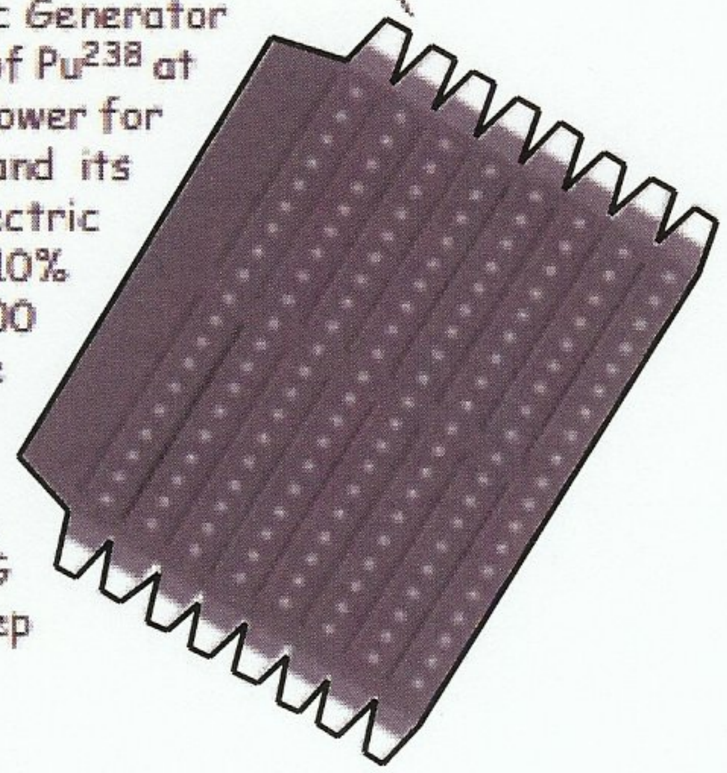
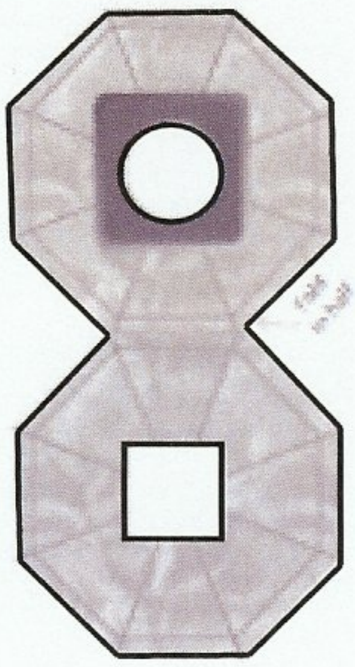
The New Horizons spacecraft and instrument suite were specifically designed to use as little power as possible, even so with everything running they require ~190 watts of electricity. At Pluto the sun is only 1/1000 as bright as it is at Earth making power production with solar cells impractical. Instead New Horizons uses a Radioisotope Thermoelectric Generator (RTG), sometimes called a 'Space Battery'.

Radioisotope Thermoelectric Generator

The Radioisotope Thermoelectric Generator (RTG) uses heat from the decay of Pu^{238} at its center to produce electrical power for the New Horizons spacecraft and its instrument payload. Thermoelectric junctions are less than 10% efficient, so to produce the 200 watts of electrical power for the spacecraft, the RTG requires more than 2000 watts of thermal energy. Vanes on the exterior surfaces of the RTG dissipate this heat away to deep space.



