

# $e^+e^-$ Higgs Factory WG1 FLAV

## 1st Meeting

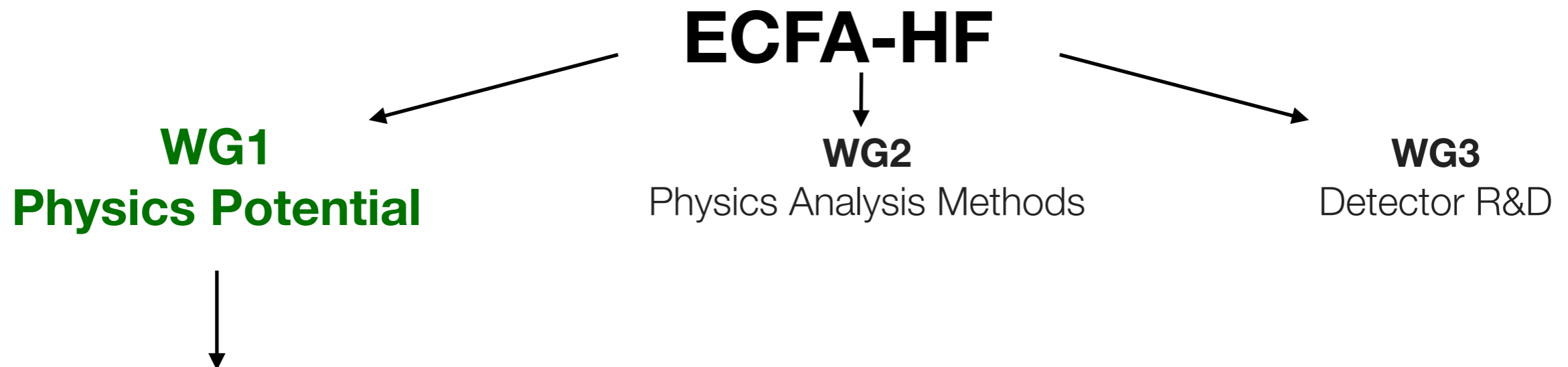
conveners: Pablo Goldenzweig, David Marzocca, Stephane Monteil

# What is ECFA - e+ e- Higgs/EW/top factory - WG1?

From: <https://indico.cern.ch/event/1044297/>

The European Committee for Future Accelerators (**ECFA**) has decided to organise a **series of workshops** on **physics studies**, **experiment design** and **detector technologies** towards a **future electron-positron Higgs/EW/Top factory**.

The aim is to bring together the efforts of various e+e- projects, to share challenges and expertise, to explore synergies and to respond coherently to this high-priority strategy item.



- PREC (Precision in theory & experiment)
- GLOB (Global interpretations in (SM)EFT and UV complete models)
- HTE (Top-Higgs-EW and connection with LHC)
- **FLAV (Flavour Physics)**
- SRCH (Feebly interacting particles, direct low-mass searches)

# WG1-FLAV

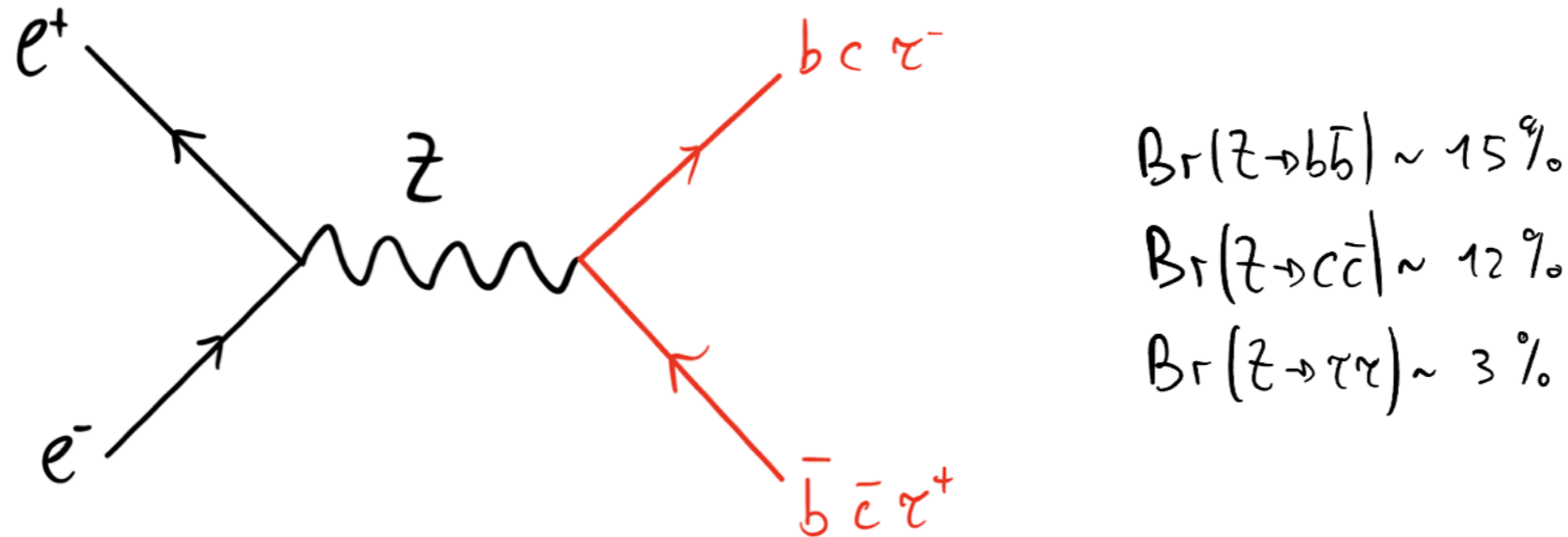
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**Mandate:** Exploration of different flavour scenarios and interplay with flavour data

