ECFA Higgs/EWK/Top Factory study: Status & report planning

- 3rd ECFA workshop @Paris
- Status of study report
- The next steps

Christos Leonidopoulos
& Aidan Robson

115th Plenary ECFA Meeting
CERN - 15 November 2024

The Big Picture

- Capture the Physics Case & ECFA study activities
  - Demonstrate what can be achieved at a future collider
  - Encourage synergies among projects & build e^+e^- community
- Physics Performance (WG1)
  - Forum to collect and discuss physics potential
  - Particular initiative: Develop thematic areas to concentrate common work → Focus topics
- Analysis Methods (WG2) & Detector Technologies (WG3)
  - Cross-referenced with Physics Topics (WG1)
  - Legacy: Common software, common studies/discussions

- Report:
  - Coherent & self-contained: should be a useful document
  - Focus on new studies (avoid already published material)
  - With references to more detailed notes/papers, when available

14 Focus Topics

- Focus Topics
  - Showcase of physics potential
  - Development of analysis tools cooperatively across projects
  - Delivery of physics results by people across projects

Focus topics for the ECFA study on Higgs / Top / EW factories

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Abstract

In order to stimulate new engagement and trigger some concrete studies in areas where further work would be beneficial towards fully understanding the physics potential of an e^+e^- Higgs / Top / Electroweak factory, we propose to define a set of focus topics. The general reasoning and the proposed topics are described in this document.

https://arxiv.org/abs/2401.07564

- HtoSS: $e^+e^- \to Zh$: $h \to ss$
- ZHang: ZH angular distributions and CP studies
- Hself: Determination of the Higgs self-coupling
- Wmass: Mass and width of the W boson
- WWdiff: Full studies of WW and evW
- TTthresh: Top threshold - detector-level studies of $e^+e^- \to t\bar{t}$
- LUMI: Precision luminosity measurement
- EXscalar: New exotic scalars
- LLPs: Long-lived particles
- EXtt: Exotic top decays
- CKMWW: CKM matrix elements with on-shell and boosted W decays
- BKtautau: $B^0 \to K^{0*}\tau^+\tau^-$
- TwoF: EW precision - 2-fermion final states
- BCfrag/Gsplit: Measurement of b- and c-fragmentation functions and hadronisation rates and measurement of gluon splitting to bb / cc

Analysis Tools & Detector Tech

- WG2 (Physics Analysis Tools) & WG3 (Detector Technologies) follow a more top-down approach

- WG2: software, generators, technical benchmarks, beamstrahlung, luminosity, simulation, reconstruction

- WG3: bridge between DRD collaborations and HET factory detector concepts (Vertex, Tracking, Calorimetry, PID) Integration, Mechanics & Cooling

3rd ECFA workshop on HET factories

- Following tradition of previous ECFA workshops, aim for real "working workshop"
- Last ECFA workshop before next European Strategy for Particle Physics update
- Last opportunity for teams to advertise latest & greatest work ahead of ESPP update

https://indico.in2p3.fr/event/32629/overview

3rd ECFA workshop on HET factories

- Plenary contributions: 40
- Parallel contributions: 88
- In addition: ECR discussions
- Participants: 206

https://indico.in2p3.fr/event/32629/overview

Timeline: what has happened

- 20 October: deadline for analysis teams to submit 2-page summary
- 20 Oct – 10 Nov: Compilation & editing by WG1 subgroup conveners & editors and WG2/WG3 editors (+coordinators & chief editors)

