

# IDT WG3 - Topical Group

## Modelling & Precision Theory

**ilc** *international development team*



Gudrun Heinrich - Stefan Höche - Li Zhao (李钊) - Jürgen Reuter

1st Topical Working Group Meeting - June 10, 2021



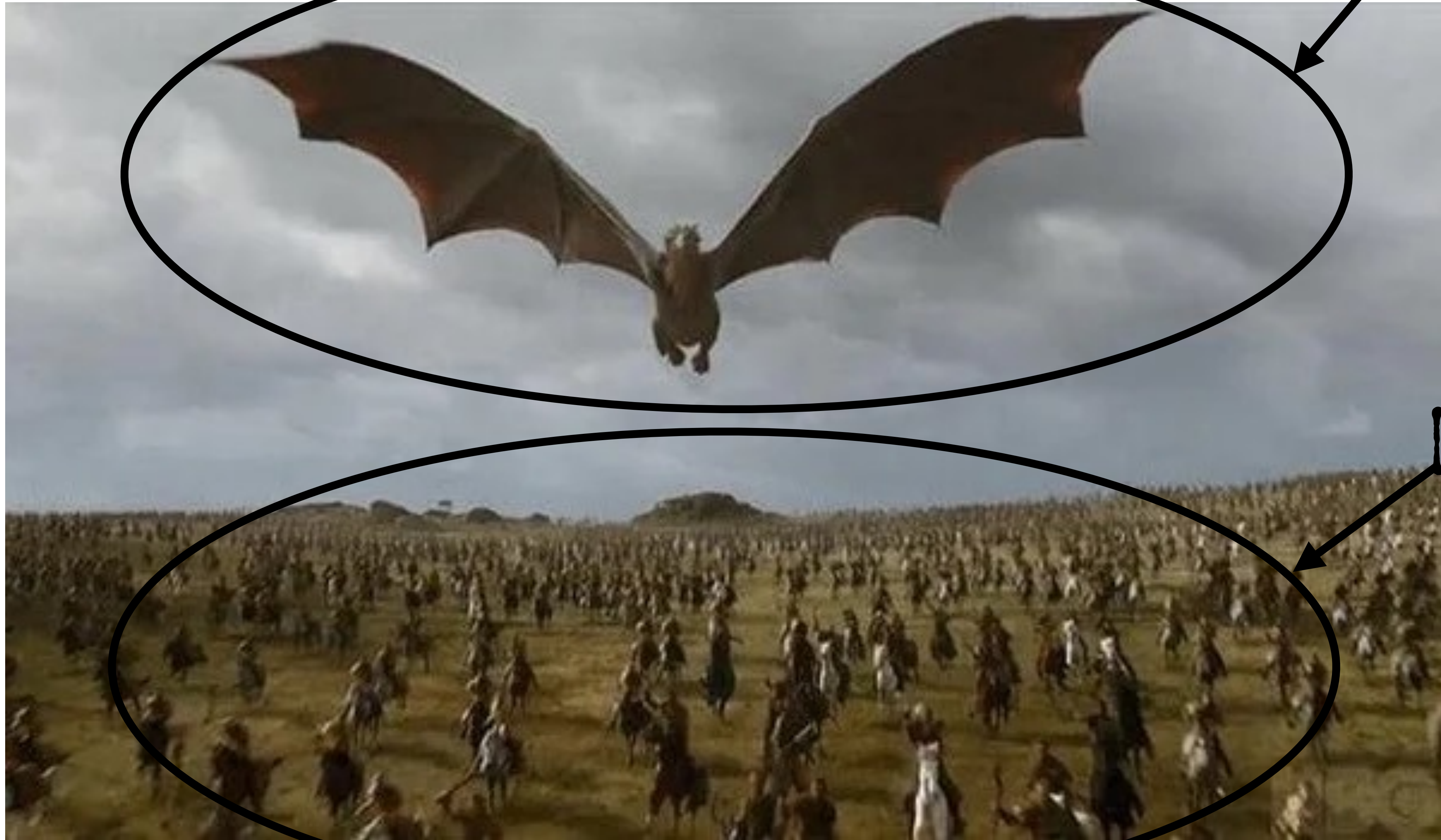




Source:  
HBO, August 2017







**New Zoom Meeting**

**HEP Community**

Source:  
HBO, August 2017



# WG3 Physics Opportunities Topical Groups

<https://linearcollider.org/team/wg3/physics/>

Higgs properties

Shinya Kanemura (Osaka) , Georg Weiglein (DESY) , Patrick Meade (Stony Brook), Chris Potter (Oregon)

Top/Heavy Flavor/ QCD

Hua-Xing Zhu (Zhejiang) , Adrián Irlles (Valencia), Alexander Mitov (Cambridge), N.N.

