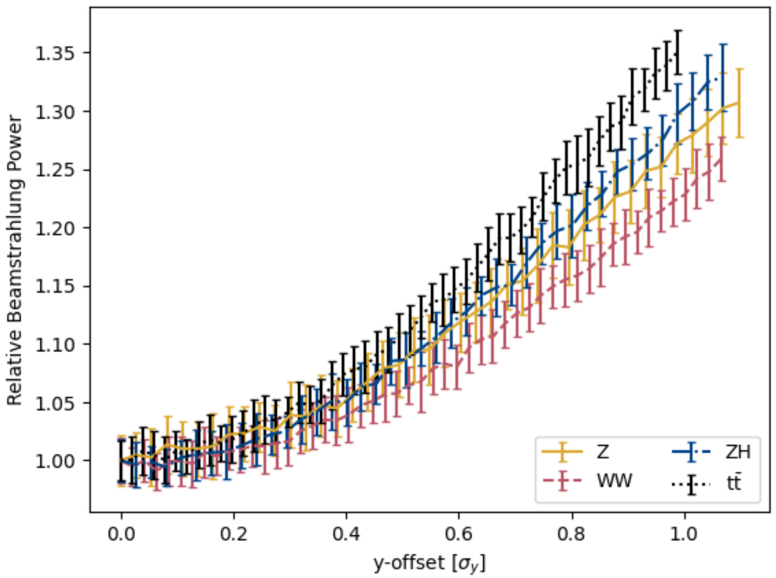
luminosity as a function of incident beam offset for the vertical plane



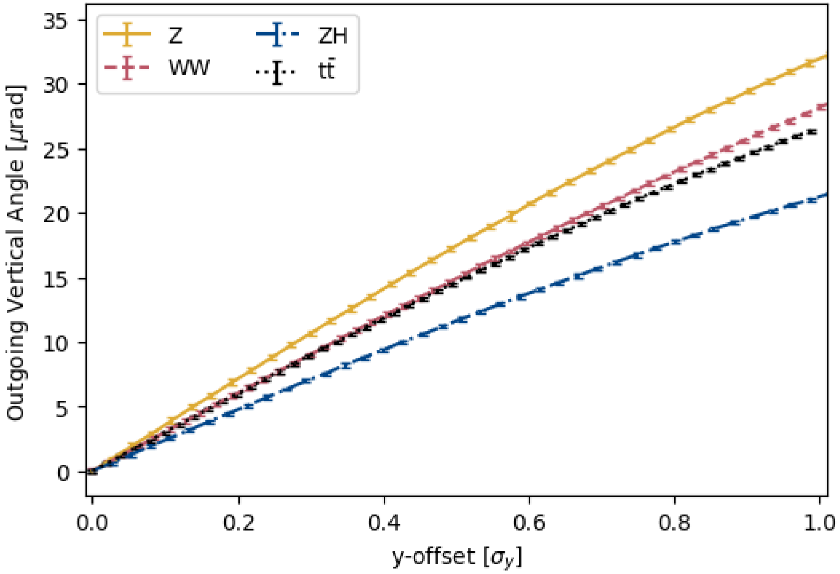
beamstrahlung power as a function of incident beam offset in the vertical plane

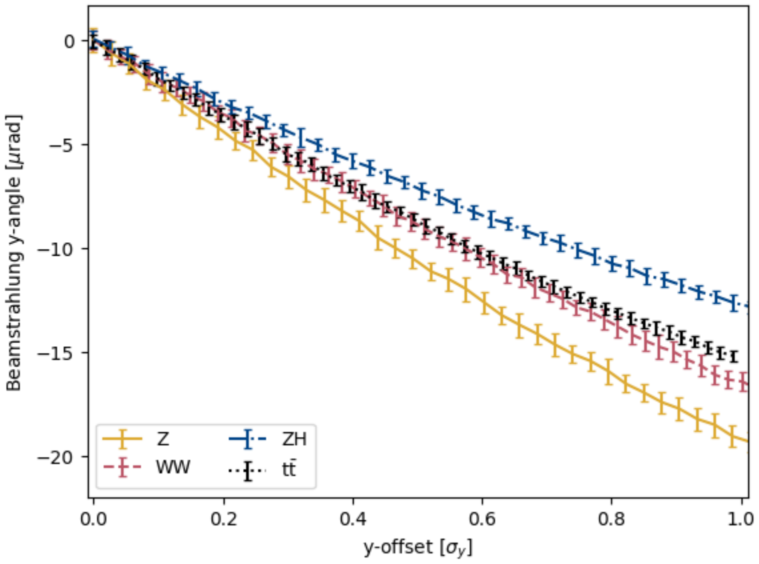
precise energy calibration requires:

$$\Delta y^* < 0.02\sigma_y^*$$



outgoing centroid beam deflection as a function of incident beam offset for the vertical plane

