

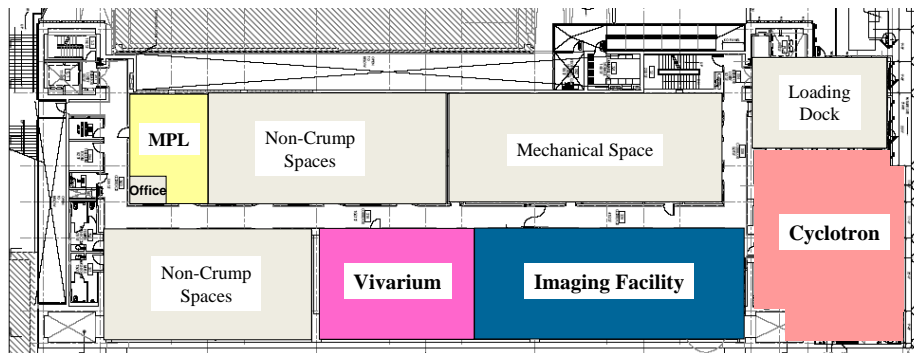
Cyclotrons & Radiochemistry

David Stout PhD

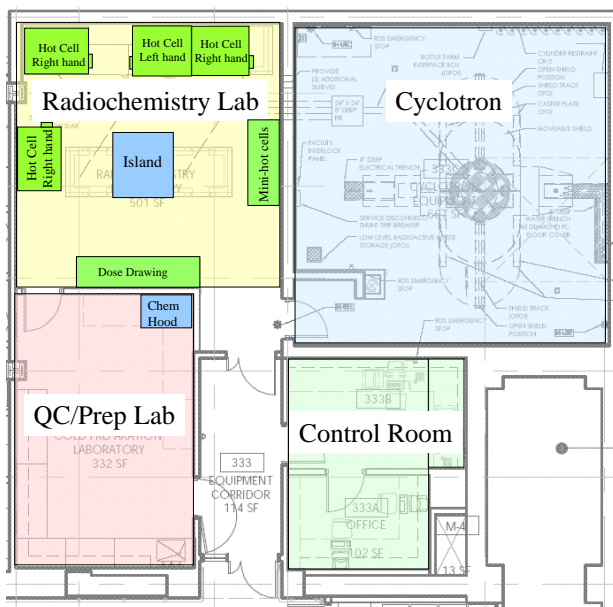
Topics

- **Cyclotrons:** How to accelerate protons
- **Cyclotrons:** Targetry, making radioactive atoms
- **Radiochemistry:** Half-life limitations, Chemistry in a box
- **Safety:** Radioactive, chemical, electrical, mechanical issues
- **Operational Consideration:** logs, stack monitoring, usage, transfer records, access & personnel
- **Visual Tour:** Installation & systems

Crump Cyclotron & Radiochemistry: Installation and Visual Tour



Cyclotron Area



Radiochemistry

4 Hot cells
6 Mini cells



QC Lab

This room is used for storage and quality control purposes

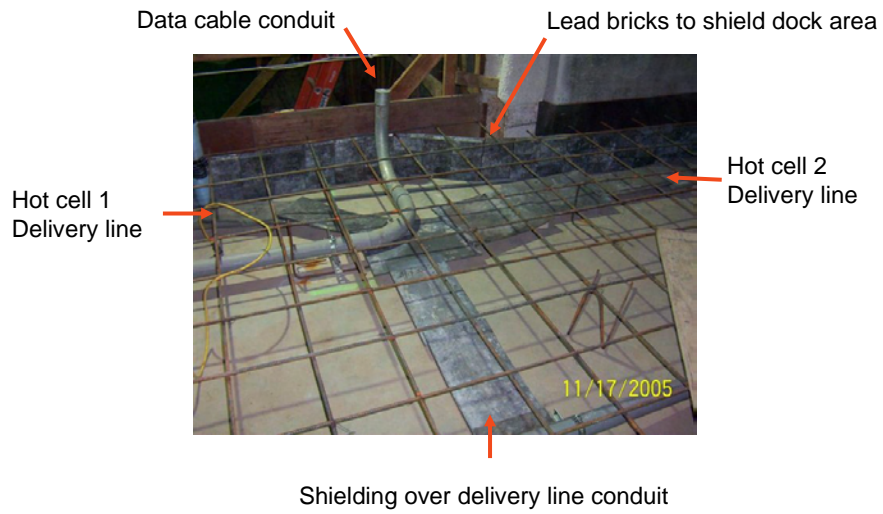
- Analytical HPLC
- GC-MS
- Flammable solvent storage
- Fume hood
- Glove box for oxygen sensitive reagents
- Freezer and refrigerator
- Supplies



