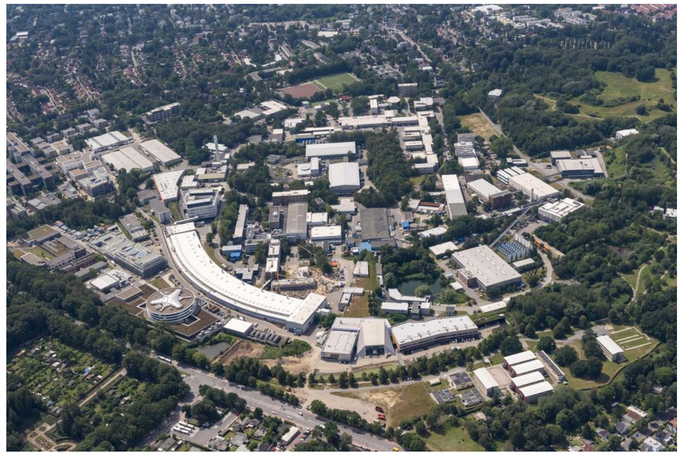
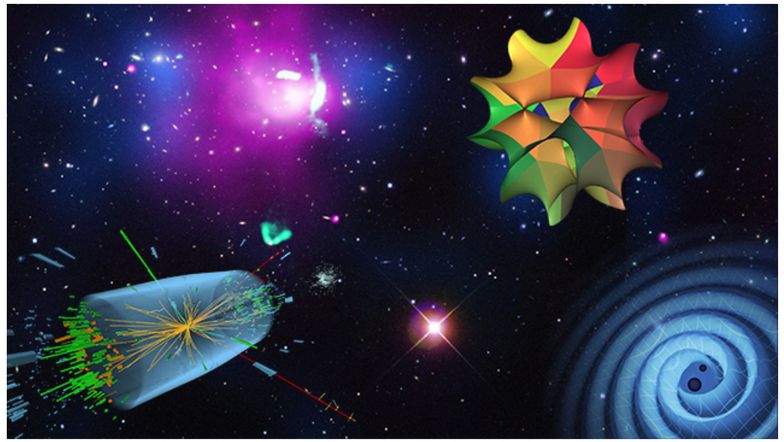
Future Collider —Theory Activities

DESY — University of Hamburg — Quantum Universe





Gudrid Moortgat-Pick & Jürgen Reuter

DESY / UHH Future Collider Theory Activities

- Beam dump experiments
- Beam structure / PDFs
- BSM sensitivity
- Global Fits
- Model building & Benchmarks
- Monte Carlo development
- Precision predictions & Calculational methods
- Strategy Planning

DESY(HH/Z)/UHH staff involved:

Fadi Bishara
Johannes Blümlein
Markus Diehl
Christophe Grojean
Hyungjin Kim
Bernd Kniehl
Thomas Konstandin
Peter Marquard
Sven Moch
Gudrid Moortgat-Pick
Zoltan Nagy
Georgios Papathanasiou
Jürgen Reuter
Kai Schmidt-Hoberg
Andreas Ringwald
Geraldine Servant
Bibhushan Shakya
Frank Tackmann
Georg Weiglein
Alexander Westphal

