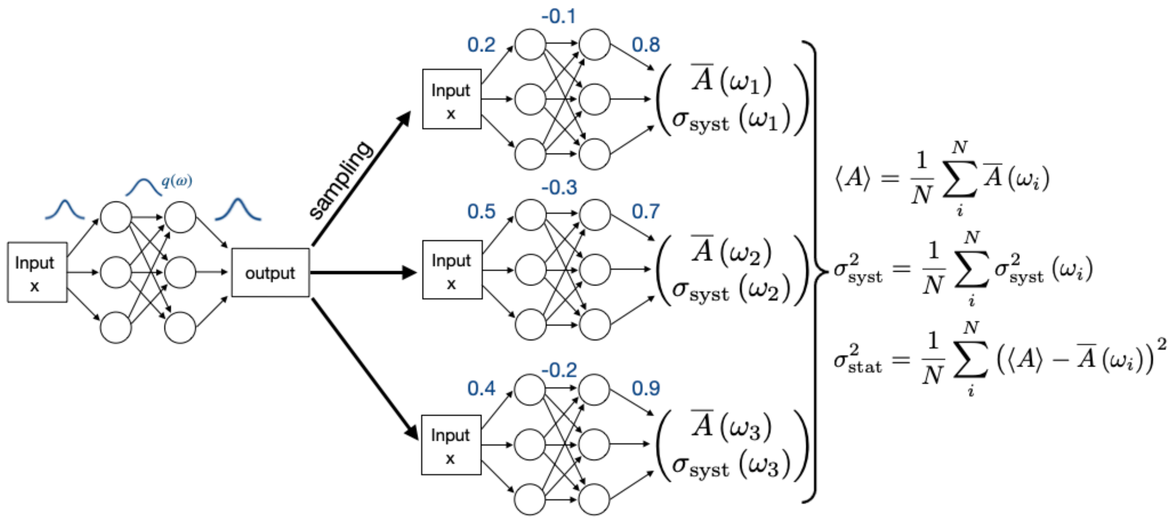
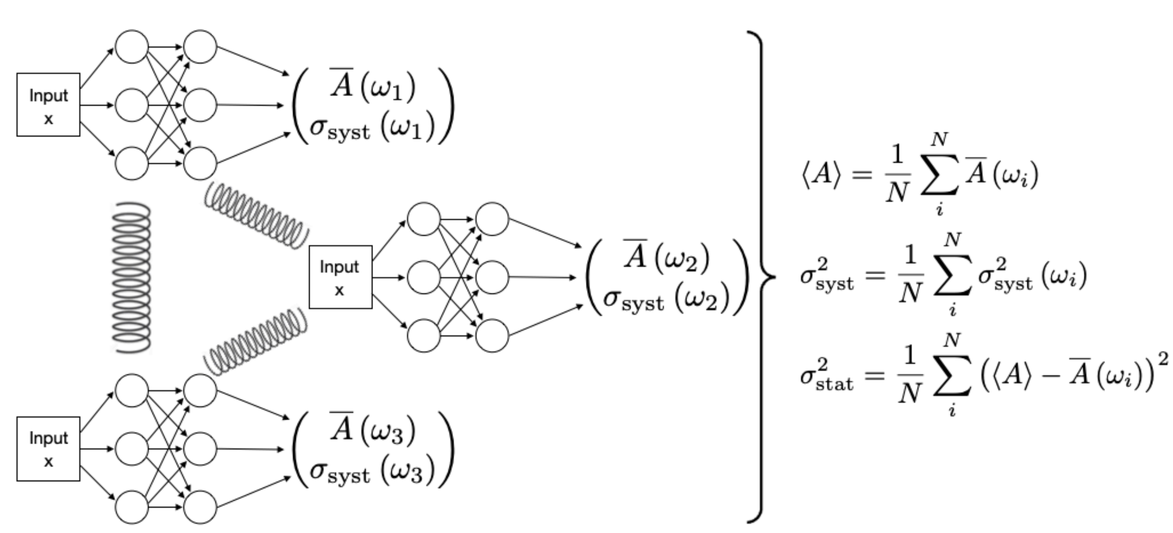
Learning Uncertainties using Amplitude regression

