

# NUCLEAR PHYSICS: MODELS, RADIOACTIVITY

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(4/8/2010)

Supplementary Material for  
PHY 3305 (Modern Physics)  
Harris, Ch. 11.3-11.6

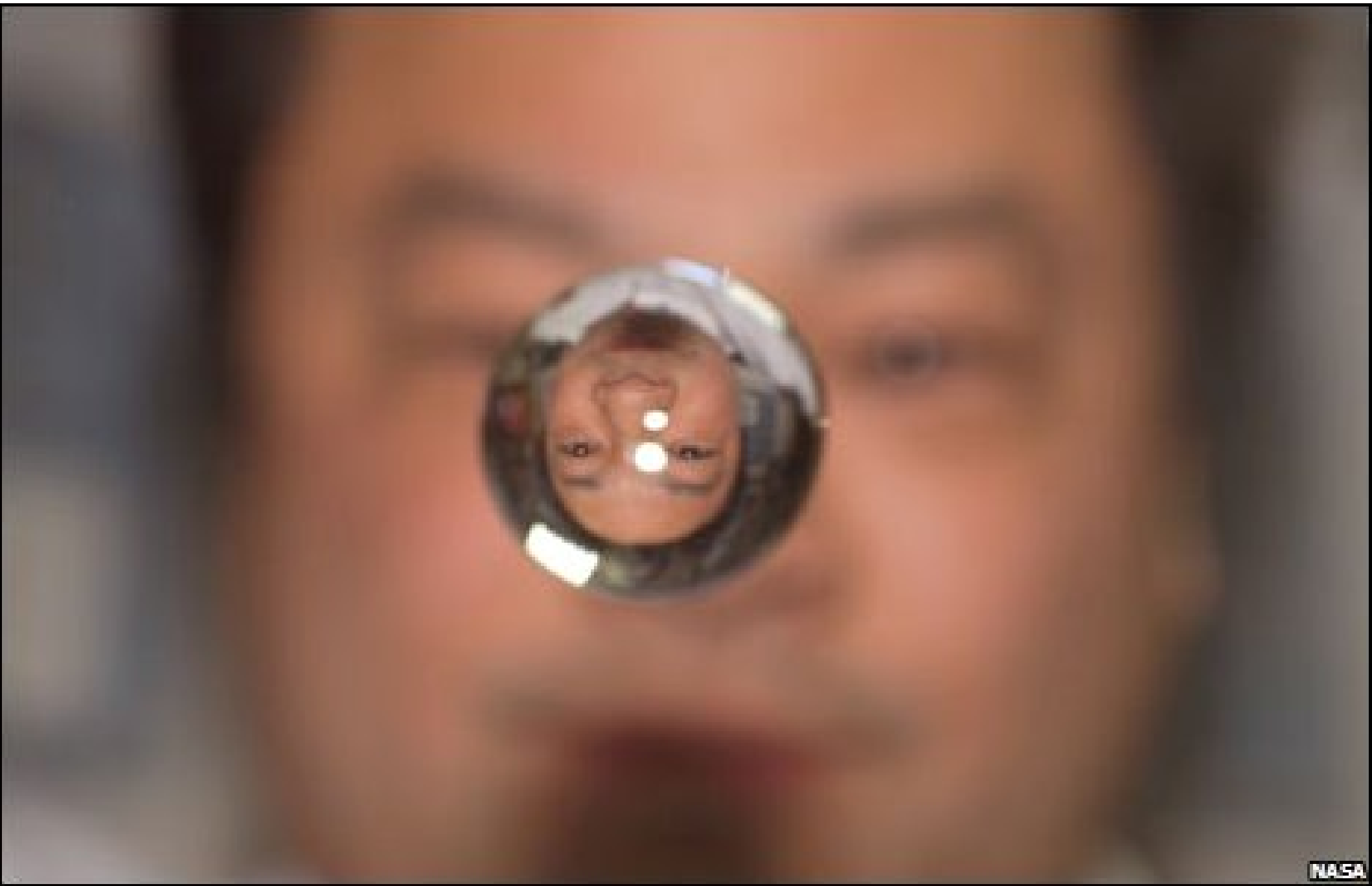
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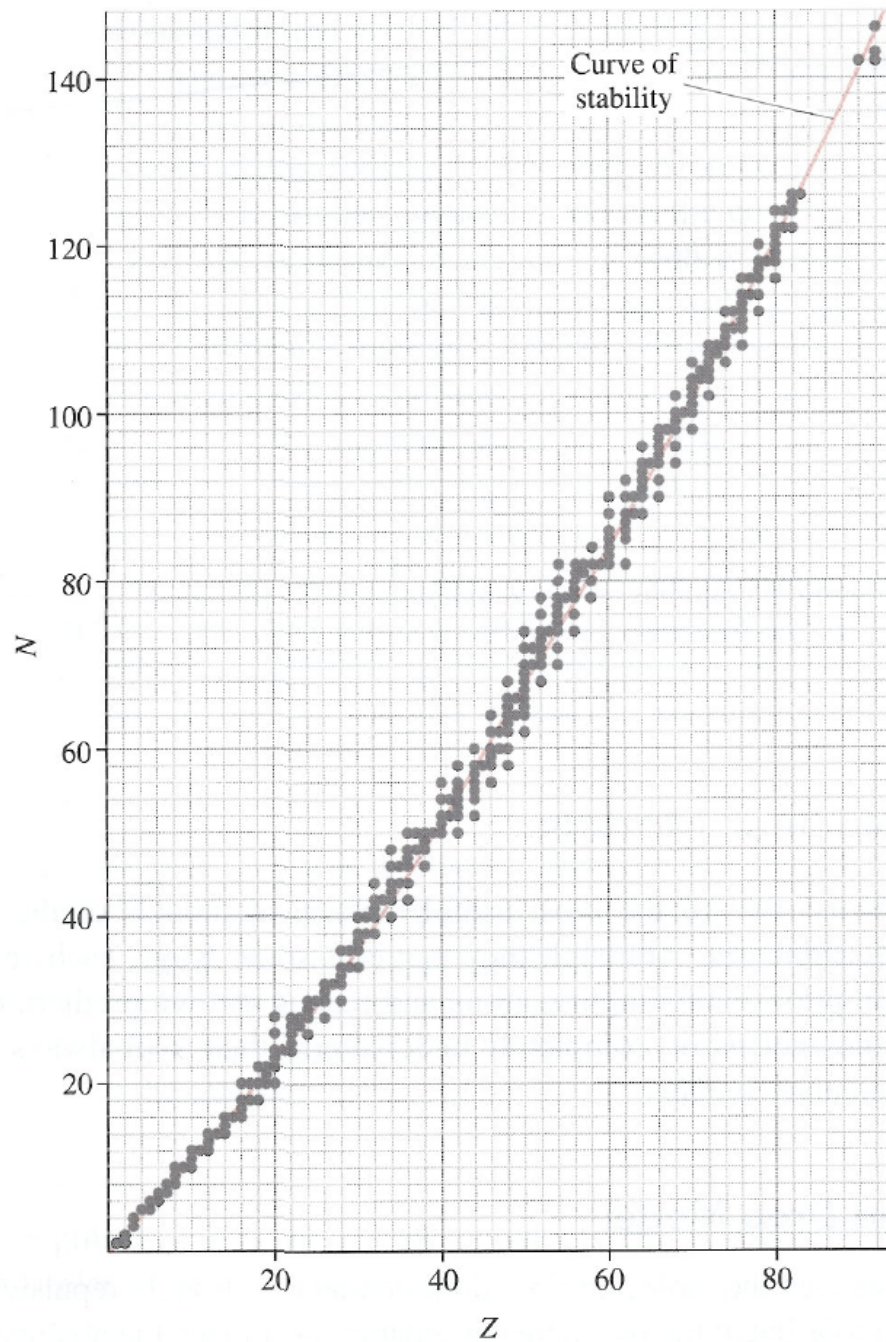
Photos from NASA -  
zero-gravity water



