

A decorative graphic element in the top left corner consists of a 4x4 grid of squares. The colors transition from white to light blue to medium blue to dark blue across the rows and columns.

# FCC Accelerators and Beam Physics Day

**Y. Papaphilippou**

December 2<sup>nd</sup>, 2021

# ABP – Accelerators & Beam Physics



Group Leader: Yannis Papaphilippou

**ABP**  
Accelerators & Beam  
Physics  
GL: Y. Papaphilippou  
DGL: R. Scrivens

**CEI**  
Coherent Effects &  
Impedances  
SL: G. Rumolo

**HSL**  
Hadron Sources &  
Linacs  
SL: A. Lombardi

**INC**  
Incoherent Effects  
SL: H. Bartosik

**LAF**  
Lepton Accelerators  
& Facilities  
SL: E. Gschwendtner

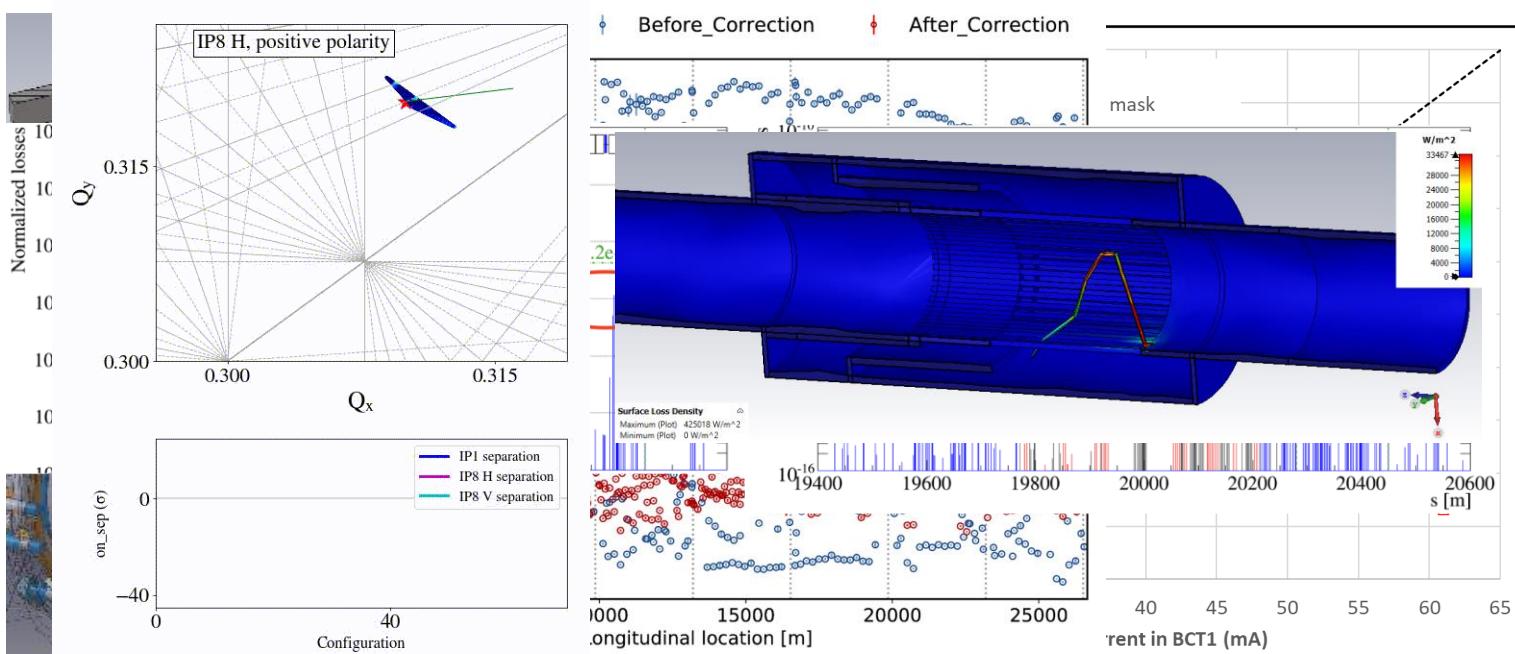
**LNO**  
Linear & Non-linear  
Optics  
SL: R. Tomas