RTG end cap



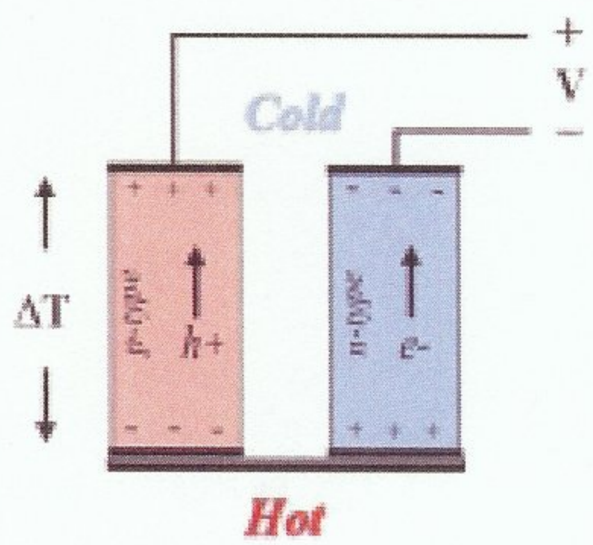
RTG Thermal Shield

This Multi Layer Insulation covered shield prevents the waste heat radiated by the RTG from striking the New Horizons spacecraft. A small amount of heat conducts through the titanium RTG mount into the spacecraft structure and is used to keep the spacecraft electronics from getting too cold.

Electricity from heat?

In thermo-electric junctions, specially formulated materials inhibit atom-to-atom heat transfer relying on mobile electric charge carriers to convey thermal energy.

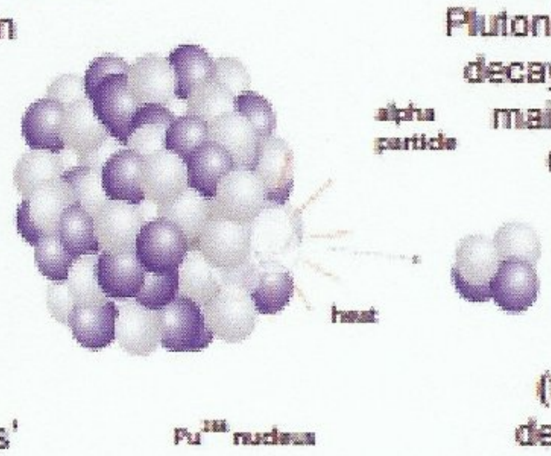
When one end of a junction is warmed and the other cooled, thermally excited electrons from the warm end vibrate about displacing other electrons towards the cooler end. As long as the heat is dissipated away from the cool end, the electrical charge imbalance is maintained and a few volts of electrical potential is produced.



A complementary junction can be made of materials that use positive charge carriers, instead of electrons, to convey heat and charge away from the warm end. Connected beside a junction of the other type a complete circuit can be formed, or multiple pairs can be linked to increase the output voltage.

