



# Technical Benchmarks

**Alan Price on behalf of WG2**

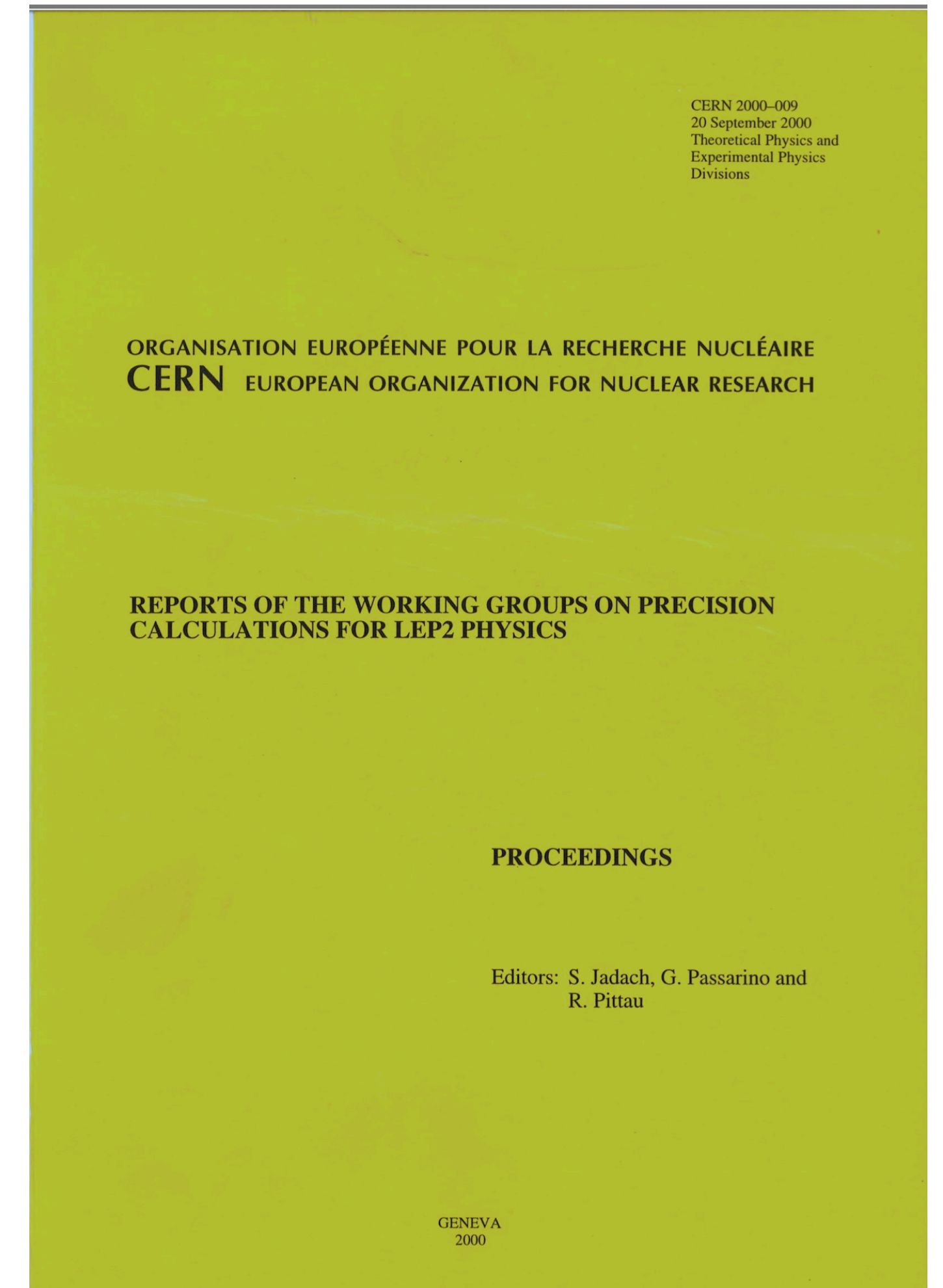
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# Benchmark Aims

