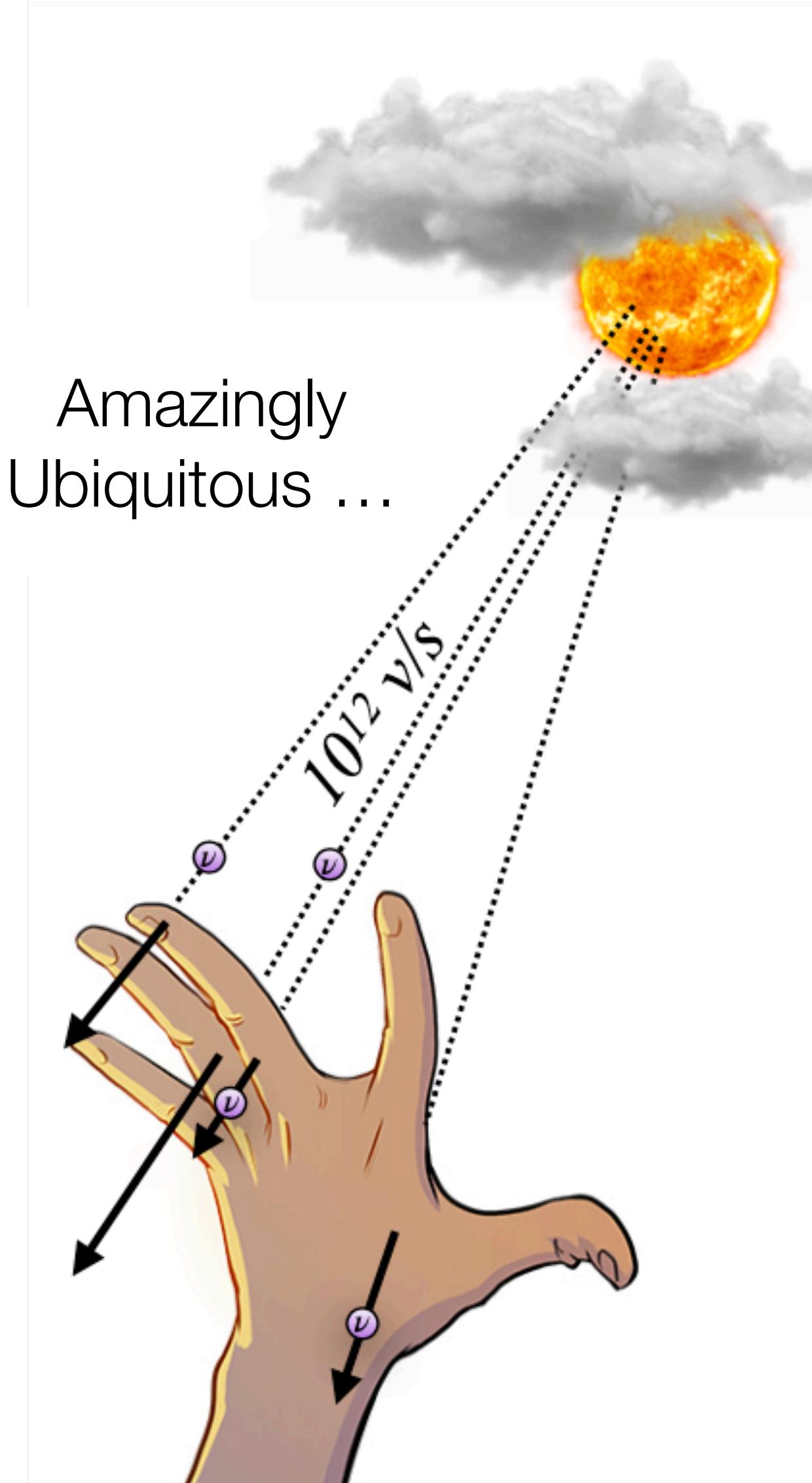
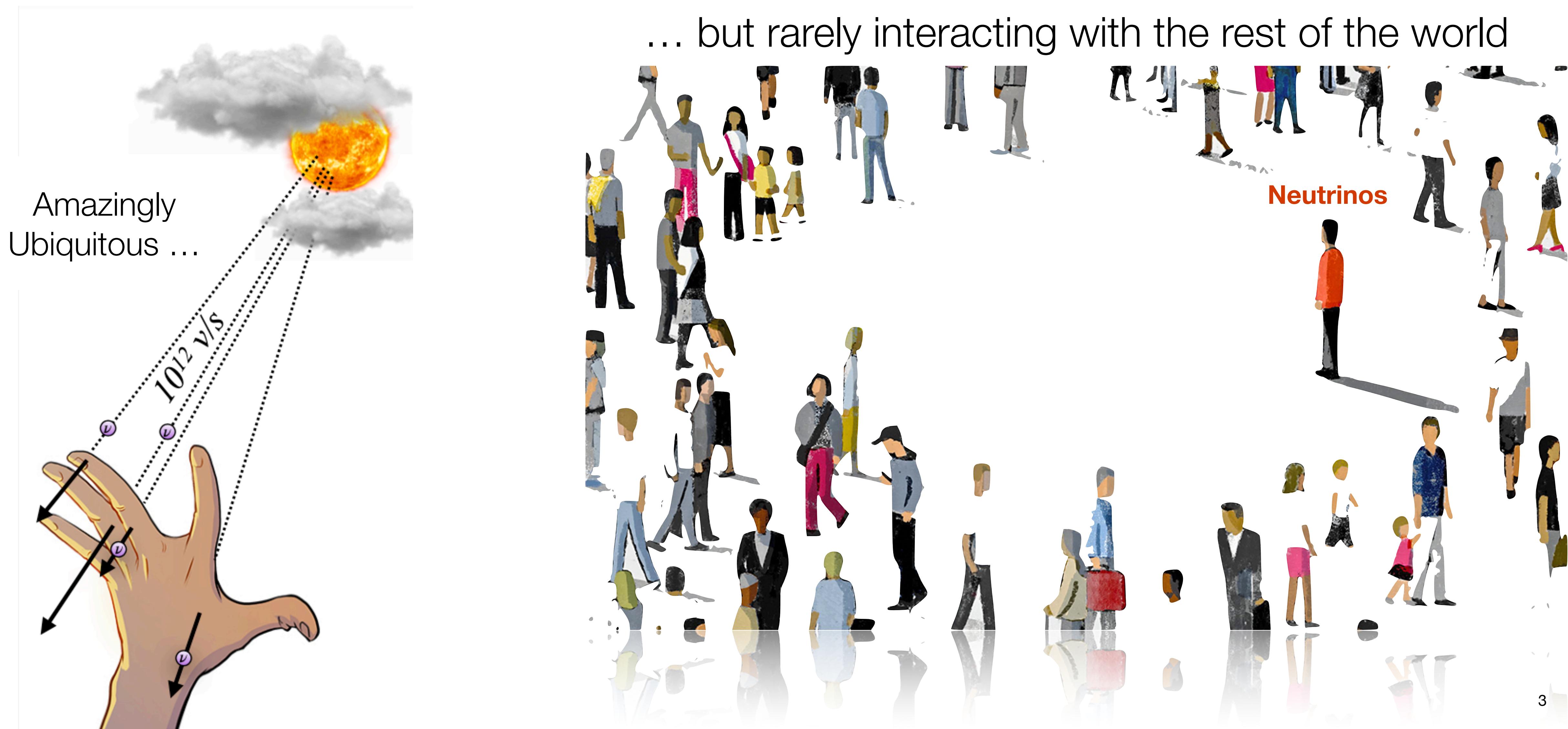