98 contributions in total

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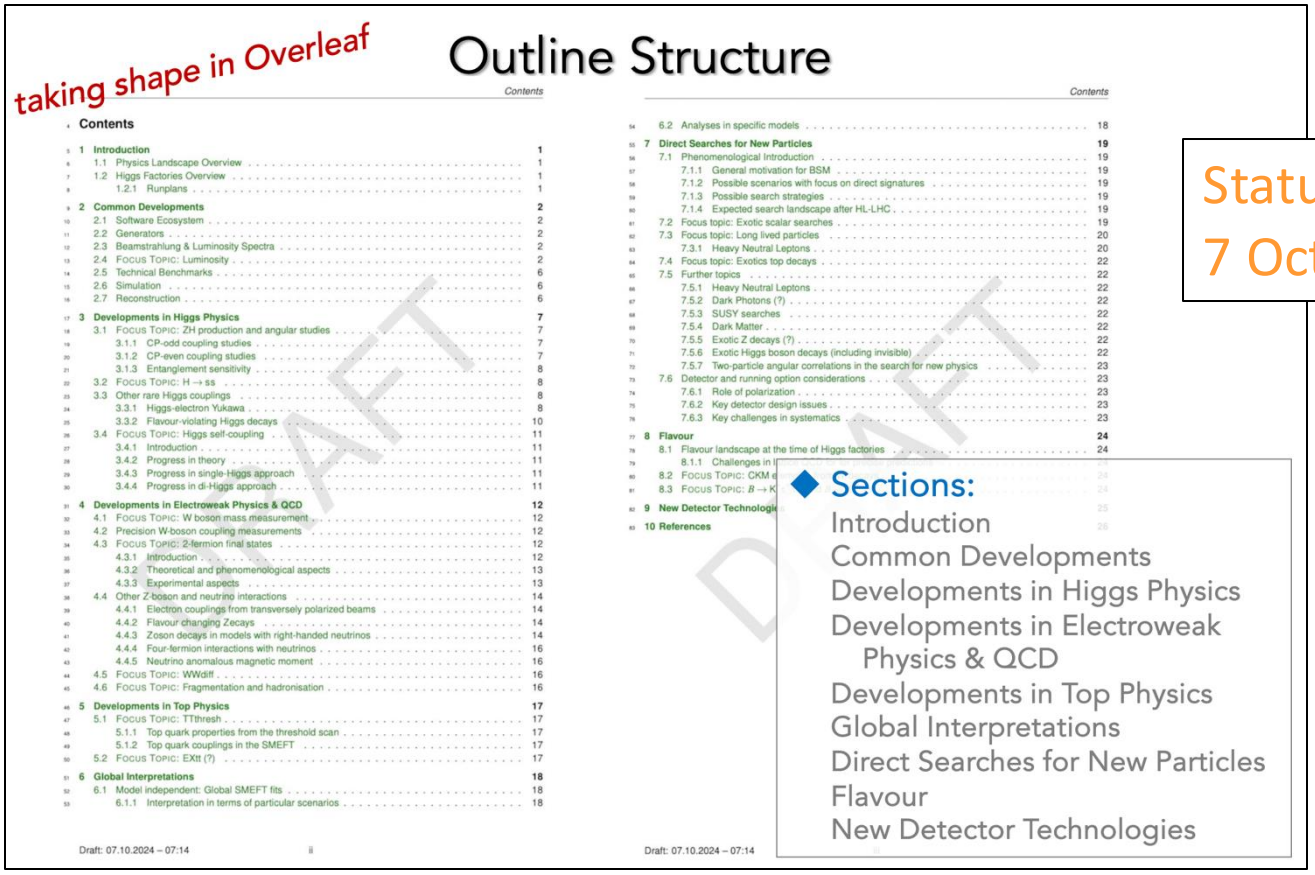
taking shape in Overleaf

Outline Structure



Contents

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Draft: 07.10.2024 – 07:14

◆ Sections:
- Introduction
- Common Developments
- Developments in Higgs Physics
- Developments in Electroweak Physics & QCD
- Developments in Top Physics
- Global Interpretations
- Direct Searches for New Particles
- Flavour
- New Detector Technologies

