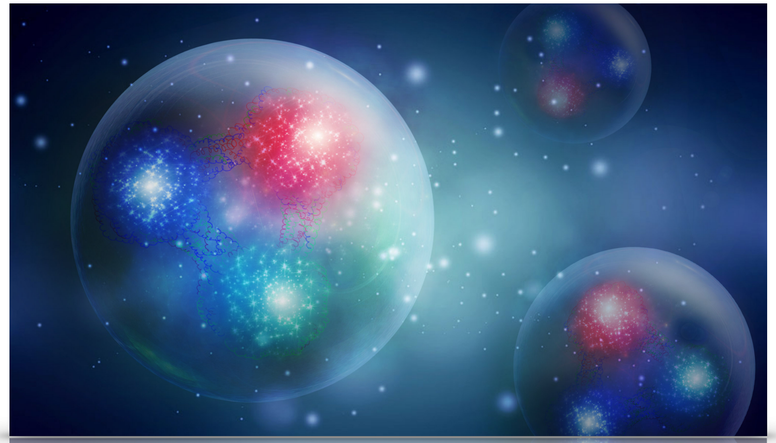
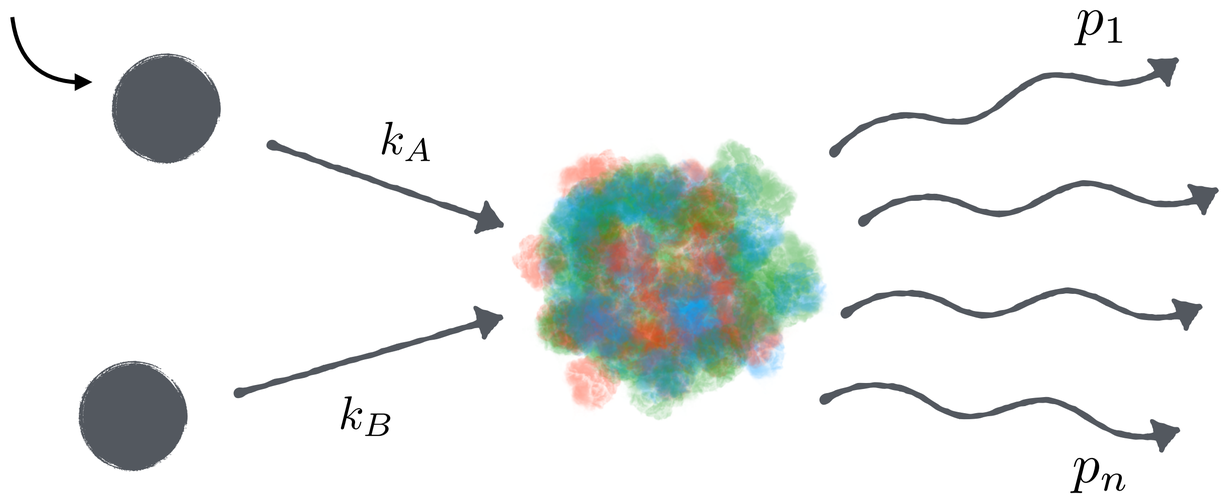


Prometheus

Application of artificial neural networks to analysis of experimental data from high-energy scattering experiments