Neutrino: The Messenger of our Universe

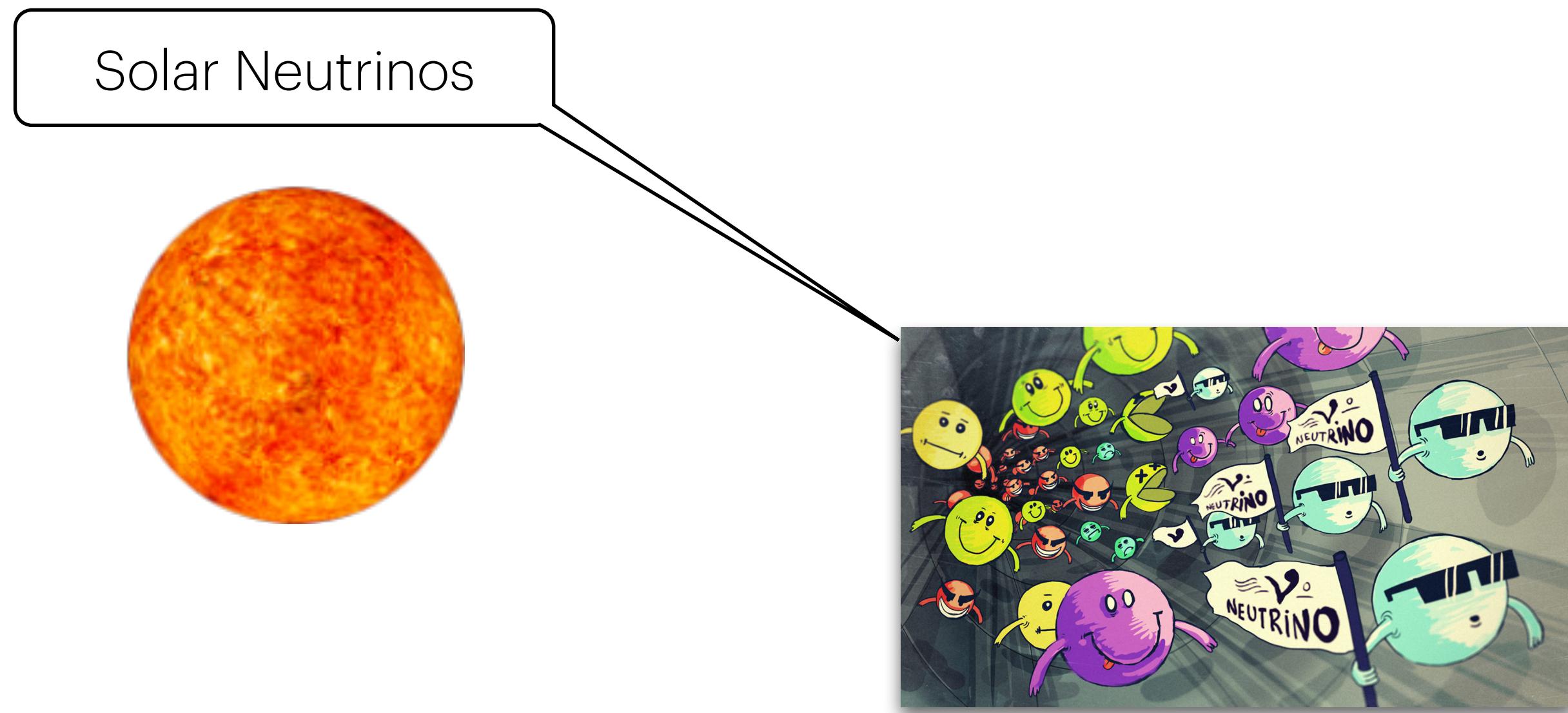


Neutrino: The Messenger of our Universe



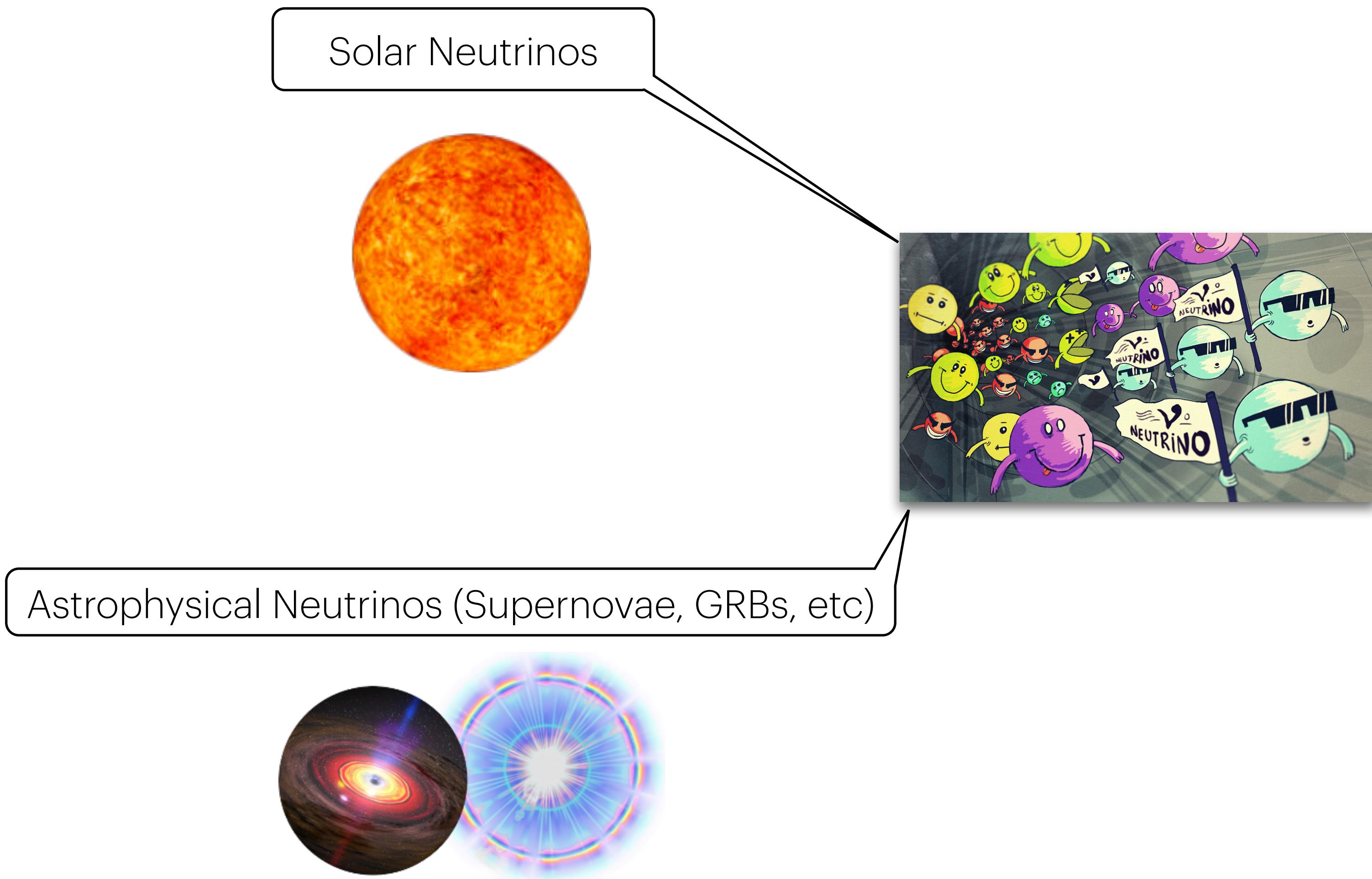
Neutrino: The Messenger of our Universe

The non-interacting nature means neutrinos are un-disturbed while traveling through the universe!



Neutrino: The Messenger of our Universe

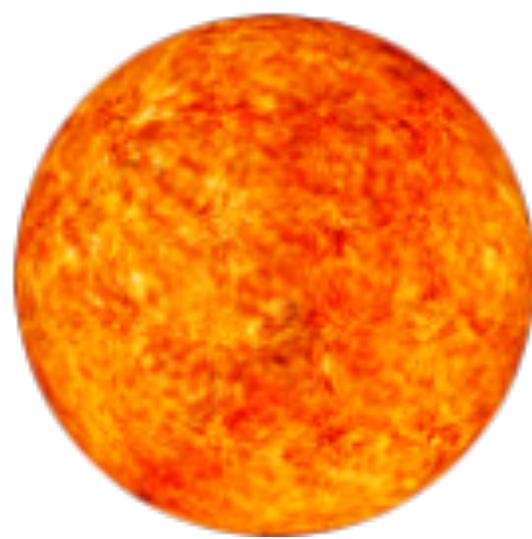
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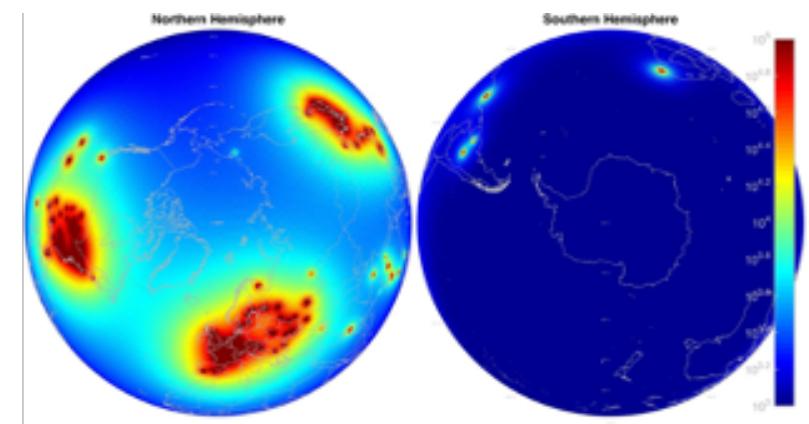
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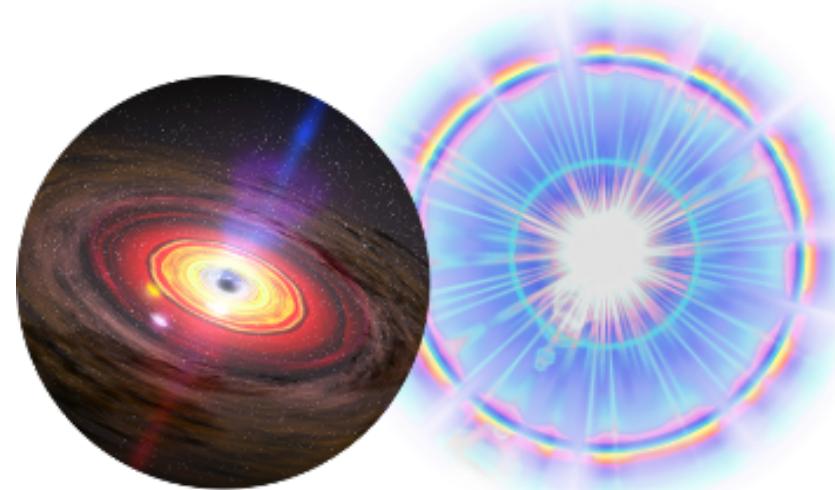
Solar Neutrinos



Geo Neutrinos



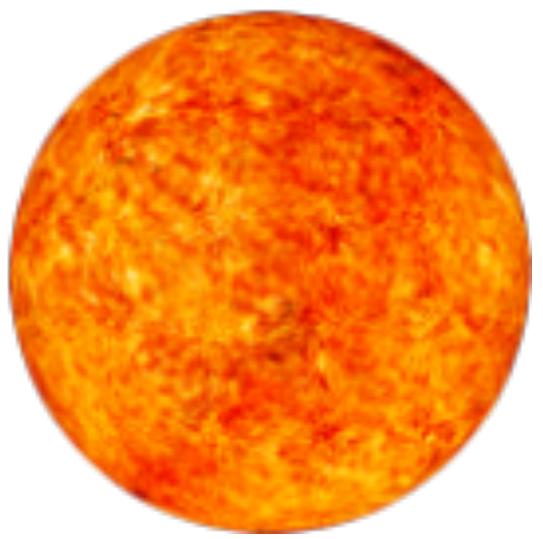
Astrophysical Neutrinos (Supernovae, GRBs, etc)