**NDC**  
Non-linear Dynamics  
& Collimation  
SL: S. Redaelli

**ABP-Computing**  
Panel  
Chair: G. Iadarola

- Conducting theoretical, numerical and experimental **beam physics** studies, including **operational support** throughout entire CERN **Accelerator Complex** and for **upgrades** (LIU, HL-LHC) or new **projects** (AWAKE, CLEAR, CLIC, FCC, Muons, PBC, Medical), covering
  - Design maintenance and operation of **hadron sources**.
  - Linear and nonlinear **optics** and beam dynamics.
  - Halo** generation and **collimation**.
  - Cooling, coherent and incoherent collective effects**
  - Development of **accelerator physics computer codes**

Also strongly involved in **teaching** and raising the **next generation of accelerator physicists**



# ABP structure 2021



**ABP Computing Panel**  
Ch: G. Iadarola

**ABP**  
**Accelerators & Beam Physics**  
GL: Y. Papaphilippou  
DGL: R. Scrivens

**GAO**  
A. Valenza

**CEI**  
**Coherent Effects & Impedances**  
SL: G. Rumolo

N. Biancacci  
X. Buffat  
G. Iadarola  
L. Mether  
E. Metral  
N. Mounet  
B. Salvant  
C. Zannini

**K. Paraschou (2022)**  
  
E. De La Fuente Garcia (FTEC)  
D. El Dali (TECH)  
L. Giacomet (DOCT)  
S. Johannesson (DOCT)  
S. Joly (DOCT)  
P. Kicsiny (DOCT)  
A. Kurtulus (DOCT)  
P. D. Meruga (TECH)

**HSL**  
**Hadron Sources & Linacs**  
SL: A. Lombardi

G. Bellodi  
S. Bertolo  
F. Di Lorenzo  
D. Kuchler  
J.-B. Lallement  
J. Lettry  
E. Mahner  
C. Mastrostefano  
M. O'Neil  
E. Sargsyan  
F. Wenander

I. Gamazo Garcia  
T. Koevener  
A. Vnuchenko  
  
G. R. Montoya Soto (DOCT)  
J. Etxebarria Erdoiza (FTEC)  
H. Pahl (DOCT)  
M. Theodosiou (TECH)  
J. Thiboud (FSU)

**INC**  
**Incoherent Effects**  
SL: H. Bartosik

F. Antoniou  
F. Asvesta  
I. Efthymiopoulos  
D. Gamba  
F. Schmidt  
G. Sterbini  
  
**S. Kostoglou**  
**A. Poyet**

I. Mases Sole (FTEC)  
W. Krasny (PJAS)  
E. Lamb (DOCT)  
T. Prebibaj (DOCT)  
N. Triantafyllou (DOCT)  
M. Zampetakis (DOCT)

**LAF**  
**Lepton Accelerators & Facilities**  
SL: E. Gschwendtner

C. Carli  
R. Corsini  
B. Holzer  
A. Latina  
G. Roy  
D. Schulte  
F. Zimmermann

V. Cilento  
E. Fol  
M. Hofer  
K. Skoufaris  
G. Zevi Della Porta

K. Andre (DOCT)  
M. Boscolo (PJAS)  
E. Carideo (DOCT)  
L. Dyks (DOCT)  
F. Elverson (TECH)  
W. Farabolini (PJAS)  
J. Farmer (PJAS)  
R. Janeiro Costa (DOCT)  
V.-C. Musat (TECH)  
J. Olivares Herrador (DOCT)  
V. Rieker (DOCT)  
D. Shatilov (PJAS)  
B. Stechauner (TECH)  
L. Verra (DOCT)  
Y. Zhao (PJAS)  
T. Von Witzleben (DOCT)

**LNO**  
**Linear & Non-linear Optics**  
SL: R. Tomas

R. De Maria  
L. Deniau  
S. Fartoukh  
A. Huschauer  
E. Maclean  
T. Persson  
  
**J. Keintzel**  
**L. Van Riesen-Haupt**  
**A. Wegscheider**

J. Dilly (DOCT)  
M. Le Garreg (DOCT)  
E. Manosperti (DOCT)  
A. Pastushenko (DOCT)  
G. Simon (DOCT)  
F. Soubelet (DOCT)  
W. Van Goethem (DOCT)

**NDC**  
**Non-linear Dynamics & Collimation**  
SL: S. Redaelli

R. Bruce  
M. Giovannozzi  
P. Hermes  
F. Van Der Veken

**A. Abramov**  
**M. D'Andrea**  
**G. Azzopardi**  
**B. Lindstrom**

R. Cai (DOCT)  
F. Capoani (DOCT)  
A. Frasca (TECH)  
S. Jagabathuni (STAG)  
J. Molson (PJAS)  
C. Montanari (DOCT)  
T. Pugnat (PJAS)  
G. Russo (DOCT)