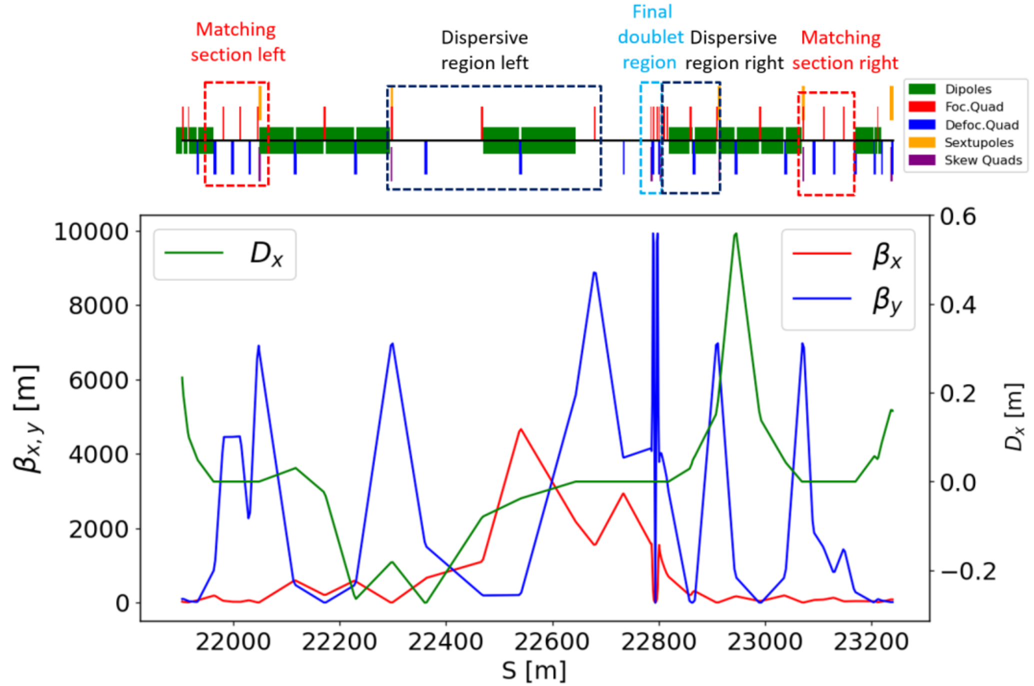




beamstrahlung angle as a function of incident beam offset for the vertical plane

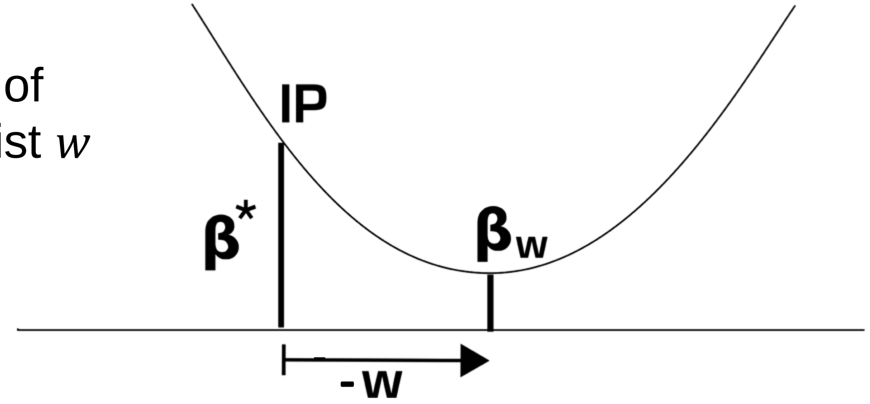
J. Salvesen

IP optics tuning knobs

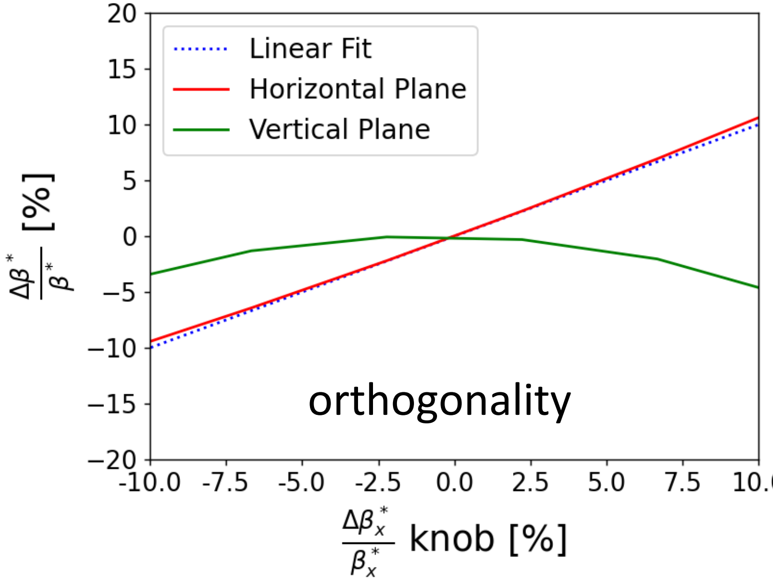


interaction region (IR) layout and magnets used for developing the tuning knobs, including optical functions