- projections on the flavour physics potential of future Higgs factories
- projections on the flavour physics potential of existing colliders
- implication of these and other flavour experiments (g-2, ...)
- interpretation of flavour anomalies in BSM models and what they imply for Higgs factories
- added value of an e+e- Higgs factory wrt HL-LHC & Belle 2
- EFT interpretations of flavour data, eventually joined global-global effort with WG1-GLOB?

# Low-energy flavour potential

Future Tera-Z factories will deliver  $O(10^{12})$  Z bosons, that will result in unprecedented clean and boosted samples of B and D mesons (and baryons) and tau leptons.



The resulting yields will allow **very precise studies of rare decays** (some inaccessible at HL-LHC or Belle-2, like  $b \rightarrow s \tau \tau$ ), CP properties, and of **low-energy NP models** (ALPS, etc..)

Particle production ( $10^9$ )	$B^0/\bar{B}^0$	$B^+/B^-$	$B_s^0/\bar{B}_s^0$	$B_c^+/\bar{B}_c^-$	$\Lambda_b/\bar{\Lambda}_b$	$c\bar{c}$	$\tau^+\tau^-$
Belle II	27.5	27.5	n/a	n/a	n/a	65	45
FCC-ee	620	620	150	4	130	600	170

[FCC Snowmass Summary 2021 2203.06520]

*Open questions:*

- > What are the detailed experimental prospects? (*interplay with SRCH group for ALPS models*)
- > What is the flavour physics potential of having polarised beams?
- > Is the SM theory prediction ready to match such precision across the various channels?