- ❖ Main goal is to provide a framework to perform **technical** test of MC generators for all possible future Higgs factories
- ❖ Identify possible deviations between generators
  - ❖ Lead to discussions with WG1 and generator authors
- ❖ e+e- study has a long lifetime and MC will through many changes
  - ❖ Need a benchmark or standard candle to compare to
- ❖ “Lessons learned from LEP2”



# Generators

- ❖ Babayaga (Latest)
- ❖ KKMC (v5 cpp release)
- ❖ Madgraph (3.5.4)
- ❖ Sherpa (2.2.15)
- ❖ Whizard (3.1.4)

Versions as of this morning

## Key4Hep

- ❖ Are all generators on the best “e+e-“ release?
  - ❖ E.g Sherpa3
- ❖ Wrapper/Spack issues with KKMC
- ❖ Does generator tuning require a generator update?

- ❖ Python Package developed to run MC
- ❖ Run the Python package
- ❖ Run the generator in KEY4HEP
- ❖ Translate HepMC/LHE into EDM4HEP
- ❖ Analyse events
- ❖ Read EDM4hep to make a summary

## Available in Key4hep

Process	$\sqrt{s}$ (GeV)	Generator	Cross Section (pb)
$\mu^+\mu^-$	240	MadGraph5_aMC@NLO	$3.8332 \pm 0.0112228$
		Whizard	$4.4799 \pm 0.0677174$
$\mu^+\mu^-$	350	SHERPA-MC	$1.7548 \pm 0.00297814$
		MadGraph5_aMC@NLO	$1.72647 \pm 0.00184034$
		Whizard	$1.78481 \pm 0.00846396$
$\gamma\gamma$	91.2	MadGraph5_aMC@NLO	$51.941 \pm 0.027225$
		Babayaga	$49.1597 \pm 1.10742$
		SHERPA	$52.1944 \pm 0.00260813$
$t\bar{t}$	350	MadGraph5_aMC@NLO	$0.186168 \pm 0.000132046$
		Whizard	$0.186629 \pm 0.000826694$
		SHERPA	$0.184721 \pm 0.000179541$
ZH	241.123	MadGraph5_aMC@NLO	$0.19851 \pm 0.00054668$
		Whizard	$0.198518 \pm 0.00069897$
		SHERPA	$0.197514 \pm 0.00230028$

Table 1: Cross section measurements for different processes and generators.

Open Yaml example

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# Example Results

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# Timeline

**ECFA Workshop Oct 9-11 Paris**

**ECFA Report to RECFA: 12/2024 - 01/2025**

**Strategy Input March 31, 2025**

## **ECFA Workshop Oct 9-11 Paris**

Preliminary results ready and presented

ECFA Report to RECFA: 12/2024 - 01/2025

Strategy Input March 31, 2025



# Timeline

ECFA Workshop Oct 9-11 Paris

Preliminary results

**ECFA Report to RECFA: 12/2024 - 01/2025**

Iterations/Finalisation with authors

Strategy Input March 31, 2025

# Next Steps:

## Processes

- ❖  $f\bar{f}$  ( $f = e, \mu, \tau, \nu_i$ )
- ❖  $ZH$
- ❖  $W^+W^-$
- ❖  $t\bar{t}$
- ❖  $\gamma\gamma$

Next few days

## Setups

- ❖ With/without ISR
- ❖ Simple fiducial cuts
- ❖ Varied  $\sqrt{s}$

July: Test Setups  
Iterate any issues

## Distributions

- ❖ Angular distributions
- ❖ Invariant mass
- ❖ Recoil mass (HZ)
- ❖ PT, ET, ...

Sept: Short zoom meeting  
with MC authors

## Processes discussion

[Google Doc](#)