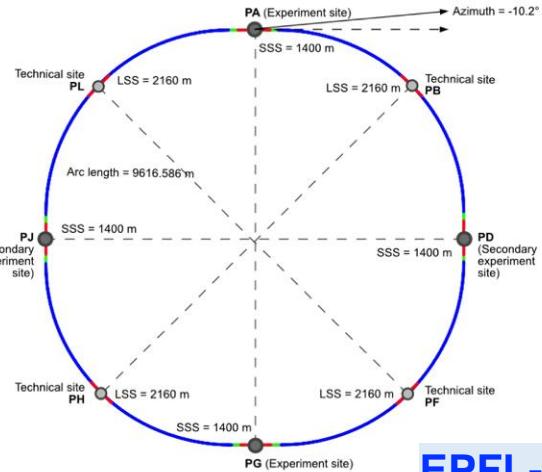
~4 staff, ~4 fellows, ~4 students,  
~5 associates already working in FCC

~50 Staff  
~15 Fellows  
~40 Students  
~15 Associates

Large number of VISCs and  
collaborators

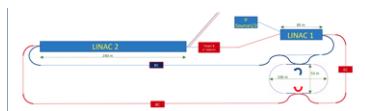
# FCC studies

**new “lowest risk” placement with 2 or 4 expt’s**

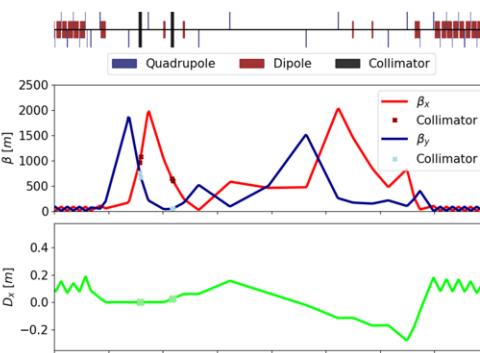


**C=91 km,  
8 surface sites  
perfect 4-fold  
super-periodicity**

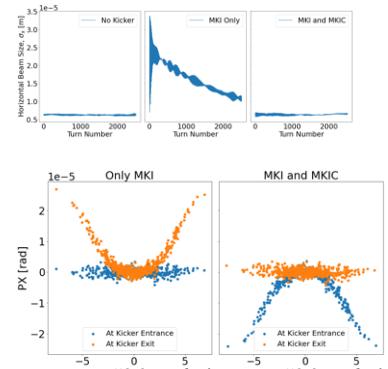
**new inj. layout**



**FCC-ee collimation optics**

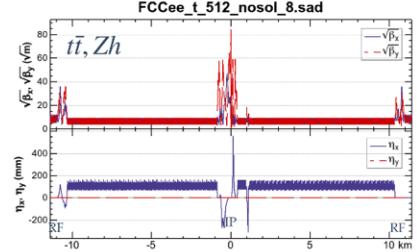


**top-up with nonlinear kicker & compensation**

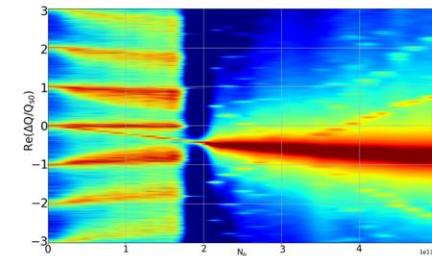


**EPFL-CERN optics & beam dynamics code development for FCC-ee**

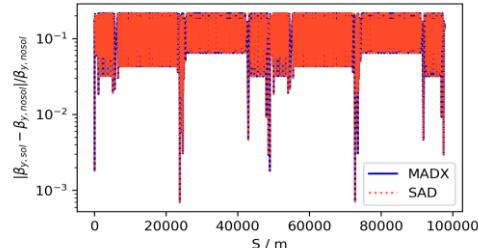
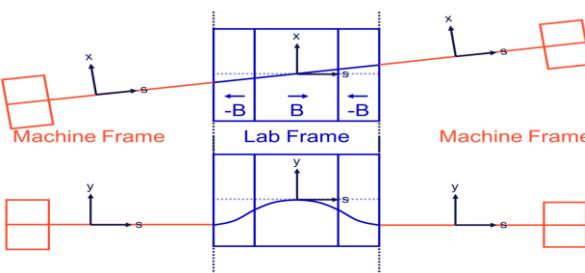
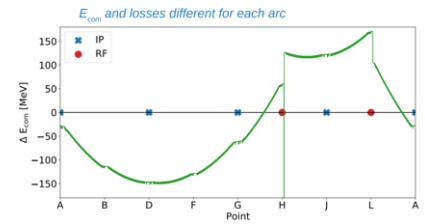
**new FCC-ee beam optics for 1/4 ring**



