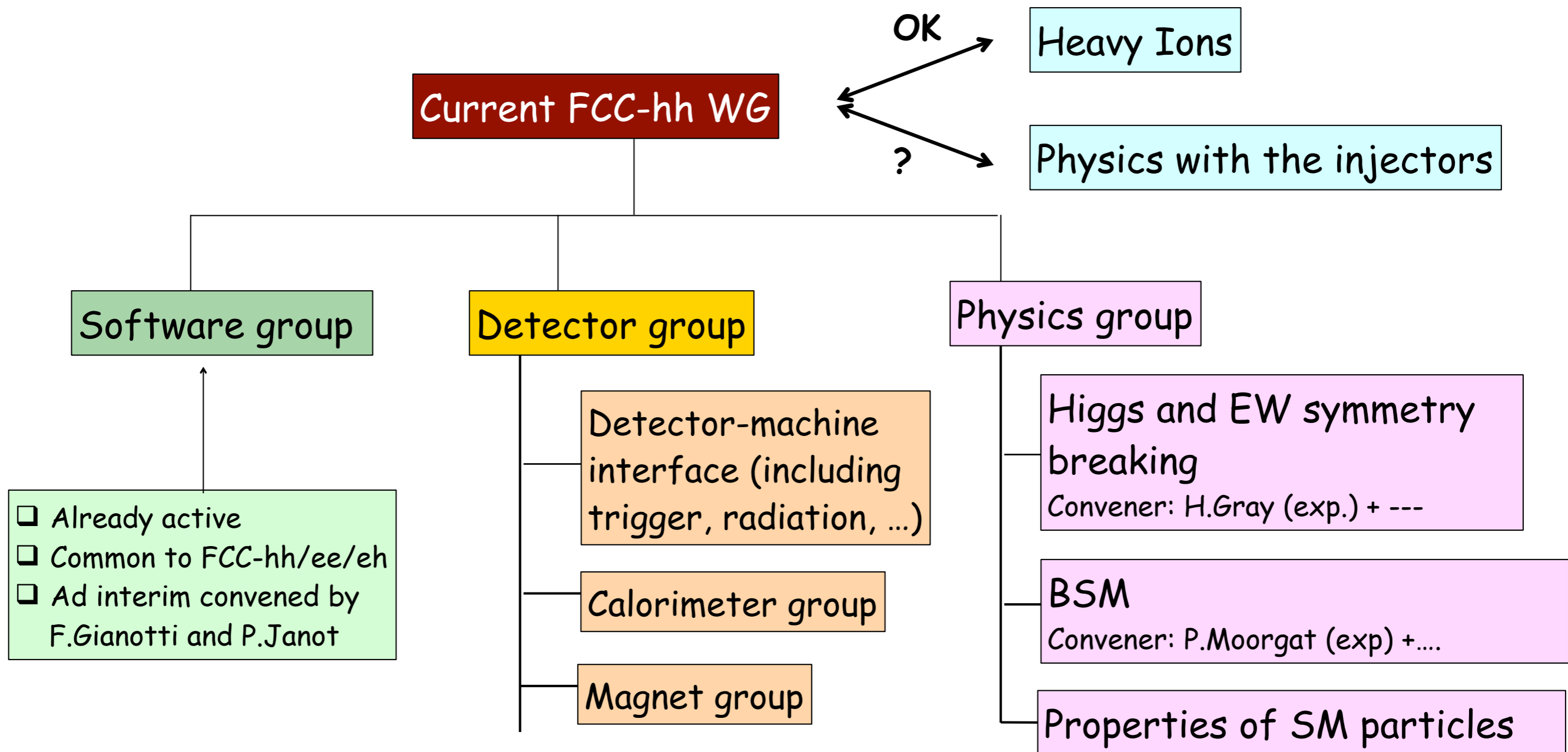


Future milestones and organizational issues

Austin, Fabiola, Michelangelo

Proposal for the WG structure of the FCC-hh studies



- ❑ Appoint conveners of above groups by end of June
- ❑ Create new sub-groups (e.g. tracking, ...) and more articulated structure gradually, as soon as critical mass (in terms of people and activity) justifies them
- ❑ Meetings of the current FCC-hh WG continue at the current pace: they will cover progress reports from the various sub-groups, discussions of items of common interest (e.g. samples to be simulated), overall planning, issues arising at the FCC Coordination, etc.

Physics topics list, current TH contributors and expressions of interest

FHC.1.1 Exploration of EW Symmetry Breaking (EWSB)

- FHC.1.1.1 High-mass WW scattering, high mass HH production
 - *EPFL/CERN (Contino, Son, Liu, Rattazzi, ...), Rojo, ...*
- FHC.1.1.2 Rare Higgs production/decays and precision studies of Higgs properties
 - *aMC@NLO (Torrielli,), Djouadi, HXSWG ?*
- FHC.1.1.3 Additional BSM Higgs bosons: discovery reach and precision physics programme
 - *Djouadi, Craig, Katz, ...*
- FHC.1.1.4 New handles on the study of non-SM EWSB dynamics (e.g. dynamical EWSB and composite H, etc)
 - *EPF/CERN*

NB: boldfaced **names**: “volunteered” to convene/steer

Physics topics list, current TH contributors and expressions of interest

FHC.1.2 Exploration of BSM phenomena

- FHC.1.2.1 discovery reach for various scenarios (SUSY, new gauge interactions, new quark and leptons, compositeness, etc.)
 - *Arbey/Battaglia/Mahmoudi, Torre/Wulzer/Thamm, Rizzo, ...*
- FHC.1.2.2 Theoretical implications of discovery/non-discovery of various BSM scenarios, e.g. address questions such as:
 - FHC.1.2.2.1 what remains of Supersymmetry if nothing is seen at the scales accessible at 100 TeV?
 - FHC.1.2.2.2 which new opportunities open up at 100 TeV for the detection and study of dark matter?
 - *Wang, Schwaller, ABM, ...*
 - FHC.1.2.2.3 which new BSM frameworks, which are totally outside of the HL-LHC reach, become accessible/worth-discussing at 100 TeV ?

