Spin Isomers as High Energy Sources

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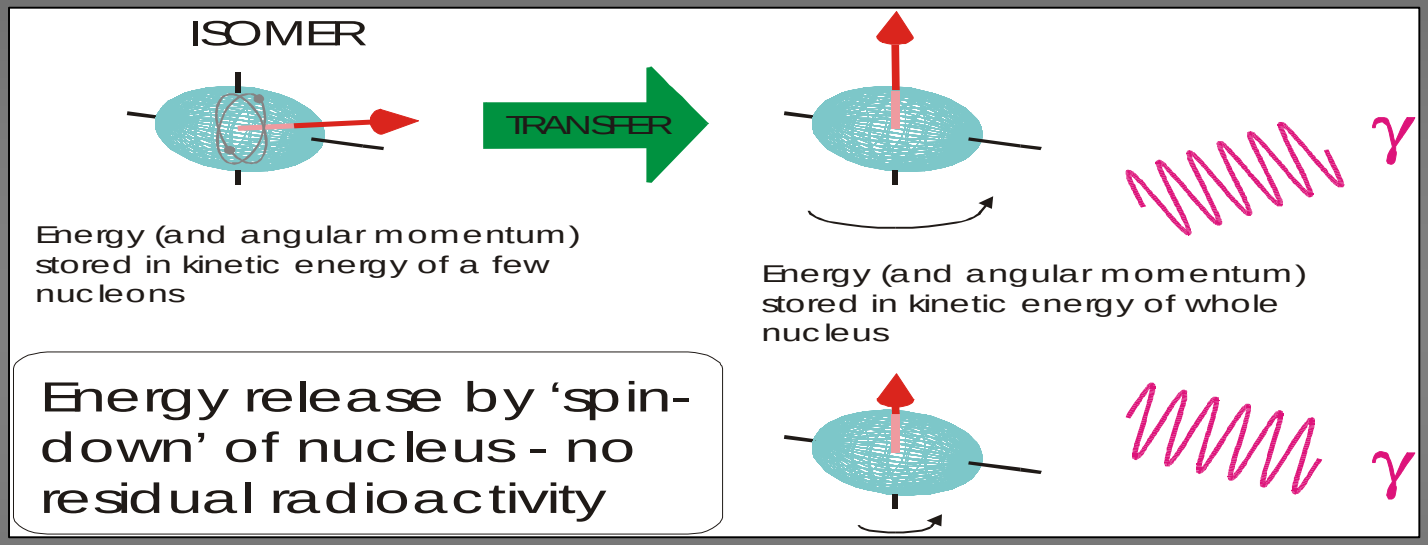
Agenda

- What is a Spin Isomer?
- Energy Applications
- Triggering the Isomer
- Production of High Energy Density Materials
- Energy Conversion
- Questions

What is an Isomer?

Instead of utilizing the binding energy of the nucleon, we are instead attempting to harness its kinetic energy from spinning.