BSM production

Shigeki Matsumoto (IPMU) , Mikael Berggren (DESY) , Werner Porod (Würzburg) , Simone Pagan Griso (LBNL)

EW physics

Taikan Suehara (Kyushu), Wolfgang Kilian (Siegen) , Graham Wilson (Kansas)

Global interpretation

Sunghoon Jung (Seoul) , Christophe Grojean (DESY) , Sven Heinemeyer (Madrid) , Tim Cohen (Oregon)

Modelling /  
Precision Theory

Zhao Li (IHEP) , Gudrun Heinrich (KIT) , Jürgen Reuter (DESY) , Stefan Höche (FNAL)





# WG3/Mod - Who are we and what do we want?



**Gudrun Heinrich, KIT**

- Precision calculations
- NNLO QCD / Multi-loop
- Higgs (+ heavy quarks)



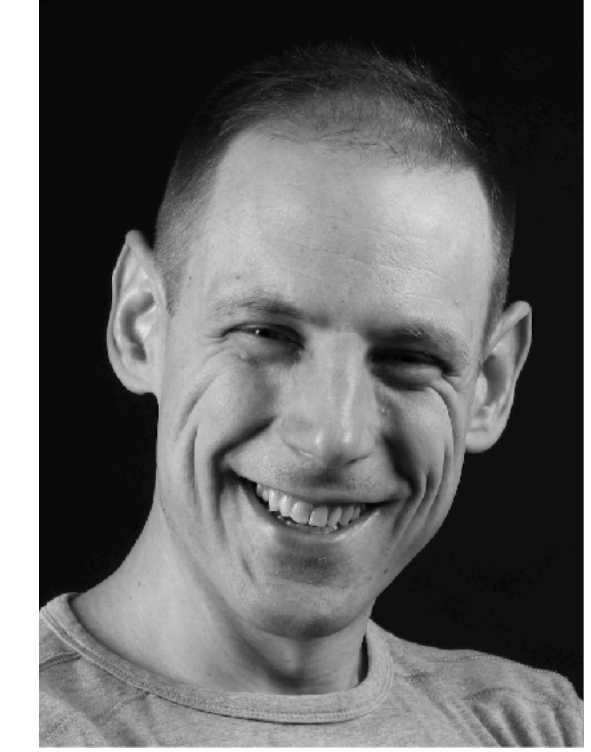
**Stefan Höche, FNAL**

- Perturbative QCD
- Jet physics
- Monte Carlo generators



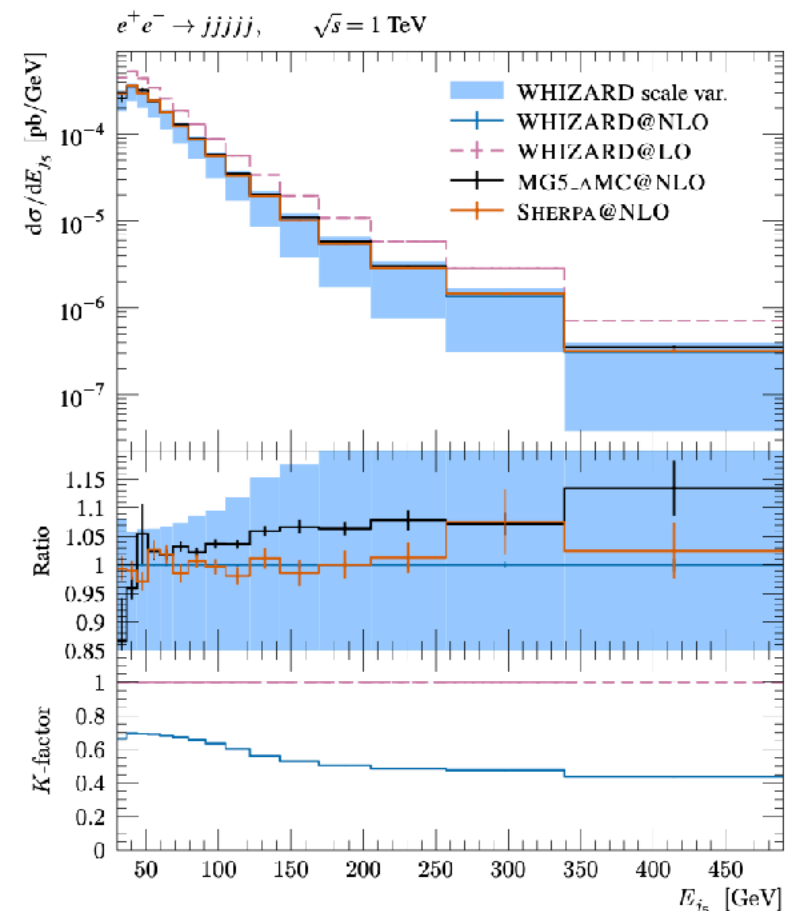
**Li Zhao (李钊), IHEP**

- (Non- &) Perturbative QCD
- Boosted objects
- Jet substructure



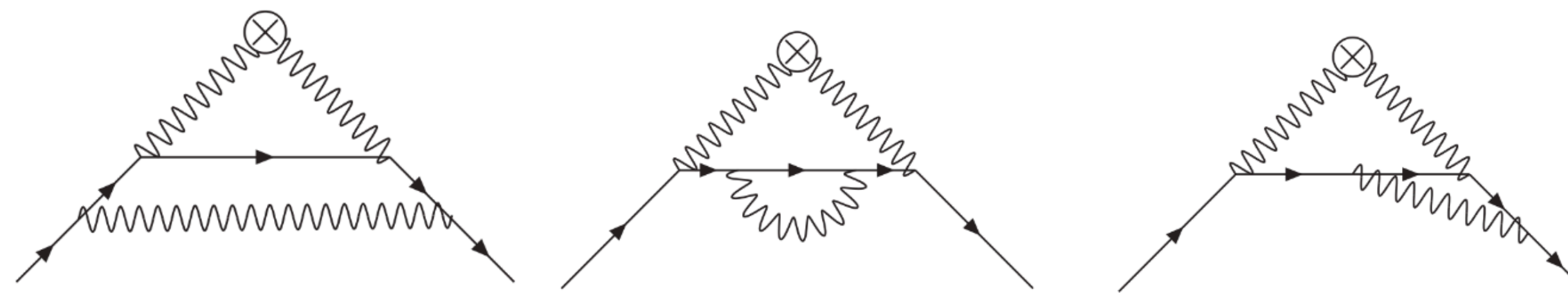
**Jürgen Reuter, DESY**

- EW physics
- BSM physics
- Monte Carlo generators



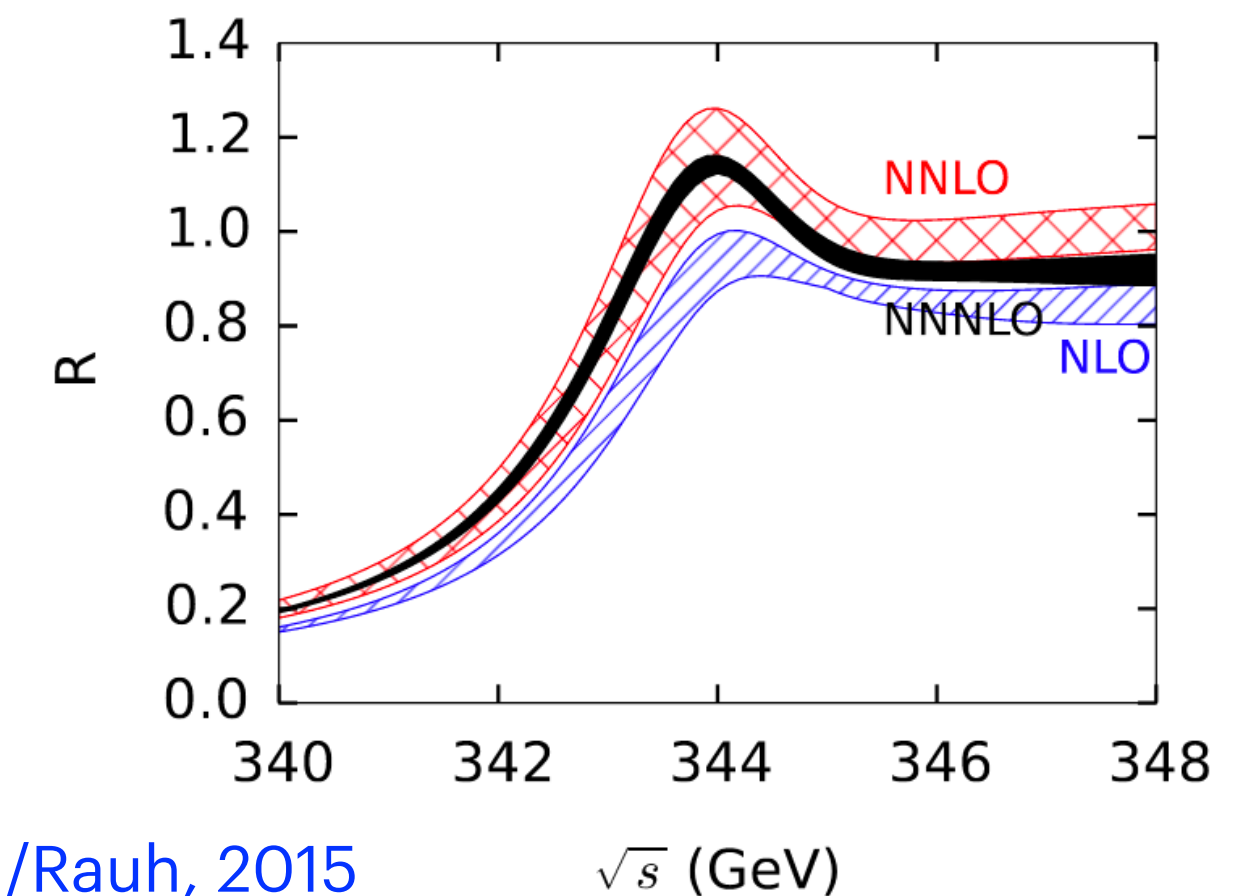
Rothe, 2021

J. R. Reuter, DESY



Ablinger/Blümlein/de Freitas/Schönwald, 2020

Beneke/Maier/Piclum/Rauh, 2015



# Physics & Scope, Connections to Topical Groups

## ● Precision Calculations for ILC

- NNLO QCD / EW / mixed
- Thresholds:  $Z$ ,  $WW$ ,  $Zh$ ,  $tt$ ,  $tth$
- New loop techniques
- QED resummation
- non-pert. QCD / fragmentation
- All-order QED factorization
- NLO SMEFT

## ● Monte Carlo implementation / studies

- YFS vs. collinear factorization
- Photon isolation
- MC tuning for ILC
- New MC techniques (ML, ...)
- Improvement on beam spectra
- Polarization in event formats
- Simulation of BSM / SMEFT

- Multi-Leg NLO QCD / EW / mixed
- QED resummation matched to MC
- QCD/EW shower and resonances
- QED matching schemes
- NNLO matching schemes
- Unfolding QED corrections