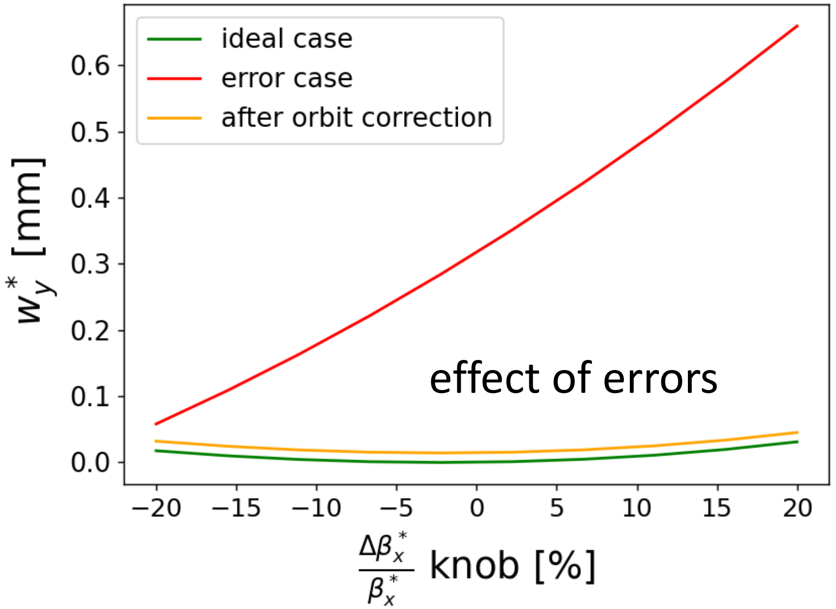
schematic of $\beta*$ and waist w



evolution of $\Delta\beta^*_{x,y}/\beta^*_{x,y}$ vs $\Delta\beta^*_x/\beta^*_x$ knob setting



orbit correction is important for knobs to work



evolution of w^*_y vs $\Delta\beta^*_x/\beta^*_x$ knob setting for the raw orbit distortion (red) and after closed-orbit correction (orange)

S. Sai,
L. van Riesen-Haupt,
F. Carlier,
M. Hofer

optimizing luminosity with IP tuning

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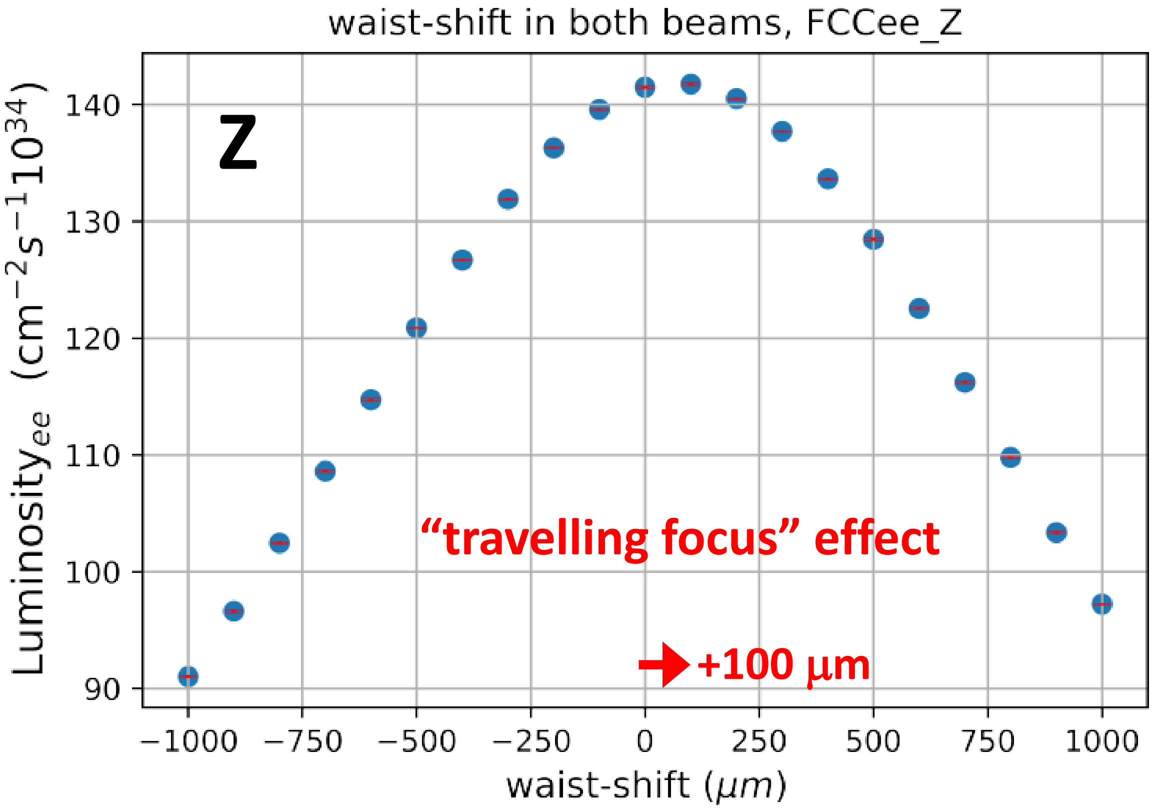
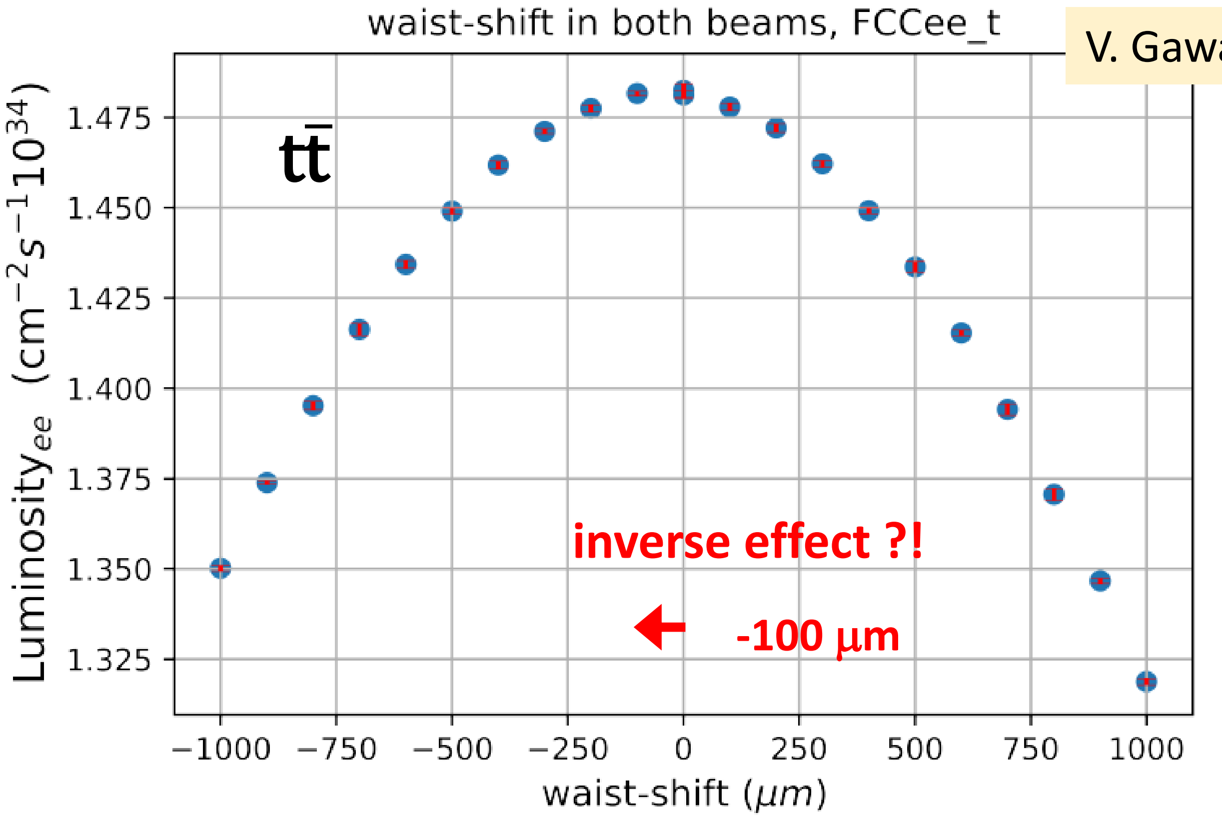
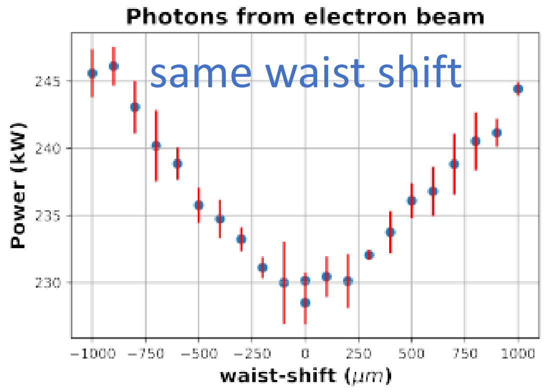
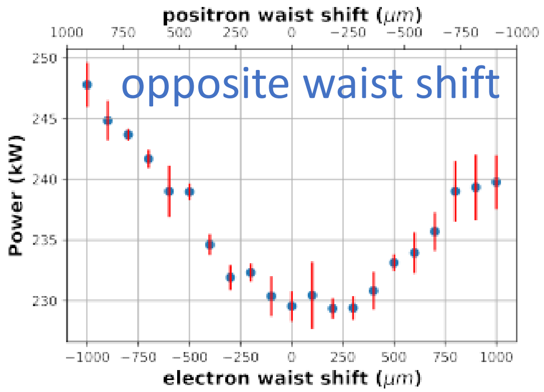
V. Gawas