Status of report on 7 October

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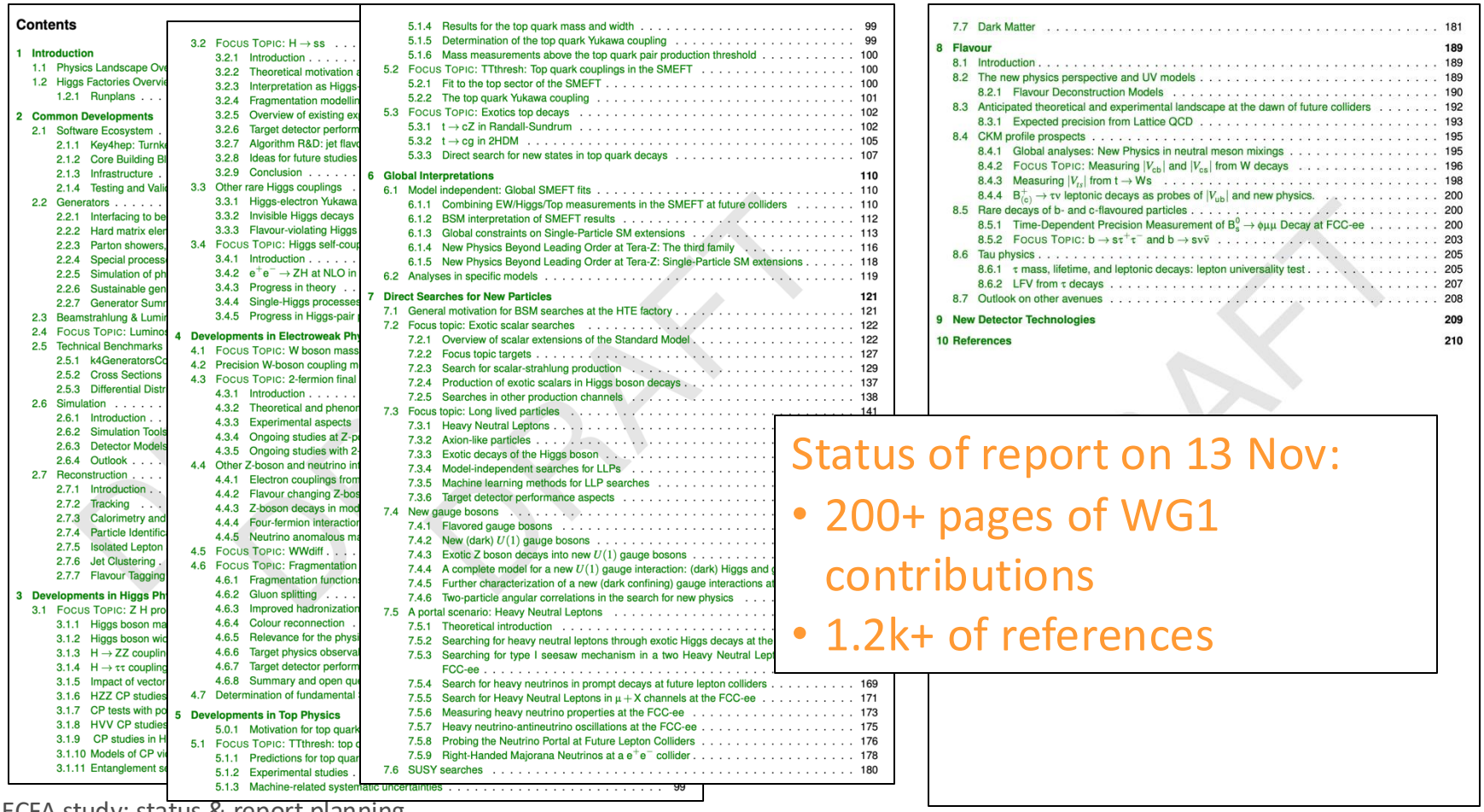

Status of report on 13 Nov:

- 200+ pages of WG1 contributions
- 1.2k+ of references

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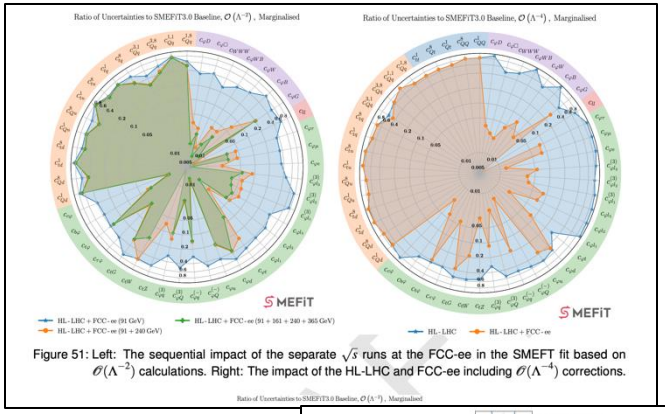

Figure 51: Left: The sequential impact of the separate $\sqrt{s}$ runs at the FCC-ee in the SMEFT fit based on $\mathcal{O}(\Lambda^{-2})$ calculations. Right: The impact of the HL-LHC and FCC-ee including $\mathcal{O}(\Lambda^{-4})$ corrections.