and, of course, many postdocs and Phd/master students

in spiritu: Peter Zerwas

ILC International Development Team Members

Convenerships: CEPC, CLIC, EIC, ILC, HL-LHC, FCC-ee, FCC-hh

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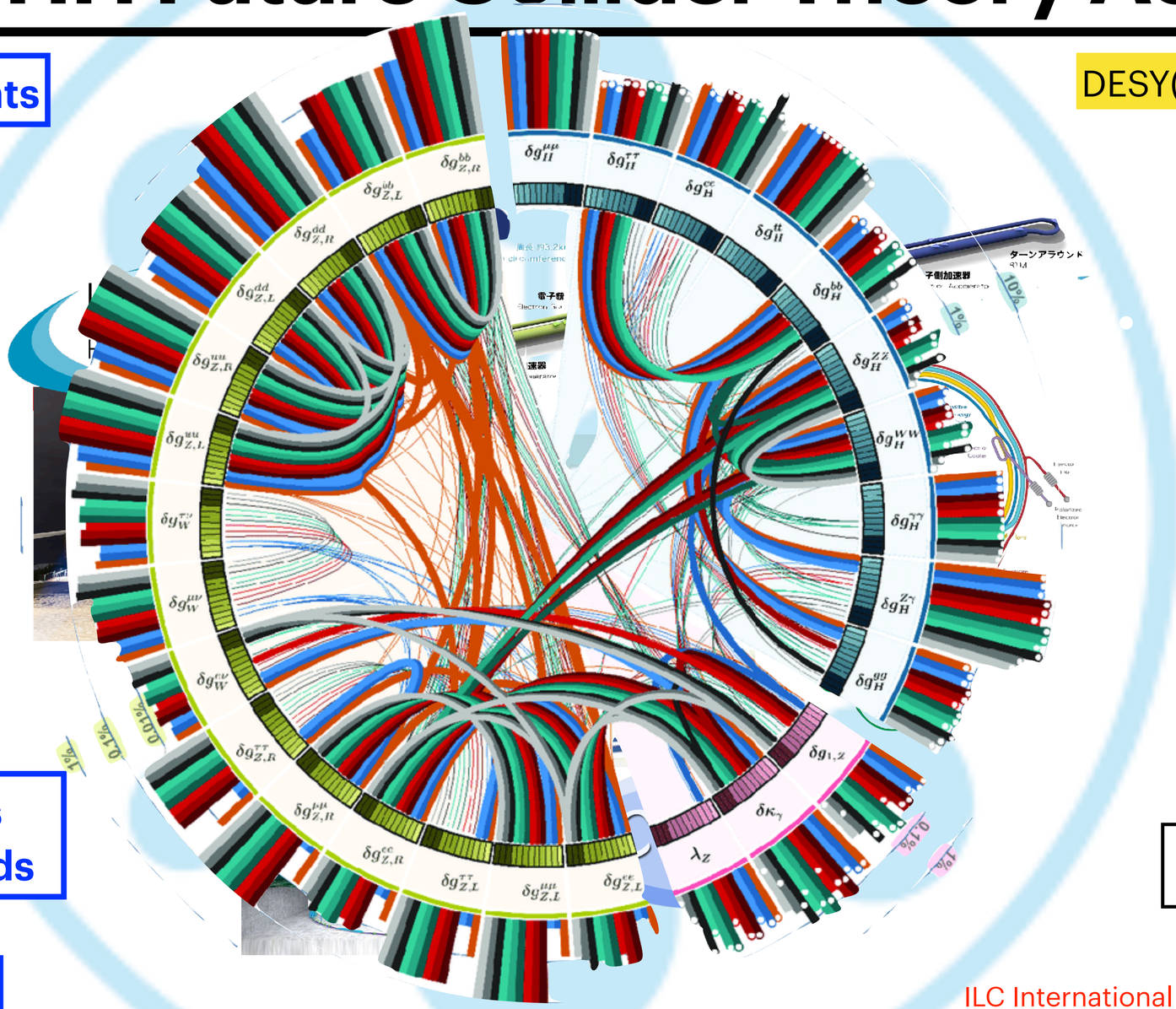