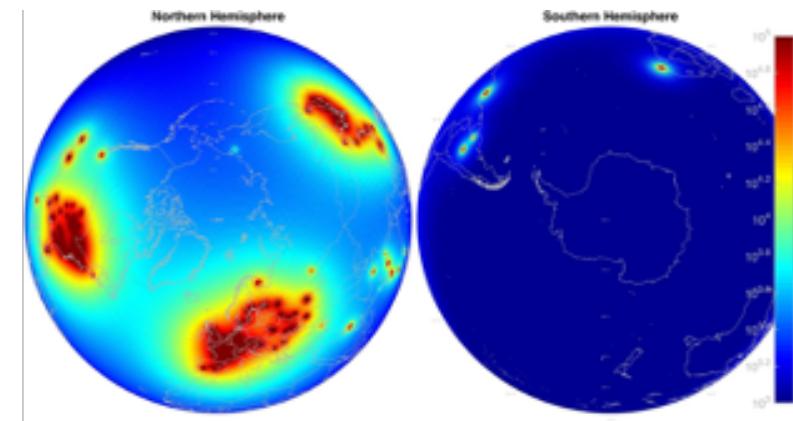
Neutrino: The Messenger of our Universe

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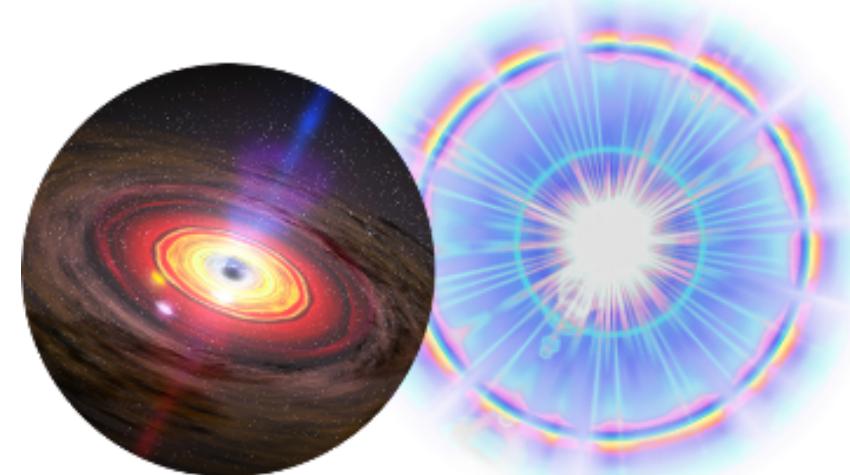
Solar Neutrinos



Geo Neutrinos

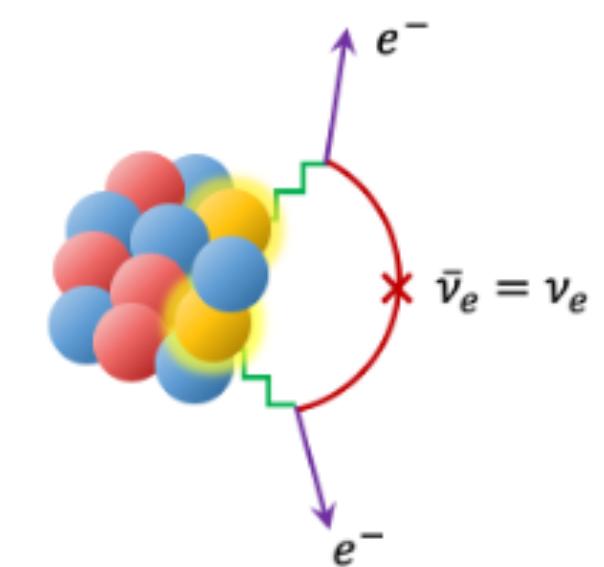
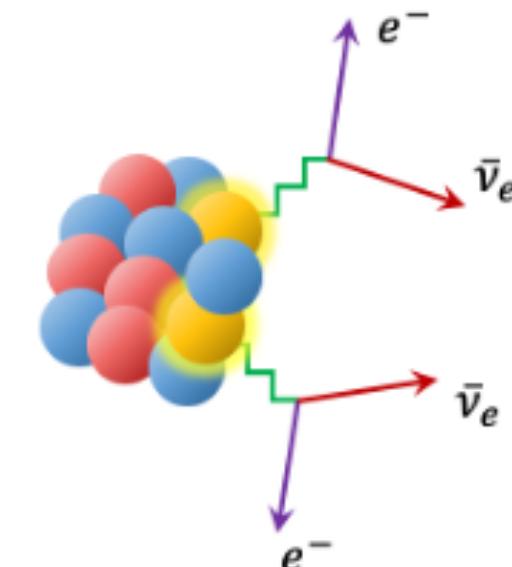


Astrophysical Neutrinos (Supernovae, GRBs, etc)



Neutrinoless Double-Beta Decay ($0\nu\beta\beta$)

Tell us what happened at the beginning of the universe!



“How to detect neutrinos, if they rarely interact with matter?”



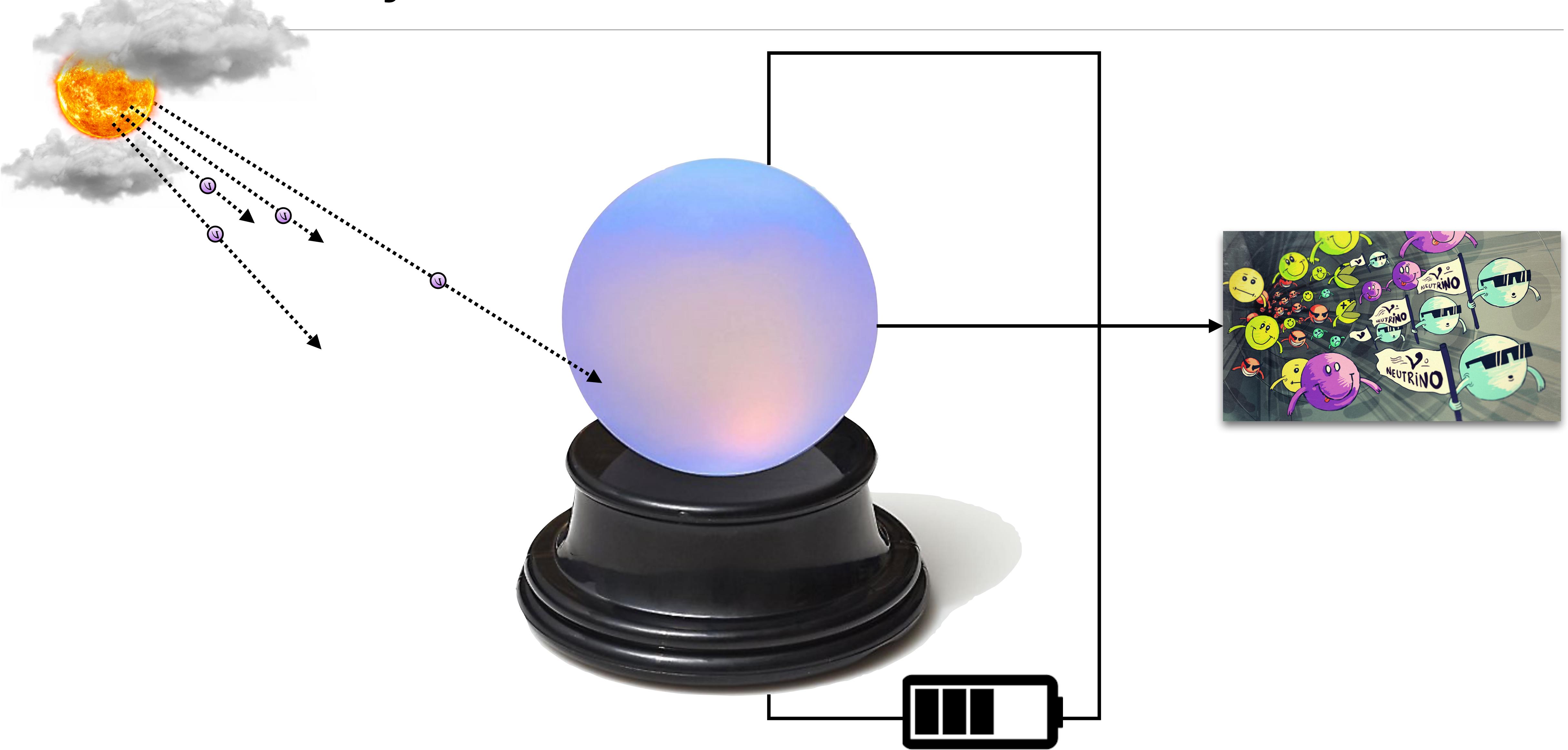
Use a “Crystal Ball”



