Twitter Thread by Black Hole Group

Black Hole Group
@BlackHolesUSP

Today, we are bringing other exciting results involving black holes and AI. We released a new paper:

"Black Hole Weather Forecasting with Deep Learning: A Pilot Study"

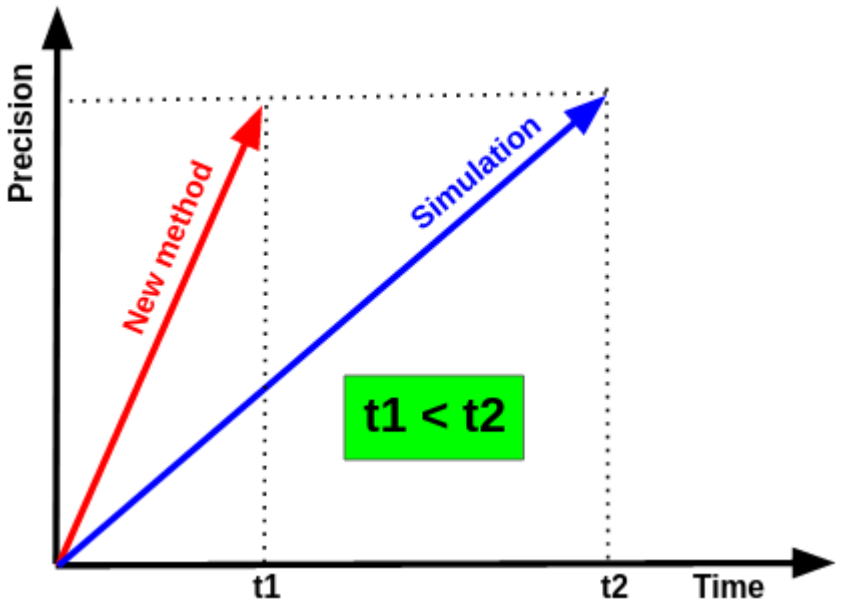
Work by Roberta Duarte (@import_robs), Rodrigo Nemmen (@nemmen) and João Paulo Navarro (from @NVIDIABrasil).

The authors used deep learning to simulate the dynamics of gas accreting onto a black hole, i.e., black hole weather forecasting.

They trained the model (U-Net) with frames from numerical solutions of the hydrodynamical equations.

Numerical simulations are time-consuming. A simple simulation can take as long as 7 days to finish. If we go with more complex simulations, this time may increase.

We want to investigate if deep learning can be a new method to simulate accurately in less time!