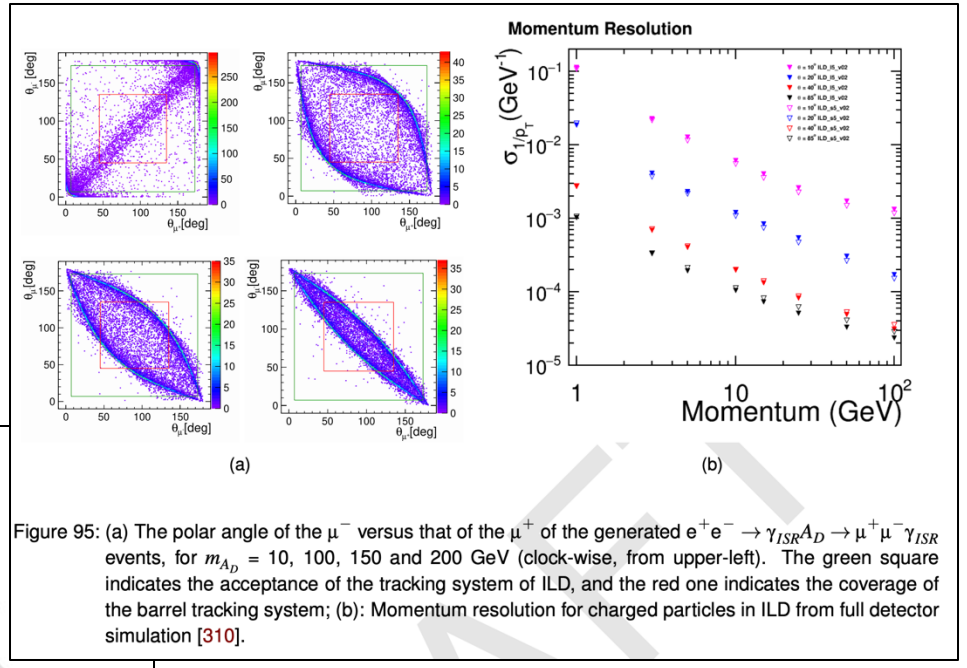

Figure 95: (a) The polar angle of the μ^- versus that of the μ^+ of the generated $e^+e^- \to \gamma_{ISR}A_D \to \mu^+\mu^-\gamma_{ISR}$ events, for m_{A_D} = 10, 100, 150 and 200 GeV (clock-wise, from upper-left). The green square indicates the acceptance of the tracking system of ILD, and the red one indicates the coverage of the barrel tracking system; (b): Momentum resolution for charged particles in ILD from full detector simulation [310].

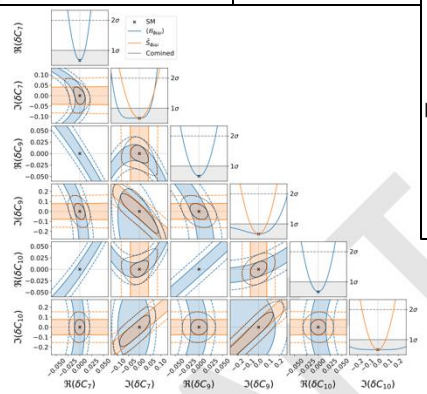

Figure 130: Constraints on the real and imaginary parts of the WCs C_7, C_9, and C_{10} from the measurements of BRs and CP asymmetry at FCC-ee.

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- 10 – 27 Nov: Editing by WG1 coordinators, WG2/3 editors & coordinators, and chief editors

WG coordinators & chief editors

- Physics program - WG1 coordinators: Fabio Maltoni, Jenny List, Jorge de Blas, Patrick Koppenburg (ECFA-WHF-WG1-coords@cern.ch)
- Physics analysis methods - WG 2 coordinators: Patrizia Azzi, Fulvio Piccinini, Dirk Zerwas (ECFA-WHF-WG2-coords@cern.ch)
- Detector technologies - WG3 coordinators: Felix Sefkow, Mary Cruz Fouz, Giovanni Marchiori (ECFA-WHF-WG3-coords@cern.ch)

- Chief editors: Christos Leonidopoulos, Aidan Robson

WG2 editors

Section editors

Andre Sailer, Frank Gaede, Gerardo Ganis
Carlo Carloni Calame, Juergen Reuter, Marco Zaro
Alan Price
Thorsten Ohl, Daniel Schulte
Andre Sailer, Brieuc Francois, Daniel Jeans
Loukas Gouskos, Taikan Suehara, Ulrich Einhaus

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- 10 – 27 Nov: Editing by WG1 coordinators, WG2/3 editors & coordinators, and chief editors
- 27 Nov – 18 Dec: Editing by chief editors
- 18 December: circulation of 1st draft to contributors, IAC, P-ECFA/R-EFCA
- 17 January: Deadline for comments on 1st draft
- 24 January: Deadline for final results/plots from contributors
- February: incorporation of comments & latest results/plots
- 21 February: Final version sent to P-ECFA/R-ECFA
- 7-8 March: R-ECFA approval during country visit, followed by arXiv submission

Summary

Huge amount of activity, exciting new results on HET factory prospects, large number of contributions

Challenge: produce a coherent & self-contained document in a very short time

Months ahead are going to be intense for contributors, editors, coordinators, reviewers

We are on track to deliver the 1st draft to community before the Xmas break

Backup

FAQ: late submissions

- What happens if a study/contribution misses these deadlines?