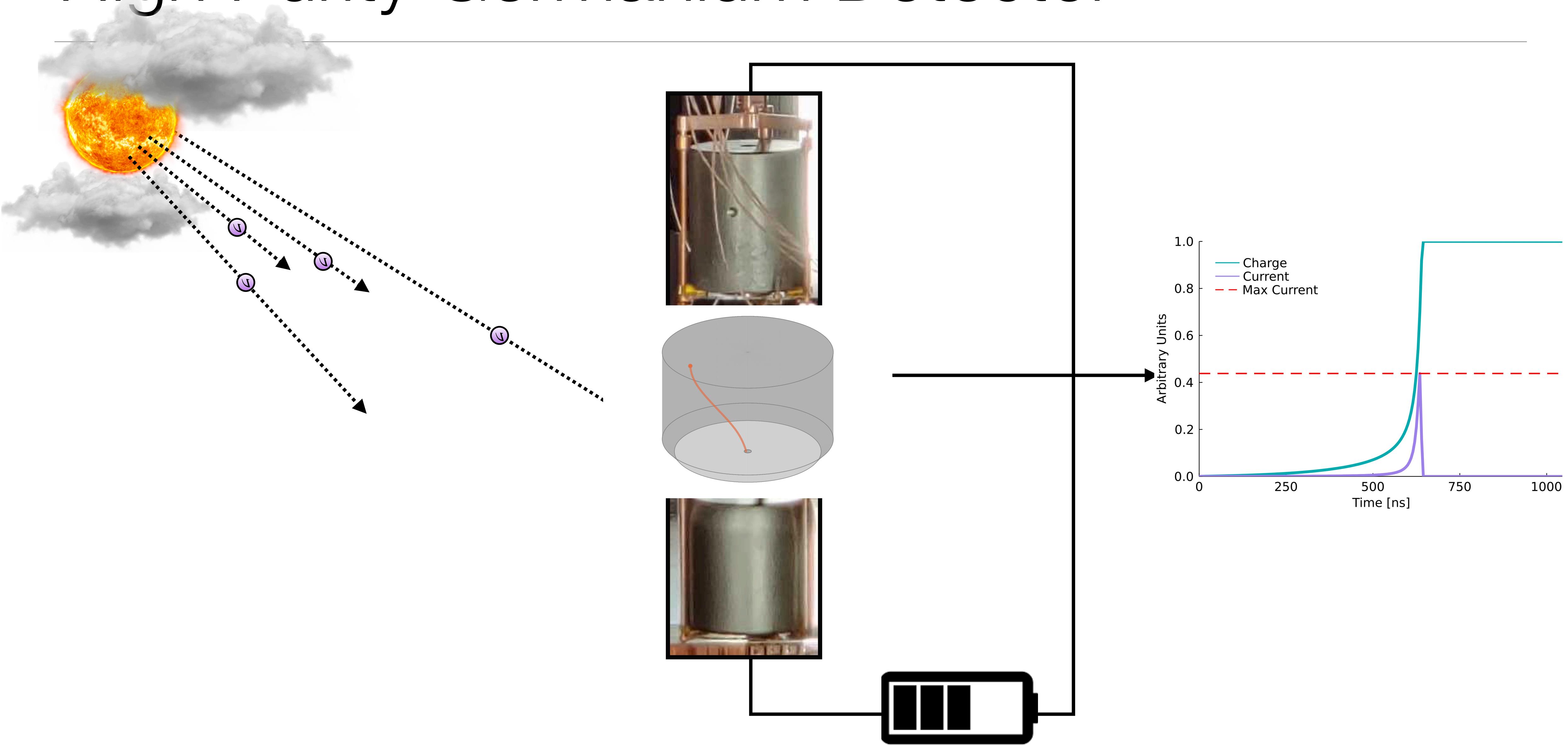
Use a “Crystal Ball”

