

Summary of FCC-Phys activities in the French Labs

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IRFU	Saclay
CPPM	Marseille
IJCLab	Orsay
IPHC	Strasbourg
IP2I	Lyon
LAPP	Annecy
LPC	Clermont
LLR	Palaiseau
LPNHE	Paris
LPSC	Grenoble
L2IT	Toulouse

People involved

Activities, Goals

Physics interest

Algorithms interest,
subdetector interest

Future R& D ?

Previous Lab involvement
in Future Collider R&D

The strong accelerator activities related to FCC at CEA (IRFU, CEA-Grenoble) and at IN2P3 (IJCLab, LAPP) are not reported in this talk and in this workshop. Will be covered in the next FCC-France workshop which will take place in Annecy in about 6 months.

Physicists involved : R.Aleksan (FCC), F. Couderc (CMS), E. Locci (CMS), S. Ganjour (CMS), P. Schwemling (ATLAS), B. Tuchming (D0)

Physicists involved in other e+e- FC : P. Attie, M. Besancon, P. Colas, S. Ganjour, M. Titov

Activities, Goals :

- Physics studies
- Accelerator design
- R&D on Tracking : technology, simulation and impact on physics

Physics interest :

- EW physics (W mass (thesis), Z coupling to ν_e)
- B Physics (CP violation)

Algorithms interest, subdetector interest :

Tracking Detector resolution

R&D :

- TPC (readout and Ion Backflow)
- Wireless detector data transmission

IRFU is involved in the TPC R&D for ILC and is contributing in detector, readout, testbeam.

Physicists involved (started or committed to start by end of 2020)

- S. Muanza (ATLAS), M. Barbero (ATLAS), M. Hilali (M2)

Activities, Goals

- Physics fast simulation
- Discussions to prepare R&D on pixel detector

Physics interest,

- MC Generators
- Search for heavy charged Higgs boson decaying into $W(-\rightarrow l\nu)+H(-\rightarrow b\bar{b})$

Algorithms interest, subdetector interest

- b-tagging (TBC, long term)
- Pixel detector, readout electronics
- (monolithic sensors, μ -electronics design small feature size)

Future R&D at CPPM

- R&D on Depleted CMOS sensors for FCC-ee

Physicists involved : N. Morange (ATLAS), M-H Schune (LHCb), J. Lefrançois (LHCb) + intern

Planned involvement : L. Serin, D. Fournier, S. Simion, L. Duflot

Physicists involved in other e+e- FC : R. Pöschl , D. Zerwas, M. Winter

Activities, Goals :

- R&D on calorimeters : technology, simulation and impact on physics

Physics interest :

- B physics
- Higgs and EW physics

Algorithms interest, subdetector interest :

Calorimeters

Future R& D : Two developments planned

- High-granularity LAr calorimeter (ANR proposal with T. Guillemin, C. de la Taille)
- Powder-O calo concept

IJCLab is involved in the Calice R&D since 2005 and is contributing in detector assembly, readout, and is doing testbeam coordination. R. Pöschl is current spokesperson of CALICE.

Physicists involved in FCC or already involved in another e+e- FC project

J. Andrea (CMS), A. Besson (ILC), Z. Elbitar (ILC)

Physicists interested, starting after 2020 : J. Baudot, G. Dujany

Activities, Goals

- Participation to a new detector design and determine impact on the physics.
- Participation to the FCC-SW (generator, simulation, reconstruction)

Physics Analysis interest

- B-physics,
- Precise top-quark measurements and EFT interpretation.

Algorithms interest, subdetector interest

- Design studies for the vertex detector,
- Impact on tracker geometry and integration strategy on physics performance.

Future R&D at IPHC

- focused on pixelated detection layers: sensors & integration,
- short term: involvement in ongoing R&D projects having specs of interest to FCC

IPHC is involved in Microvertex R&D since 1999 for ILC and is member of ILD

Physicists involved : G. Boudoul (CMS), D. Contardo (CMS), S. Gascon (CMS)

Physicists involved in other e+e- FC: G. Grenier, I. Laktineh, L. Mirabito

Activities, Goals:

- Past: FCC software coordination+author of reference fast simulation (C. Bernet)
- Pursue a detector R&D program applicable to several future collider options

Physics interest: Higgs boson physics (SM + BSM), for ee and hh

Algorithms interest, subdetector interest

- Algorithms: PFA with machine learning, precision timing
- Subdetectors: Electromagnetic and Hadronic Calorimetry, Muon chambers,DAQ, Tracking/Pixel detectors

Current and Future R& D

- Semi-digital HCAL (sub-ns time measurement), GRPC ('Videau' geometry) developments
- Monolithic Active Pixel sensor (MAPs) program for tracker/high-granularity calorimeters in 8'' 65nm technology (based on CMS CiC exp.)

IP2I is involved in Calice R&D since 2006 and is contributing to hadronic calorimeter and GRPC development, electronics and DAQ, advanced reconstruction techniques (PFA, precision timing)

Physicists involved : T. Guillemin (ATLAS)

Physicists 'interested': M. Delmastro, J. Levêque

Activities, Goals

- Contribution to the FCC-ee detector design studies and to FCC-SW

Physics interest

- Higgs properties and couplings

Algorithms interest, subdetector interest

- Electromagnetic calorimeter design (ANR grant GRANULAR submitted)
- Software for calorimeter reconstruction

Future R&D at LAPP

- Interest in tracker for FCC-ee (e.g. microchannel cooling)

LAPP was involved until end of 2018 in CLIC: R&D micromegas (for SDHCAL)

LLR Palaiseau (contact R. Salerno)

Physicists involved : C. Ochando (CMS), R. Salerno (CMS), Y. Sirois (CMS)

Physicists involved in other e+e- FC : V. Boudry, J-C Brient, F. Jimenez Morales, H. Videau

Activities, Goals

- Work on fast simulation
- Optimisation of the detector properties for optimal physics reach

Physics interest :

- Study the EWSB (Scalar sector, Higgs self-coupling, VBS)

Algorithms interest, sub-detector interest

- high-granularity Si-based calorimeter
- Particle Flow event reconstruction

Future R&D @ LLR ?

