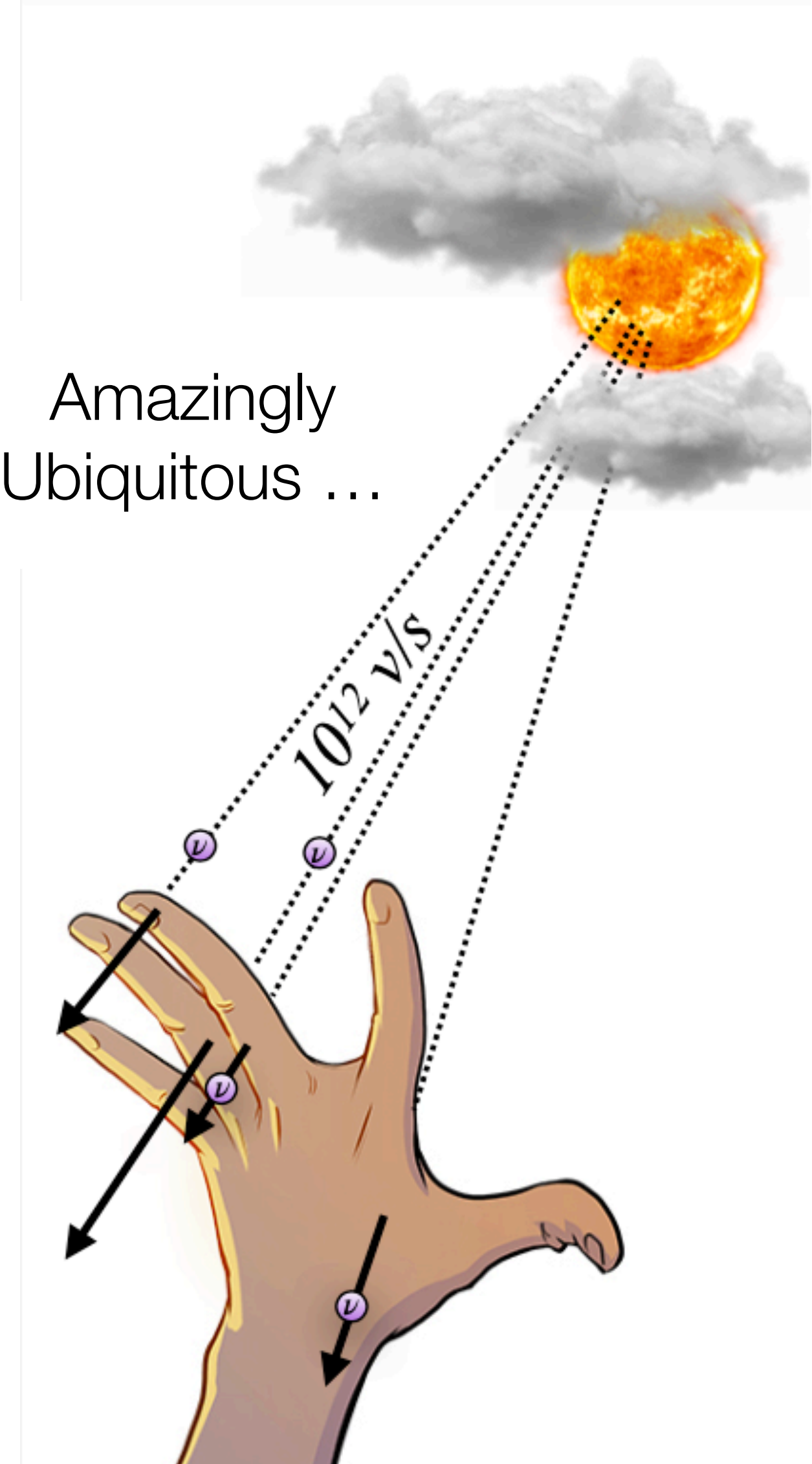
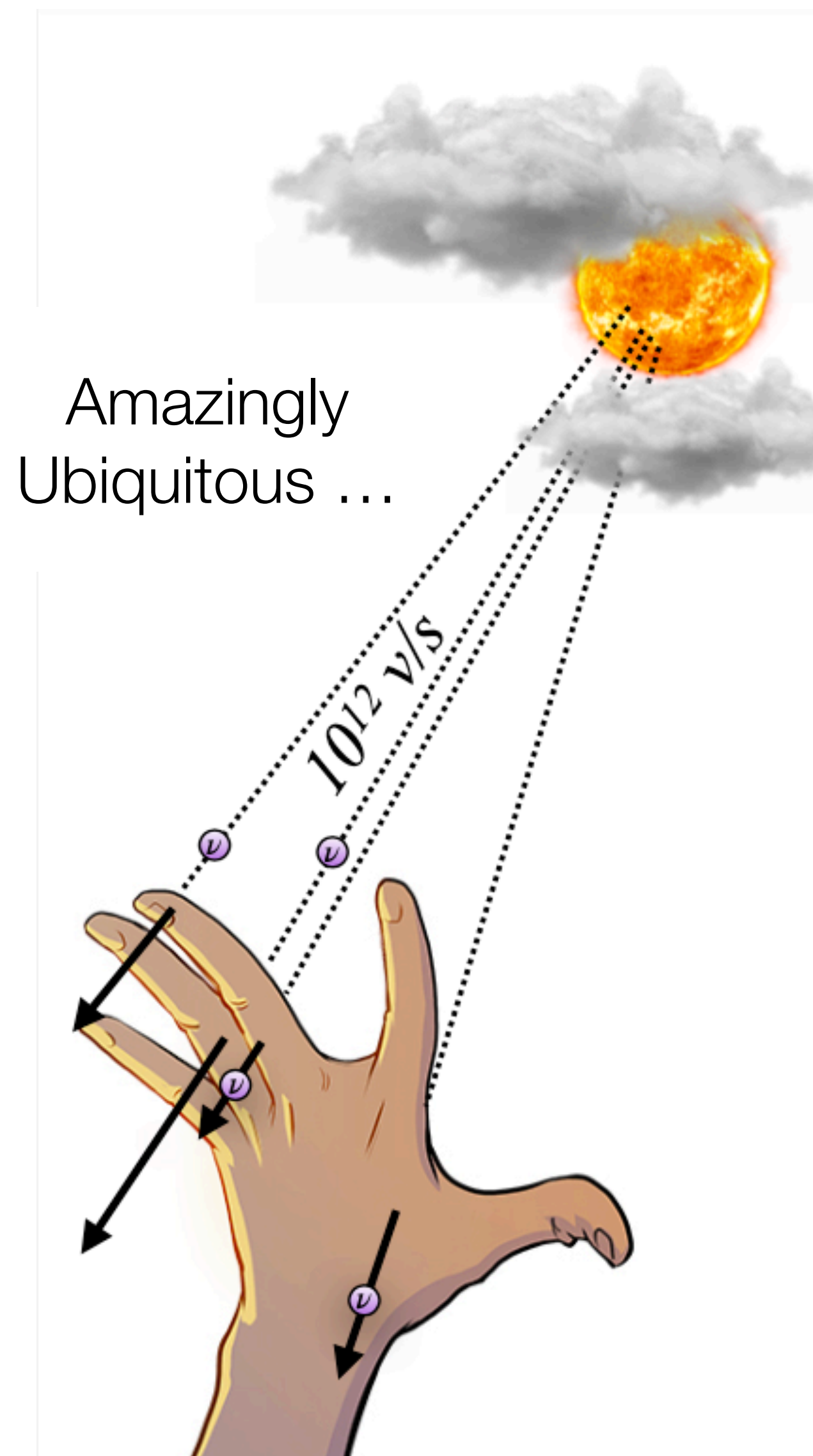


