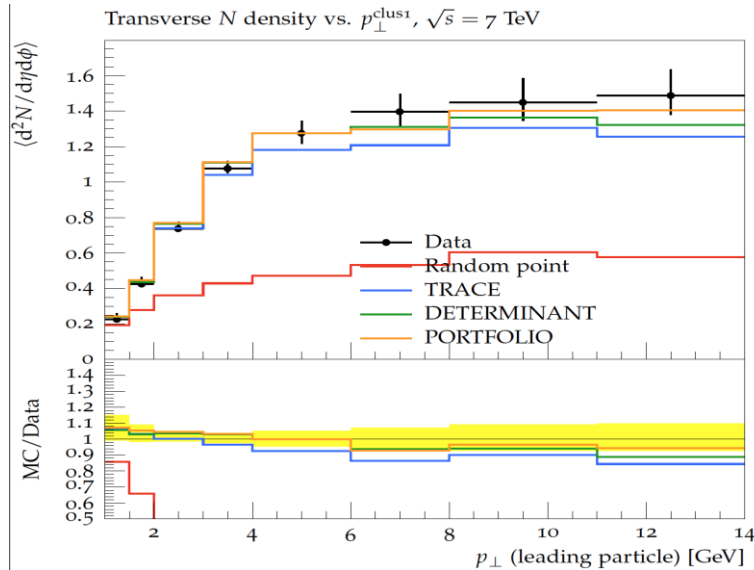# Automated physics event generator tuning

Scientific Achievement

Automated tuning of physics event generators: Formulation as bilevel optimization with equality constraints. Problem solved with surrogate-model optimization.

Optimization outcome: shown is the observation data (black) and the simulation model predictions (solid lines) when using three different outer optimization objective function models (portfolio, trace, determinant) and a randomly chosen solution (upper graphs). The lower graph shows how well the simulation predictions fall within the uncertainty band of the observations (ideally, the colored graphs lie within the yellow area). (Image Credit: Holger Schulz, U Cincinnati)

Significance and Impact

This approach allows for more robust theoretical predictions at the LHC. Current inefficiencies and potential biases in the treatment of observables addressed through bilevel optimization.

Research Details

– Automatically adjusts the weights for each observable to influence the final tuning. Formulation of an outer optimization problem to *automatically* assign weights to observables used in the tune.

– Outer optimization by surrogate model approach with equality constraint to achieve good solutions efficiently.

– Modeling of the outer optimization problem with design of experiment (trace, determinant) and portfolio optimization (minimize the mean and variance of errors over all observables simultaneously) approaches.

– Inner optimization using HEP community tool PROFESSOR.

– Better tunes are obtained more efficiently.