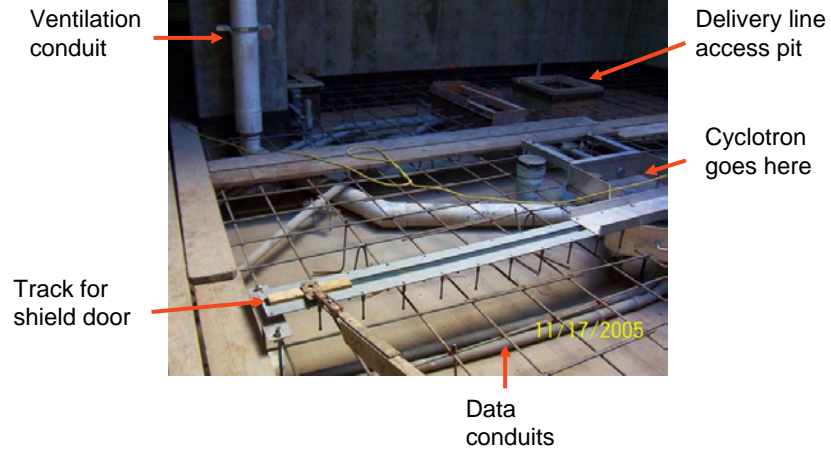
QC Lab



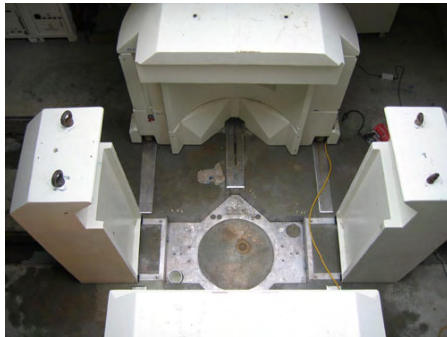
Crump Cyclotron Installation



Crump Cyclotron Installation



Crump Cyclotron Delivery

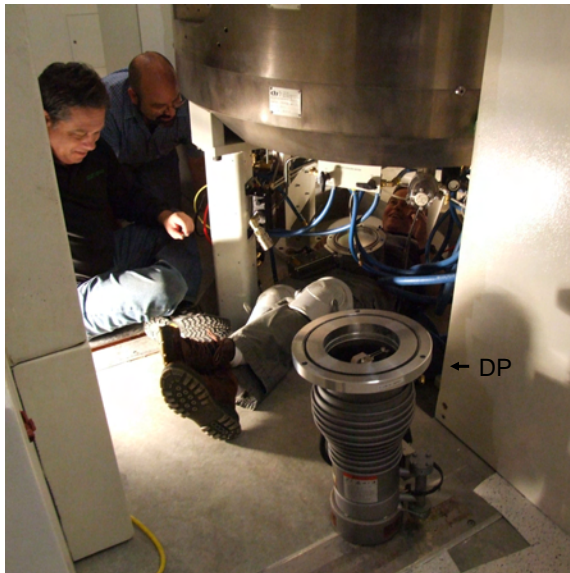


Cyclotron lowered into place Dec. 2005
Afterwards the roof was built and the room enclosed