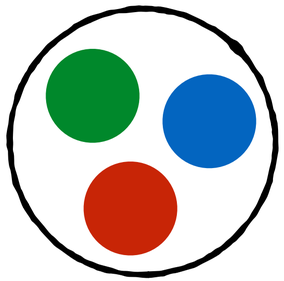
Andrey Tarasov

Protons

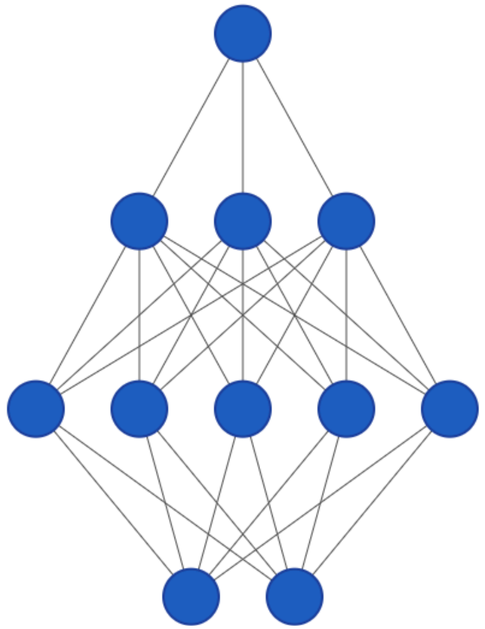


Observables

Quarks inside the proton



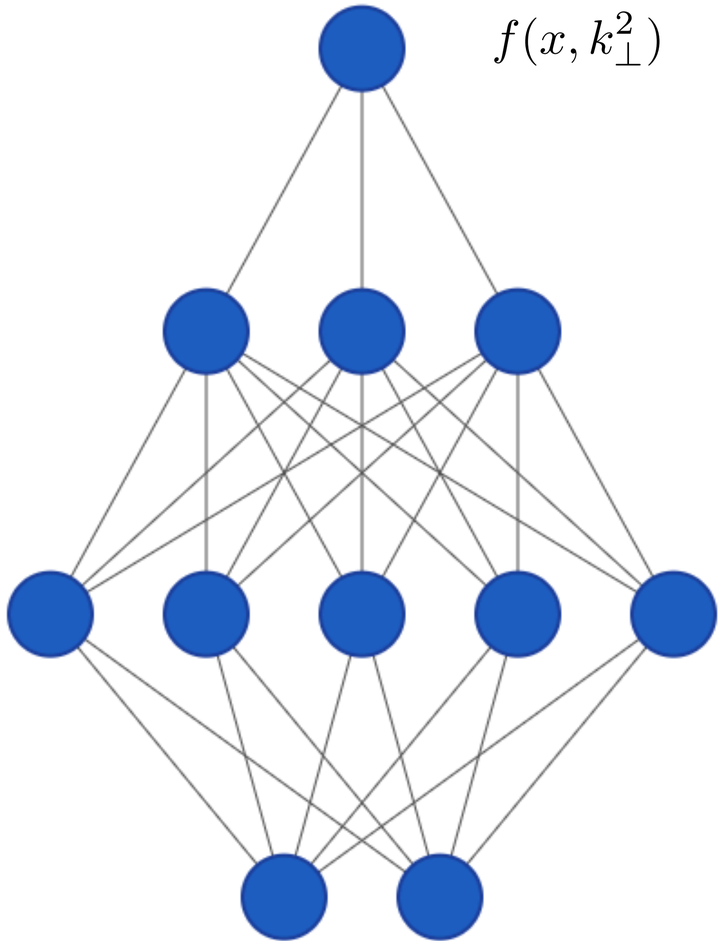
Distribution of quarks inside the proton