EW physics

Higgs properties

Top/Heavy Flavor/ QCD

Global interpretation

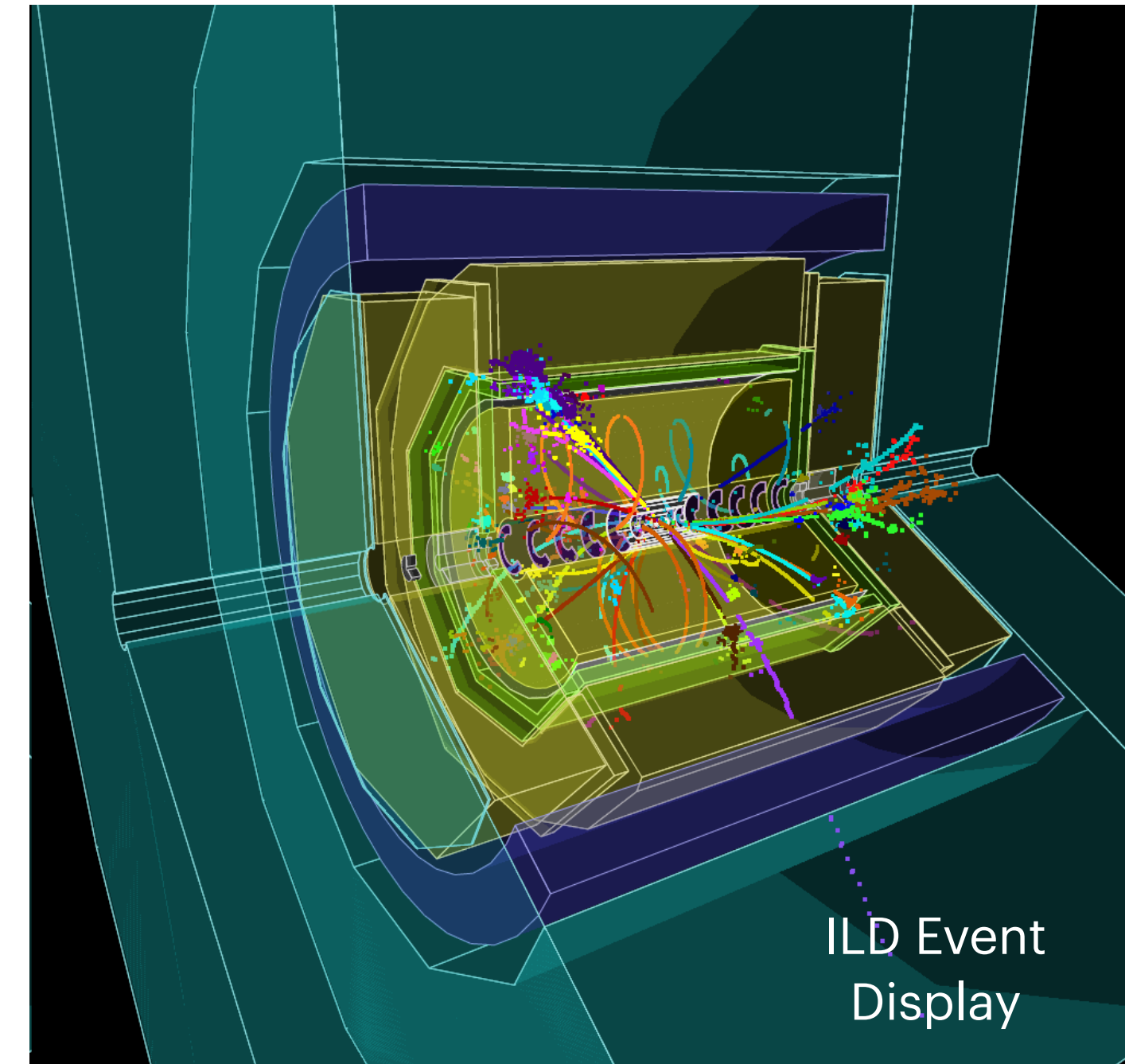
BSM production





# Brainstorming ...Ideas to be discussed/studied

- Transferral of SLC/LEP legacy, smoothly enhancing existing ILC simulations (+ CLIC / CEPC)
- Motivate people to work on ILC theory, precision & simulation
- High-energy LEP (160-210 GeV) hadronization tunes: Status and “quality”
- QED showers, collinear vs. YFS factorization, is there a best scheme (?)
- Matching between resummation and matrix element
- Strategies for Monte Carlo production: process classification vs. “# fermions”
- [MC] treatment of physics thresholds:  $Z$ ,  $WW$ ,  $Zh$ ,  $tt$ ,  $WWh$ ,  $ZZh$ ,  $tth$ , ...
- Deficiencies of existing event formats (HepMC vs. LCIO vs. ..., correlated polarization!)
- Identify needed improvements on theory calculations ([N]NNLO EW, mixed etc.)
- Need for new loop techniques: sector decomposition vs. Mellin-Barnes vs. Loop-tree
- Special treatment for special processes: Bhabha, radiative Bhabha ...
- BSM calculations / simulations: where do we stand? what do we have to improve? when?



• Please deliver input and ideas: email or spreadsheet !?

• Plan:  $\approx$  monthly meetings