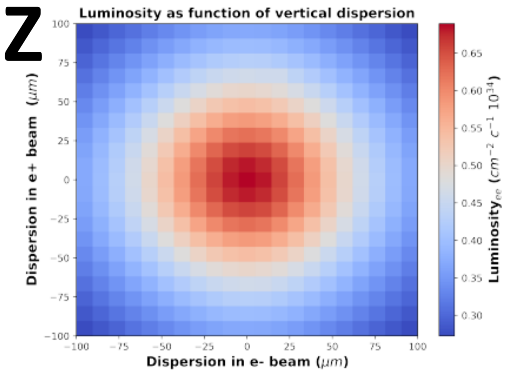


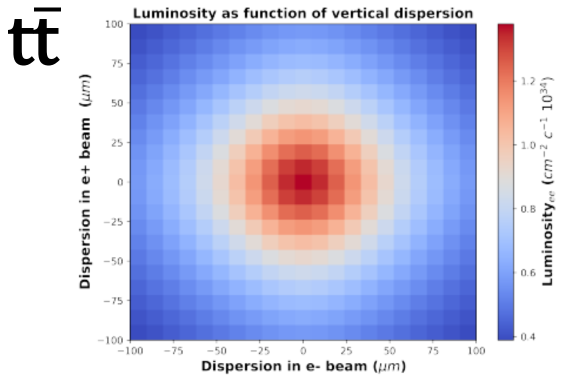
e$^-$ beamstrahlung power versus e$^+$/e$^-$ waist shift





luminosity versus residual e$^+$/e$^-$ vertical IP dispersion D_y*





mid-term review recommendations for FCC-ee acc. design

from FCC SAC, FCC CRP, CERN SPC, and CERN FC

- ✓ **well-defined baseline layout for the entire FCC-ee machine, including injector; optimise e^+e^- injector, especially the linac design**; examine failure modes at injection

- clarify **order of the energy stages**, with motivation for running order linked explicitly to the physics case

