Improved Prediction Scheme for Turbulent Transport by Combining Machine Learning and First-Principle Simulation

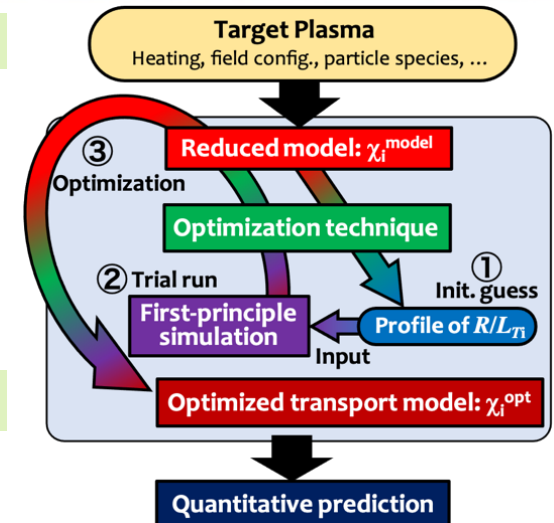## Quantitative turbulence analysis by GKV simulations

- Nonlinear gyrokinetic (GK) simulations using flux-matching technique can reproduce the experimental transport fluxes, quantitatively.
- However, for quantitative estimates, numerous GK runs should be performed

A new scheme to predict turbulent transport

- To reduce calculation costs and keep prediction accuracies, a new scheme is developed combining first-principle sims, reduced transport model, and optimization technique employed in machine learning.
- By a few GK runs, we can estimate transport fluxes with almost same accuracies of many NL runs.

Application to transport analysis

- Transport dynamics is examined for LHD plasma using the optimized model developed here, and we perform the integrated transport simulation.
- We can perform the transport analysis with keeping the accuracies of many GK runs.

Optimized model's result vs. original GK sims.

$\rho = 0.65$

Axes: χ / χ_i^{GB} versus R_0 / L_{Ti}

- Initial model
- Optimized model
- Original NL sims.