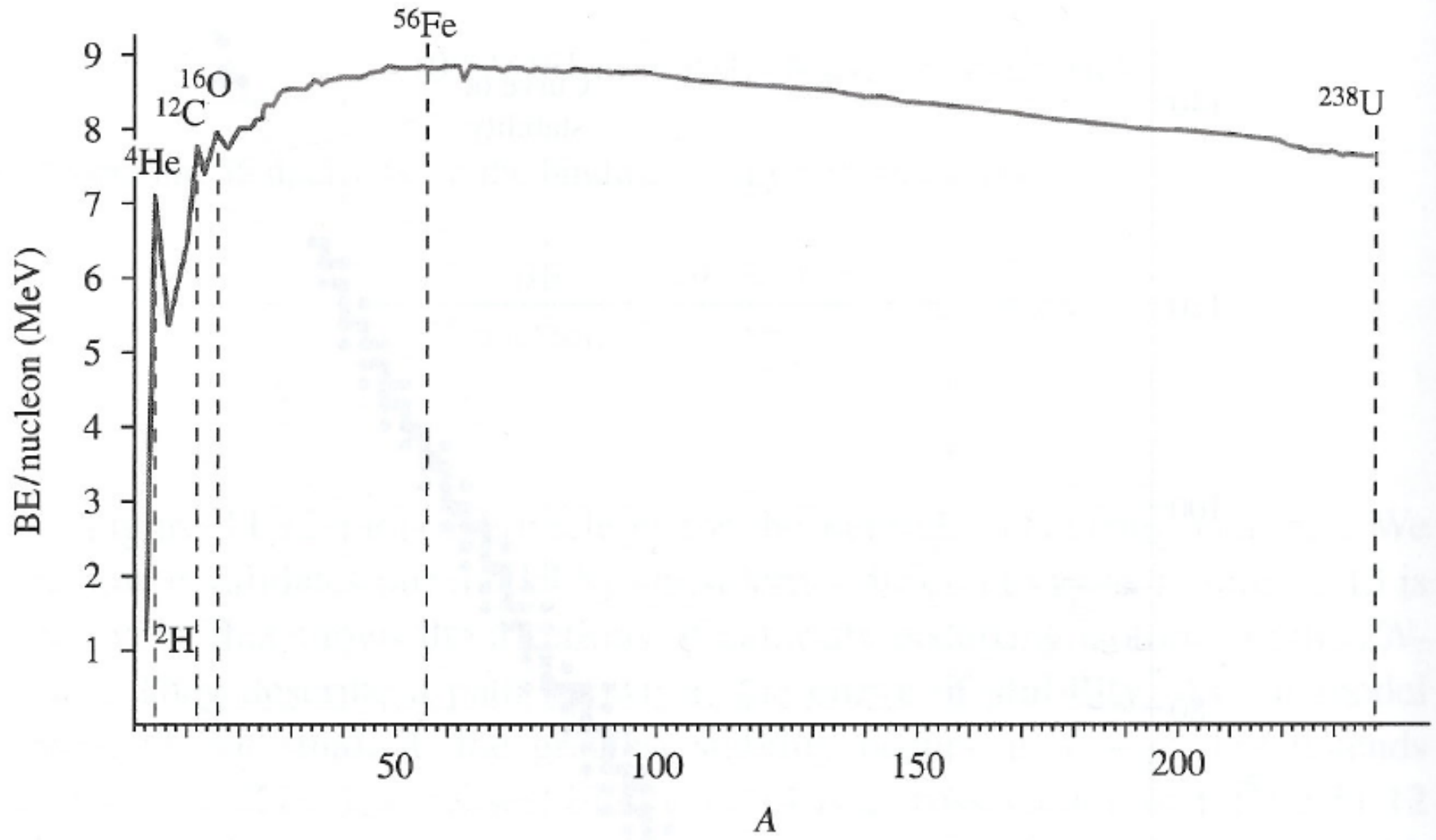


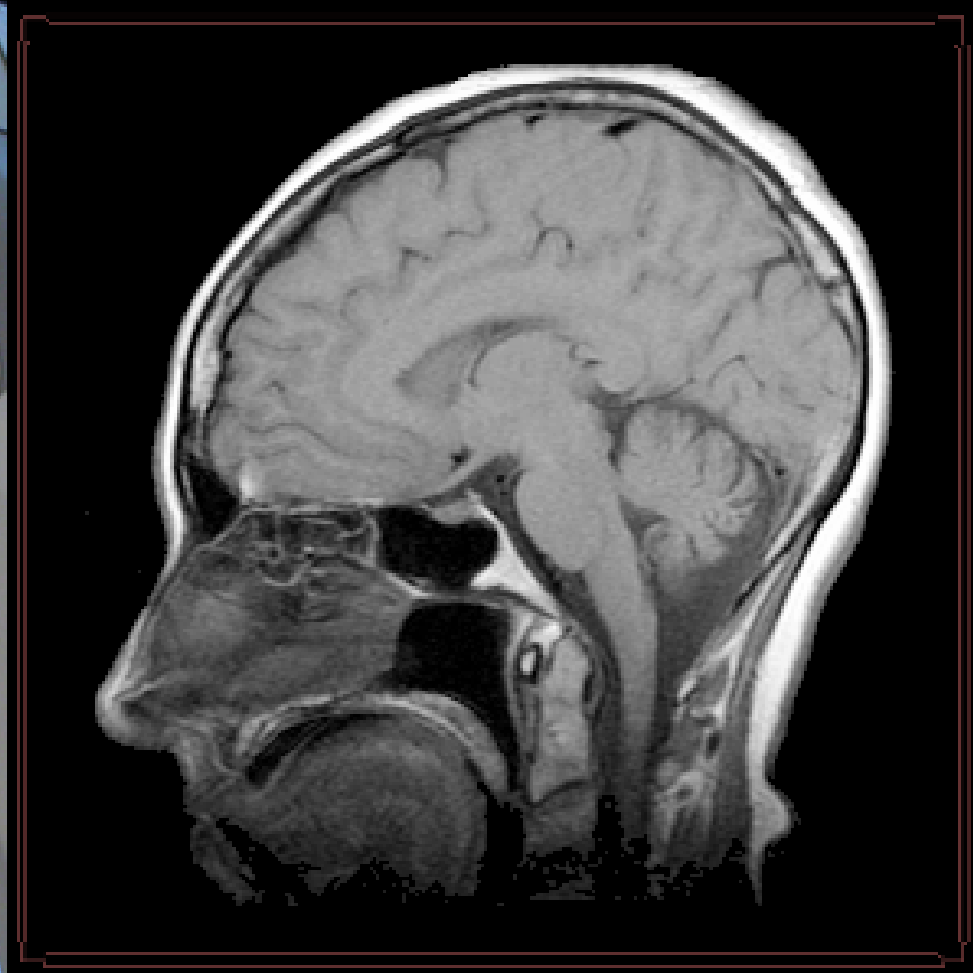


**Figure 11.13** Naturally occurring nuclei cluster along the curve of stability.



**Figure 11.14** Binding energy per nucleon versus  $A$ .





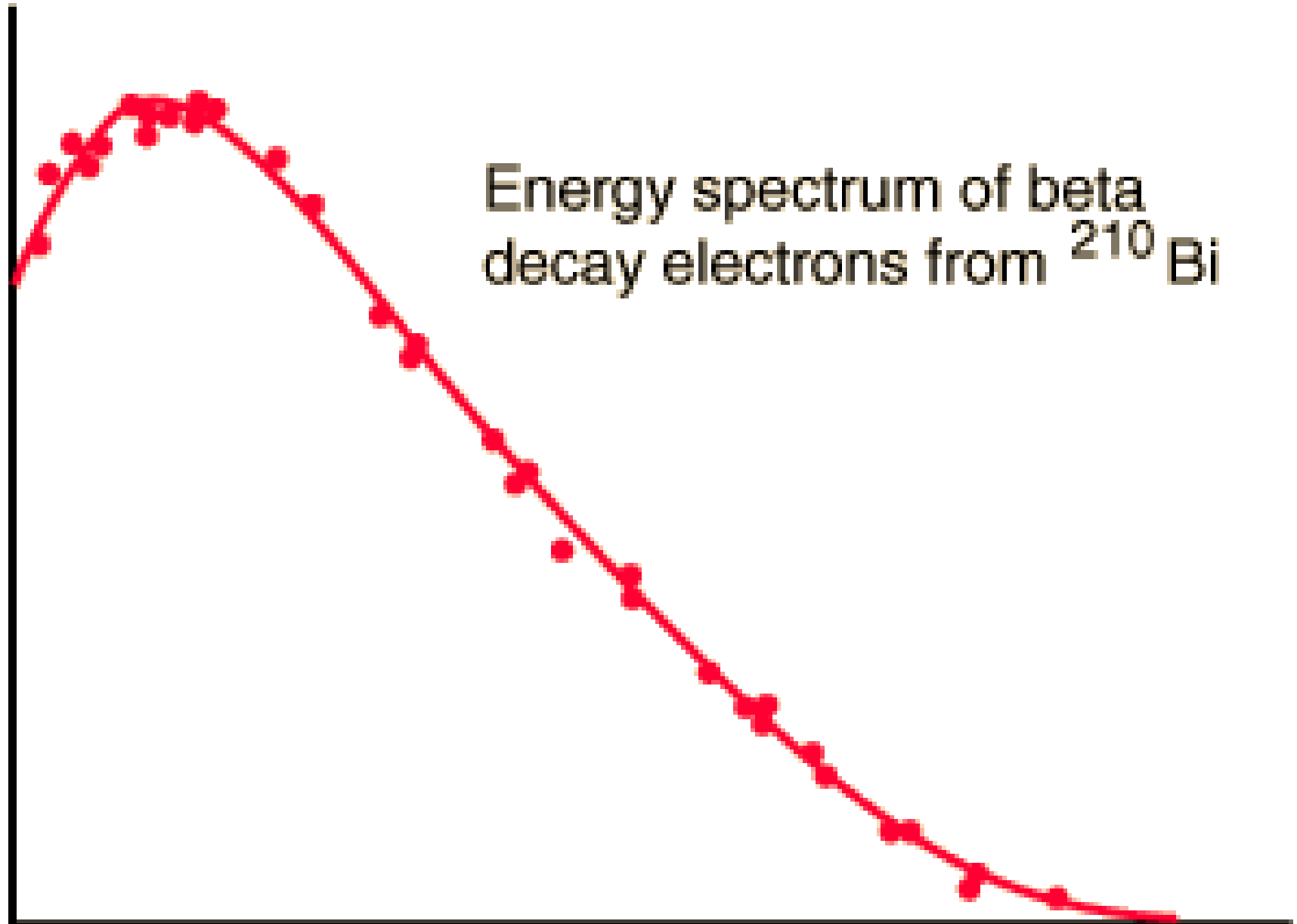


