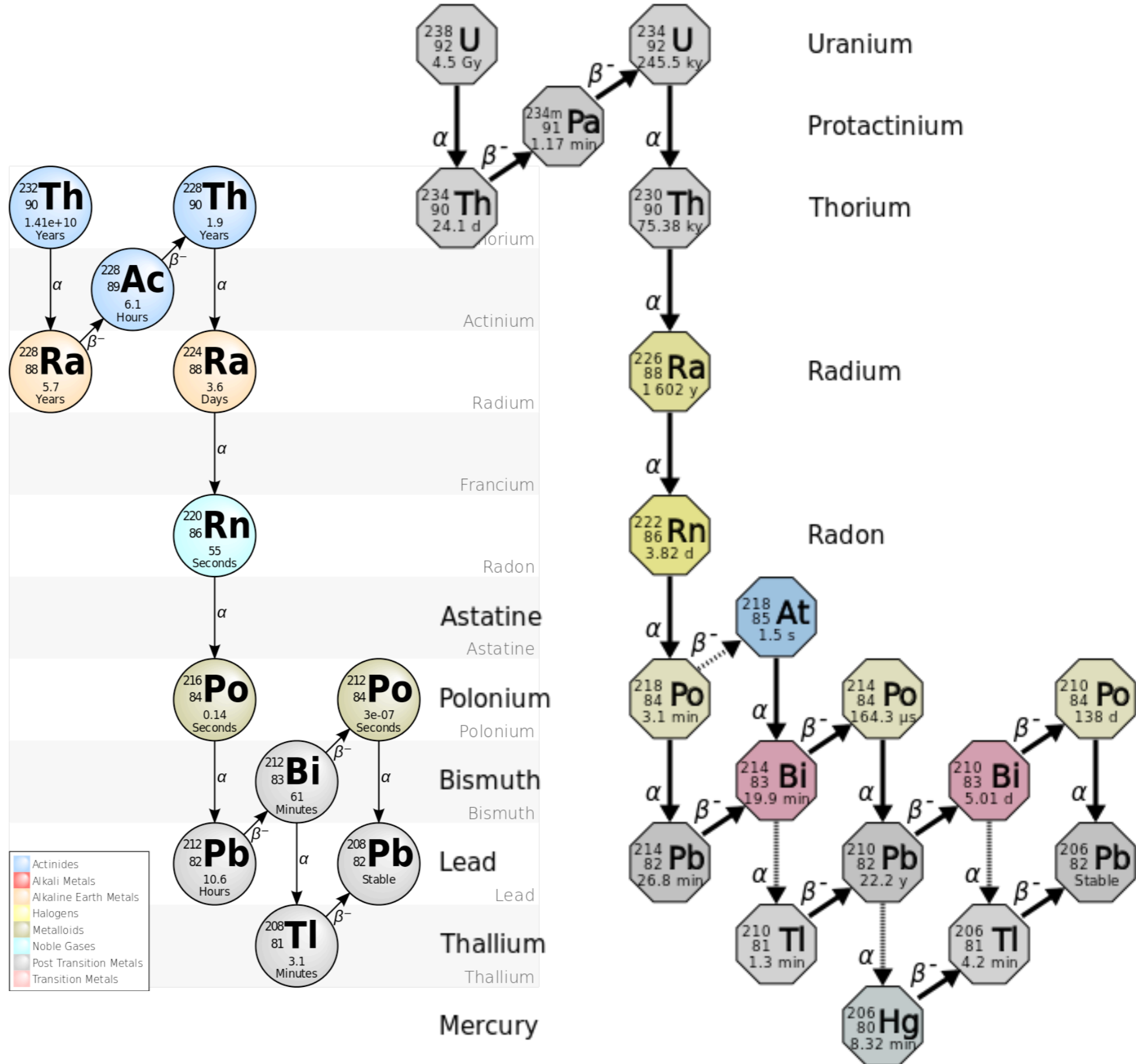


How can we get Rn220 without Rn222?

We want Th232 or Th228 as the parent isotope in the generator, with zero contamination from the uranium-chain Th230.

One has to go through an artificial nuclear process here. Eckert&Ziegler's Th228 was taken from artificial U-232 (which naturally decays to Th228 with a 70y halflife).