We use ANN to model distribution of elementary particles inside the proton

Output

$f(x, k_\perp^2)$

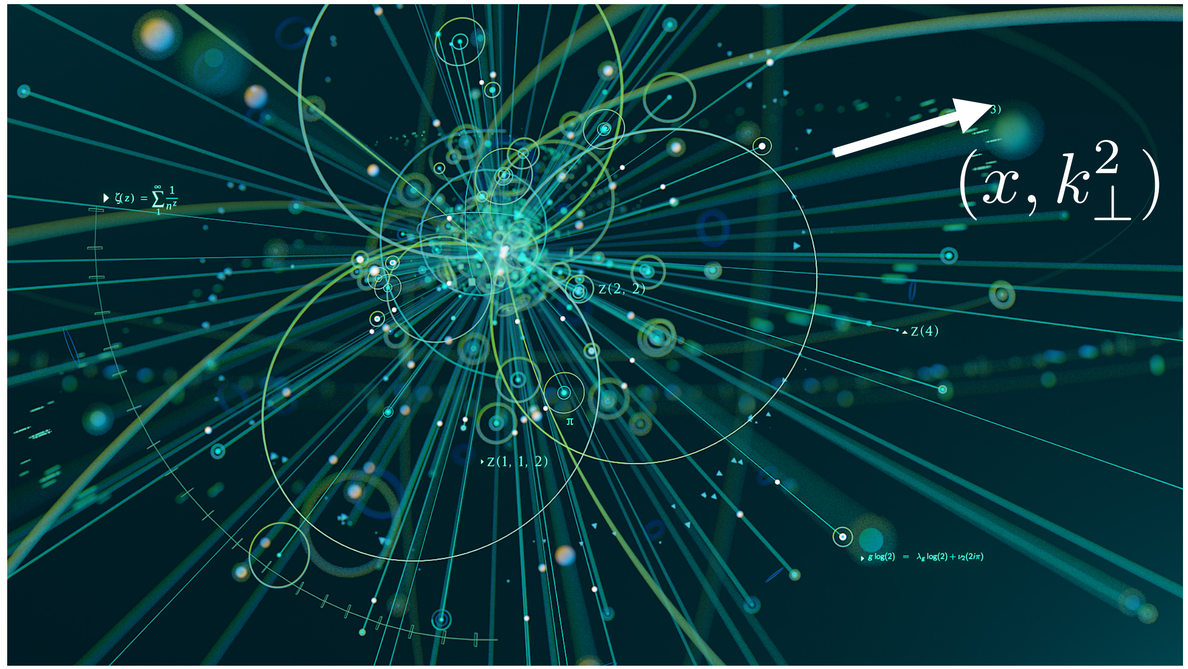


Input

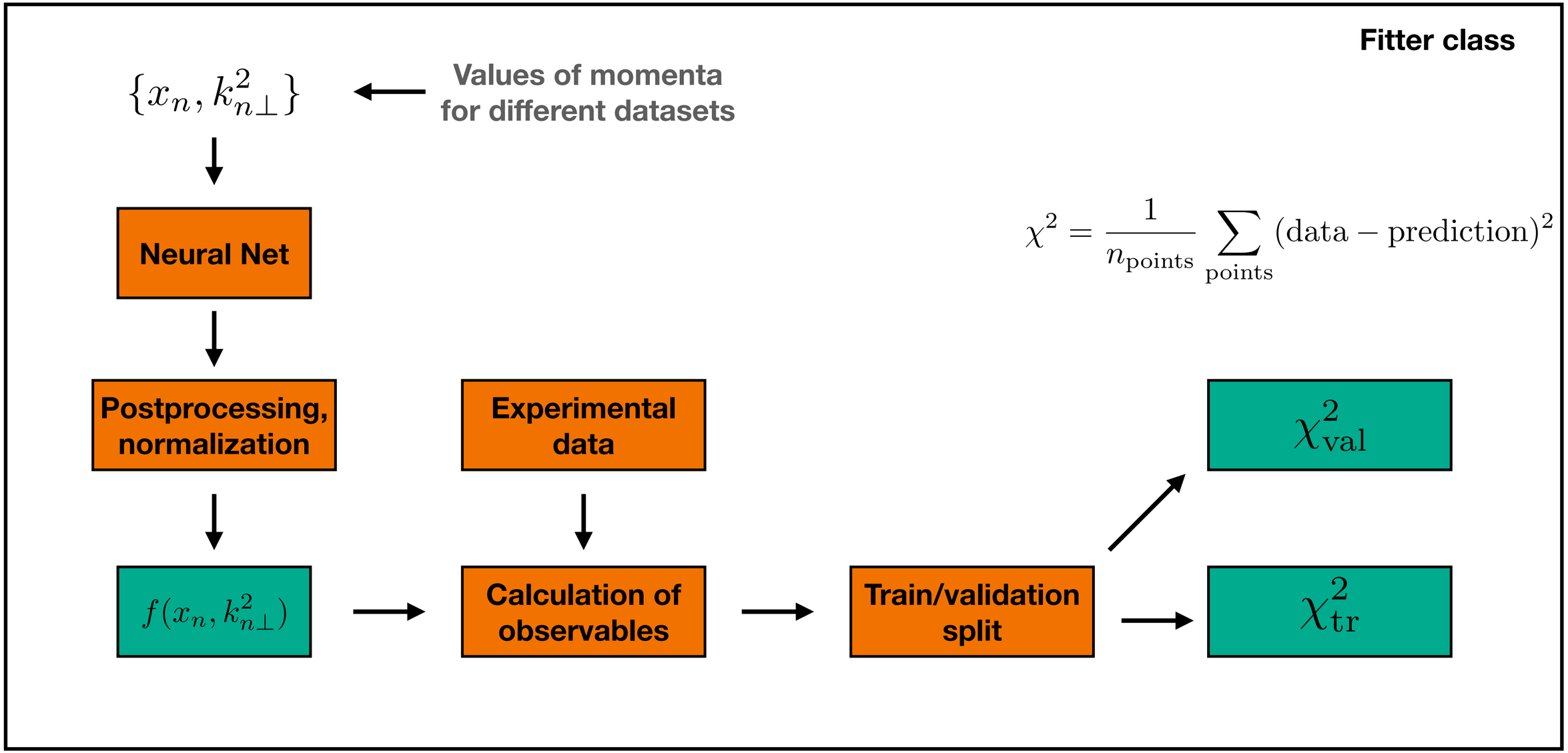
x $k_\perp^2$