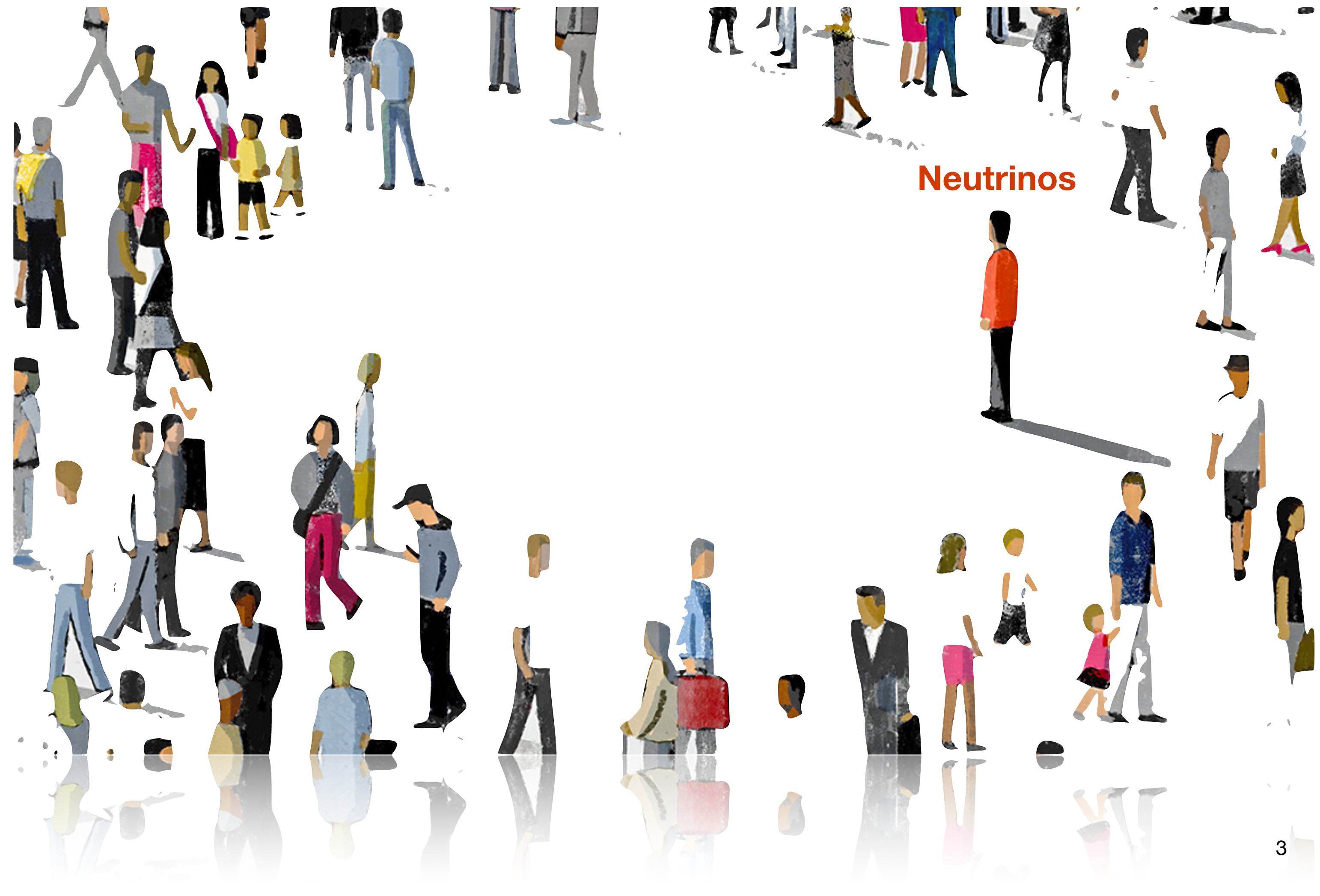
Neutrino: The Messenger of our Universe



Neutrino: The Messenger of our Universe



... but rarely interacting with the rest of the world



Neutrino: The Messenger of our Universe

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

Solar Neutrinos



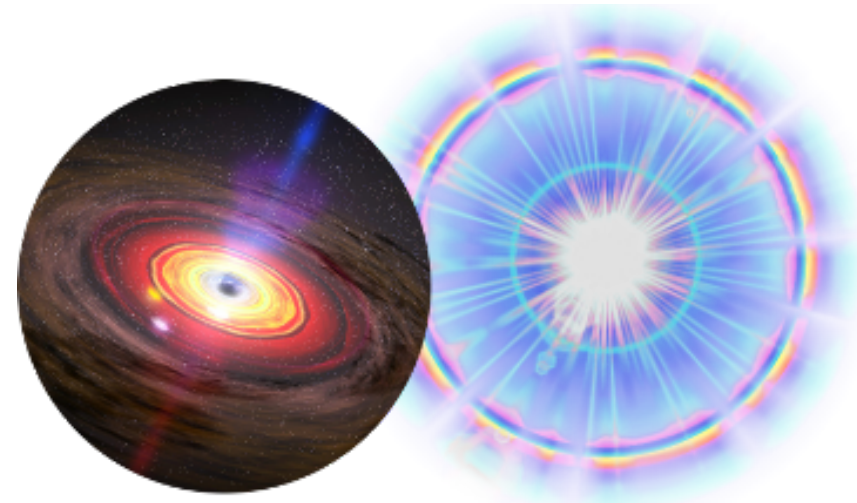
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Solar Neutrinos



Astrophysical Neutrinos (Supernovae, GRBs, etc)