Reassurance from E&Z: "we have performed gamma spectroscopy on this batch and there is no apparent Ra-226 peak at 186 keV."

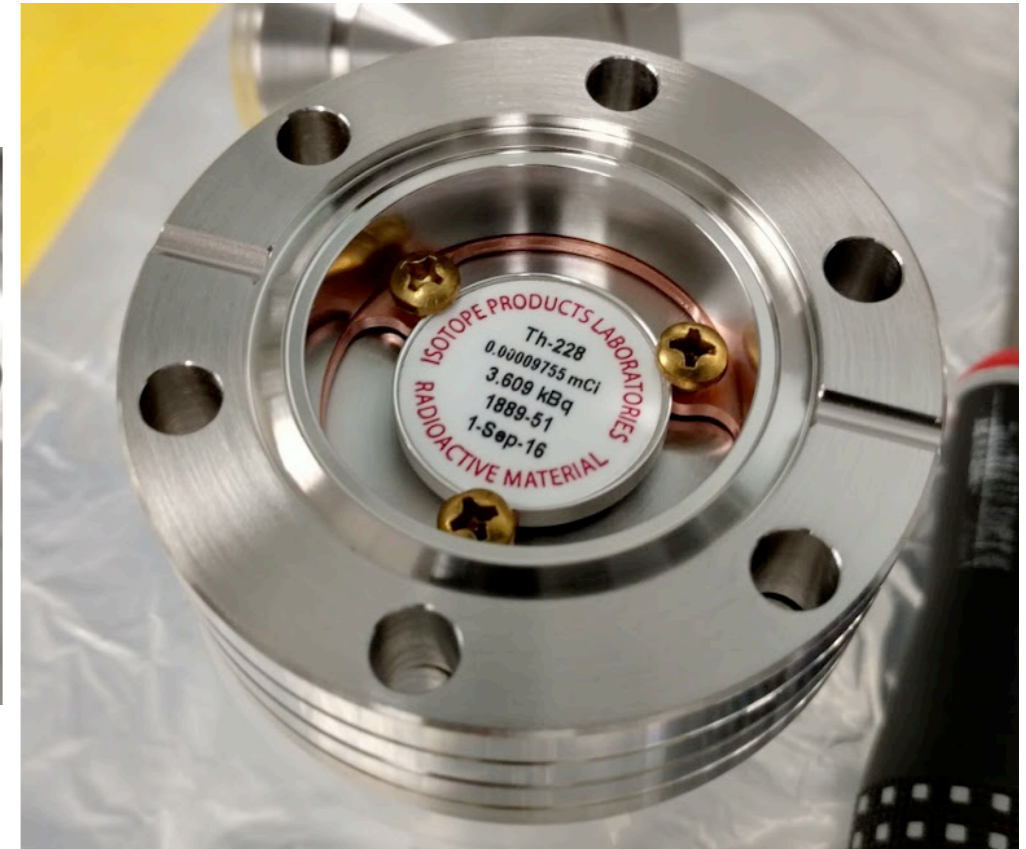
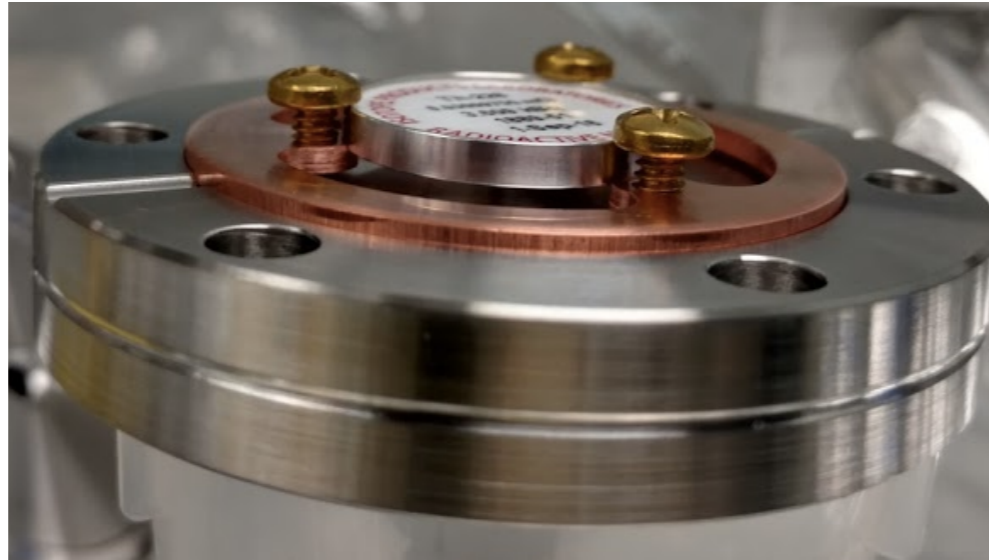


