UNC’s Mini-Cyclotron Facility

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Mini Cyclotron

World’s first cyclotron

Invented by E.O. Lawrence in 1929

Only 4” in diameter
Dose-on-Demand Biomarker Generator
ABT Biomarker Generator - Cyclotron

38” Height

48” Diameter

5’ Height

8’ Diameter
ABT Biomarker Generator – Chemistry/QC Module
Radionuclide Production

- O-18 \((p, n)\) F-18
- \(^{18}F \) – fluoride \((^{18}F^-)\) ions in water
- 109.8 min \(T_{1/2}\)

Proposed:
- N-14 \((p, \alpha)\) C-11
- 20 min \(T_{1/2}\)
Compact Accelerator

- 7.5 MeV Positive Ion Cyclotron
- Internal targets
- F-18, C-11 in development
- Production Rate of 1.0 mCi/min $[^{18}\text{F}]$fluoride
- 1.16 T Magnet
- <5 mA Beam current
- <300 uL Target Volume

- **Weight ~ 7000 lbs**
Proposed Production Statistics

- Bombardment time ~ 35 minutes
  - F-18 yield ~ 35 – 37 mCi
- FDG Synthesis/Purification ~ 35 minutes
  - FDG 10 – 12 mCi
  - Decay Corrected Yield ~ mid-40’s%
- Optimization of yield and target efficiency ongoing
Facility Layout

Building: ~ 28’ x 18’
Cyclotron room: 16’ x 17’
Utility room: 8.5’ x 7’
Ante room: 6.5’ x 7’
Utility Room Equipment and Supplies
Utility Room Equipment and Supplies
Chemistry Production and QC Module
Reagent Kit
Chemistry

Mannose Triflate $\xrightarrow{\text{K}^{[\text{18} F], \text{K}_{222}, \text{MeCN}}}$ $\Delta$ 2-[$^{18}$F]Fluoro-1,3,4,6-tetraacetoxy glucose (TAG)

HCl (1.0 N) $\Delta$ 2-[$^{18}$F]Fluoro-deoxyglucose (FDG)
Dose Synthesis Card
Dose Synthesis Card (DSC)

- Extraction Column
- Reaction Vessel
- Sterile Dose vessel
- Waste vessel
- 0.22 um sterile filter
Quality Control Tests

- pH
- Organic Solvents
- RCY (Radiochemical Purity)
- Radioisotopic Purity
- Chemical Purity
- Filter Integrity Test (FIT)
- Sampling for Endotoxicity
- Sampling for Sterility
Radiation Protection Issues

- Cyclotron is self-shielded
- Chemistry Module is self-shielded
- No radioactive effluents (air or water)
- Makes short-half-life radionuclides
- Any potential excitement??????
Target Assembly
Target

Target Window

Clamp

Target Reservoir
MCA Spectrum Report
Capabilities

- F-18 FDG
- F-18 FLT
- F-18 NaF
- F-18 MISO
- C-11 Compounds
Capabilities

- 17 MeV GE Cyclotron in a vault designed for two
  - O-15, N-13, C-11, and F-18
- MR/PET Fusion Imaging system
- 7 Tesla Full body MRI system
- PET/CT Full body scanner
- 850 MHz NMR system
- 9.4 T Animal MRI scanner
- 1.2 GHz NMR system
The End

Questions?