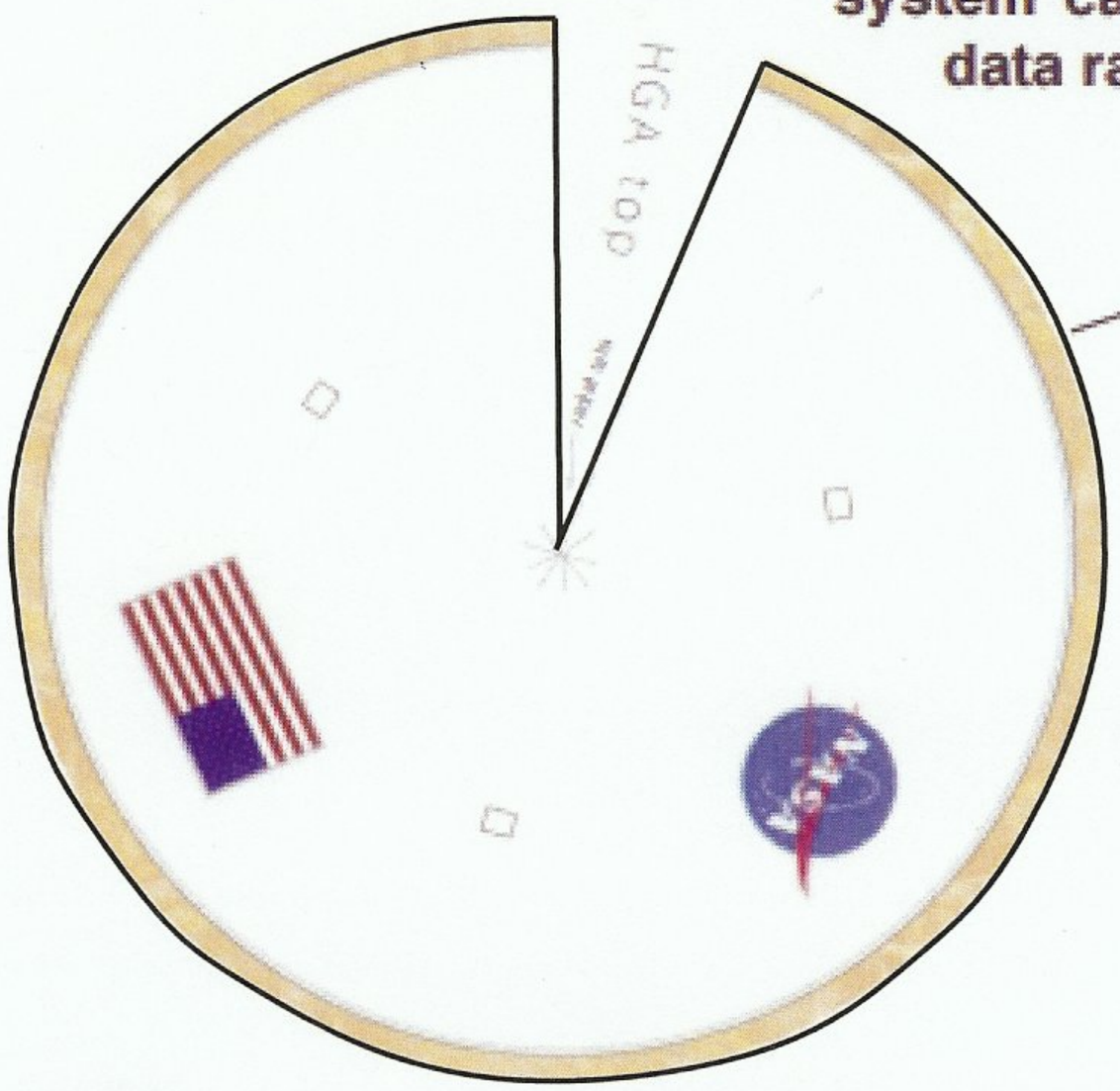
Radioactive Decay

Many elements occur in various different forms, called isotopes, which differ in the number of neutrons in their nuclei. The deficit or surplus of neutrons make the nuclei energetically unstable causing them to, randomly over time, drop or 'decay' to more stable states. In decaying to the more stable states the energy difference is released as free particles and heat which 'radiates' away.



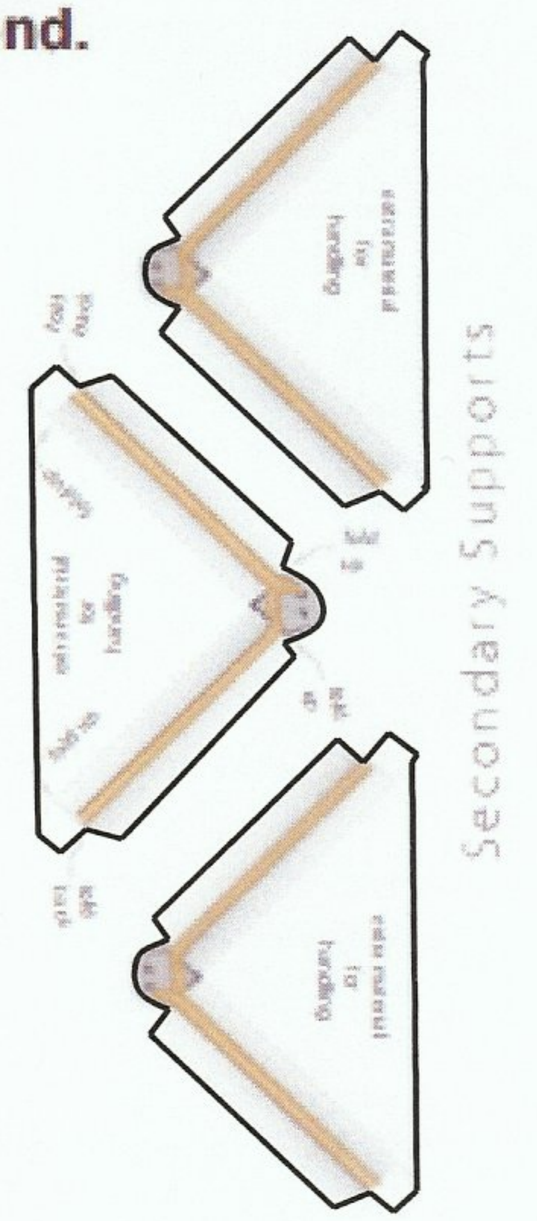
The RTGs on New Horizon use an isotope of Plutonium Pu^{238}, which has 6 too few neutrons. As it decays to a stable state, Pu^{238} emits radiation mainly in the form of alpha particles, which consist of two protons and two neutrons bound together into a particle identical to a helium nucleus. At launch the RTG will produce about 250 watts of electrical power using the heat of Pu^{238} decay. With a Pu^{238} half-life (the time it takes for half of the radioisotope to decay) of 88 years, the RTG power will drop to about 200 watts when New horizons reachs Pluto.