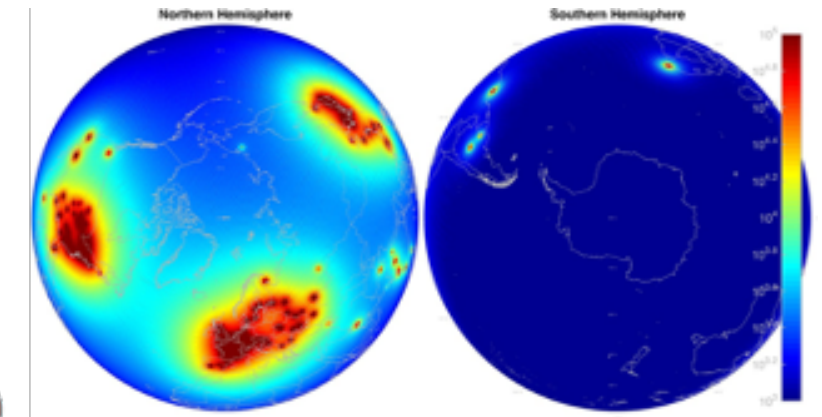
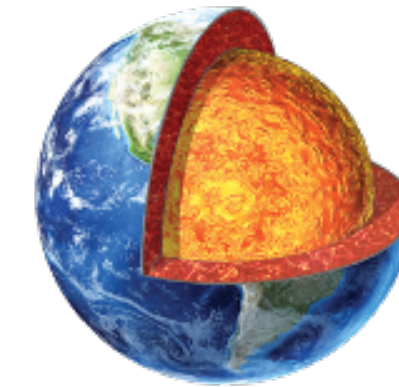
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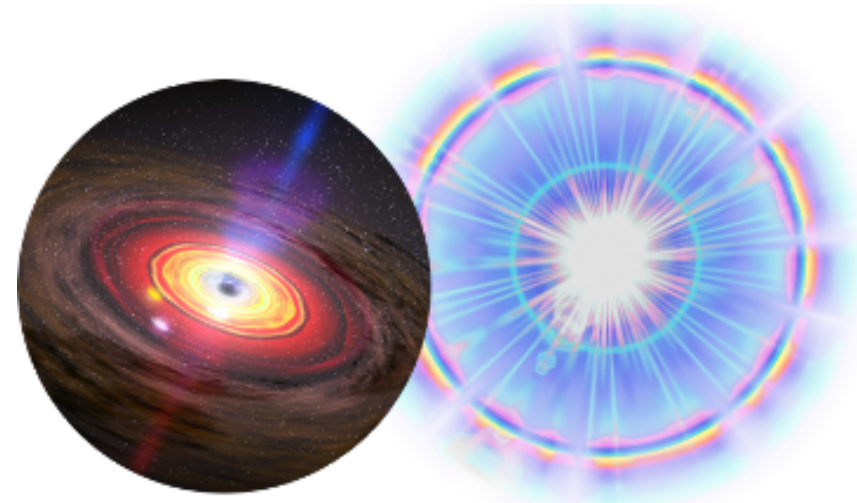
Solar Neutrinos



Geo Neutrinos



Astrophysical Neutrinos (Supernovae, GRBs, etc)



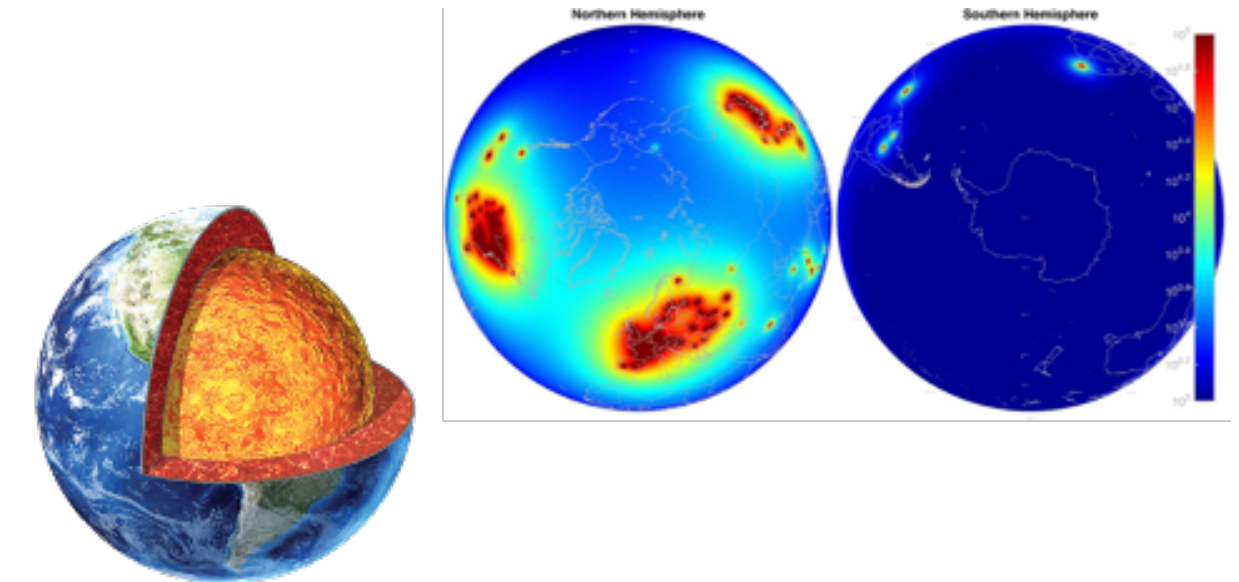
Neutrino: The Messenger of our Universe

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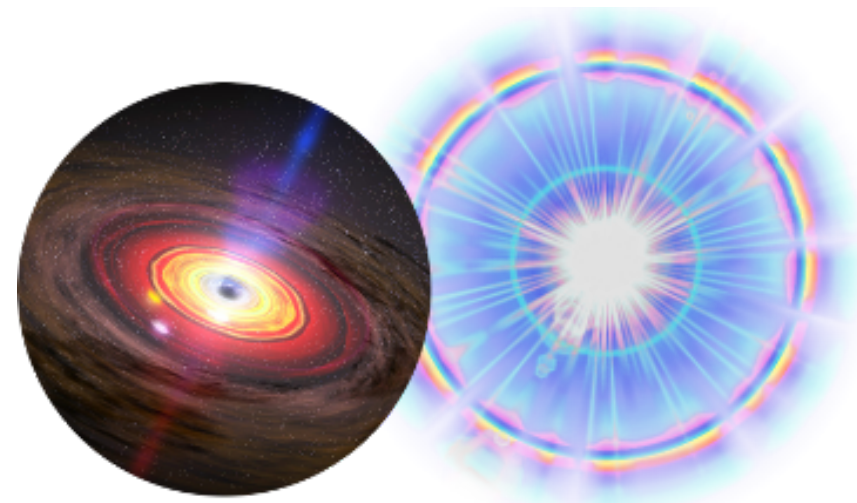
Solar Neutrinos