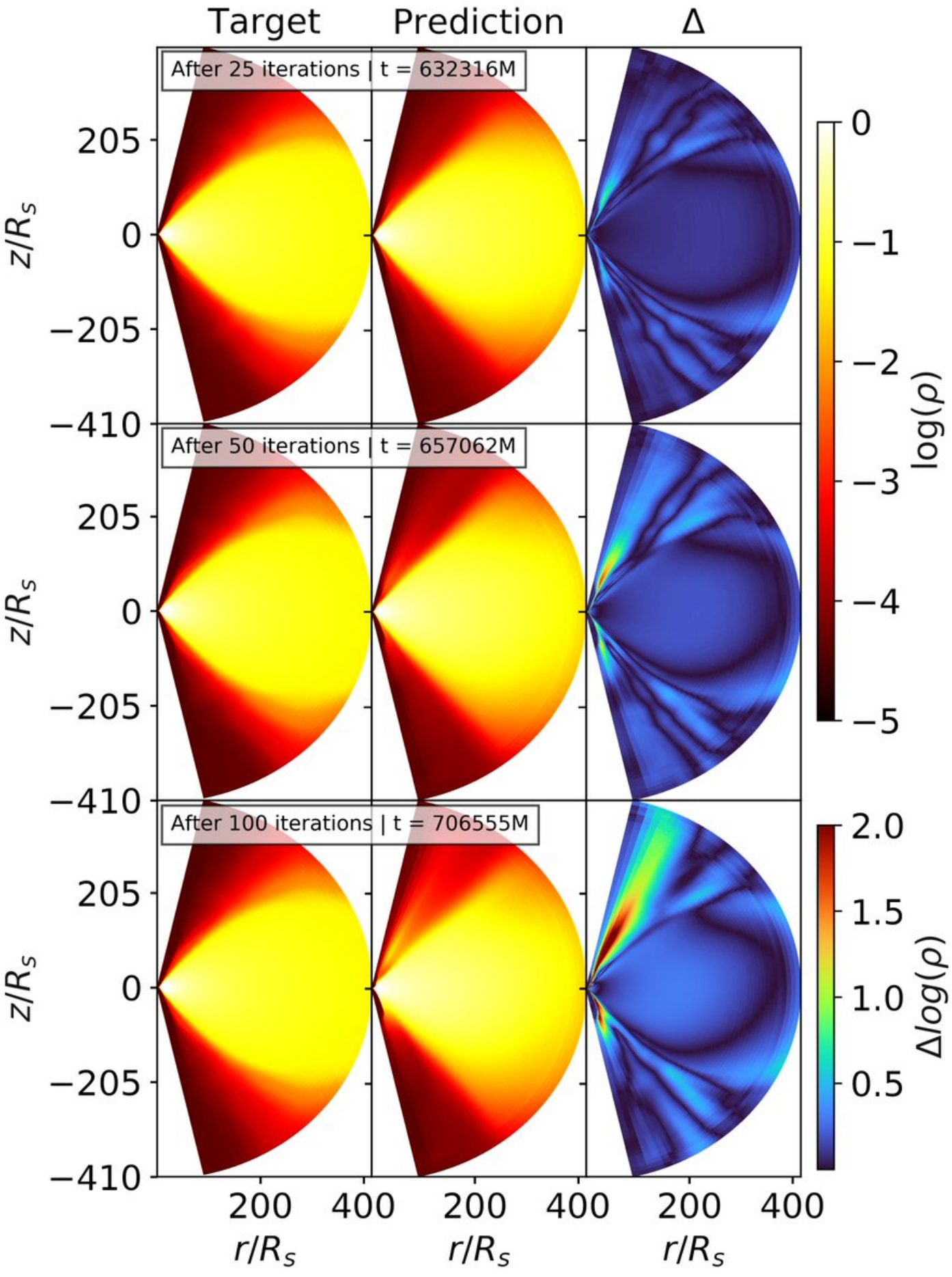


In the paper, they discussed two examples:

1- The model simulating only one system after learning only from this system
2- The model simulating an unseen system after training with several systems with different initial conditions

In the first example, they trained the model with a single system and analyzed how the model simulates by iterative predictions.

The result is that the model can simulate up to 8e4 gravitational time accurately with a speed-up of 30000x faster!

