

Multi-Fidelity Emulator: Problem

- Problem: Training an emulator* **requires a large number of simulations**
- Number of **high-fidelity** simulations is limited ...
- But we have tons of **low-fidelity** simulations!

*Emulator: a model learns the mapping relationship from cosmological parameters θ to summary statistics (e.g., matter power spectrum)



Multi-Fidelity Emulator: Analogy



We have a limited number
of professors ...

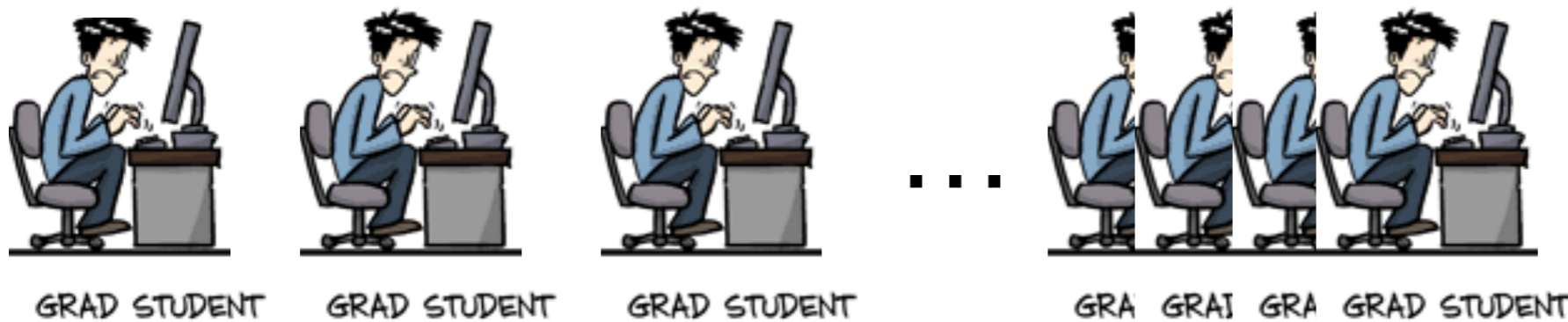
JORGE CHAM © 2011

Multi-Fidelity Emulator: Analogy



But we can have tons of grad student workers

I'M GOING TO RESEARCH WHATEVER MY PROFESSOR WANTS!



JORGE CHAM © 2011

Modified from PHD Comics: "The Evolution of Intellectual Freedom"