Some shiny stuff.

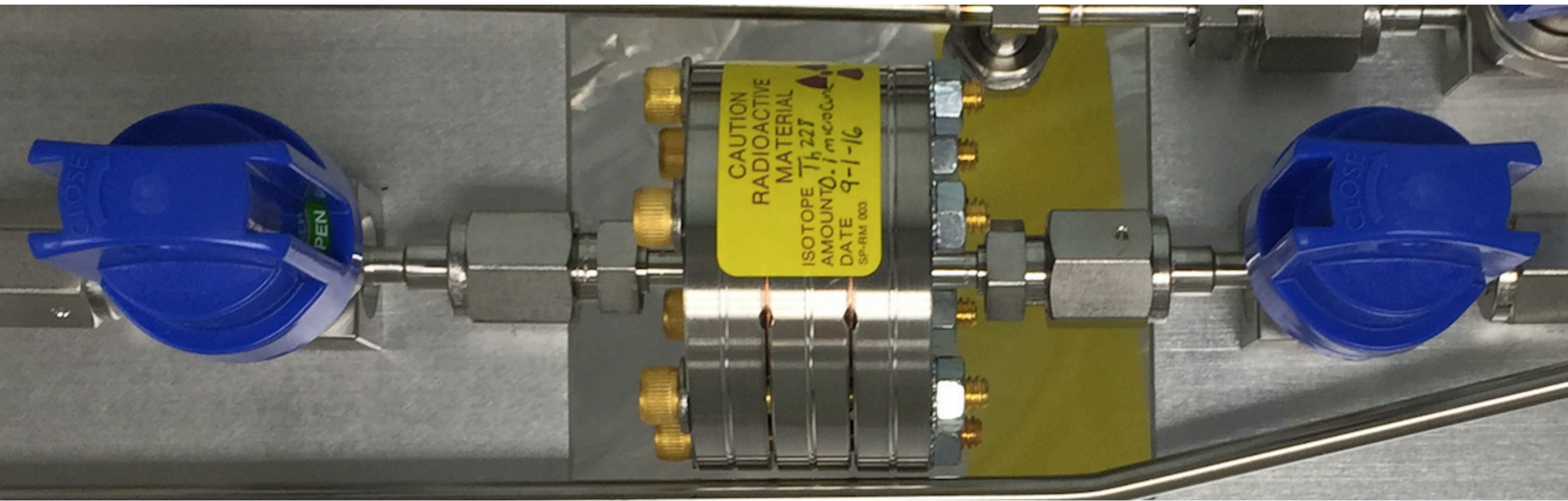
bare electroplated Th228.
do not eat.



