Collider Phenomenology

Research highlights of the Hamburg and Zeuthen groups

This image is a place-holder for the respective program - image

Helmholtz Program: Matter and the Universe (MU)

PoF III Research Theme: Lattice Field Theory

DESY Research Unit: Theoretical Particle Physics

Christophe Grojean
Center Evaluation DESY, 5 – 9 February 2018

HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES

DESY

Collider Phenomenology

Research group “ Elementary Particle Physics”

Guidelines for presentations’ format

- Structure and composition of the HH and ZH groups
- 5 main topics of interest: (i) Precision predictions: QCD, EW, BSM, (ii) Precision Higgs physics and EW symmetry breaking, (iii) Standard candles: Drell-Yan, top, jets, (iv) Dark matter, (v) Flavour physics
- Connections with other DESY theory activities (Particle cosmology, String theory, Lattice QCD)
- Close interactions with experimental groups (ATLAS, CMS, ILC, Belle2)
- Strong involvement in different WGs
- Link to universities

Research highlights: running at 5-loops - Higgs characterisation

1/2 slide on 5-loop running

- 5-loop renormalisation constants available for a general gauge group
- Full agreement with Nc=3 Feynman gauge results

1/2 slide on Higgs Simplified Template XS

- Strong interactions for TH-EXP interactions
- Reduce theory dependence folded into measurements
- Allow flexible reinterpretation in different scenarios (SM, BSM, EFT…)

Further achievements

Selected achievements (only mention, not discuss in detail)

- 3-Loop anomalous dimension
- Muon anomalous magnetic moment (QED @ 4-loops)
- QCD renormalisation: 4 loops on-shell and 5-loop MS (running constants)
- Jet algorithms and jet substructures (N-jettiness)
- Drell-Yann at NNL+NNLL+PS+MPI
- Multiparton interactions
- Threshold resummation in parton shower
- Precision top physics at lepton colliders
- Non-perturbative renormalisation of lattice PDFs
- Higgs physics in MSSM: Higgs mass predictions, CP-violating effects, interference effects
- Higgs coupling characterization: EFTS etc
- VBS @ LHC
- ALPs
- Higgs portal DM

Outlook

Making maximal use of current and coming collider data

- Being able to cover a broad and complementary range of topics is key
- Strong connections with cosmology, string, and lattice
- Direct interactions with experimental groups at DESY are essential

Preparing for the future colliders

Tackle fundamental questions about matter and the universe

Meet the challenges and participate to the emergence of new paradigms ruling matter at the tiniest distances