Geo Neutrinos

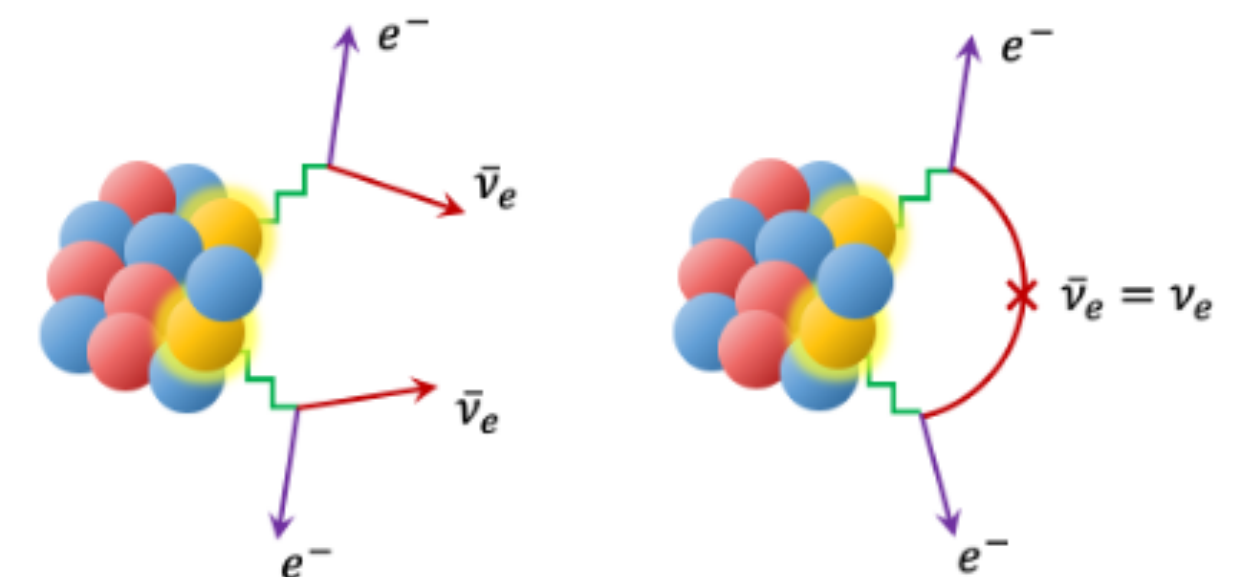


Astrophysical Neutrinos (Supernovae, GRBs, etc)



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

Tell us what happened at the beginning of the universe!



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



Use a “Crystal Ball”