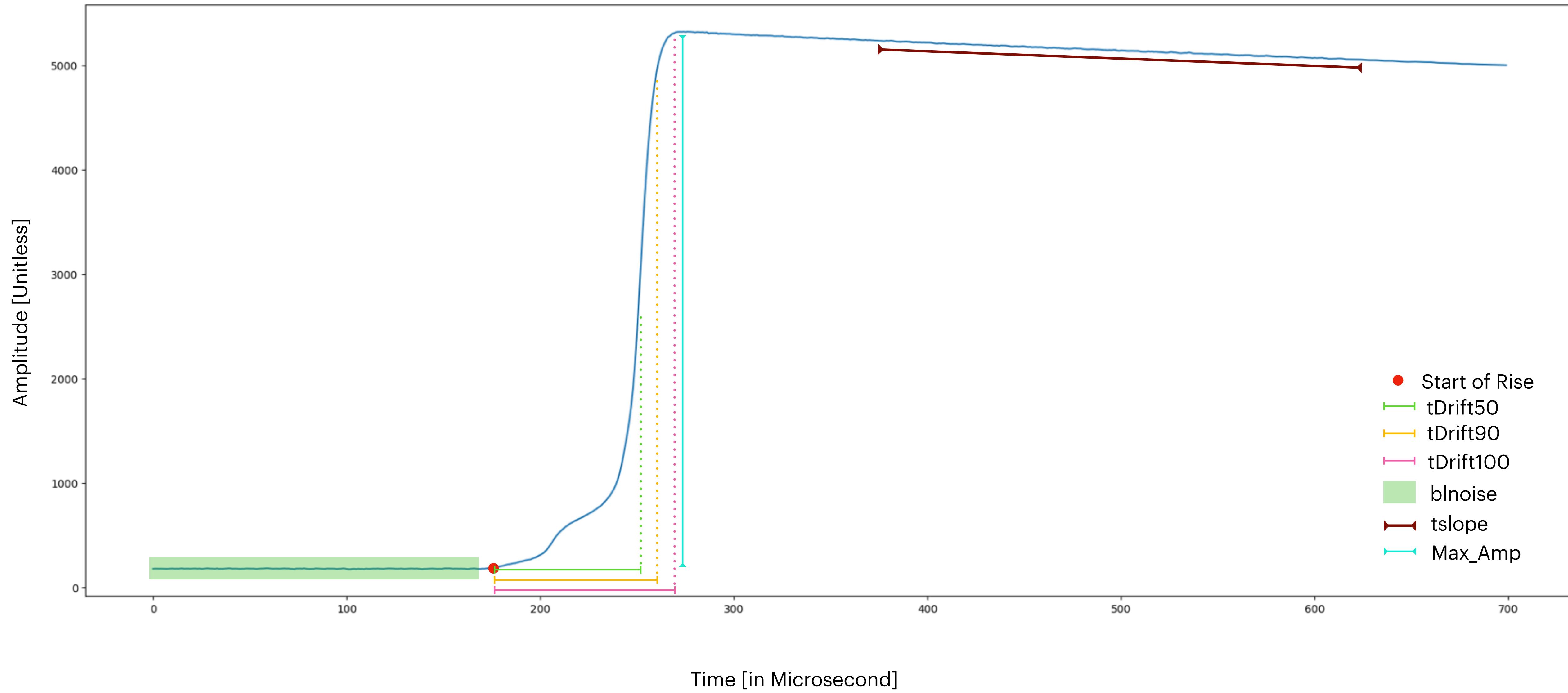


Use a “Crystal Ball”