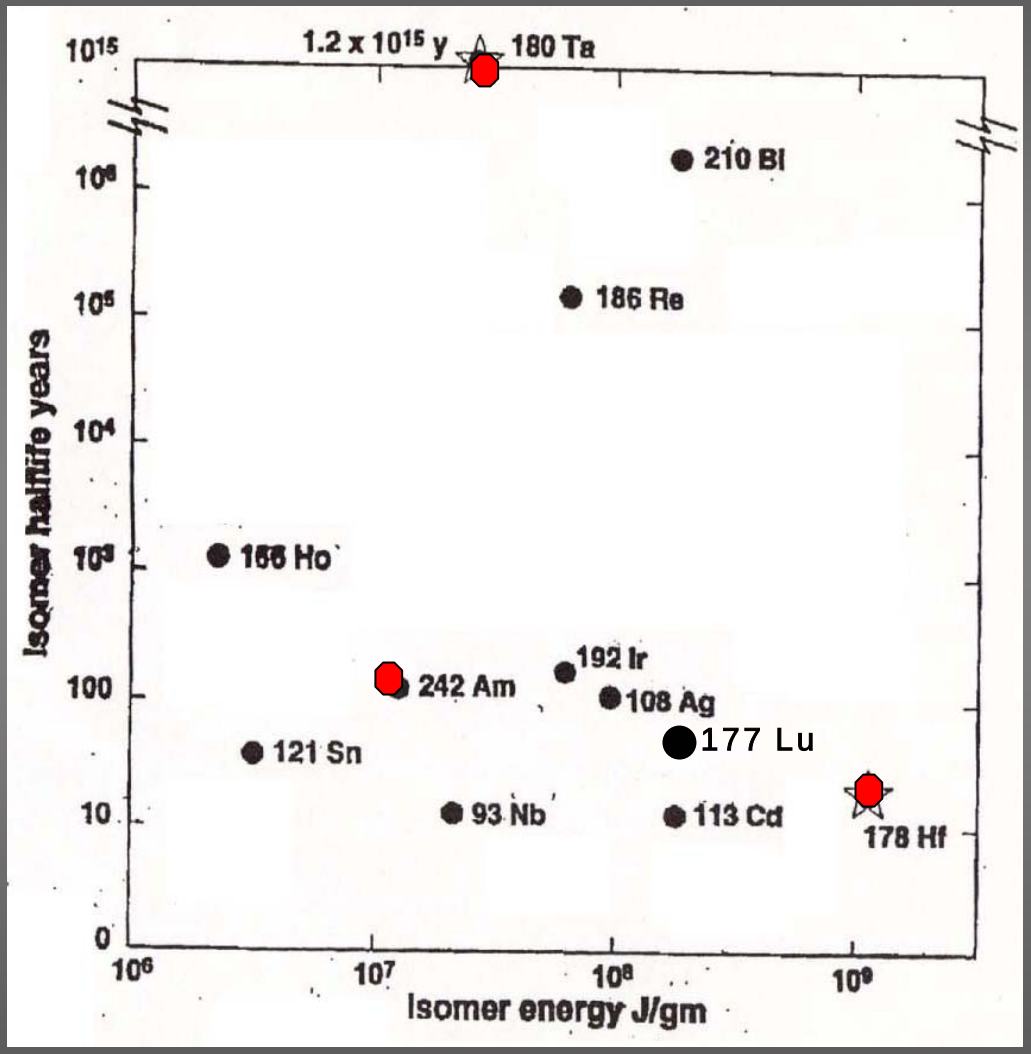


Nuclear Spin Isomer

Spin = ~ 10^{20} Rotations/Sec

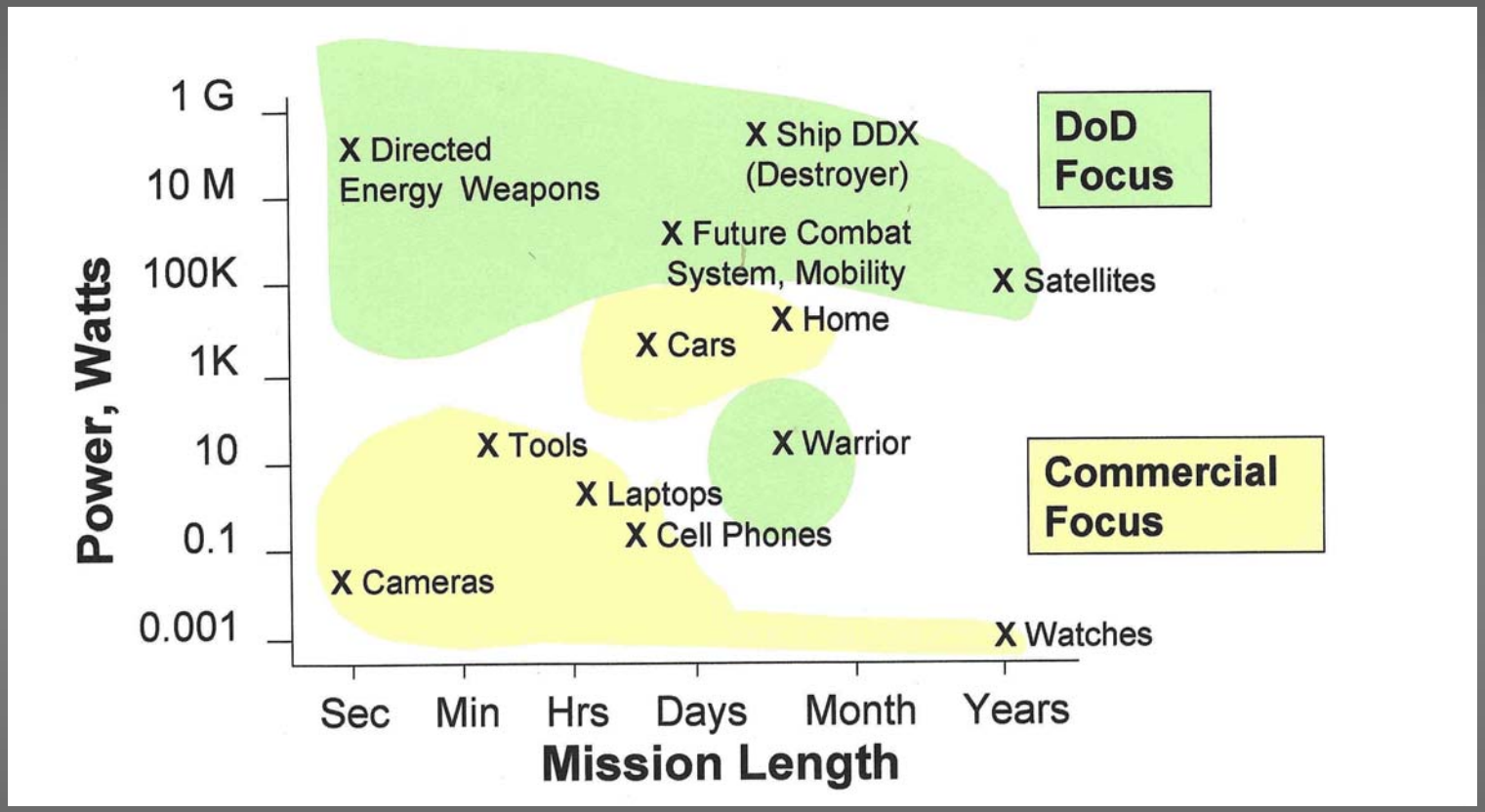
Energy = (1/2)(Moment of inertia) (Frequency)^2

What is an Isomer?



- 180Ta has longest lived state of 1015 years
- 178Hf has highest energy density with >109 J/g
- 242Am is most abundant

Energy Applications



Common Power Versus Time Requirements

Energy Applications

Weapon

- Avalanched triggering yields lethal effects
- Gamma production yields a range of non-lethal effects
- EMP for electronics disruption
- Chemical/Biological kill

Power Source

- Long term, high density power and energy storage
- Energy from gammas can be a dense source of intense, clean, sustainable, stable energy

Triggering the Isomer

Measure triggering through burn-up experiments (irradiation) to accelerate decay.

Low energy trigger capability for gain?

Production of High Energy Density Materials

- No critical mass required
- Requires nuclear reactor or particle accelerator
- Can only be made in very small amounts (less than 1 gm)
- Extremely expensive

Energy Conversion

Direct Capture

- Simple collection of the emitted charged particles

Betavoltaics

- Ionization near a P-N or P-I-N junction in a semiconductor

Thermovoltaics

- Thermoelectric conversion uses a thermal gradient between two different materials to create a current via the Seebeck effect.
- Thermionic conversion creates a current by boiling electrons off a cathode (at high temperature) and catching them at an anode

Photovoltaics

- Conversion of the decay energy to light and subsequent conversion to electricity

Questions