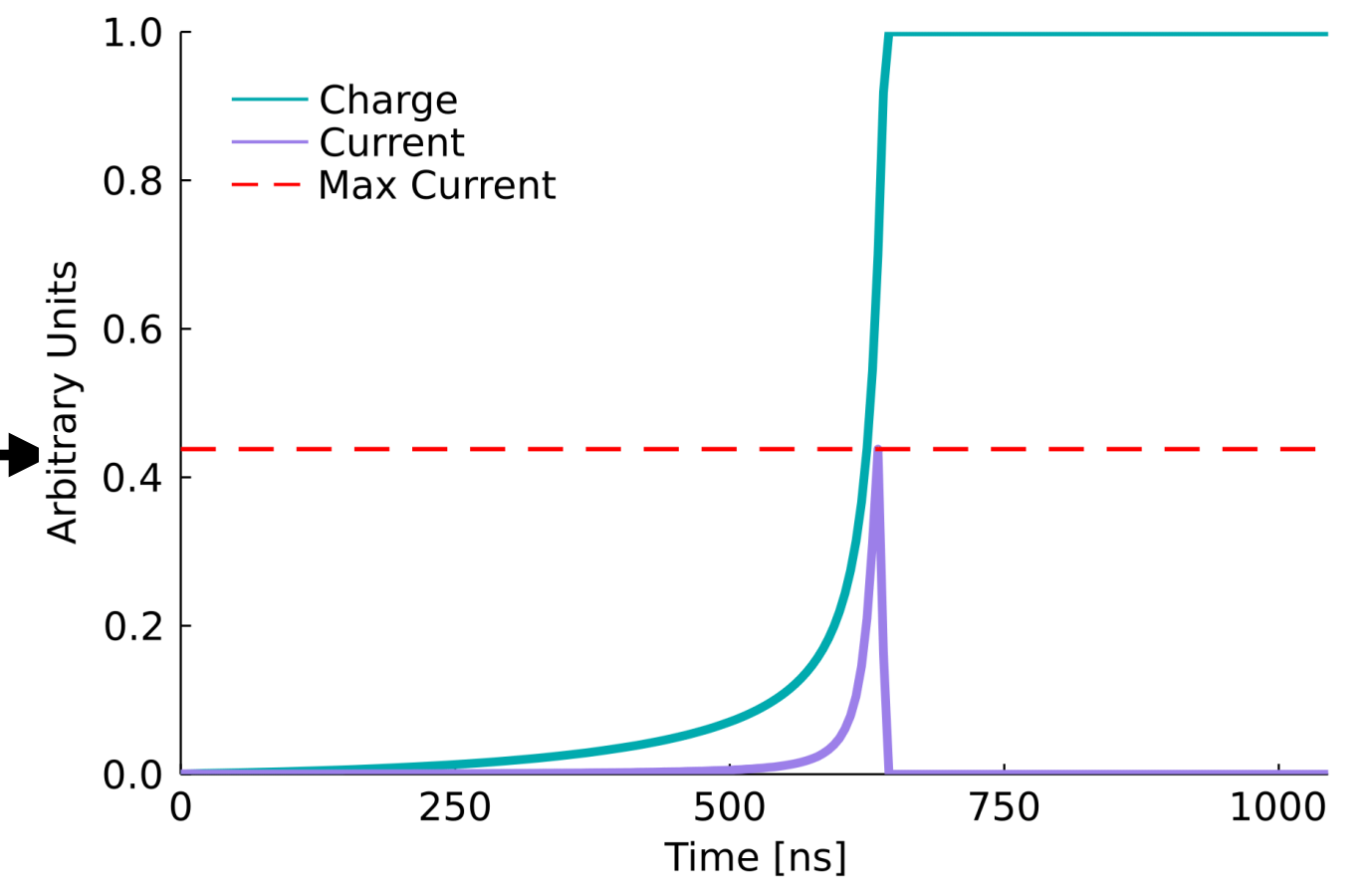
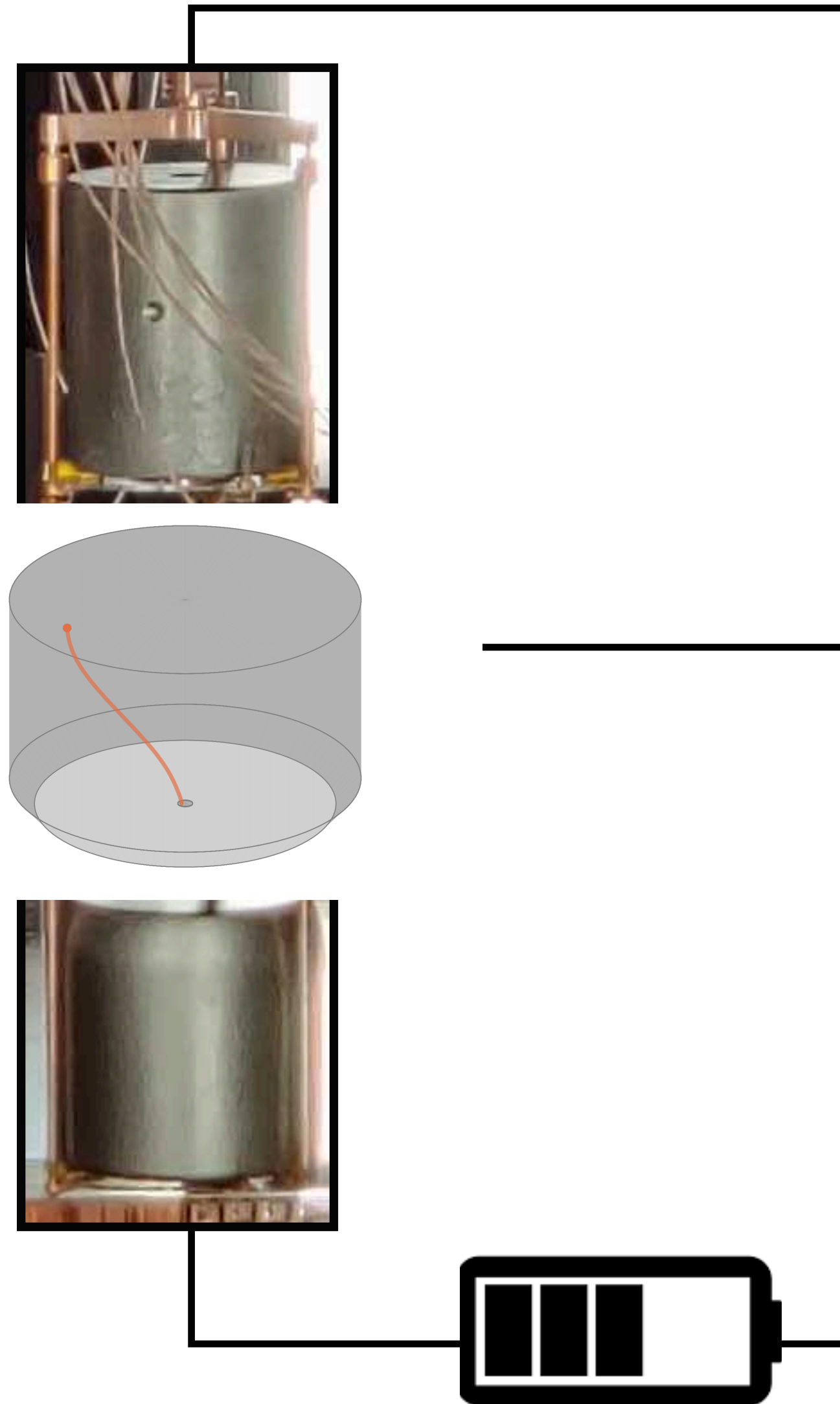
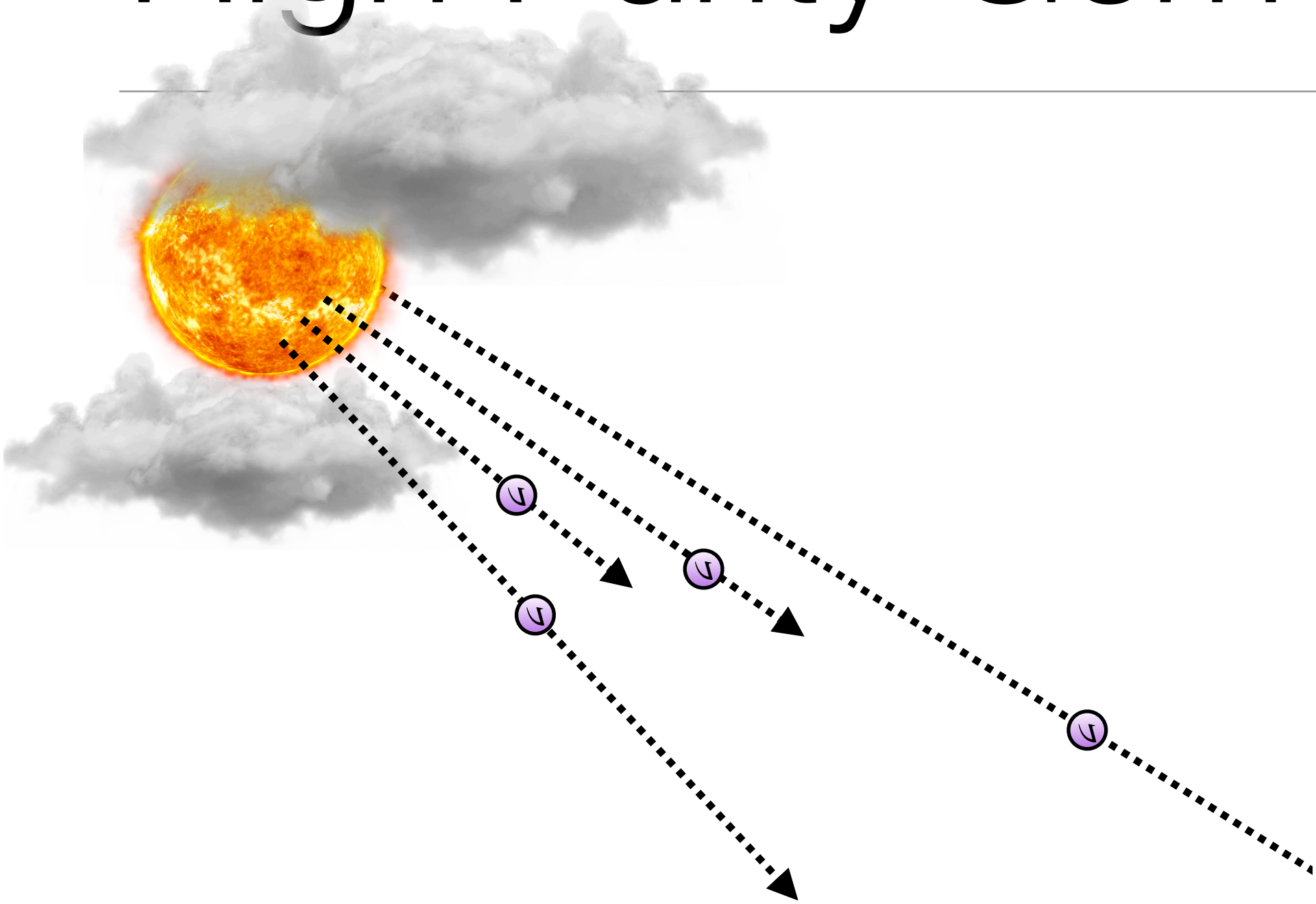
Use a “Crystal Ball”