**TMCI threshold w longit. imp.**



**com energy vs RF layout**



- Method to simulate “SAD-like” tilted solenoid in MADX
- Part of ongoing strategy to simulate FCC-ee in MADX
  - Including comparison studies and implementation of features such as “tapering”

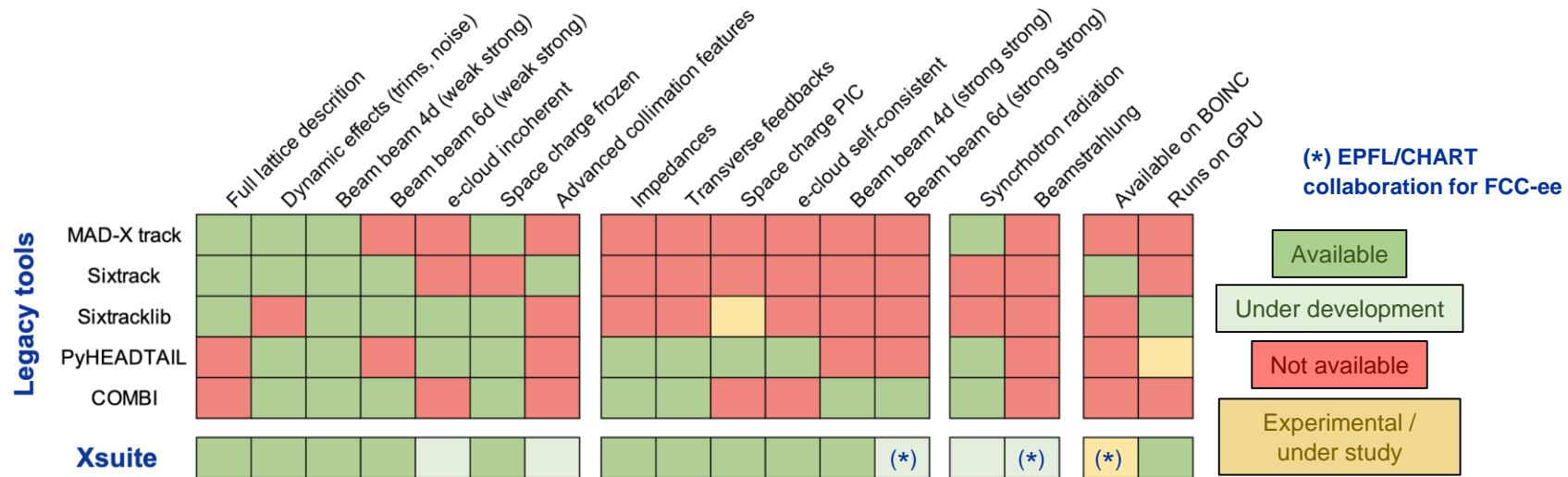
# Rationalization and modernization of simulation codes



Project launched to rationalize and modernize software for multiparticle simulations (aka **tracking**)

→ Moving from a heterogenous range of programs each with limited capabilities to an integrated modular toolkit (Xsuite)

- Allows usage across **injectors, LHC, HL-LHC** and design studies (e.g. PBC, FCC)
  - Enables exploitation of **modern computing platforms** (e.g. GPUs) for a wide range of applications
  - Strong **simplification of development and maintenance process** (removed several duplications)



# Strengthening FCC studies in ABP



- FCCee
  - Design coordination
  - Code development (spin-dynamics, polarisation)
  - Impedance and coherent effects
  - E-cloud
  - Optics and correction
  - Beam-beam
  - Collimation system
  - Top-up injection
  - MDI
  - Booster ring design
  - Injector
  - Beam measurements (DAFNE, SuperKEKb,...)
- FCChh
  - Design coordination
  - Collimation
  - Optics
- Identify areas where **existing ABP expertise** is required to allow **stronger engagement** of our group to **FCC studies**