High Purity Germanium Detector

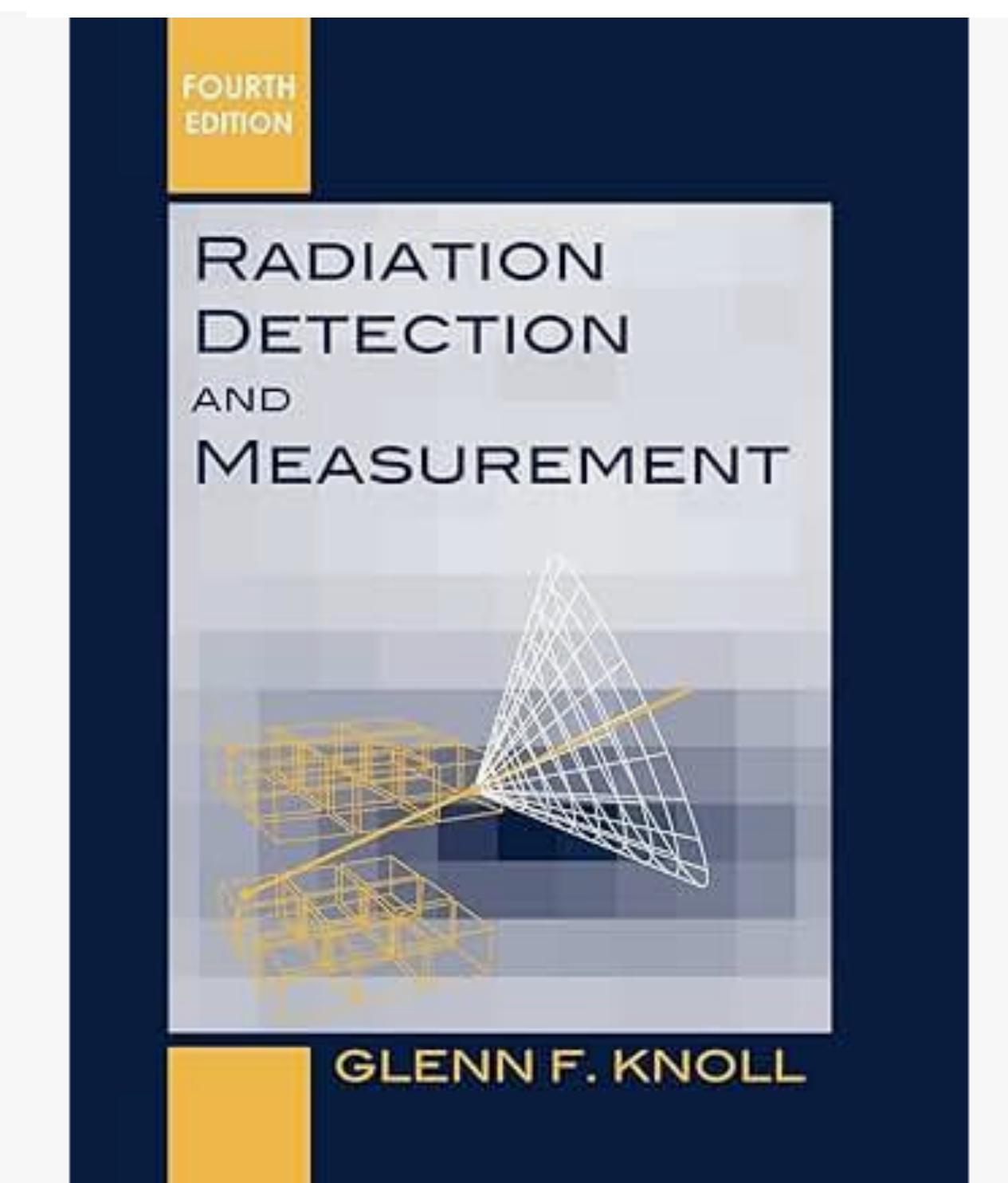
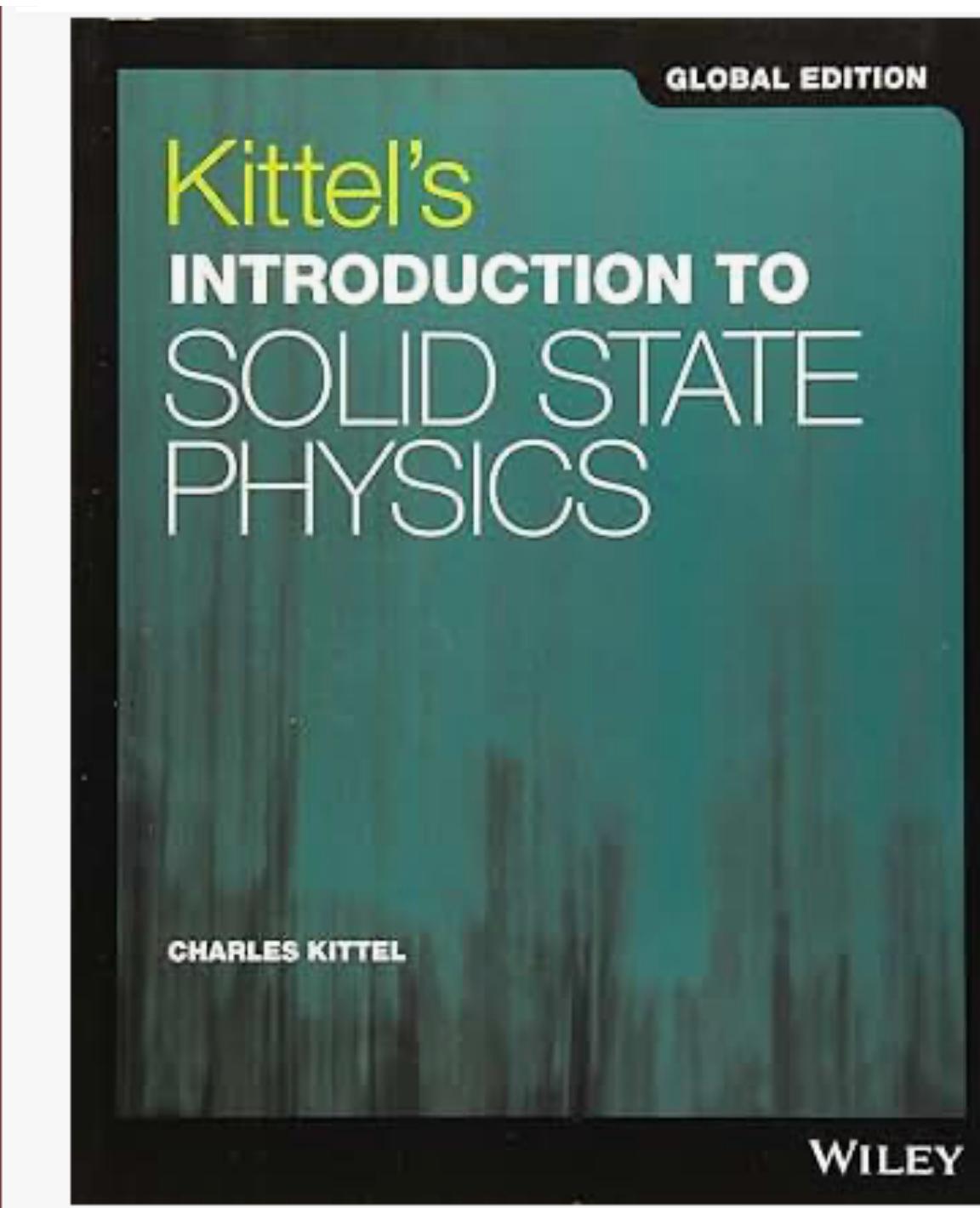