Bayesian Neural Network (BNN)

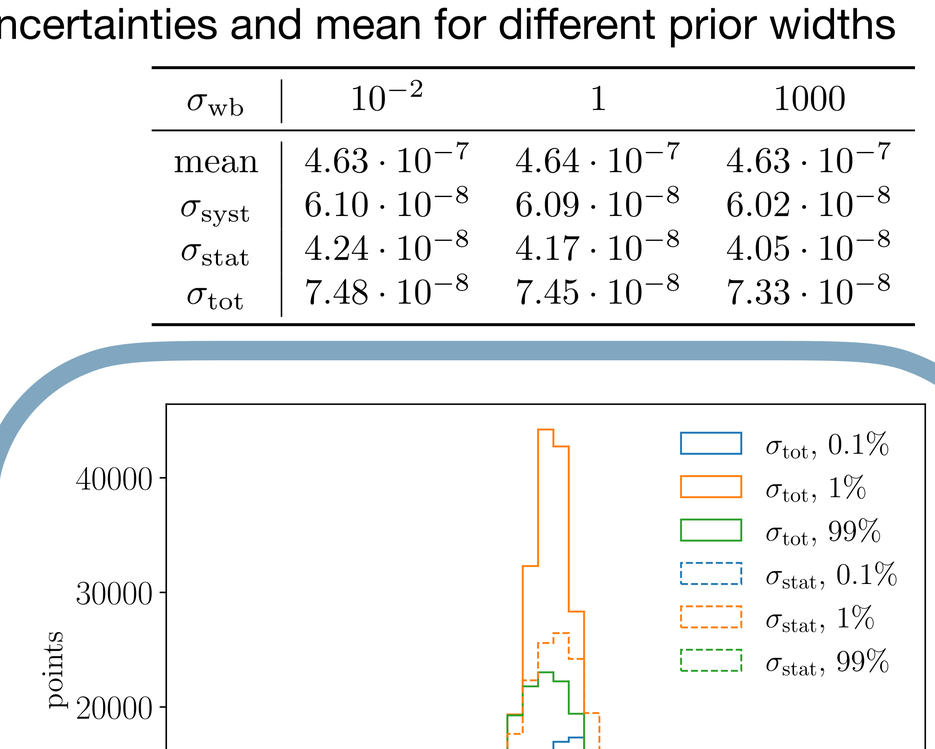


Repulsive Ensemble (RE)



Training: prior **independent**
uncertainties and mean for different prior widths

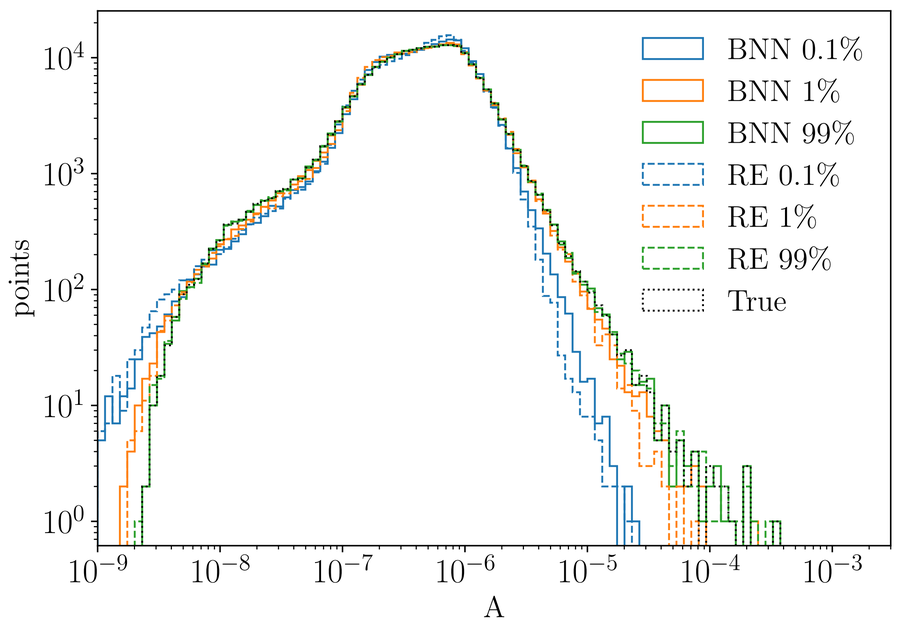
σ_{wb}	10^{-2}	1	1000
mean	$4.63 \cdot 10^{-7}$	$4.64 \cdot 10^{-7}$	$4.63 \cdot 10^{-7}$
σ_{syst}	$6.10 \cdot 10^{-8}$	$6.09 \cdot 10^{-8}$	$6.02 \cdot 10^{-8}$
σ_{stat}	$4.24 \cdot 10^{-8}$	$4.17 \cdot 10^{-8}$	$4.05 \cdot 10^{-8}$
σ_{tot}	$7.48 \cdot 10^{-8}$	$7.45 \cdot 10^{-8}$	$7.33 \cdot 10^{-8}$