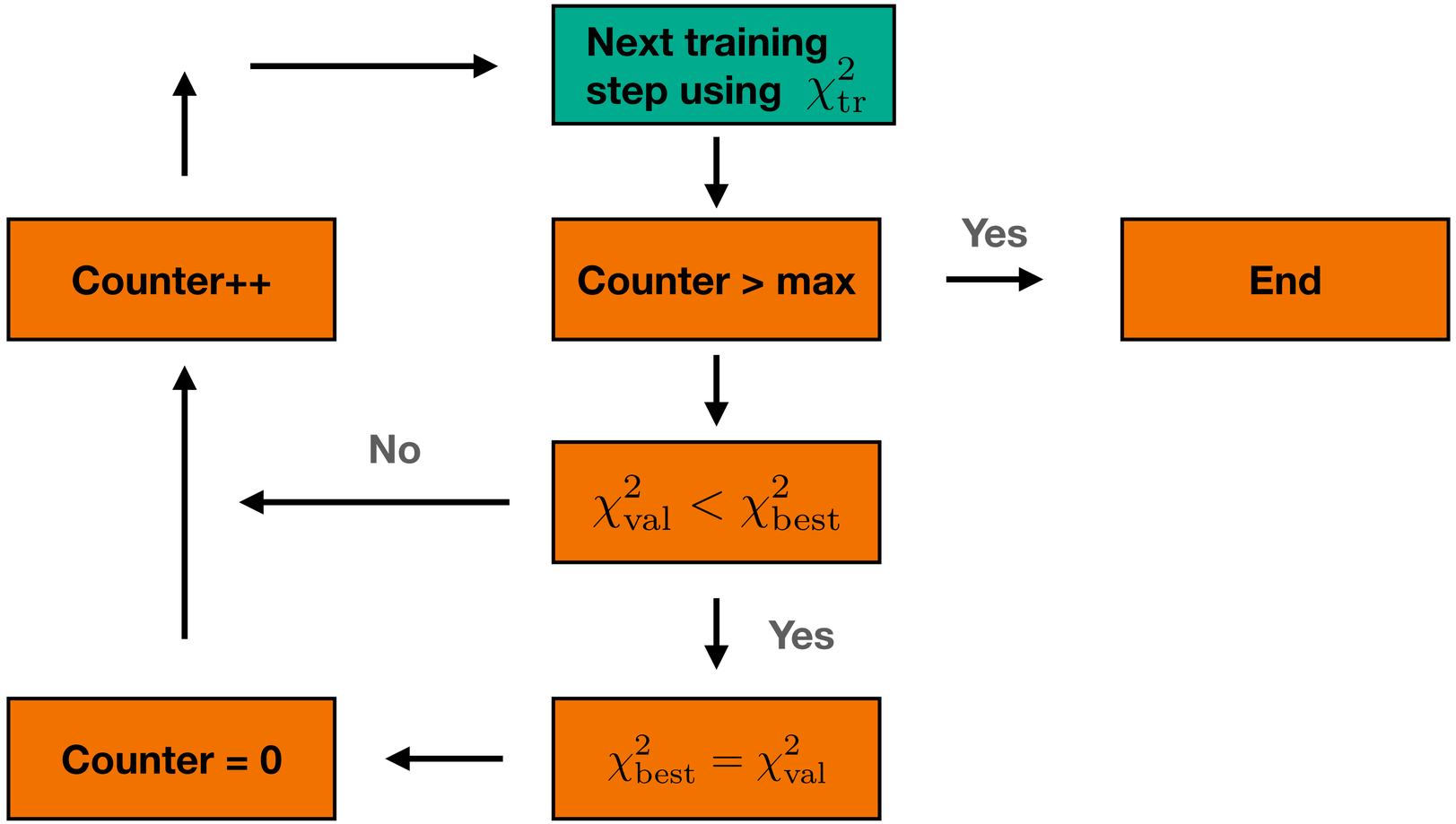
Momentum (“speed”) components of an elementary particle inside the proton