# On-shell flavour potential

$$Z \rightarrow ff', \quad h \rightarrow ff'$$

A Higgs/EW factory will also test to a very high precision

**lepton (and quark) flavour-violating couplings of the Z and Higgs bosons**

*> interplay with the HTE subgroup.*

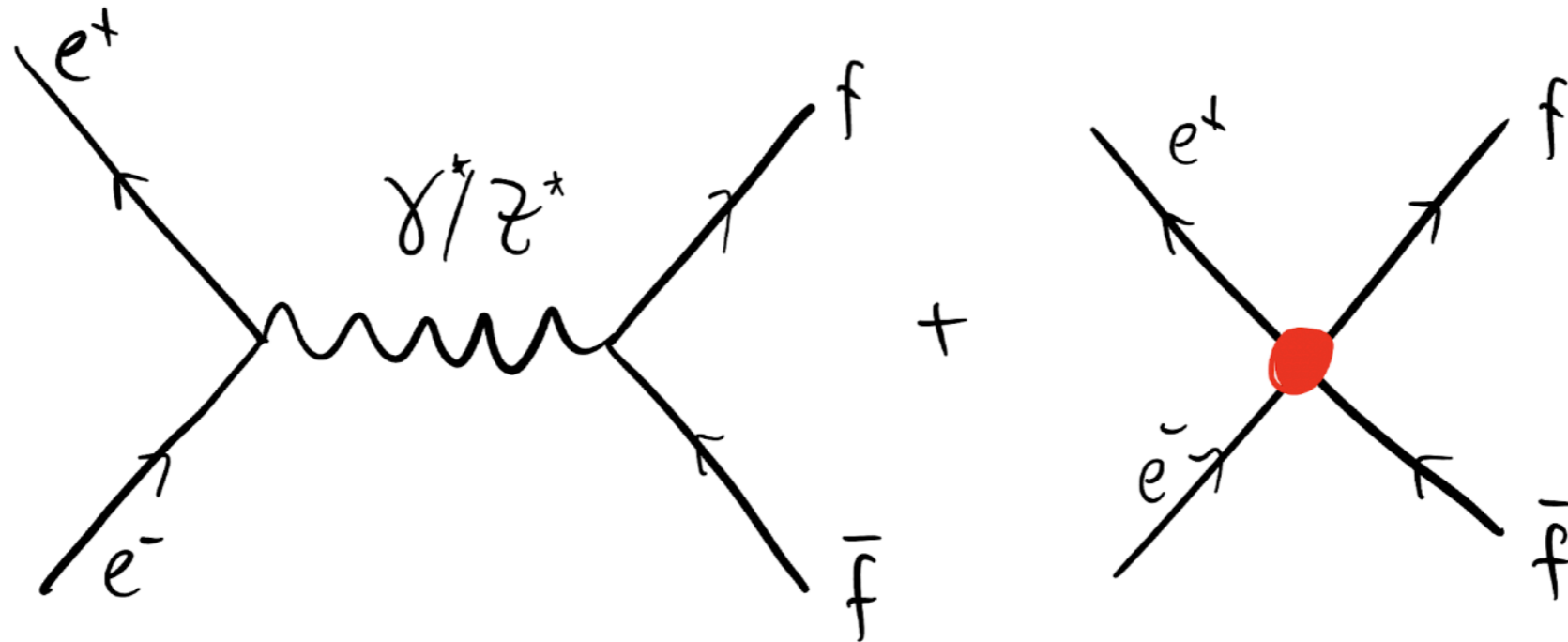
$$W^+ \rightarrow c \bar{b}$$

What is the prospect for **measuring  $V_{cb}$  directly from W decays?**

*> interplay with the HTE subgroup.*

# “High-energy” flavour potential

$$e^+ e^- \rightarrow \gamma^*/Z^* \rightarrow ff', \quad h \rightarrow ff'$$



Going at **center of mass energies above the Z boson** (t-tbar threshold and above), a Higgs factory can become sensitive to 4-fermion contact interactions with electrons. This is the analogous of high-pT di-lepton tails at LHC.

Question:

What is the New Physics potential for such studies? > *interplay with GLOB group.*

# Final Goal

The final goal of this effort will be to write a **chapter in the ECFA-Higgs Factory white paper** in ~1-2 years.

# Next Meeting

A blue banner with white and orange text. The text reads "First ECFA WORKSHOP." with a small orange dot at the end of the word "WORKSHOP". The background of the banner features a stylized white and blue circular graphic.

**First ECFA WORKSHOP.**

on e+e- Higgs/EW/Top Factories, October 5-7, 2022, in Hamburg

<https://indico.desy.de/event/33640/>

- > Plenary sessions on all aspects of ECFA e+e- Higgs/EW/Top factories
- > Parallel sessions for each WG1 subgroup:

We will have 2 sessions of 1.5h each

**Call is open for Abstracts** for our parallel sessions: **deadline July 22nd!** Please APPLY!

# Today's meeting

- |                |           |  |       |
|----------------|-----------|--|-------|
| <b>2:00 PM</b> | → 2:20 PM | <b>Welcome and installation of the meeting</b><br><b>Speakers:</b> David Marzocca (INFN Trieste), Pablo Goldenzweig (KIT - Karlsruhe Institute of Technology (DE)), Stephane Monteil (Université Clermont Auvergne (FR)) | 🕒 20m |
| <b>2:20 PM</b> | → 2:45 PM | <b>Survey of the Snowmass process regarding Flavour physics.</b><br><b>Speaker:</b> Angelo Di Canto (Brookhaven National Laboratory (US))  | 🕒 25m |
| <b>2:45 PM</b> | → 3:10 PM | <b>Flavour physics at ILC</b><br><b>Speaker:</b> Phillip Urquijo (University of Melbourne (AU))  | 🕒 25m |
| <b>3:10 PM</b> | → 3:35 PM | <b>Flavour physics studies at CEPC</b><br><b>Speaker:</b> Manqi Ruan (Chinese Academy of Sciences (CN))  | 🕒 25m |
| <b>3:35 PM</b> | → 3:45 PM | <b>Coffee break</b>  | 🕒 10m |
| <b>3:45 PM</b> | → 4:10 PM | <b>Flavour physics studies at FCC-ee</b> ¶<br><b>Speaker:</b> Stephane Monteil (Université Clermont Auvergne (FR))   | 🕒 25m |
| <b>4:10 PM</b> | → 4:35 PM | <b>Theory challenges for Flavour physics at Higgs and EW factories</b><br><b>Speaker:</b> Marzia Bordone (CERN)  | 🕒 25m |
| <b>4:35 PM</b> | → 4:45 PM | <b>Discussion and next steps</b>   | 🕒 10m |