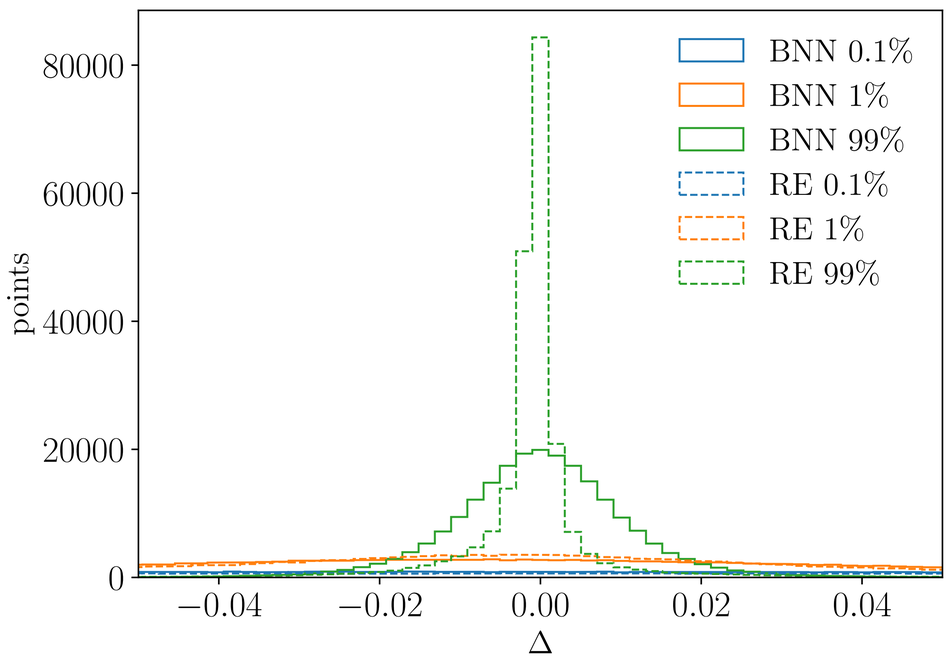


both BNN, $\Delta = \left(A - A_{NN}\right)/A$
upper: Pull for different training sizes
lower: 99% training data for various epochs

Data:

- **Amplitude regression:** $gg \to \gamma\gamma g$





comparing BNN and RE for different training sizes
with $\Delta = \left(A - A_{NN}\right)/A$

Results:

- BNNs with regularization and RE with ensemble training **more efficient** than normal neural net
- small training: good estimation of amplitudes
- BNNs: σ_{tot}: good estimation, σ_{stat}: underestimated for large training
- RE: overconfident in uncertainties

IMPRS
for Precision Tests of Fundamental Symmetries
INTERNATIONAL MAX PLANCK RESEARCH SCHOOL

Uncertainty-aware Machine Learning for the LHC

Nina Elmer[1], Luigi Favaro[1], Manuel Haußmann[2], Tilman Plehn[1]
1 Universität Heidelberg
2 University of Southern Denmark

UNIVERSITÄT HEIDELBERG
ZUKUNFT SEIT 1386