Multi-Fidelity Emulator: Analogy

HF

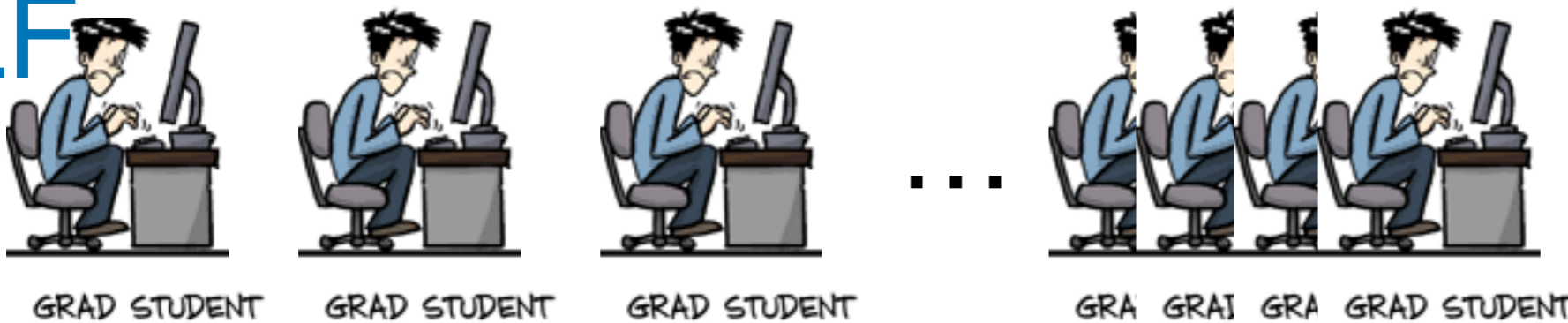


+

= better accuracy + efficiency

LF

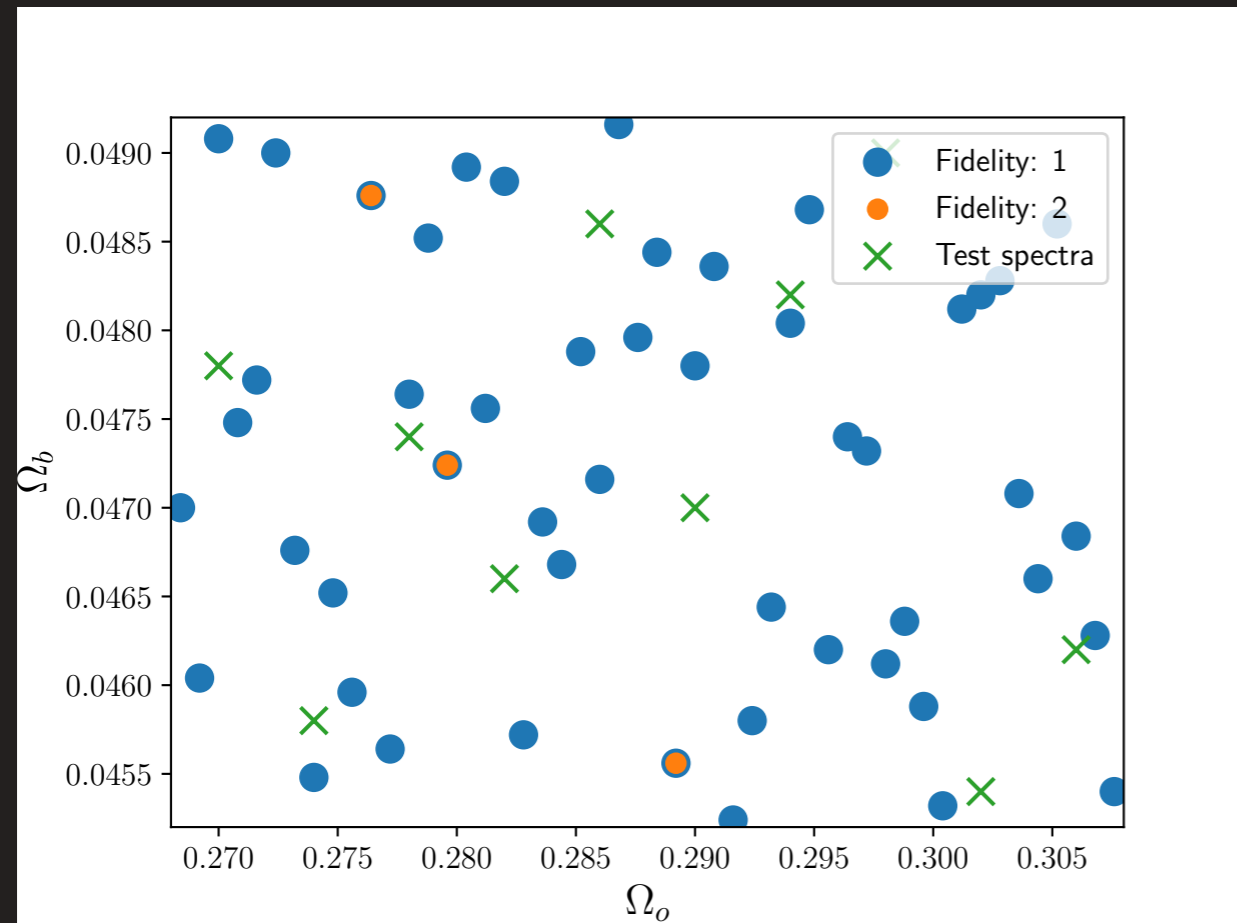
I'M GOING TO RESEARCH WHATEVER MY PROFESSOR WANTS!