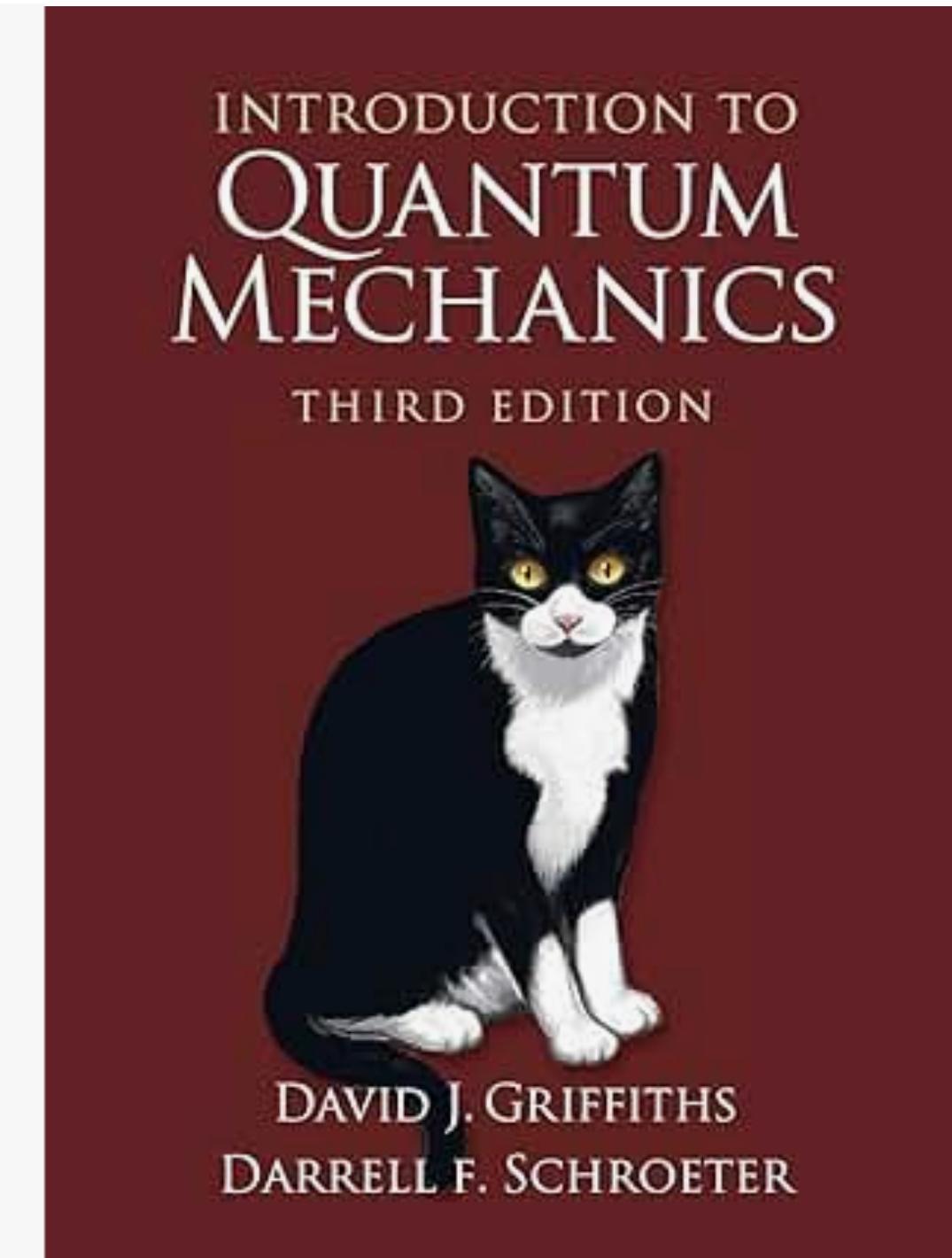
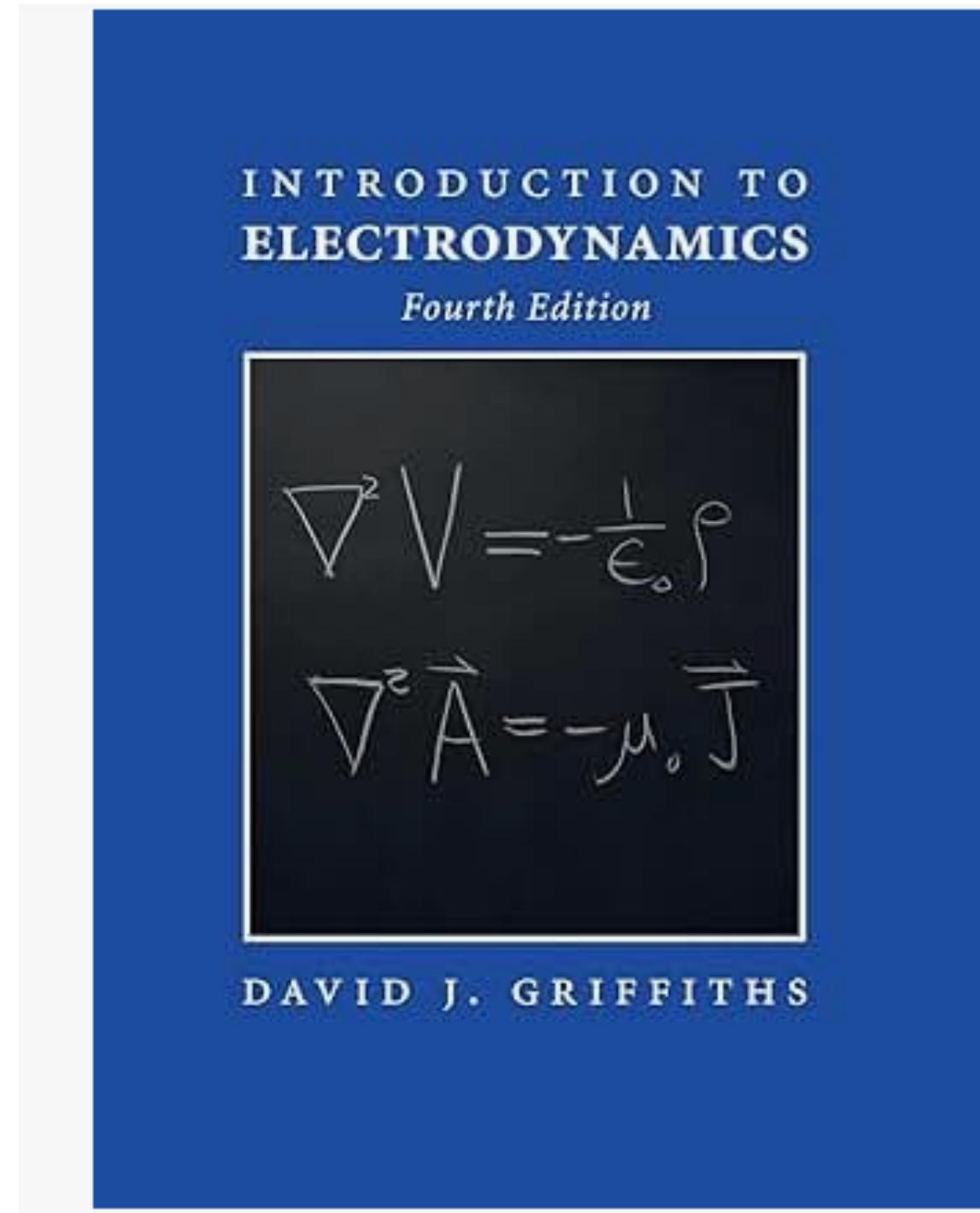