Probability for an elementary particle to have momentum components x and k

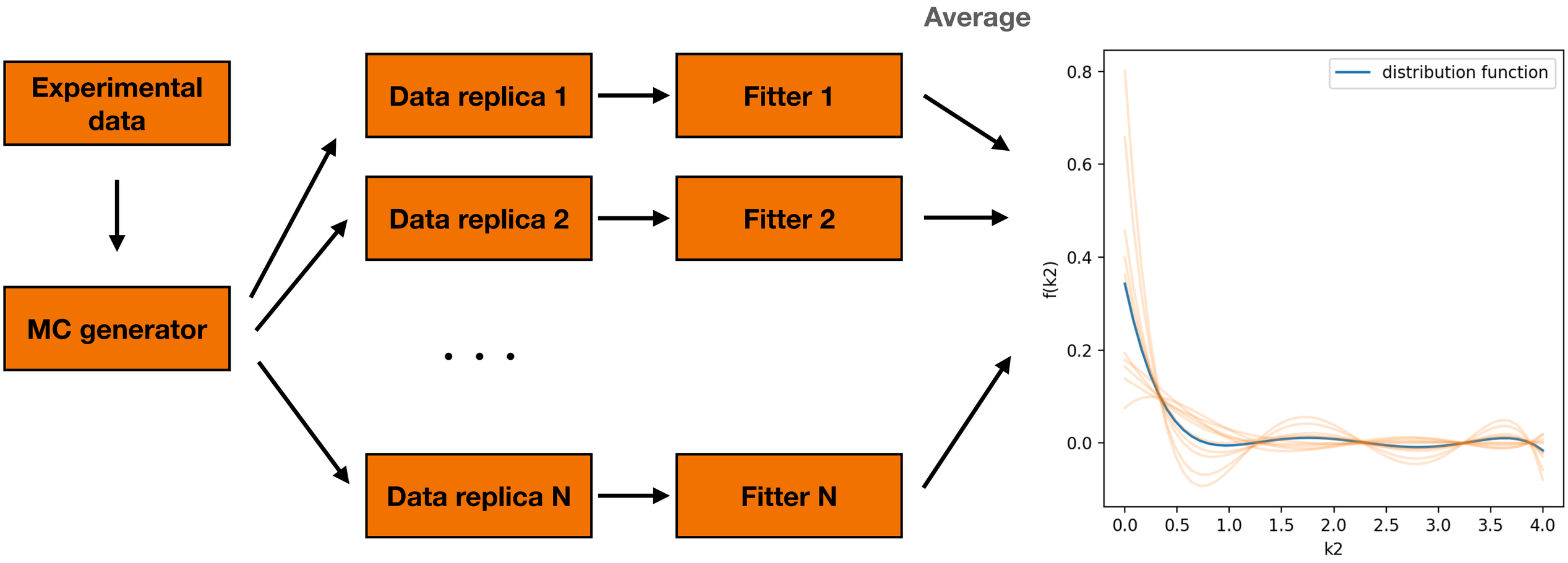


Fitter class



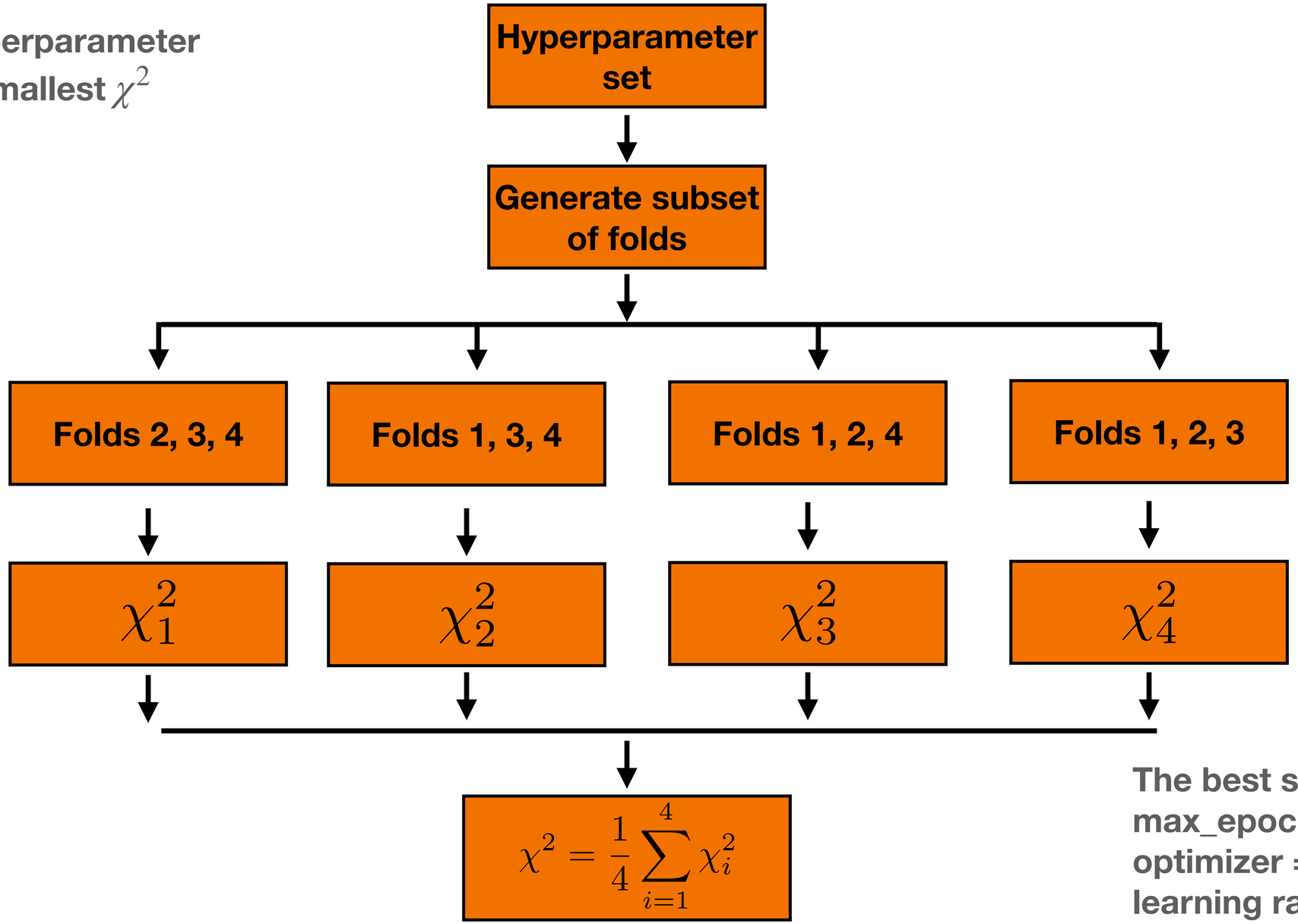


To avoid overfitting we train the model using training set and