- ✓ **consolidate design of the RF system** to allow efficient energy-staging, as well as to reduce complexity, risk, and cost; study **options to avoid the 1-cell/2-cell RF cavity reconfiguration between Z and ZH/WW running**, in order to simplify the SRF system implementation and to **improve flexibility in the physics programme**

- complete beam physics studies, including **alternative beam optics, to understand and improve the dynamic aperture with relaxed mechanical alignment tolerances**

- **develop survey and alignment techniques**, procedures and instrumentation, **to guarantee the alignment of magnets [on the girder] to perhaps 50 μm at 1 σ,** study the need for motorised jacks on the girders; develop automated alignment procedures (e.g. allowing remote beam-based alignment); **develop and apply, in simulations, the whole set of beam-based correction techniques with high priority**

- **identify residual risks to achieving the design luminosity, with lessons to be learnt from other facilities like SuperKEKB, and specify required further critical-path R&D**

towards a risk register

risk	impact	mitigations
insufficient dynamic aperture with errors & correction	beam lifetime shorter than design value	intensity margins in the injector complex; optics with relaxed β_y*
larger than expected beam-beam emittance blow up	decrease in specific luminosity	better optics correction and BBA to minimize bare emittance; at Z also reducing detector field
electron cloud at the Z	emittance blow up, instabilities	bunch trains with gaps, or 50 ns spacing
dust events	sudden local beam losses	install clean & coated chambers
unexplained sudden beam loss	limited beam current	adequate beam diagnostics, machine protection
collimator damage	limited beam current, background	reinforced machine protection, improved collimator materials & collimator design
unacceptable detector backgrounds	constraints on data taking	IR masking, collimator set up, improved halo control, modified to-up injection scheme
radiation to electronics, single-event upsets	beam aborts, loss of functionality	additional shielding where needed; relocation to alcoves; radiation-hard electronics
insufficient machine availability	reduced integrated luminosity	cryo and/or RF upgrades / additions
ground motion & magnet vibrations	optics degradation, beam blow-up, reduced luminosity	feedback systems, for beam and/or components; tracing and removing noise sources
collision offset >1 nm & D_y*> 1 μm	collision energy precision > 100 keV	improved IP tuning or larger β_y*

FCC-hh main machine parameters

FUTURE CIRCULAR COLLIDER

parameter	FCC-hh	HL-LHC	LHC
collision energy cms [TeV]	84 - 120	14	
dipole field [T]	14 - 20	8.33	
circumference [km]	90.7	26.7	
arc length [km]	76.9	22.5	
beam current [A]	0.5	1.1	0.58
bunch intensity [10^{11}]	1	2.2	1.15
bunch spacing [ns]	25	25	
synchr. rad. power / ring [kW]	1100 - 4570	7.3	3.6
SR power / length [W/m/ap.]	14 - 58	0.33	0.17
long. emit. damping time [h]	0.77 – 0.26	12.9	
peak luminosity [10^{34} cm^{-2}s^{-1}]	~30	5 (lev.)	1
events/bunch crossing	~1000	132	27
stored energy/beam [GJ]	6.3 – 9.2	0.7	0.36
Integrated luminosity/main IP [fb^{-1}]	20000	3000	300

With FCC-hh after FCC-ee: significantly more time for high-field magnet R&D aiming at highest possible energies

Formidable challenges:

- ❑ high-field superconducting magnets: 14 - 20 T
- ❑ power load in arcs from synchrotron radiation: 4 MW → cryogenics, vacuum
- ❑ stored beam energy: ~ 9 GJ → machine protection
- ❑ pile-up in the detectors: ~1000 events/xing
- ❑ energy consumption: 4 TWh/year → R&D on cryo, HTS, beam current, …

Formidable physics reach, including:

- ❑ Direct discovery potential up to ~ 40 TeV
- ❑ Measurement of Higgs self to ~ 5% and ttH to ~ 1%
- ❑ High-precision and model-indep (with FCC-ee input) measurements of rare Higgs decays ($\gamma\gamma$, Zγ, μμ)
- ❑ Final word about WIMP dark matter