Which Feature Should We Use?

- **First-Principle:**
 - We know from theory, using knowledge about what the variables represent and how they should be related
- **Data-Driven:**
 - We make a guess based on data

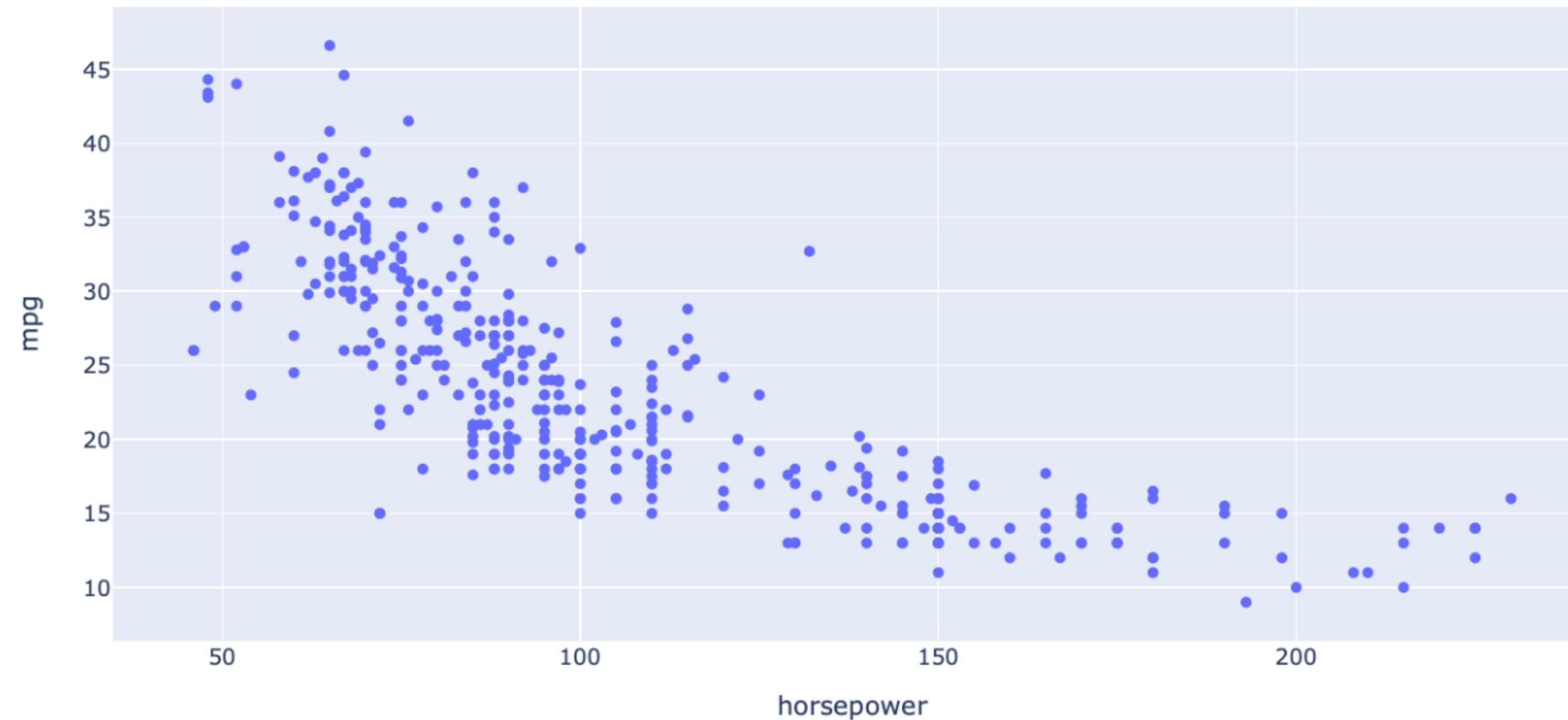
Choose Features Using First Principle Approach



~40% of Physics PhD Course Load

Choose Features Using Data-Driven Approach

MPG vs. Horsepower



Data-Driven approach allows us to model things without actually understanding the theory!