

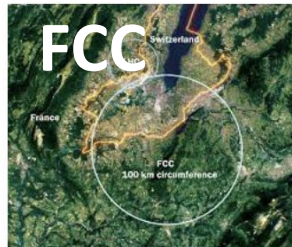
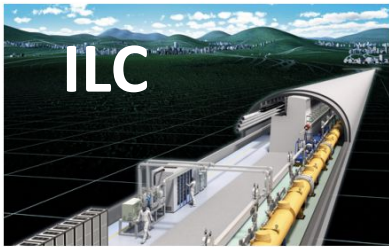
WG2 Status Report

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ECFA statement July 2020

- *ECFA recognizes the need for the experimental and theoretical communities involved in physics studies, experiment designs and detector technologies at future Higgs factories to gather. **ECFA supports a series of workshops** with the aim to **share challenges and expertise, to explore synergies in their efforts** and to respond coherently to this priority in the European Strategy for Particle Physics (ESPP).*

Goal: bring the entire e^+e^- Higgs factory effort together, foster cooperation across various projects; collaborative research programmes are to emerge



Recommendations from the IAC

- Extension to include **electroweak** and **top** factory
- **Extend the physics studies** (w.r.t studies of European Strategy update (EPPSU)), where relevant (not all completed at time of EPPSU), however, focus on e^+e^- potential
 - no discussion of pros and cons of various machines or alternatives to e^+e^- Higgs factories
- Understand better the **interplay between (HL)-LHC and an e^+e^- Higgs/EW/Top factory**
- Development of **common tools** important (software, simulation, fast simulation, ...)
- Development of **common analysis methods** of high interest
- **Exploit synergies, discuss challenges**, do not restrict to common items
- Need for **theoretical accuracy** and **MC generator improvements** ...
- ...

WG1 Physics Potential

WG2 Physics Analysis Methods

What is WG2?

GENERATORS

SIMULATION

RECONSTRUCTION

ALGORITHMS & TOOLS

SOFTWARE ECOSYSTEM

- Monte Carlo generators for e+e- precision EW, Flavour, Higgs, and top physics,
- Luminosity measurements
- Fast simulation and the limitations of such techniques
- Full Simulation
- Track and vertex reconstruction algorithms
- Jet algorithms / jet reconstruction
- Particle-flow reconstruction and global event description
- Requirements on particle identification
- Flavour tagging algorithms
- Importance of timing information
- Constrained fit

Why a WG2?

- **Take stock** of the current status of development of the various items:
 - From the different lepton collider communities
 - From the LHC experience
- **Recognise** the overall needs for the precision/sensitivity of the future measurements from ee colliders (common and specific) through discussion and exchange
- **Help** satisfy those needs triggering and/or following up work in the specific communities
- Efficiently **apply** the latest tools and information for the benefit of all in a common software ecosystem for the future (key4hep)

How to accomplish the plan?

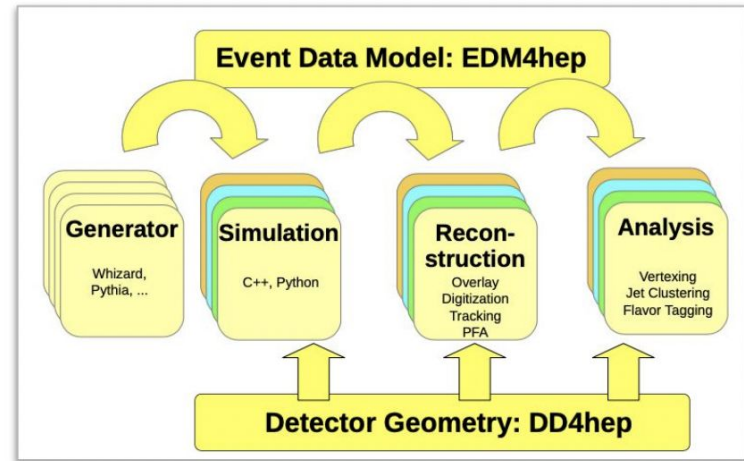
- Topical workshops
- Collecting experts in the same room
- Preparing the Agenda with questions and objectives in mind to guide the discussion
- Follow-up meetings on technical aspects

- **Possibility to openly discuss technical issues in a constructive atmosphere.**
- **Engaging the interest of LHC (or other) colleagues into the future e^+e^- projects**

Software Ecosystem - Key4HEP

Create a software ecosystem integrating in optimal way various software components to provide a ready-to-use full-fledged solution for data processing of HEP experiments