use validation set to estimate the quality of the fit



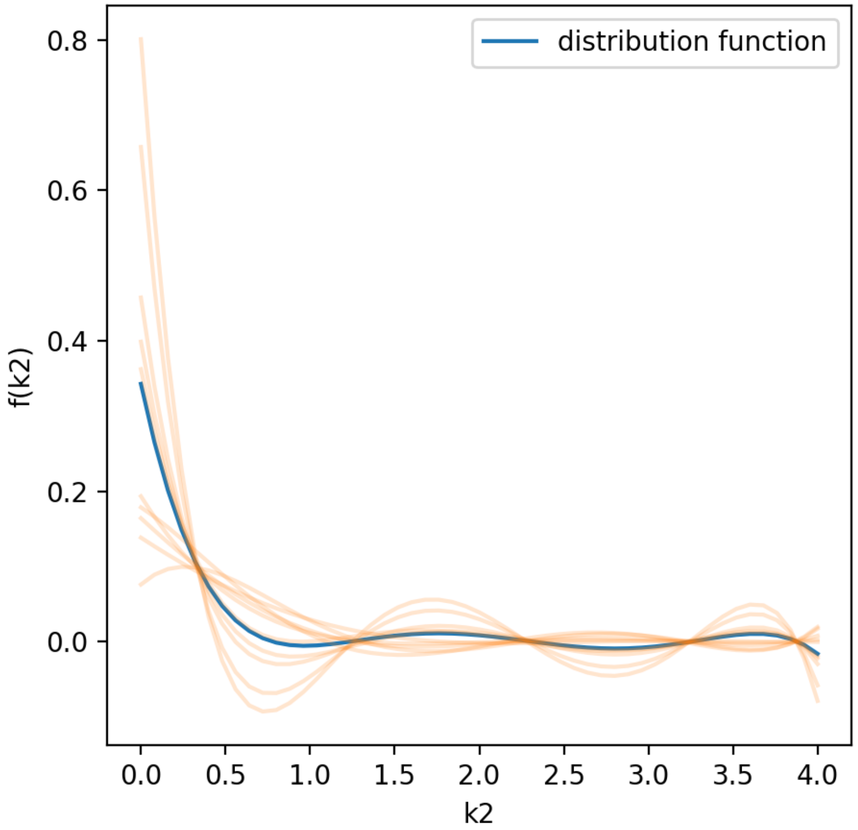
To take into account experimental errors we use the Monte Carlo approach and calculate the final result as an average over pseudo data (replicas)