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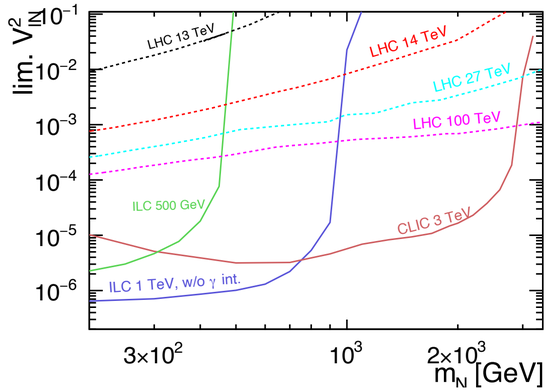
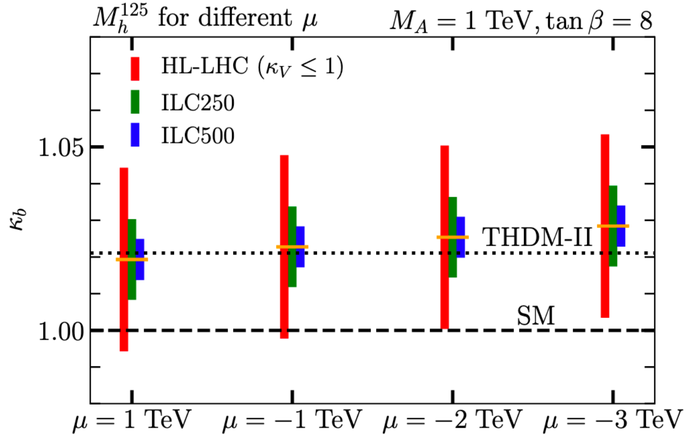
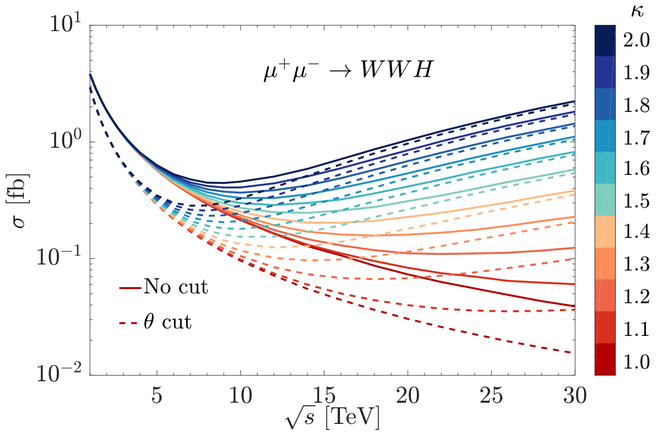
New Physics at Future Colliders

- Phenomenology of BSM models: SUSY, extended Higgs sectors (THDM...), composite Higgs models, Little Higgs, Higgs portal, Twin Higgs, ...
- Precise calculations/predictions/parameters scans in different models
- Exploitation of collider-specific features, e.g. beam polarization, tunable energy, collider running scenarios, GigaZ etc., necessary collider energies (FCC-hh)
- Approaches for parameterizing SM deviations, e.g., SMEFT, validity and tests
- Special particles: WIMPs/axions/neutrinos....:
- Dump Experiments at ILC (ILC+, DM@positron dump), non-collider experiments
- Impact of gravitational waves, inflation, phase transitions at colliders
- Global fits: Higgs couplings, SUSY Parameter fits,...
- Application of new methods, e.g. ML, BDT, MCMC, ...
- Physics potential of future machines, e.g. FCC-hh, μ-collider, etc.

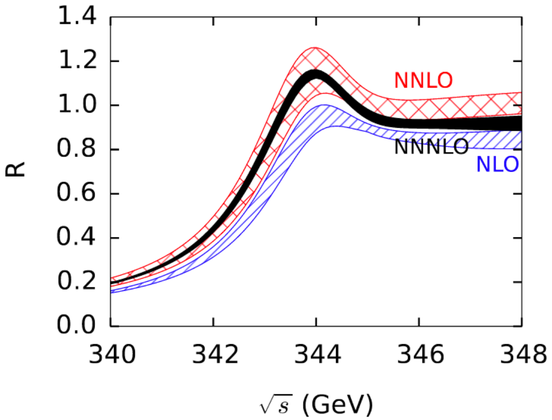




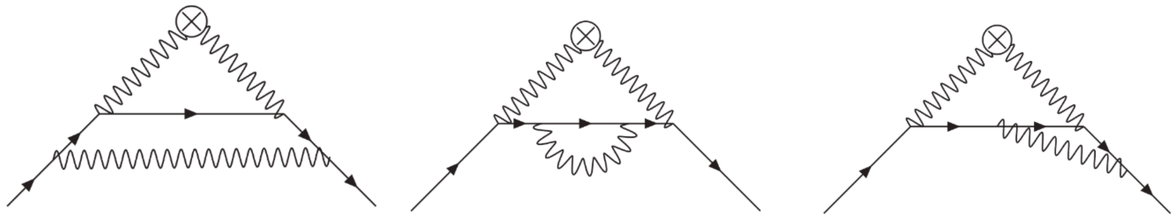


Precision Predictions and Tools for Future Colliders

- **Many LHC calculations transferable to FCC-hh:** NLO, NNLO, Resummation, Parton Showers, …
- **Parton structure predictions (HL-LHC/EIC/FCC-eh/hh):** PDF fits, Parton correlations, Double Parton Scattering