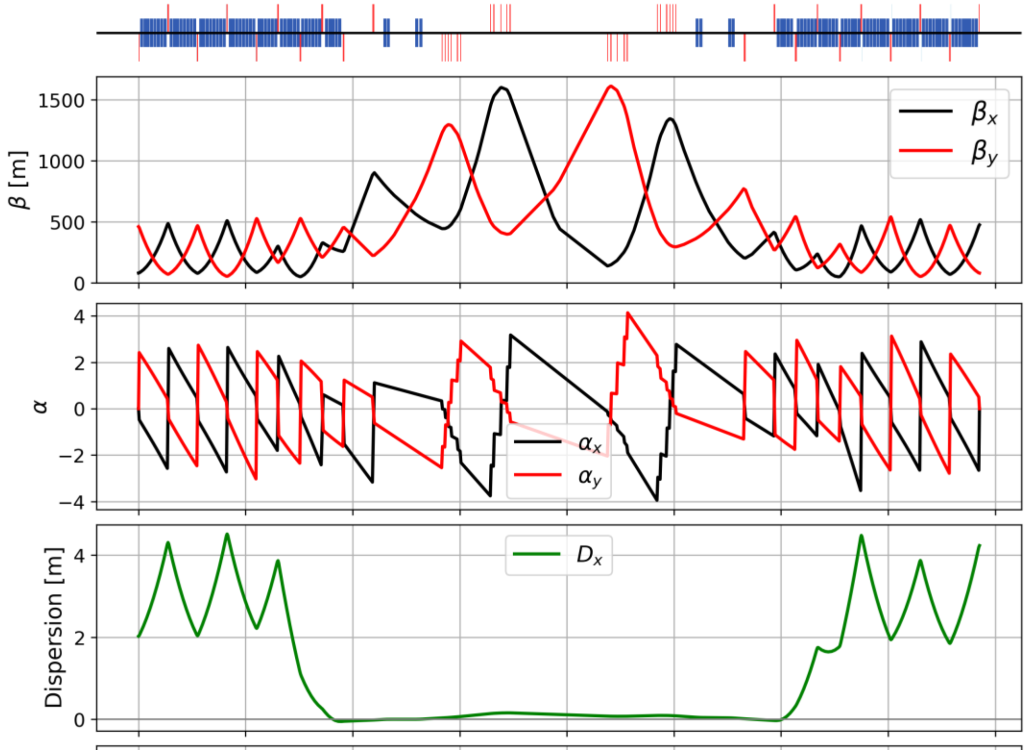
F. Gianotti

FCC-hh optics design & collimation

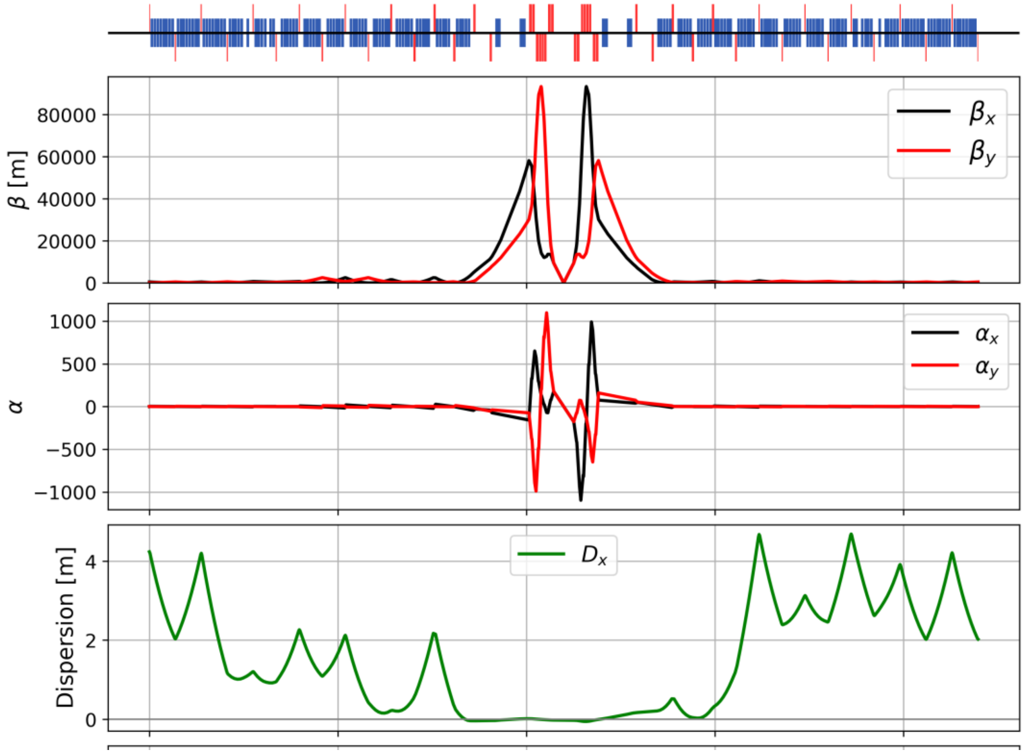
A. Abramov, W. Bartmann, M. Giovannozzi, S. Izquierdo Bermudez, G. Perez, T. Risselada, E. Todesco

- adaptation to new layout and geometry
- shrank β collimation & extraction by ~30%
- optics optimisation (filling factor, combined function options, etc.)

- validation of collimation performance
- injector options (LHC, scSPS, …)
- considerations on injection energy