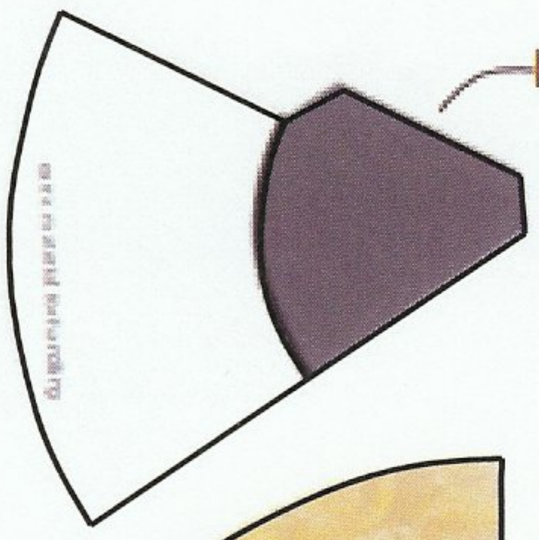
When the New Horizons spacecraft is at Pluto its radio signals will take 4 hours 25 minutes to reach Earth. Along the way the 15 watts from the spacecrafts transmitter will spread out and drop to tens of nano watts collected by the 70m (230 ft) dishes of the Deep Space Network. If there is enough electrical power at Pluto, both halves of the spacecrafts redundant radio system can be used to boost the combined data rate to 1500 bits per second.



High Gain Antenna

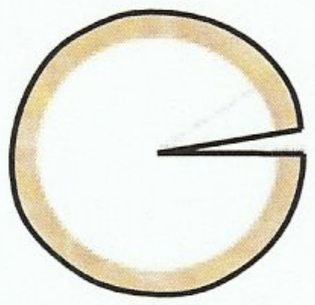
The size of the High Gain Antenna (HGA) main dish affects the spacecrafts radio reception and transmission. A larger dish not only collects more incoming signal, it also forms the outgoing signal