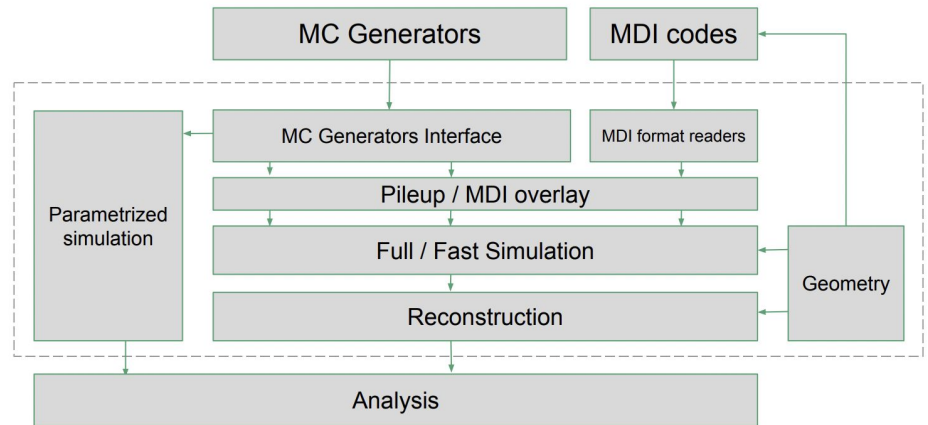
- KEY4HEP federates FCC, ILC, CLIC , CEPC and other experiments
- In use or medium term migration plan
- Supported by R&D efforts (AIDA, CERN EP etc.)
- WG2 will build on this effort



- Crucial connection with software ecosystem experts representing the different experiences and needs

Frank Gaede (Desy) ILC
Gerardo Ganis (CERN) FCC
André Sailer (CERN) CLIC

Typical workflows to support



Generator TWS - Day1 - Taking Stock

Plans of generator groups from:

- PYTHIA
- HERWIG
- SHERPA
- Madgraph5_aMC@NLO
- KKMC/BHLUMI
- WHIZARD
- Powheg
- BabaYaga
- Geneva

Special codes

- Guinea Pig
- CIRCE
- Photos/Tauola/
TauSpinner

Other activities:

- HEP-SF
optimization

Take home message:

- Performance improvements (multithreading, GPU, vector CPUs usage etc) ongoing
- Physics developments (photons 😊)
- Common physics questions discussed
- Need consistent treatment of Beamstrahlung

Generator WS - Day2 - Interface

Interface generators-Software

Ecosystem:

- key4Hep
- EDM4HEP
- HepMC

Production Experience:

- feedback from ILC and CLIC
- feedback from FCC-ee
- feedback from LHC

Main points:

- Data models discussion (HepMC,EDM4HEP,..)
- Lessons learned from LHC experience:
 - Big productions need care
 - Communication with authors essential
 - Performance (for LHC) still an issue
- Benchmarks: important topic that will need follow-up meeting(s) also including WG1

Generator Topical WS - Next steps

Contacts for generators identified:

- PYTHIA: Ilkka Helenius
- HERWIG: Simon Plaetzer
- SHERPA: Alan Price
- Madgraph5_aMC@NLO: Stefano Frixione
- KKMC: Staszek Jadach
- Tauola et al: Zbigniew Was
- WHIZARD: Juergen Reuter
- Powheg: Emanuele Re
- BabaYaga: Carlo Carloni Calame
- Geneva: Simone Alioli
- Guinea Pig: Daniel Schulte
- Circe: Thorsten Ohl

Strategy:

- CONTACTS for efficient communication
- TOPICAL Workshops to identify issues
- FOLLOW-UP of open questions in seminar-like settings
- TASK-FORCE to be setup to address questions not solvable in a single go

Work Plan

Topical Meetings (1-2 days)

- Generators Topical Workshop, 9-10 November 2021 @CERN (Hybrid)
- Simulation Topical Workshop, 1-2 February 2022 @Padova (Hybrid)
- Reconstruction Topical Workshop, XX Spring 2022 @? (Hybrid)
- Followup Generator Workshop, before summer 2022 (Hybrid) (proposal by Siegen to be discussed)

Follow-up Seminar-Style Meetings (half-day):

- Beam Issues, January (Zoom)
- Interface Generator-KEY4HEP, TBA (Zoom)
- Generator Benchmarks, TBA - *content to be defined with WG1*

Further considerations

- We recognize that most of the technical work concerning analysis tools and performance studies happens inside the different projects (FCC-PED, IDT,...)
- The WG2 serves as a forum to:
 - **efficiently** share technical knowledge, not only concerning lepton colliders, but also coming from the LHC experience
 - **optimize** the solution of common issues
 - **attack** new (specific) needs providing the solutions within a software ecosystem that will allow a general usage
- **Through this activities, we are looking forward to engage a new generation of physicist into making a future lepton collider a reality**