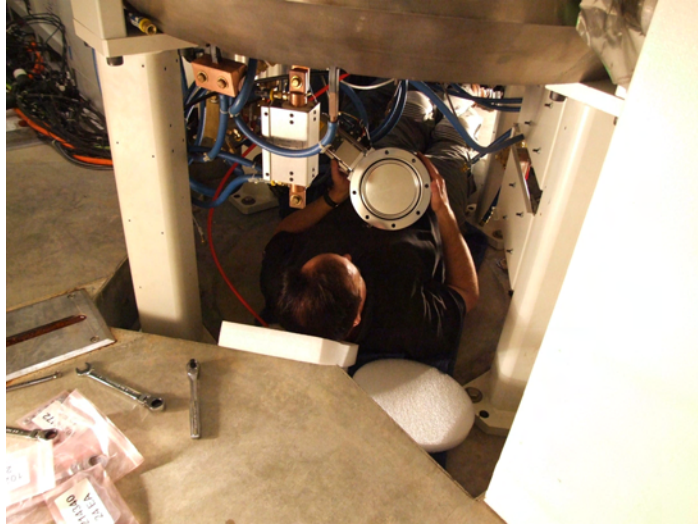




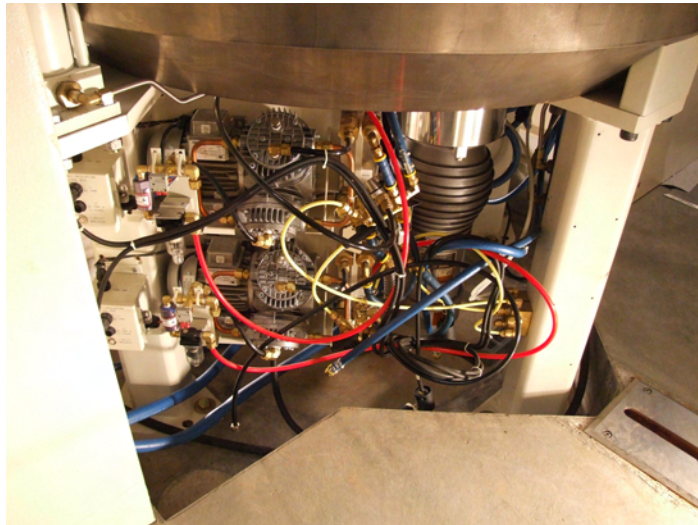
A stream of oil is shot up through the cone, spraying on the metal bar, creating a mist of oil that entails any gas molecules into the oil. Water cooling on the outside condenses the oil and a mechanical vacuum pump removes any vapors.



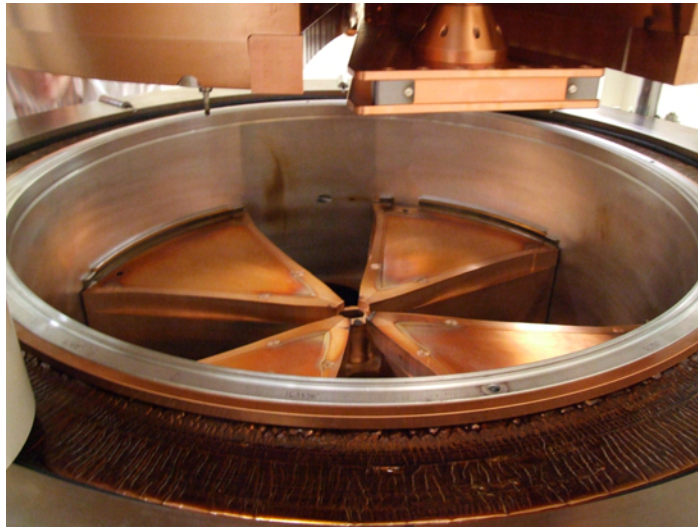
Diffusion pumps were removed during commissioning to install butterfly valves between pumps and main vacuum tank.



Butterfly valves are located between the DPs and tank, allowing DPs to be isolated from the tank for servicing or opening of the tank.



Side view of cyclotron showing helium cooling system and diffusion pump



Outer copper coil is the main magnet. Inner copper parts are the hills, gaps are called valleys.



Pie shaped wedges are the Dees, which accelerate the protons. Just left of the Dee is the specially shaped trim bar. Silver part is where the extractor foil carousel will be mounted.



View looking up at the Dees and hills. Steel plug in the center is where the ion source will drop in. Note the Dees have different lengths based on position.

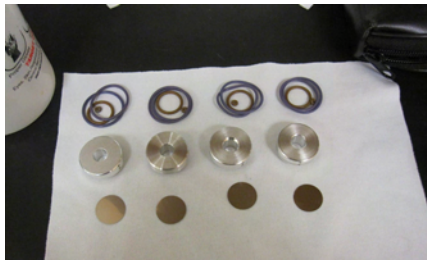


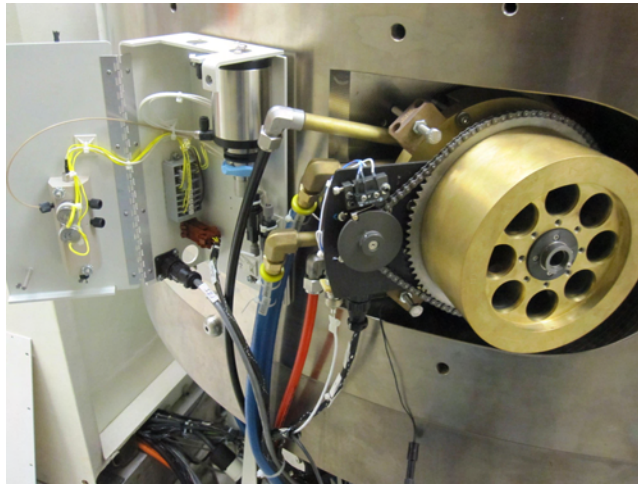
View looking down where hills meet together. Central hole is for the base of the ion source. One diffusion pump is located directly under the ion source.