Physics topics list, current TH contributors and expressions of interest

FHC.1.3 Continued exploration of SM particles

- FHC.1.3.1 Physics of the top quark (rare decays, FCNC, anomalous couplings, ...)
 - *MLM, Aguilar-Saavedra, Tsinikos, Kamenik, Zupan, Perez, ...*
- FHC.1.3.2 Flavour Physics:
 - charm and bottom quark (rare decays, CPV, ...)
 - tau lepton (e.g. tau \rightarrow 3 mu, tau \rightarrow mu gamma and other LFV decays)
 - *Isidori, Silvestrini,*
- FHC.1.3.2 W/Z physics
 - *Melia, MLM, ...*
- FHC.1.3.3 QCD dynamics
 - *Skands, MLM, ..*

FHC.1.5 Theoretical tools for the study of 100 TeV collisions

- FHC.1.5.1 PDFs
 - *Rojo, Melia, Fuks, PDF4LHC*
- FHC.1.5.2 MC generators
 - *Skands (pythia), mg5-aMC@NLO, Alpgen, ...*
- FHC.1.5.3 NⁿLO calculations
 - *Zanderighi*
- FHC.1.5.4 EW corrections
 - *Christiansen, Chiesa/Piccinini/... ,*

Plan for the above:

- start documenting what's been discussed so far
 - document reference benchmark cross-sections, distributions for relevant SM, Higgs, BSM processes
 - organize dedicated mtgs, focused on specific topics, increase interaction TH/exp
 - stimulate dedicated simulations, to address issues needed for the progress of the detector designs
- => have report by Winter 2015
- start interaction with FCC-ee/eh physics groups, to study and document synergies/complementarity

Proposed physics topics to be used in the study of synergy/complementarity among experiments at FCC-hh/ee/eh

List-v1.1 (John, Christophe, Alain)14-05-2014, update MLM 28.5.2014

-- Higgs physics:

- precision studies
- higher-dimensional operators, composite Higgs
- rare and exotic decays
- multiple Higgs production
- extra Higgs bosons

-- Interface with cosmology:

- dark matter
- baryogenesis
- right-handed/(almost) sterile neutrinos

-- New physics related to EWSB:

- WW scattering
- supersymmetry
- extra dimensions
- composite models

-- Rare processes:

- Rare H decays
- Rare W/Z decays
- Rare top decays and top properties
- lepton-flavour violation

-- Extensions of the SM:

- extra vector-like fermions
- SU(2)_R models
- leptoquarks

-- QCD:

- Perturbation theory
- Modelling final states

-- EW/SM precision issues

- parameter measurements (m_{top} , m_W , ...)
- higher-order EW corrections
- c/b flavour studies

Physics topics list, current TH contributors and expressions of interest

FHC.1.4 Opportunities other than pp physics:

- FHC.1.4.1 Heavy Ion Collisions
 - *HI WG (Dainese, Masciocchi, Wiedemann)*
- FHC.1.4.2 Fixed target experiments:
 - FHC.1.4.2.2 Heavy Ion beams for fixed-target experiments
 - *HI WG (Dainese, Masciocchi, Wiedemann)*
 - FHC.1.4.2.1 "Intensity frontier": kaon physics, $\mu 2e$ conversions, beam dump experiments and searches for heavy photons, heavy neutrals, and other exotica...
 - *Contacts ongoing:*

We plan to initiate some (mainly brainstorming) activity about opportunities for smaller dedicated collider experiments, as well as fixed-target experiments using beams extracted at different stages of the the injection chain (in strong contacts with the machine experts) → aim at a first workshop in September-October
→ please let us know if you are interested

Issues for detector studies, and detector/machine interface

- Deciding if we do eta <6 integrated into GP or separate is rather an important point
 - => missET? jet reconstruction? Lepton ID? Tracking?
 - => need to define soon physics scenarios to be used for dedicated studies
 - => are there scenarios where final states above 5-10 TeV require such eta coverage ?

- We need to decide soon the physics samples that need to be generated and with which level of simulation (DELPHES, full, etc.)
 - please let us know your priorities

 - Continue and intensify efforts to put in place software infrastructure allowing different levels of simulations.
 - This is super-critical for any experimental study.
 - Next check-point: FCC-ee WS on 19-21 June.

- Need more people to work on tracking detector layout and performance: volunteers ???

- Calorimetry issues:
 - need to understand the importance of granularity (e.g. for boosted objects) and the impact on the number of channels and hence cooling (cannot switch power off between trains, as at ILC/CLIC)
 - interplay between ECAL and HCAL important for performance (e.g. compensation) and design (space) reasons

- Trigger (and DAQ): very little done so far, need to ramp up efforts. May organise a dedicated mini-workshop.

- need to see concrete models for the mechanical support structure, in the scenarios with a nested solenoid solution
- do we have to worry about L^* reduction ?
 - => impact on maintenance scenarios, forw regions, beta* focusing, ...
- can the experiments tolerate the presence of an injector in the FCC tunnel?
- clustered collision points are still an option and have many advantages
 - => explore potential issues and opportunities