- **Development of new calculational techniques:** Amplitudes methods, ML, bootstrap, …
- **Precision observables for future colliders:** Top, Higgs, W/Z properties, EWPO, …
- **Strong development of tools:** `Deductor, HiggsBounds, MasterCode, SCETlib, Whizard, …`
- **Precision predictions for e^+e^- colliders:** full SM studies, higher order QED/EW, beam/polarization studies



	$\sigma_{\rm LO}$[fb]	$\sigma_{\rm NLO}$[fb]	K	$\sigma^{\rm std}_{\rm NLO}$
$e^+e^- \to jj$	622.737(8)	639.39(5)	1.027	0.69
$e^+e^- \to jjj$	340.6(5)	317.8(5)	0.933	0.53
$e^+e^- \to jjjj$	105.0(3)	104.2(4)	0.992	1.11
$e^+e^- \to jjjjj$	22.33(5)	24.57(7)	1.100	0.99
$e^+e^- \to jjjjjj$	3.583(17)	4.46(4)	1.245	–

- **High energy lepton (e/μ) colliders:** EW showers, EW PDFs, exclusive radiation patterns

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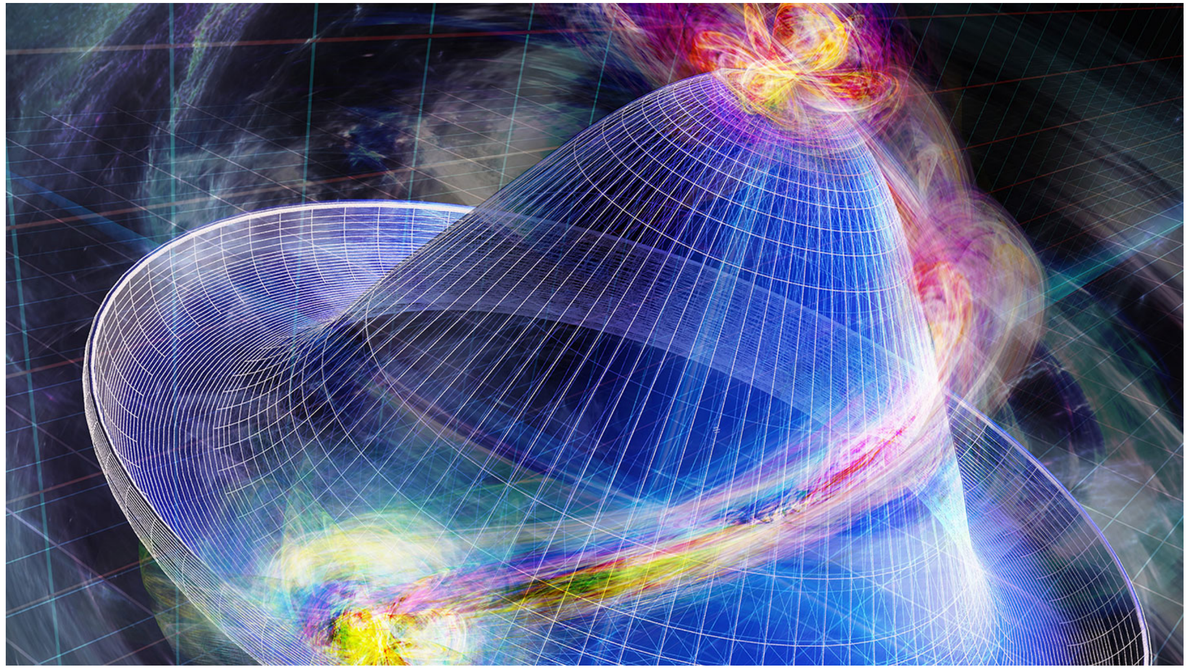
Organizational involvement

- **Intense T/EXP collaboration:** for many of the future colliders, particularly HL-LHC, FCC-hh, ILC
- **DESY Theory Workshop:** every 3rd year focus on collider phenomenology
- **Linear (ILC) Collider Activities :** Linear Collider School, Linear Collider Forum → Future Collider Forum
- **DESY Summer School:** strong theory involvement, world-wide participation, many FC projects
- **Monte Carlo School:** ~ annual event, techniques and tools,
- **Cluster 'Quantum Universe':**

  regular lectures, colloquia, workshops with FC context

CLUSTER OF EXCELLENCE
QUANTUM UNIVERSE



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