betatron collimation straight



experimental straight

examples for possible FCC-ee diversity program

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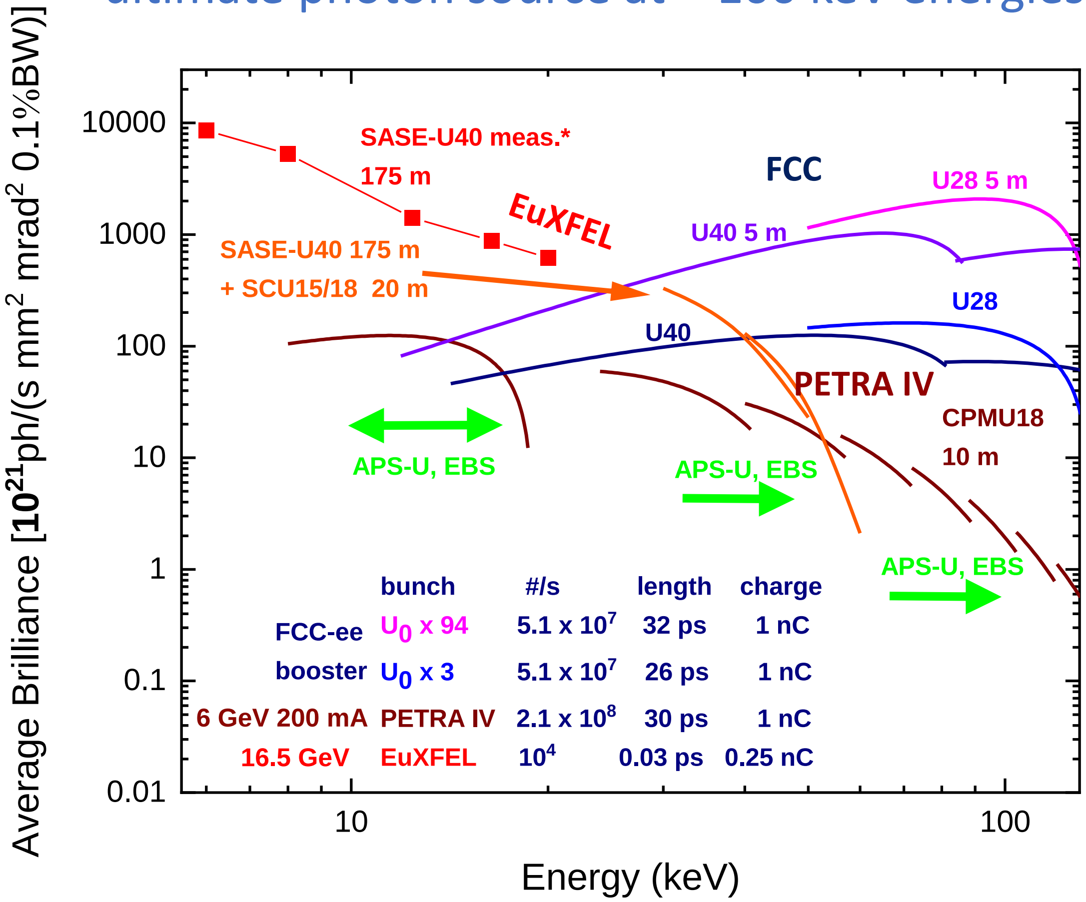
World's most powerful light source for very hard X-rays

ultimate photon source at ~100 keV energies



FCC-ee booster at injection with 28 (40) mm period undulator (wiggler) offers highest average brilliance at E_γ>30 keV

S. Casalbuoni, EuXFEL

Compton-back scattering source at >10 GeV energies

Comparison of ELI-NP and FCC-ee Compton Backscattering Source (FCC-ee-CBS), assuming Yb:YAG laser (2.3 eV)

	ELI-NP	FCC-ee-CBS-20	FCC-ee-CBS-45
beam energy [GeV]	0.72	20	45.6
average beam current [A]	0.8x10^{-6}	0.15	0.15
beam size at laser CP [mm]	~0.5	~0.5	~0.5
max photon energy [GeV]	**0.02**	**14**	**73**
photon flux [1/s]	**10^9**	**~10^{14}**	**~10^{14}**

3-5 orders of magnitudes more flux and higher photon energy than ELI-NP

Non-perturbative QED Experiments – proving the boiling of the QED vacuum

Comparison of FCC-ee QED explorer configurations and the European XFEL based LUXE proposal.

	LUXE	**FCC-ee linac**	**FCC-ee booster**
beam energy [GeV]	14 (17)	20	20 or 45.6
conversion	bremsstr.	bremsstrahlung	laser Compton (cf above)
bunch charge [nC]	0.25 (1)	**3**	**3** (fraction converted to γ)
#bunches	1	2 or 4	up to 16,000
repetition rate [Hz]	1 (10)	100	3,000
rms spot size [μm]	5	3 (1 cm β)	30

M. Benedikt, F. Zimmermann, M. Doser, S. Casalbuoni, 10.5281/zenodo.7675663

Tuesday - FCC-ee baseline design & optics, top-up, chair Angeles Faus-Golfe/IJCLab , 8h30-10h00

GHC optics & parameters, Katsunobu Oide/U Geneva

Beam-beam studies for FCC-ee, Peter Kicsiny/EPFL

FCC-ee collimation, Giacomo Broggi, Sapienza

Top-up injection, Yann Dutheil/CERN

Optics alternatives & lessons optics, chair Mika Masuzawa/KEK, 10h30-12h00

LCC Optics, Pantaleo Raimondi/FNAL

Nested Magnet Optics for FCC-ee, Leon Van Riesen - Haupt/EPFL

Monochromization Optics, Angeles Faus-Golfe/IJCLAB

The IOTA Research Program and Possible Studies Relevant for the FCC, Giulio Stancari/FNAL

FCC accelerators: FCC-ee injector incl. booster I, chair: Mark Palmer/BNL, 13h30-15h00

High-energy booster overview, Adnan Ghribi / GANIL

RF-based optimisation of the booster cycle, Alice Vanel/CERN

Booster and collider filling scheme, Hannes Bartosik/CERN

Injector complex: status and outlook, Paolo Craievich/PSI

Injection/extraction systems across the complex, Sen Yue/ CERN

Still Tuesday - FCC-ee injector incl. booster II, chair: Sakhorn Rimjaem/Chiang Mai U., 15h30-17h00

Static and dynamic beam dynamic effects in the e-, common and HE-linacs, Simona Bettoni / PSI

RF Design Studies of Accelerating Structures for the FCC-ee Pre-injector Complex, Adnan Kurtulus / CERN

Positron source and capture system, Iryna Chaikovska/ IJCLab

Damping ring: status and outlook, Antonio de Santis / INFN-LNF

Positron bunch and energy compressor, Simone Spampinati/ INFN-LNF

FCC-ee injector incl. booster III, chair: Iryna Chaikovska/IJCLab, 17h30-19h00

PSI Positron Production (P-cubed) project, Nicolas Vallis / PSI & EPFL

Development of p-cubed and FCCee positron source targets at CERN Ramiro Mena/ CERN