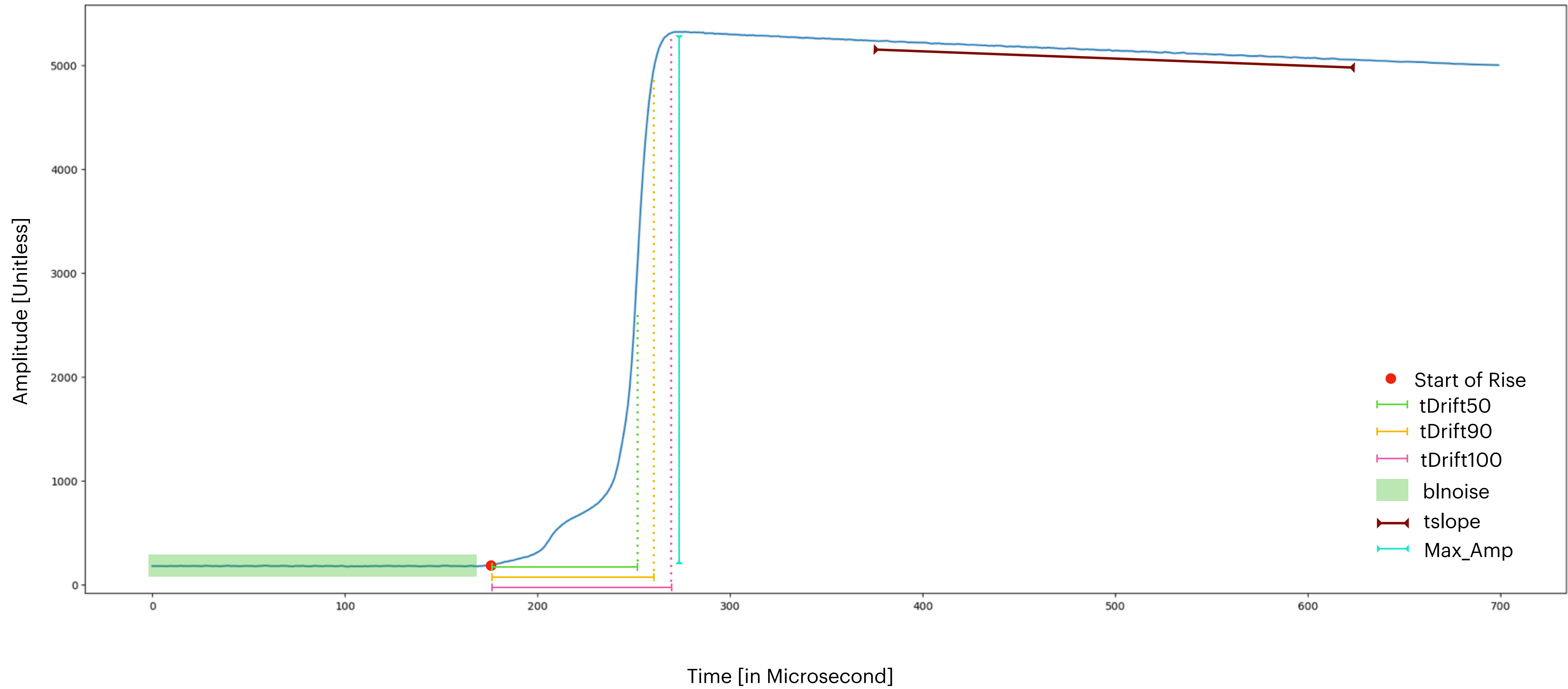


Use a "Crystal Ball"



High Purity Germanium Detector





Which Feature Should We Use?