Ion source is placed vertically through the top of the vacuum tank. Old RDS 112 system had a horizontal source.



Targets bodies are aluminum. Liquid targets are made of silver or tantalum. Chilled water circulates around the targets to remove heat.





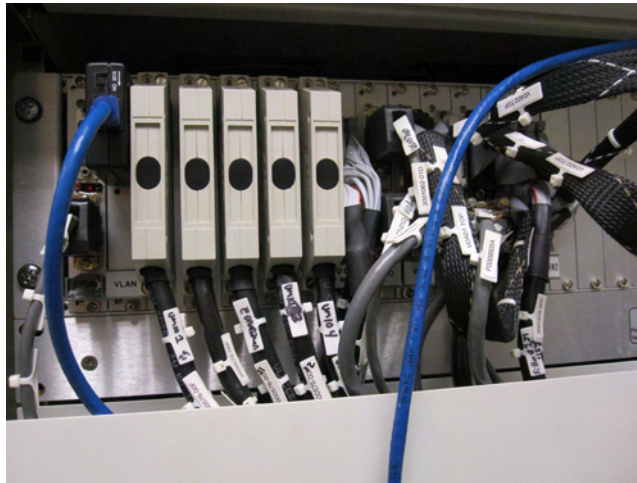
Target carousel without targets. Chain and motor rotate carousel to different positions. Tubing is for chilled water and helium cooling. Box on tank is the target support unit for the F-18 target, with fill and vent valves.



Target carousel filled with targets. Left side of cyclotron has electrical power panels and target support units.



Power supply cabinets for cyclotron, also includes target support units.



Cyclotron is operated by a VME computer located in the power panel. Controls and data files are located on the remote PC called a SCADA node.



Gas tanks used for cyclotron operations. Hydrogen is explosive at almost any concentration, so it is housed in a separate ventilated enclosure.

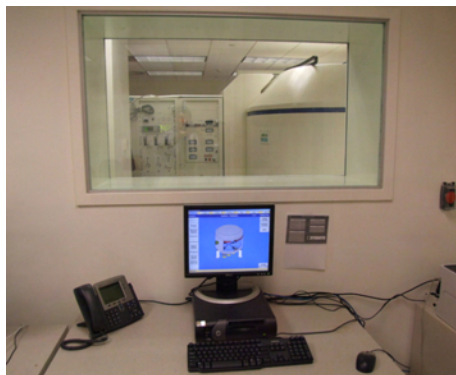


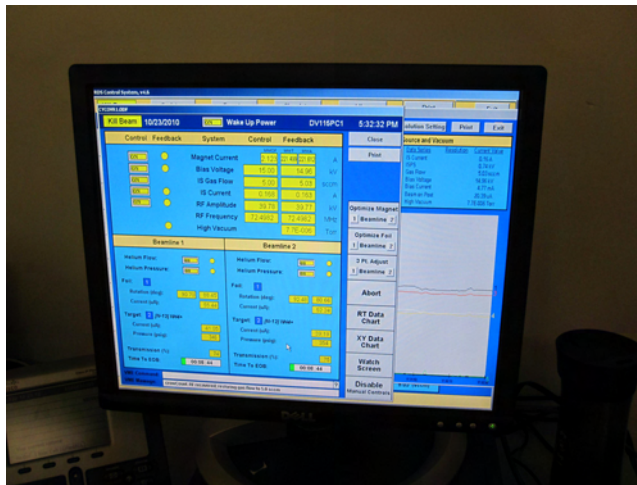
Building chilled water supply. Since flow is only 3-4 gpm, a separate booster pump was installed (upper left corner).

On the right side of the cyclotron is the water systems and hydraulics cabinet. Building chilled water cools a secondary deionized chilled water system that pumps water through the magnet, power supplies, ion source and diffusion pumps.



Cyclotron Control Room





Cyclotron control software. Enables automated or manual control of isotope production.



Siemens installed the Crump cyclotron in October 2010 with the help from Dirk, Darin and Wesley Williams and David Stout.