Energy spectrum of beta decay electrons from  $^{210}\text{Bi}$

Intensity

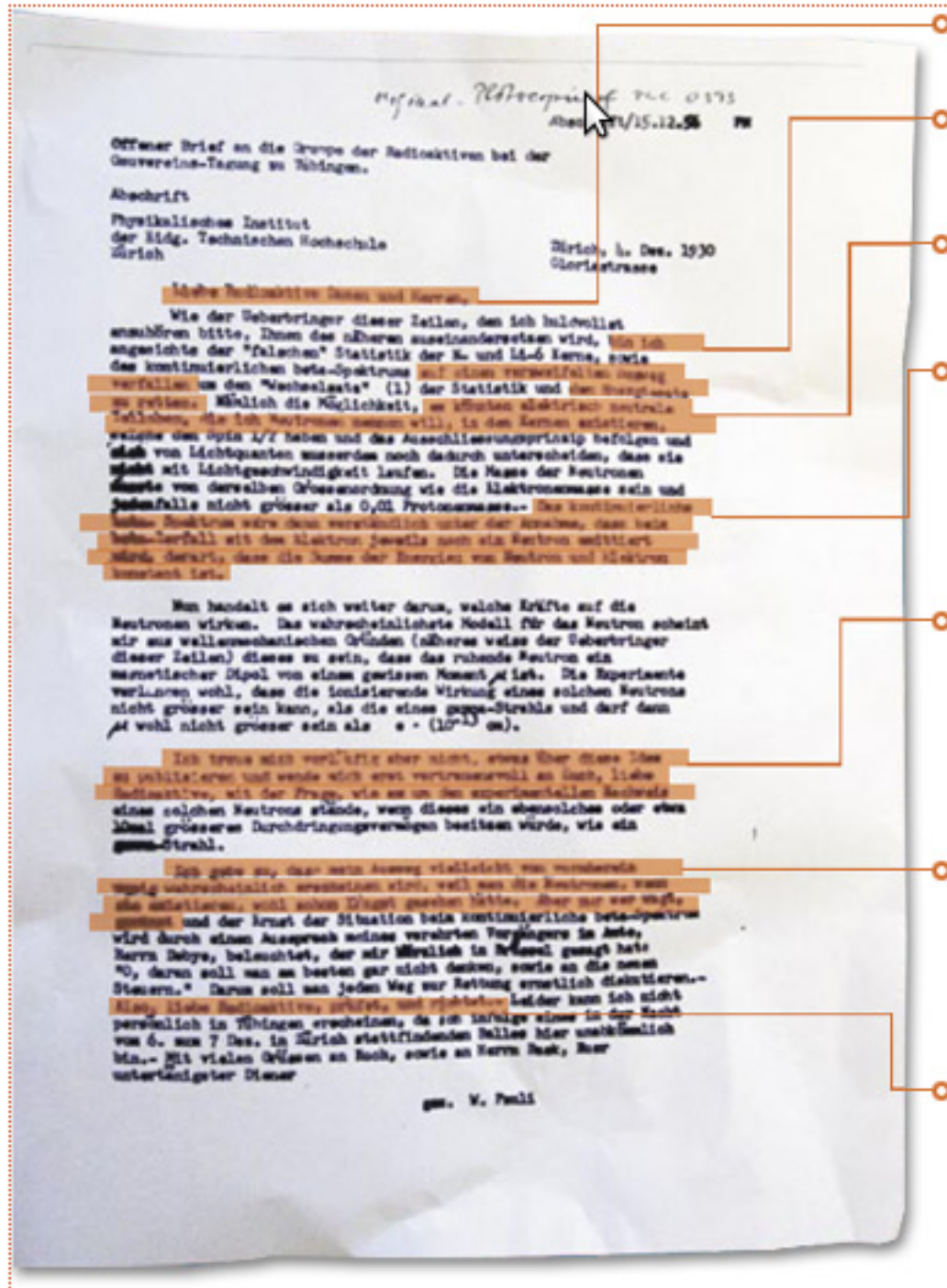
0 0.2 0.4 0.6 0.8 1.0 1.2

Kinetic energy, MeV





# logbook: neutrino invention



Dear Radioactive Ladies and Gentlemen!

I have hit upon a desperate remedy to save...the law of conservation of energy.

...there could exist electrically neutral particles, which I will call neutrons, in the nuclei...

The continuous beta spectrum would then make sense with the assumption that in beta decay, in addition to the electron, a neutron is emitted such that the sum of the energies of neutron and electron is constant.

But so far I do not dare to publish anything about this idea, and trustfully turn first to you, dear radioactive ones, with the question of how likely it is to find experimental evidence for such a neutron...