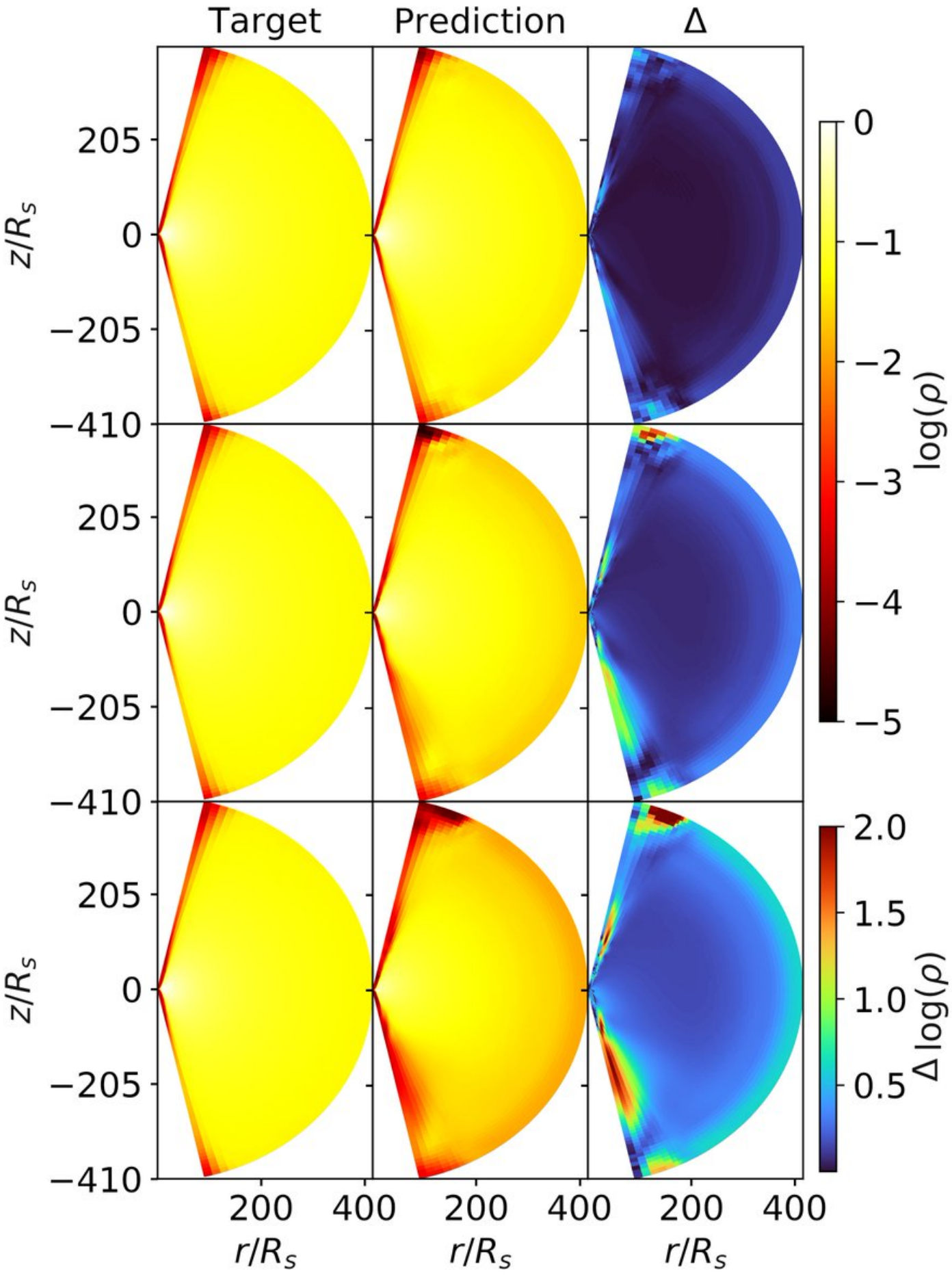


In the 2nd example, they fed the model seven different simulations with the same physics but other initial conditions. They informed the model how the initial conditions differ from one to another.

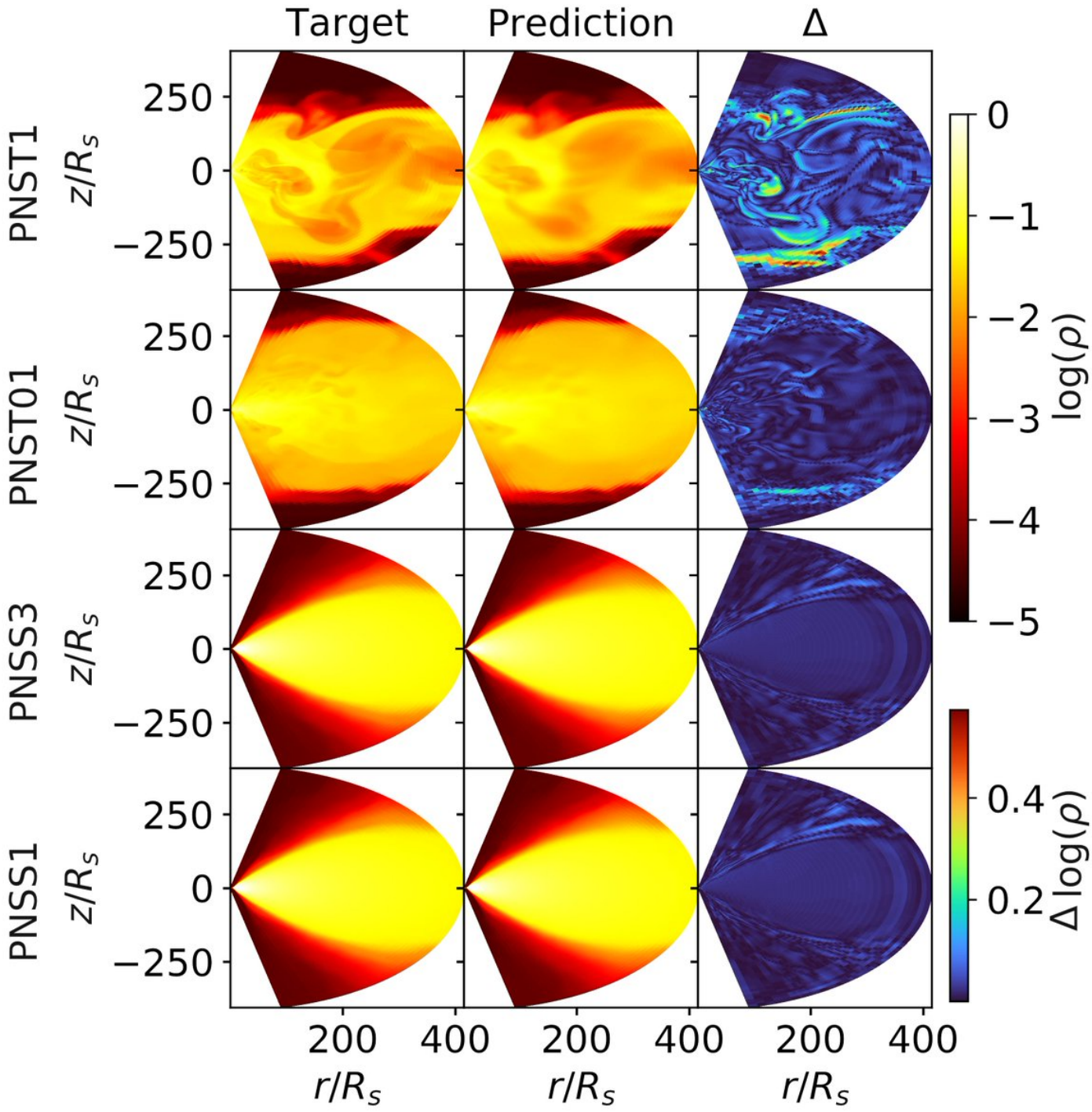
However, they hid one system to understand the generalization power of the model!

They analyzed how the model can simulate an unseen system only by looking at previous systems!

It simulated the unseen system for 4e4 gravitational time, showing that the model can generalize the black hole physics presented in the dataset!



In the second example, the model can also simulate the systems it learned from:



For more details, please check it out on arXiv: https://t.co/VBh3RQnhov