Positron source design and experiment for FCC, SuperKEKB and ILC, Yoshinori Mori/ KEK

Polarized injector for CEPC, Zhe Duan/IHEP

22 talks on Tuesday

Wednesday - Collective Effects, Chair … , 8h30-10h00

FCC-ee single beam collective effects, Mauro Migliorati/Sapienza

Collective effects in the high energy booster, Adnan Ghribi/GANIL

Xsuite simulations of beam-beam effects with impedance contribution, Roxanna Soos/EPFL

Transverse feedback options for FCC, Dmitry Teytelman/Dimtel

Electron Cloud studies for the FCC-ee, Luca Sabato/ EPFL

FCC-ee optics correction & tuning, chair Mark Boland/CLS, 10h30-12h00

14 talks on Wednesday

Status of optics correction studies, Rogelio Tomas/CERN

EIC Dynamic aperture optimization & implications for FCC, Yunhai Cai/SLAC

Beam-based alignment simulations, Xiaobiao Huang/SLAC

Update on the vibration work for the FCC-ee, Freddy Poirier/CNRS

Jointly with PED: Machine Detector Interface (MDI) I, chair: Fabrizio Palla/ INFN Pisa, 13h30-15h00

MDI Overview, Manuela Boscolo/INFN-LNF

Mechanical model of the MDI, Francesco Fransesini/INFN-LNF

Optimizing IR beam pipe elements for minimum wake field energy loss, Alexander Novokhatski/SLAC

IR magnet system, John Seeman/SLAC

Radiation dose from FLUKA in the MDI, Alessandro Frasca/U Liverpool

Thursday-- FCC-ee code development and other themes, chair: Yunhai Cai/SLAC, 08h30-10h00

Status, results and plans for xsuite, Giovanni Iadarola/CERN

New simulation tools for beam-beam collisions, Arianna Formenti (LBNL)

Bmad for the FCC, and a future Bmad Julia for Machine Learning, Georg Hoffstaetter de Torquat/Cornell

SuperKEKB beam diagnostics & fast losses, Hitomo Ikeda/KEK

Update on the resistive wall code development, Ali Rajabi /DESY

FCC-hh design, chair: Giorgio Apollinari/FNAL, 10h30-12h00

FCC-hh overview, main parameters & hh lattice, Gustavo Perez/CERN

FCC injection lines for ee and hh, Wolfgang Bartmann/CERN

High field magnet efforts at NHMFL, BNL & industry, Kathleen Amm/NHMFL

Joint PED: MDI II, chair: Manuela Boscolo/INFN-LNF, 10h30-12h00

Vertex detector design & integration, Fabrizio Palla/INFN Pisa

Detector Background Studies, Andrea Ciarma/INFN-LNF

Synchrotron Radiation background studies, Kevin Andre/CERN

Beam-gas beam loss & MDI collimators, Giacomo Broggi /Sapienza

Synchrotron radiation studies in the EIC experiment, Andrii Natochii/BNL

Still Thursday – joint with PED: EPOL I, chair Guy Wilkisnon/Oxford 13h30-15h00

Introduction and overview, Guy Wilkinson/ U Oxford

Polarized positron production, Joseph Grames/ MIT

Experiments at existing facilities, Jacqueline Keintzel/ CERN

The EIC polarimeter, and lessons for the FCC,: Dave Gaskel/JLAB

Joint with PED: EPOL II, chair Jacqueline Keintzel/CERN, 15h30-17h00

Simulation polarization studies at the FCC, Yi Wu/EPFL

Polarized electrons at the EIC, and lessons for the FCC, Georg Hoffstaetter de Torquat/Cornell

The FCC polarimeter, Robert Kieffer/CERN

Lessons from LEP, and final steps towards the Final Report of the Feasibility Study, Eric Torrence (Oregon)

First thoughts on the FCC depolarizer, Wolfgang Hofle/CERN

Still Thursday – Poster session | accelerator related posters chair Frank Zimmermann/CERN

Lepton injection and extraction system at FCC-ee, Sen Yue/cERN

Diagnostics for the FCC-ee positron source test facility at PSI, Nicolas Vallis/PSI

Enhancing e+ sources for future colliders through conical converter targets, Nicolas Vallis/PSI

Autoencoder Style Neural Networks for Estimation and Control with Unknown Time Varying Parameters, Alan Williams/LANL

Operational Considerations for Laser Control of FCC Bunch Intensity, Spencer Gessner/SLAC

Next generation, integrated community toolset for modelling colliders, Jean-Luc Vay/LBNL

Structural Optimization of FCC IR Support Structure, Francesco Fransesini/INFN-LNF

Exploring New Physics with the Optical Dump at LUXE and Prospects for Future Facilities, Ivo Schulthess/DESY

Material Budget of the FCC-ee IR, Giulia Nigrelli/INFN-LNF

FCC-ee tuning studies with pyAT, Elaf Musa/DESY

Simulated Performance of FCC-ee IP Tuning Knobs, Satya Sai/U Geneva

Input signals for error mitigation by interaction point fast feedback systems for FCC-ee, John Salvesen/U Oxford

Luminosity Tuning and Optimization, Vaibhavi Gawas/U Geneva

Optimization of FCC circumference for hh, Heiko Damerau/CERN

22 talks on Thursday

13 posters on Thursday

"Everyone who disappears is said to be seen in San Francisco"

Oscar Wilde, 1891

please deliver your FCC contribution before disappearing !