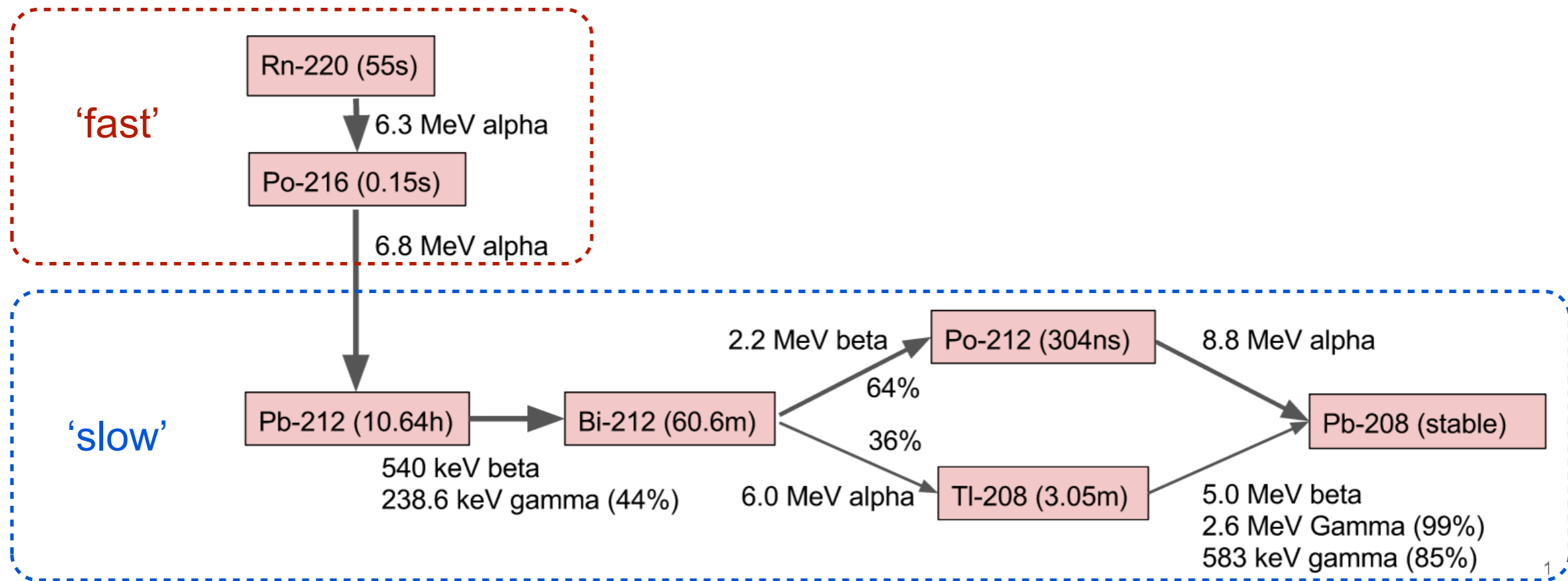
specially-machined CF gasket
(allows gas flow around source)



gold-plated bolts. go big or go home.
also, valves that can be pad-locked, to make jaret smile.



What do we expect to see?



During flow, we expect a constant rate of Rn220+Po216 alpha pairs (awesome for flow mapping), and we expect this flat rate to fall off suddenly when flow stops. On top of this, the 'slow' portion of the chain is gradually building up (linearly building up, if the injection is shorter than the 10.6h timescale).

The 'fast' rate is 2x the Rn220 rate. The 'slow' rate depends on how close we are to secular equilibrium, ie, how long the flow-through was. If secular equilibrium is reached, we expect ~2.36x Rn220 rate for the slow chain, taking into account that the Po212 decays will not add new triggers. So, 'fast' and 'slow' are roughly equal after a very long (day) Rn220 flow, and the 'slow' rate become smaller and smaller (relative to Rn220) the shorter the injection.

What do we actually see?

- 1) On Aug 27th, we found within a few minutes that we were able to control the trigger rate very well with the injection MFC set point. We decided $\sim 15\text{Hz}$ sounded good (meaning presumably $\sim 7.5\text{ Hz Rn220}$).
- 2) Assuming emanation efficiency is near-100% (should be, due to the thin-film nature of the Th228), then the change from $\sim 3700\text{Bq}$ at the source to $\sim 7\text{Bq}$ in the active volume represents an average flow time of ~ 8.2 minutes.
- 2) We see a faster-than-expected Pb212-chain buildup during the few-hour injections.
- 3) We see a larger-than-expected Pb212-chain population present after the injection, by a factor of ~ 2 .

We have to assume that Pb212 is also entering the active volume through the liquid flow, not just Rn220. In retrospect, this is not too surprising... We go through a lot of Rn220 half-lives between the source and the active volume (~ 7), meaning there is a LOT of Pb212 in circulation. To double the Pb212 rate, we just have to say something like "Pb212 has a ~ 1 minute survival time before getting stuck in circulation", which doesn't sound crazy to me, especially in the condenser portion, where the Xe is liquid.