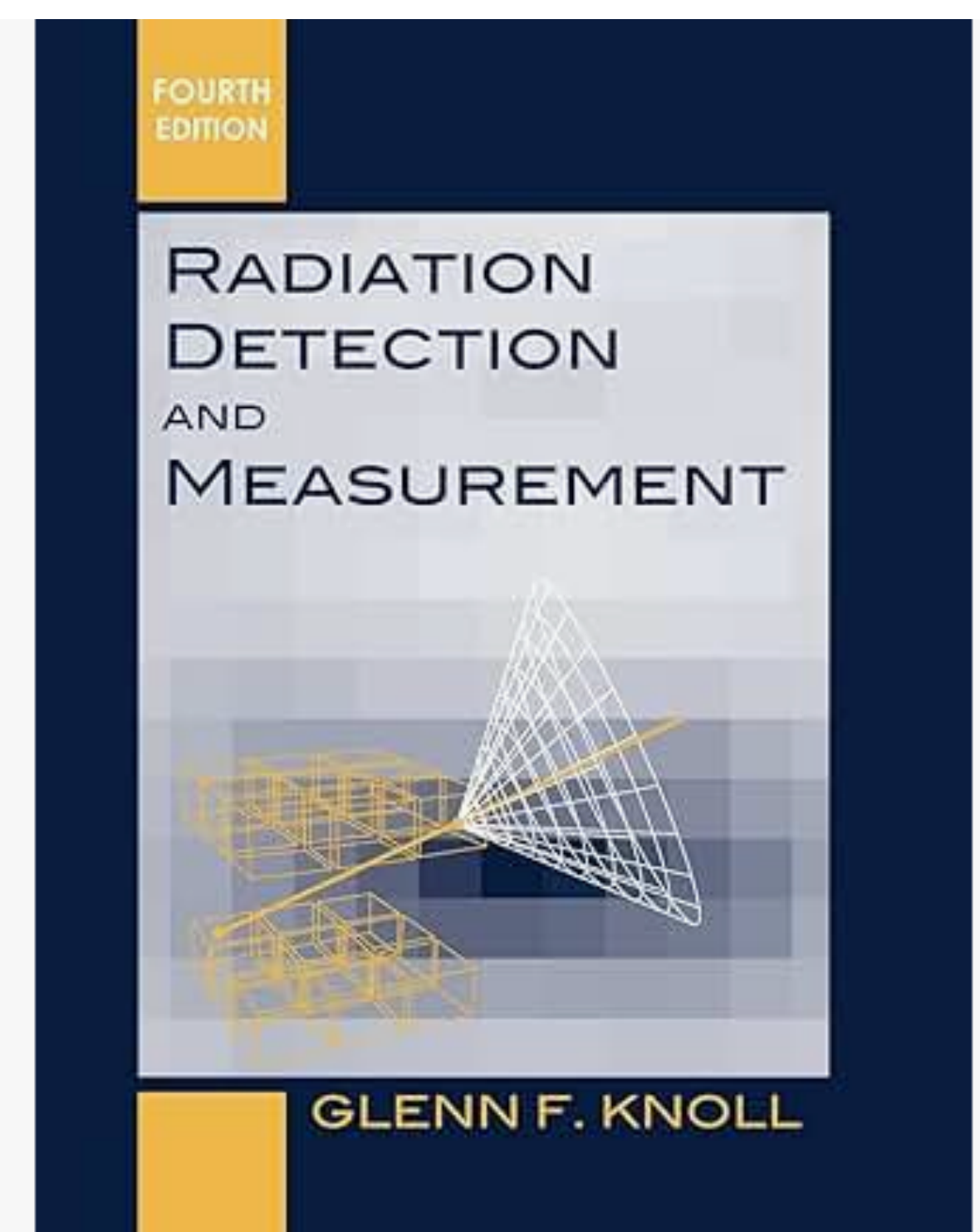
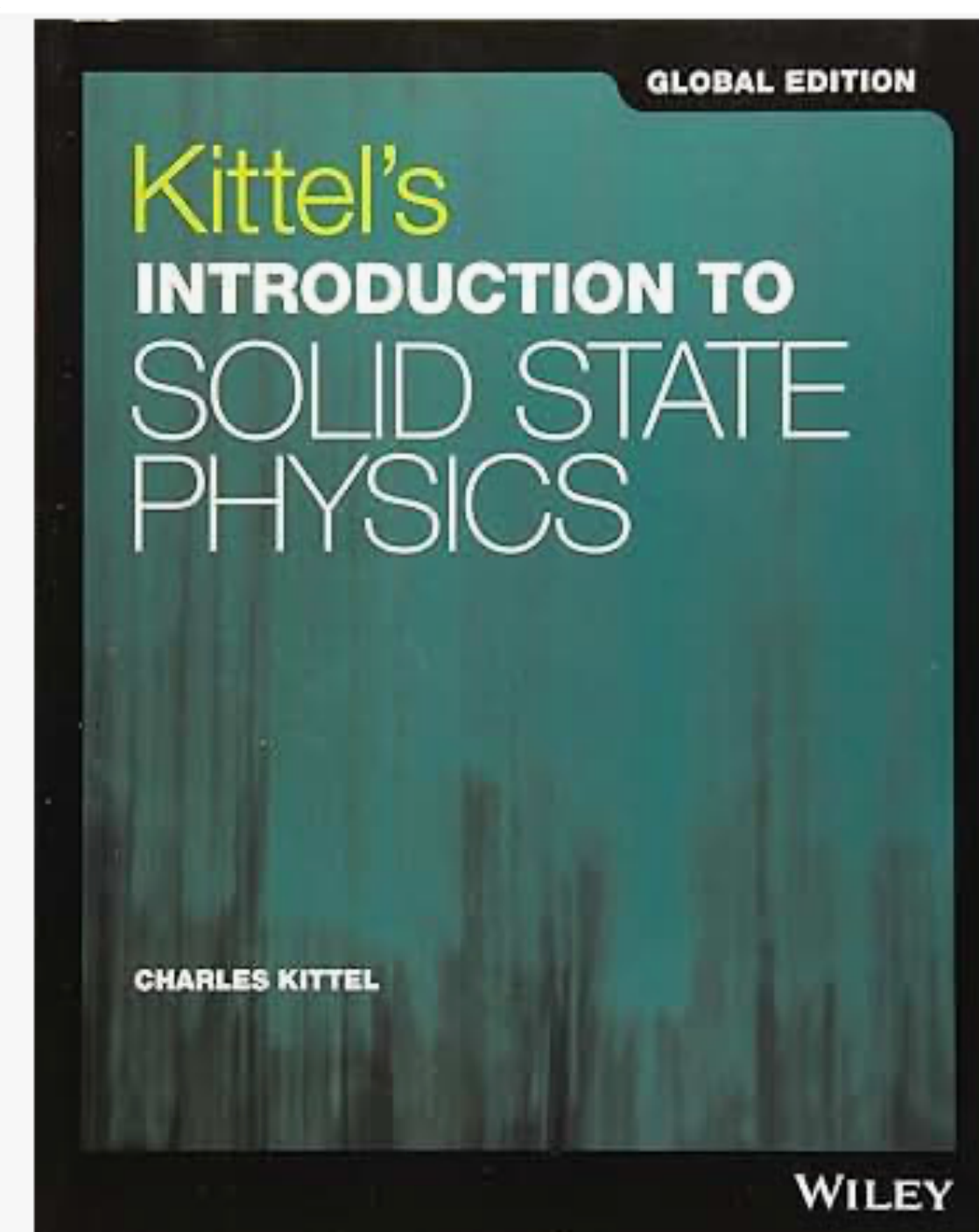
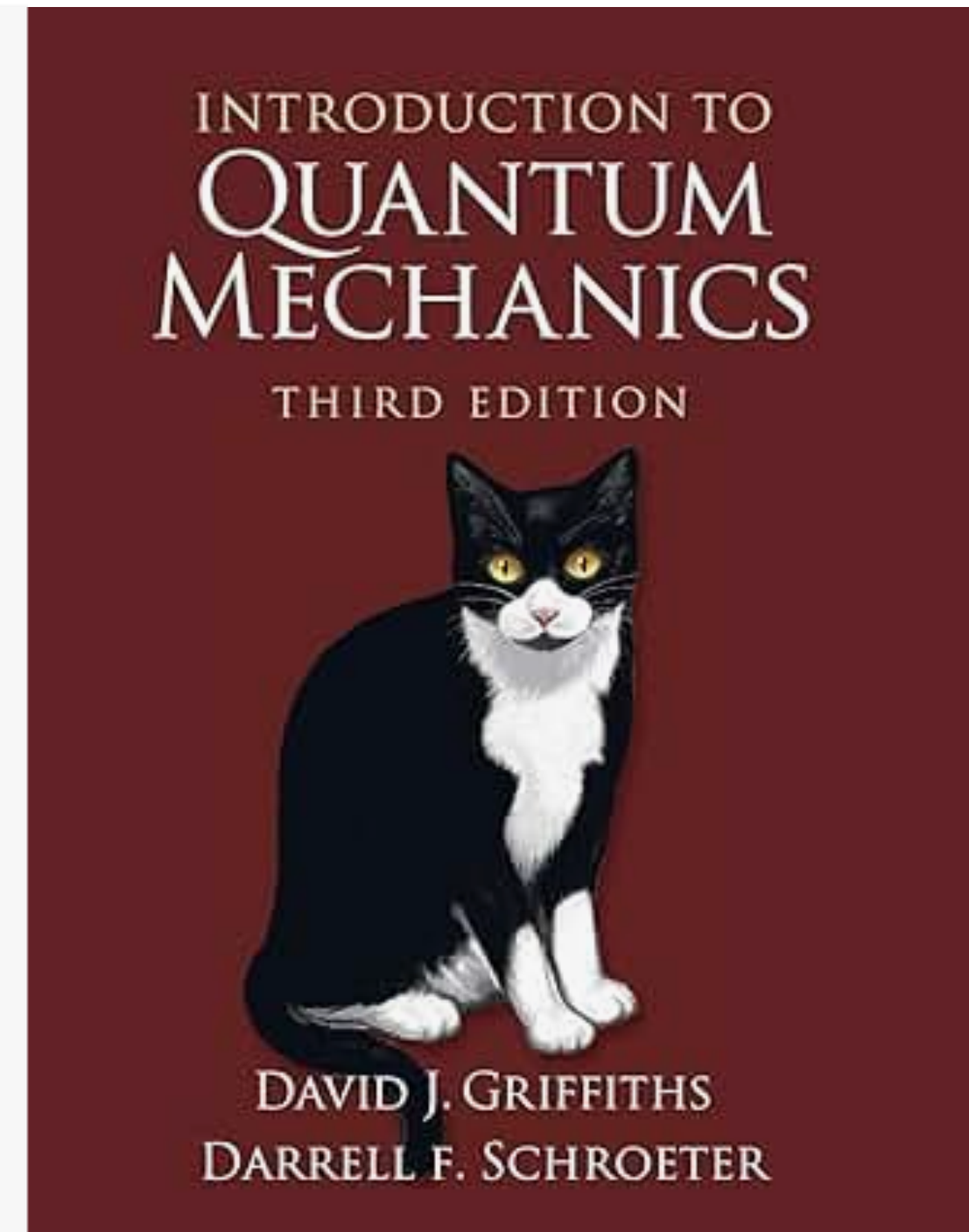
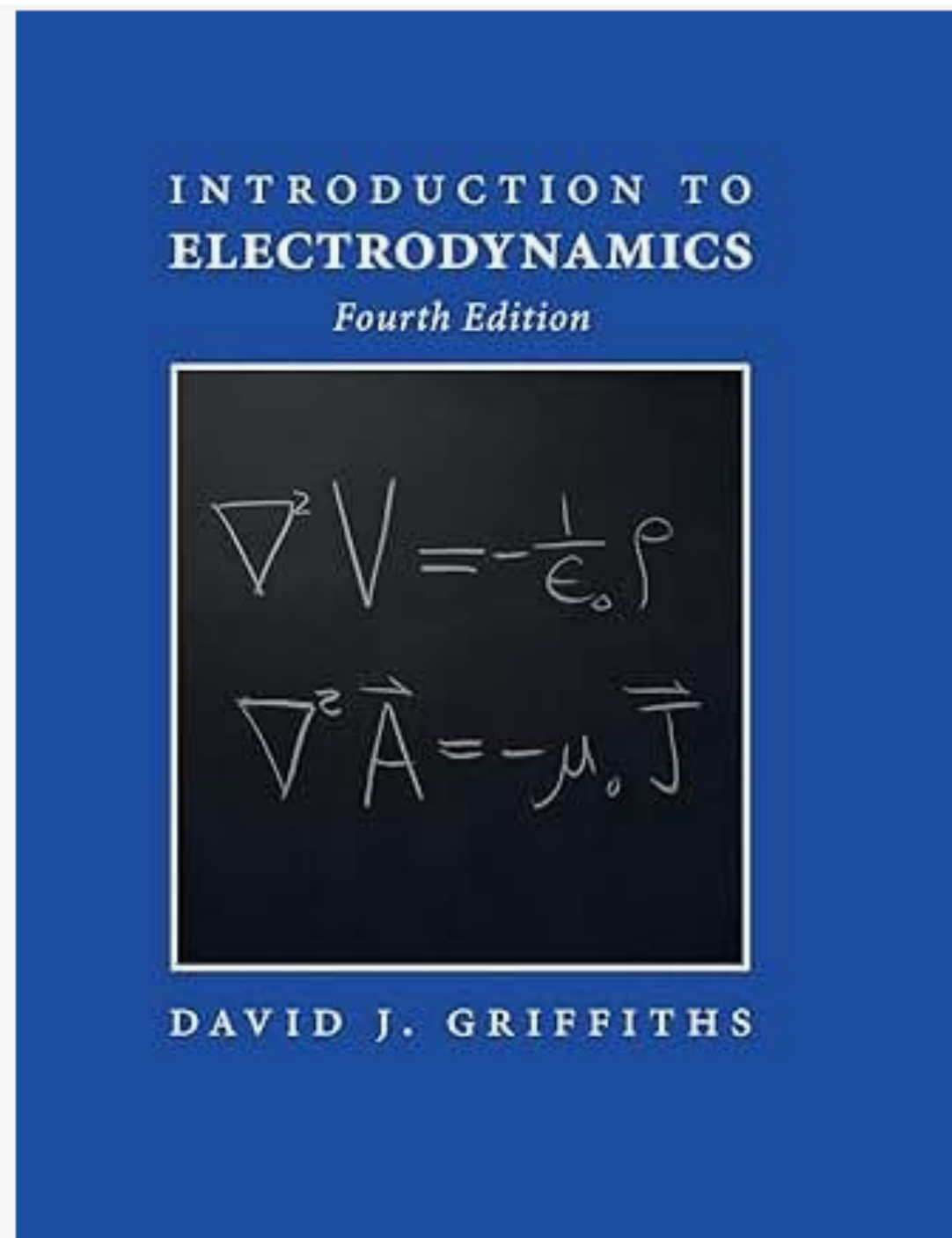
- **First-Principle:**