- Analyses/work/results that may mature on a longer timescale should not (and will not) be ignored.
- There is the possibility of submitting a short addendum to our report in time for consideration at the Symposium.

WG coordinators

- Physics program - WG1 coordinators: Fabio Maltoni, Jenny List, Jorge de Blas, Patrick Koppenburg (ECFA-WHF-WG1-coords@cern.ch)
- Physics analysis methods - WG 2 coordinators: Patrizia Azzi, Fulvio Piccinini, Dirk Zerwas (ECFA-WHF-WG2-coords@cern.ch)
- Detector technologies - WG3 coordinators: Felix Sefkow, Mary Cruz Fouz, Giovanni Marchiori (ECFA-WHF-WG3-coords@cern.ch)

- Chief editors: Christos Leonidopoulos, Aidan Robson

WG1 convenors

WG1-PREC (Precision in theory & experiment):
Ayres Freitas (Pittsburgh), Paolo Azzurri (Pisa),
Adrian Irles (Valencia), Andreas Meyer (DESY)
ecfa-whf-wg1-prec-conveners@cern.ch

WG1-GLOB (Global interpretations in (SM)EFT and UV complete models):
Sven Heinemeyer (IFCA/IFT), Alexander Grohsjean (DESY),
Junping Tian (Tokyo), Marcel Vos (Valencia), Jorge de Blas (Granada)
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WG1-HTE (TOP-HIGGS-EW and connection with LHC):
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WG1-FLAV (Heavy Flavours):
David Marzocca (Trieste), Stephane Monteil (Clermont Ferrand),
Pablo Goldenzweig (KIT)
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WG1-SRCH (Feebly interacting particles, direct low mass searches):
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WG2 editors

Section editors

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Alan Price
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Loukas Gouskos, Taikan Suehara, Ulrich Einhaus

Focus Topics Expert Teams

- Expert teams formed for each Focus Topic to guide study in collaboration with WG1 coordinators/convenors

EXscalar (SRCH)	**LLPs (SRCH)**	**EXtt (SRCH)**	**HtoSS (HTE)**	**ZHang (HTE(GLOB))**	**TwoF (HTE)**
Filip Zarnecki	Rebeca Gonzalez Suarez	Nuño Castro	Valentina Cairo	Ivanka Bozovic	Adrian Irles
Mikael Berggren	Juliette Alimena	Marina Cobal	Taikan Suehara	Markus Klute	Daniel Jeans
Sven Heinemeyer	Jan Hajer	Gauthier Durieux	Loukas Gouskos	Sandra Kortner	Freya Blekman
Abdollah Mohammadi	Marcin Kucharczyk	Roberto Franceschini	Matt Basso	Cheng Li	Mogens Dam
Tania Robens	Emma Torro Pastor	María Teresa Núñez Pardo de Vera	Caterina Vernieri	Gudrid Moortgat-Pick	Jorge de Blas
Nikolaos Rompotis	Sarah Louise Williams	Kirill Skovpen	Valerio Dao	Ken Mimasu	Eram Rizvi (tbc)
	Filip Zarnecki	Marcel Vos	John Alison		Emanuele Bagnaschi
			Yotam Soreq		
Hself (Glob)	**WWdiff (Glob)**	**TTthres (Glob(HTE))**			
Junping Tian	Patrizia Azzi	Marcel Vos	**BCFrag/Gsplit (FLAV/PREC)**	**Wmass (PREC)**	**LUMI (PREC)**
Gauthier Durieux	Timothy Barklow	Patrizia Azzi	Eli Ben-Haim	Paolo Azurri	Ayres Freitas
Jose Goncalo	Jorge de Blas	Martin Beneke	Maria Ubiali	Josh Bendavid	Ivanka Bozovic
Sven Heinemeyer	Ansgar Denner	Jorge de Blas	Andrzej Siodmok	Martin Beneke	Mogens Dam
Michael Peskin	Alexander Grohsjean	Matteo Defranchis	Simon Plaetzer	Stefan Dittmaier	Fulvio Piccinini
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		Andre Hoang		Raimund Ströhmer	Maciej Skrzypek
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M. Bordone	M. Kenzie	Frank Simon			
D. Marzocca	E. Manoni	Filip Zarnecki			
	P. Goldenzweig				
	J. Kamenik				