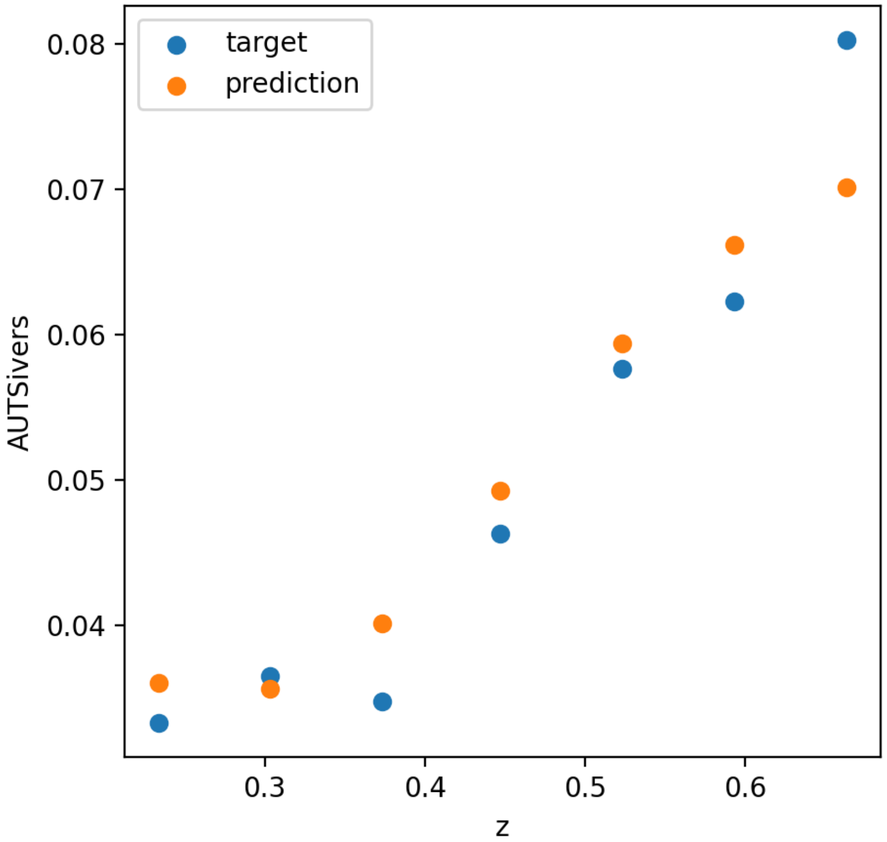
Find the best hyperparameter set with the smallest χ^2

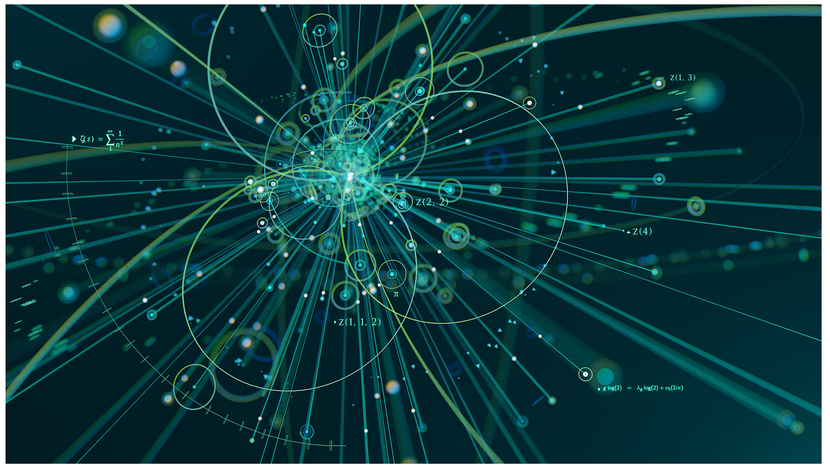


The best set:
max_epochs = 5000
optimizer = Amsgrad
learning rate = 0.01
neural net depth = 2
initializer = glorot_uniform
χ^2 per point = 1.4

We use the best hyperparameter set to train the model over different replicas:
max_epochs = 5000
optimizer = Amsgrad
learning rate = 0.01
neural net depth = 2
initializer = glorot_uniform
χ^2 per point = 1.4







After averaging over replicas we obtain a distribution function for elementary particles inside the proton which we can use to predict experimental results