- 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

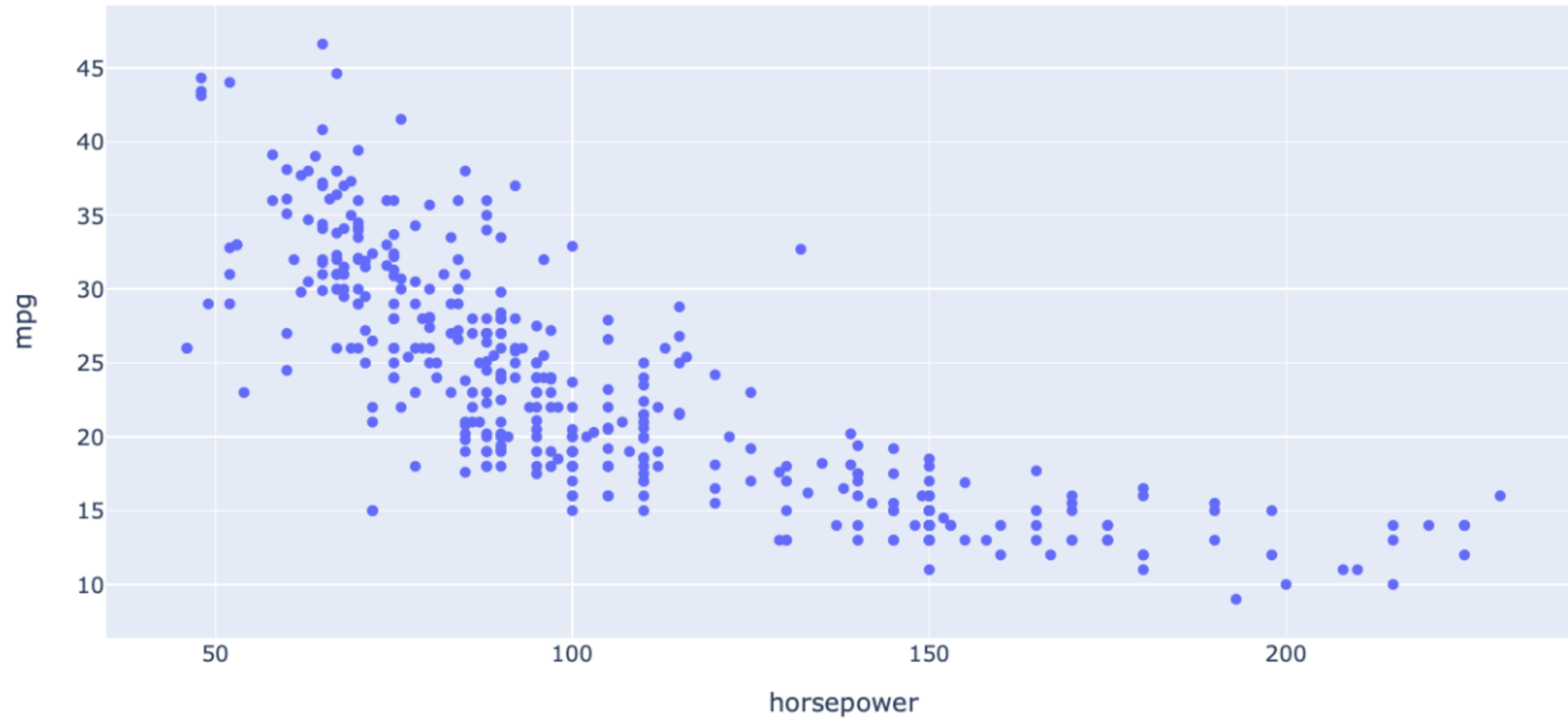
Choose Features Using **First Principle Approach**



~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!