I admit that my remedy may seem almost improbable because one probably would have seen those neutrons, if they exist, for a long time. But nothing ventured, nothing gained...

Thus, dear radioactive ones, scrutinize and judge.

Translation: Kurt Riesselmann

[A complete translation is available here \(pdf\).](#)



VALVE

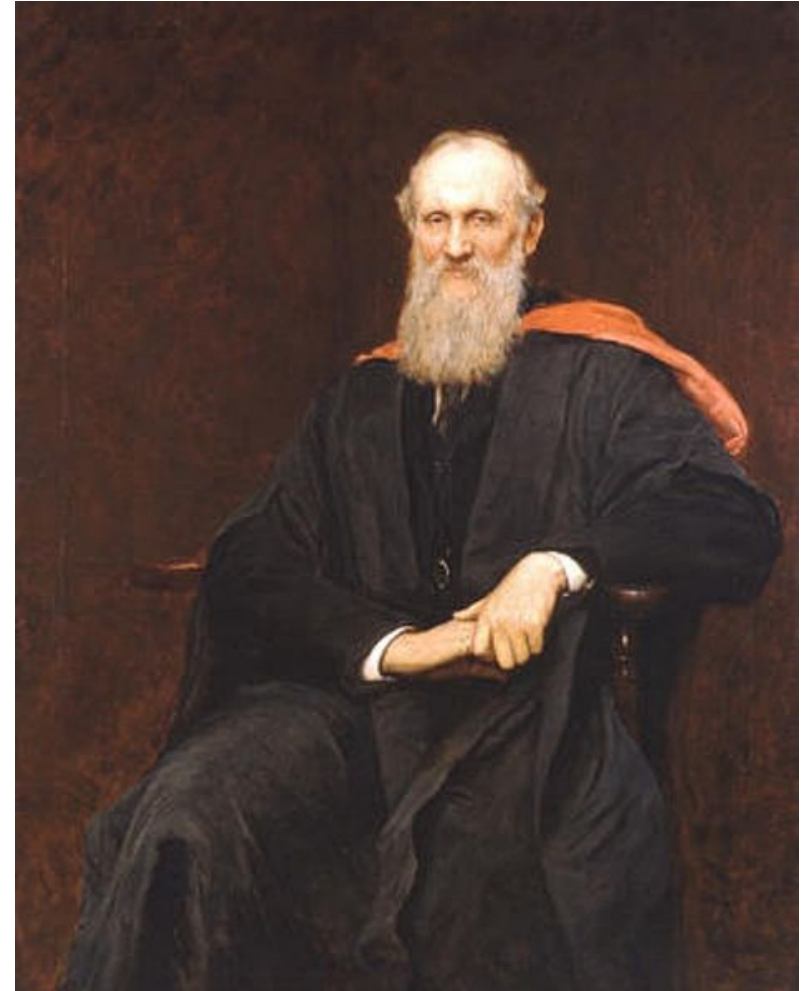
# HALF-LIFE





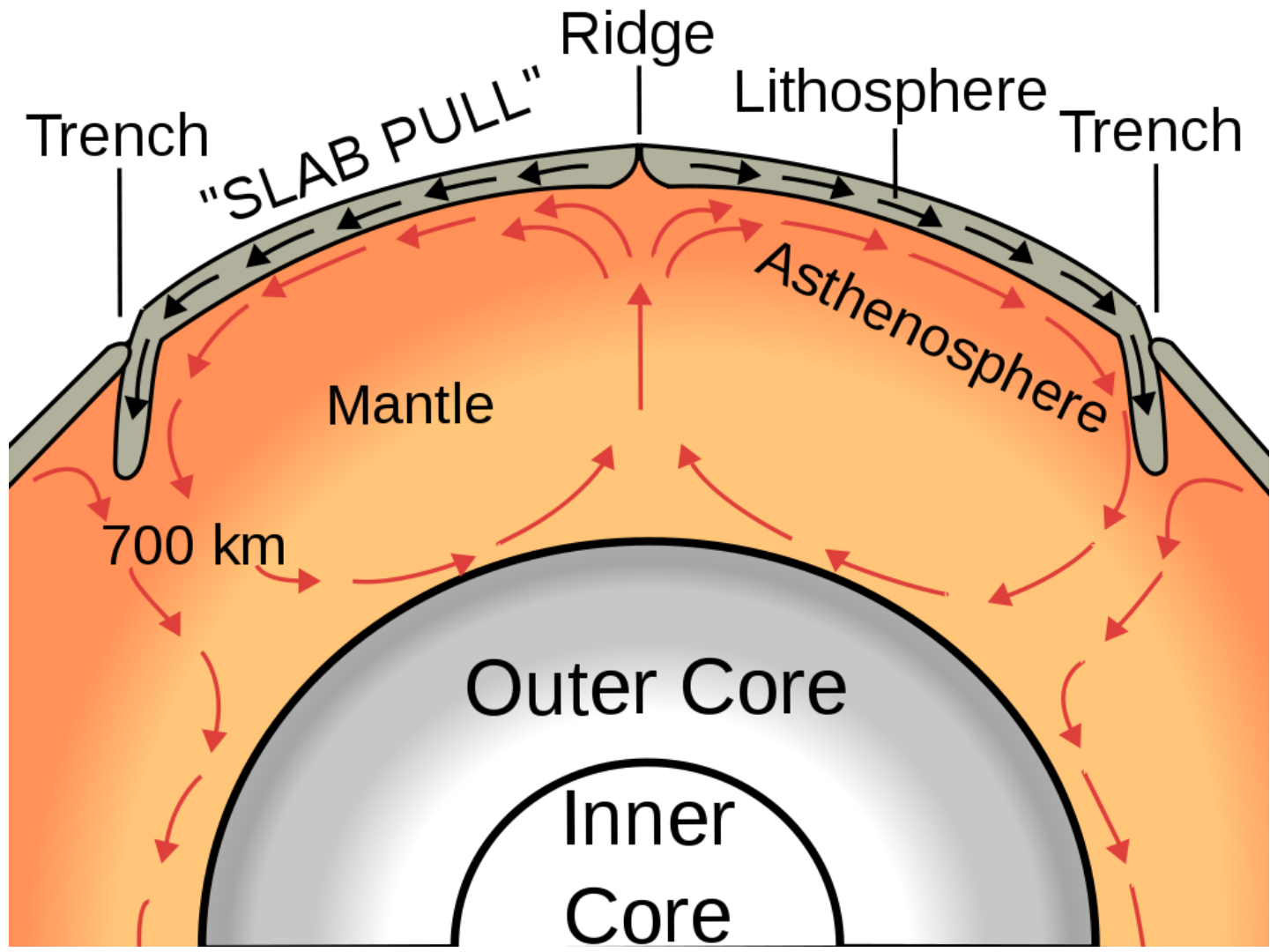


Charles Darwin  
(1809-1882)



William Rumford aka  
Lord Kelvin  
(1824-1907)





"I came into the room, which was half dark, and presently spotted Lord Kelvin in the audience and realized that I was in trouble at the last part of my speech dealing with the age of the earth, where my views conflicted with his. To my relief, Kelvin fell fast asleep, but as I came to the important point, I saw the old bird sit up, open an eye, and cock a baleful glance at me! Then a sudden inspiration came, and I said, 'Lord Kelvin had limited the age of the earth, provided no new source was discovered. That prophetic utterance refers to what we are now considering tonight, radium!' Behold! the old boy beamed upon me."

-Ernest Rutherford, recalling his lecture on radioactive energy and dating (1908)

# NEXT TIME

- Applications of Nuclear Physics
  - Fission and Fusion
- Fundamental Particles and Interactions
- Harris: Ch. 11.7, 12.1-12.2
- We have just 4 lectures left
  - the first 3 will be new material
  - the last lecture (Apr. 29) will be a review and discussion of the final exam