JORGE CHAM © 2011

Modified from PHD Comics: "The Evolution of Intellectual Freedom"

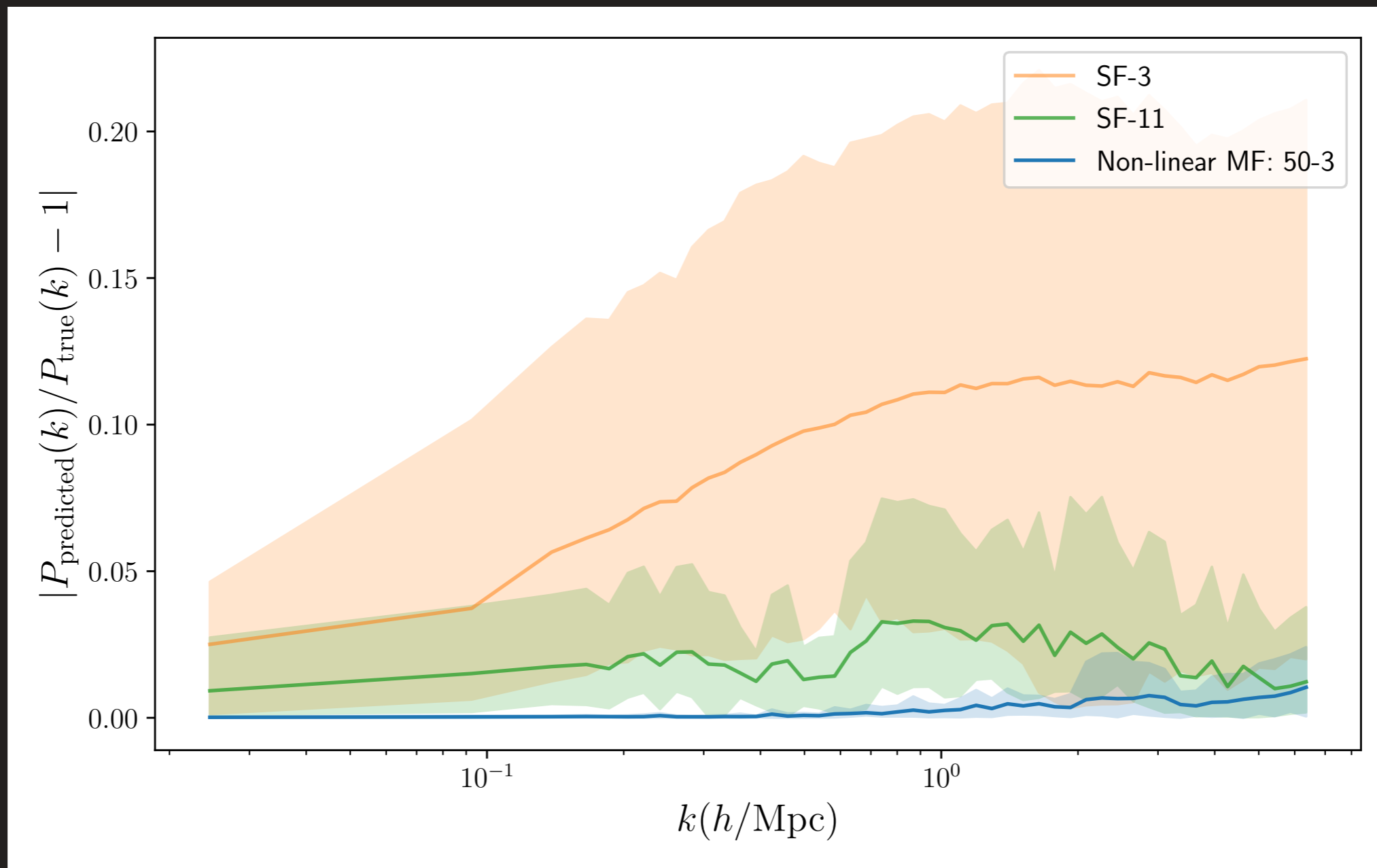
Multi-Fidelity Emulator: Nested sampling scheme



- Many **LF** simulations → cover **cosmologies**
- A small number of **HF** simulations → correct the **resolution**

Ho, Bird, Shelton (2021)
2105.01081

Multi-Fidelity Emulator: Improved accuracy with a lower cost



Outperform single-fidelity emulators with ~ 3
times lower cost

Ho, Bird, Shelton (2021)
2105.01081