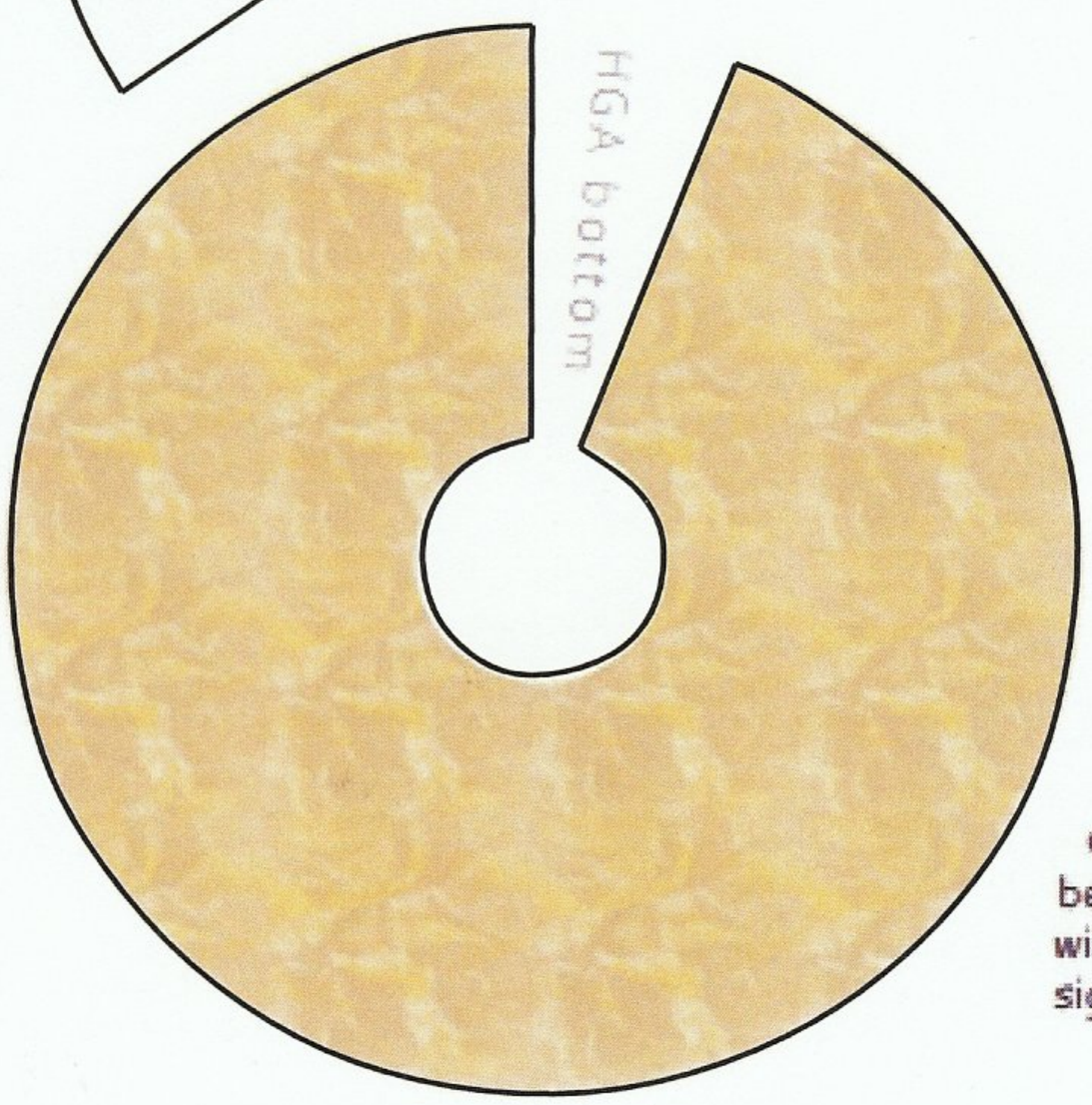
HGA Feedhorn

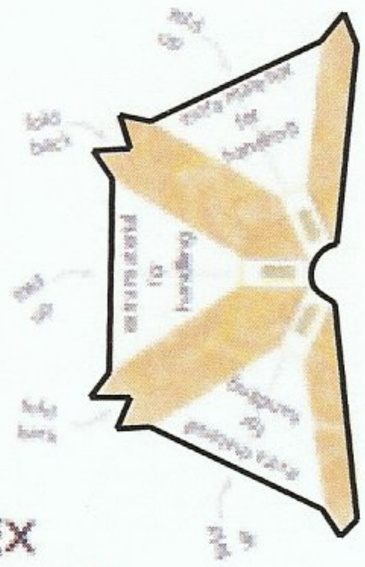
The feedhorn directs the radio signals in and out of the spacecraft, between the transmitting and receiving electronics and the antenna dishes.



HGA Secondary Dish

The secondary dish acts as a reflector between the main dish and the feedhorn. Outbound signals from the feedhorn are turned around at the secondary and spread out to cover the main dish to take advantage of its full size. Incoming signals, reflected and focused by the main dish, are redirected into the feedhorn and the receiving electronics.





REX

The Radio Experiment (REX) sits out in front of the HGA dishes. As the spacecraft passes behind Pluto, with respect to Earth, REX will precisely measure how incoming radio signals are affected by the thin Pluto atmosphere.