- high-granularity Si-based calorimeter (continuous operation, timing)

LLR is involved in the Calice R&D since 2001 and in the ILD proto-collaboration. It is contributing in all practical aspects of a Si-based highly granular ECAL: prototypes building and testing, algorithms, optimizations for ILC (& CEPC), Higgs production and BR measurements in ZH process.

LPC Clermont (contact S. Monteil)

Physicists involved : S. Monteil (LHCb) + 2 TH. on the first study A.Teixeira, J. Orloff.
More physicists interested (CDR signatures); involvement if applications are successful.
Physicists involved in other e+e- FC : D. Boumediene

Activities, Goals

- Lepton Flavour Violating Z decays: hep-ph 1412.6322
- Physics sensitivity studies related: search for $B^0 \rightarrow K^{*0} \tau^+ \tau^-$ hep-ph 1705.11106
- CDR Flavours chapter edition: CERN-ACC-2018-0056

Physics interest :

- Sensitivity studies for aSL(d,s) [CPV in B mixings] in Coll. w/ MSU Philipines. Towards detailed studies: detection asymmetries.
- *ANR proposal BooST 2020*: analysis of $b \rightarrow s \tau$ transitions. Part of the project dedicated to projections at FCC. Also IJCLab, CPPM, LPNHE.
- *PhD funding application 2021*: on EFT interpretation of top production and decays observables at FCC-ee (co-tutelle w/ TUDO).

Algorithms interest, sub-detector interest

- Case studies for detector performance [vertexing, calorimeter, PID] within the Flavours group.

LPC is involved in R&D detector on calorimeter in the CALICE project.

Physicists involved : G.Bernardi (ATLAS), A.Blondel (T2K), B.Malaescu (ATLAS),
G.Marchiori (ATLAS), L.Poggioli (ATLAS)

Physicists involved in other e+e- FC : D. Lacour

Activities, Goals

- Coordination, Physics studies, Detector requirements from benchmark processes, software & computing

Physics interest

- Electroweak (eg beam Energy calibration and polarization)
- Higgs couplings, Higgs: H to bb/cc/gg. Di-jet mass resolution
- QCD: α_s measurement at Z pole and below

Algorithms interest, subdetector interest

- b/c tagging. Jet & di-jet reconstruction
- EM calorimetry, Vertexing

Future R&D ?

- Potentially oriented towards Si sensors developments, for calorimetry and tracking

LPNHE is involved in Calice R&D since 2013 (Sensor gluing), and in ATLAS vertex detector for HL-LHC (Sensors & advanced cooling developments)

Physicists involved : F. Malek (ATLAS), A. Lucotte (ATLAS)

Future Activities

- Involvement in the simulation of the physics processes
- Implication in Calorimetry R&Ds and building
- Possibly PhD on both ATLAS and FCC activities

Physics interest

- EW Observables precision measurement (@TeraZ physics)
- Key properties of the Top
- High-precision Higgs physics
- Discovery potential in direct searches of dark matter.

Future R& D on calorimetry

- Mechanics structures and materials, Cooling, Electronics

LPSC was involved in R&D detector on calorimeter in the CALICE project.

L2IT (Laboratoire des 2 Infinis de Toulouse) was founded on January 1st 2020.
It is a CNRS/IN2P3 and Université Toulouse III - Paul Sabatier Laboratory

Physicists involved : J. Stark (ATLAS) as L2IT contact (and director) for the time being

Developing FCC activity :

not first immediate priority but one option of our scientific program.

Current related activity

The ATLAS and computing groups @L2IT are working on the measurement of the tri-linear coupling of the Higgs boson (using di-Higgs events) and on tracking algorithms for ITk (new tracker for HL-LHC phase).

Algorithms interest

Interest in the development of techniques for the measurement of the tri-linear Higgs coupling at the FCC-hh.

L2IT : especially interested in understanding what the FCC-hh will be able to say about the quartic Higgs coupling. “It would be a pity to build a new hh collider that is just short of what it takes to study the quartic Higgs coupling”. What exactly does it take ?

Conclusions

Physicists involved :

- About 30 permanent physicists involved on FCC (including those by the end of 2020)
- Potential for ~15 more, soon after (2021)
- Large technical teams in all the labs.
- Numbers are significant, % of involvement has to grow, taking into account HL-LHC.
(Reminder: Accelerator R&D/personpower not covered in this talk)

Wide Physics interest :

- Higgs, Electroweak, Top, Heavy Flavour, QCD, BSM

Algorithms interest,

- b-tagging, particle-ID, Tracking and Calorimeter reconstruction, Particle Flow

Subdetector interest

- Microvertex, P-ID, Tracker, Calorimeter

Future R&D ?

- Exploit current expertise on MicroVertex, Tracking (TPC), and Calorimetry (Calice) ?
→ See round table at 6PM:

Can FCC(-France) benefit from the ILC(-France) expertise ?