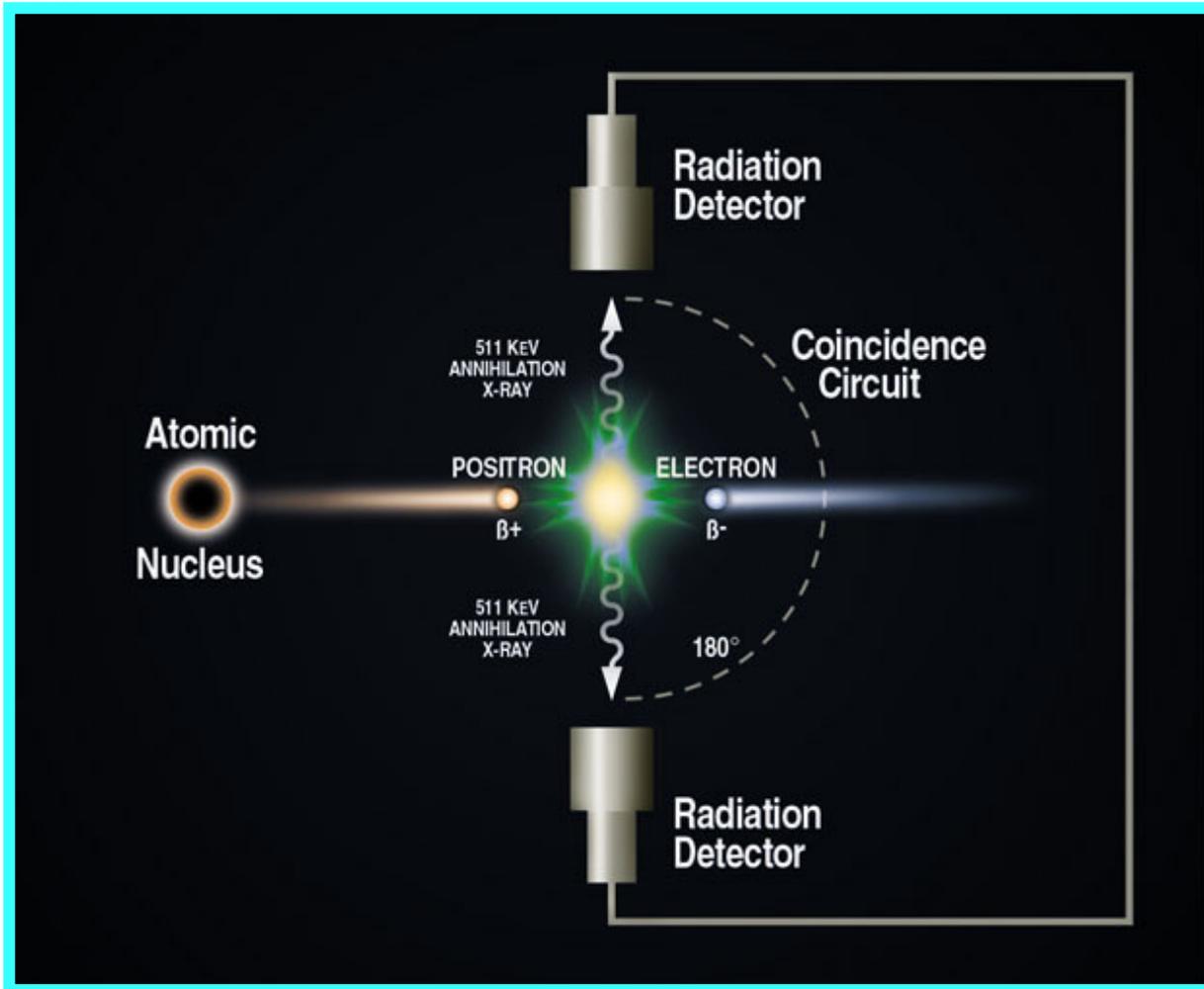


Introduction of the Development of New PET Tracers

The Center for Translational Neuroimaging

Kun-Eek Kil

Principles of PET-1

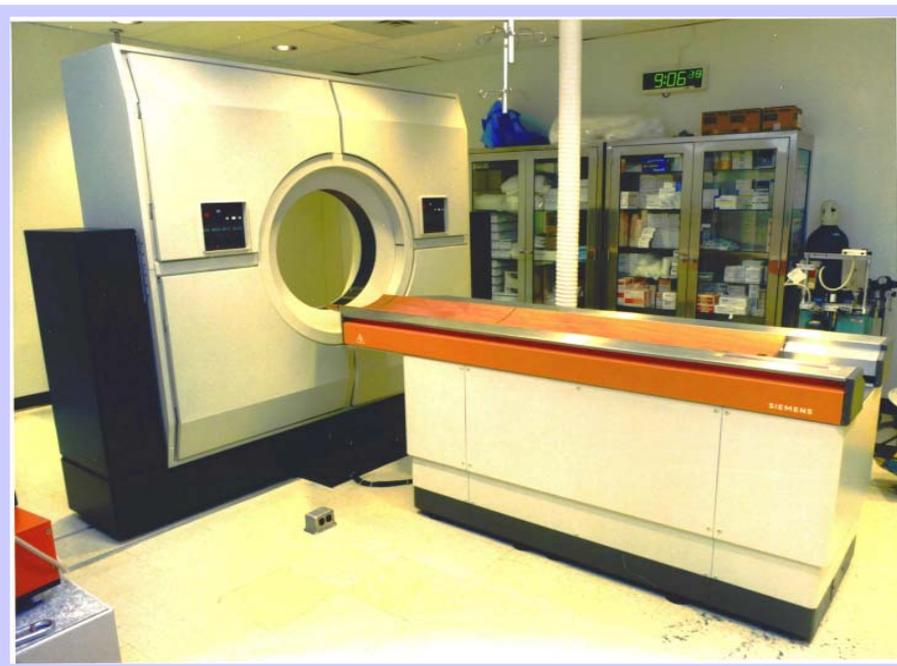


PET: Positron Emission Tomography

Principles of PET-2

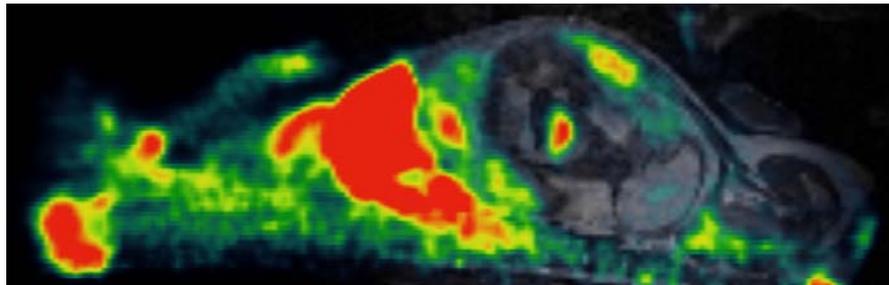
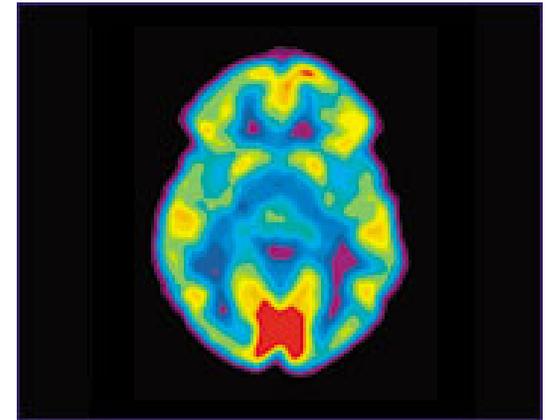


Cyclotron

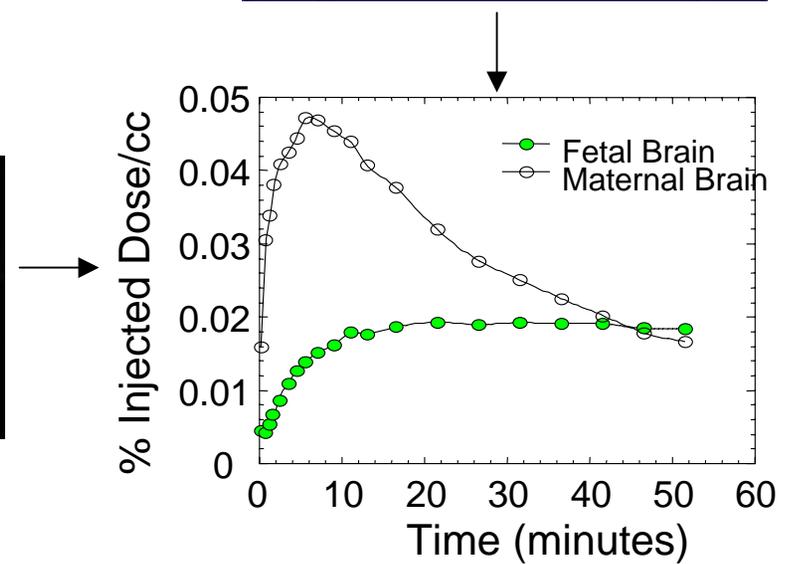


Scanner

Principles of PET-3



Nicotine Image



Applications of PET Tracers

- To provide a non-invasive method for diagnosing diseases such as cancer and mental disorders
- To evaluate the pharmacokinetics of drugs at the development stage
 - PET shows the absorption, distribution, metabolism, and elimination of drugs after various routes of administration.
- To provide in-vivo images with better resolution for specific physiological phenomenon

Development of PET Radiotracers

Synthesis of a New Radioactive PET Tracer

- Exploration of Synthetic Route to Precursor
- Optimization of Labeling Reaction Conditions
- Separation & Purification by HPLC

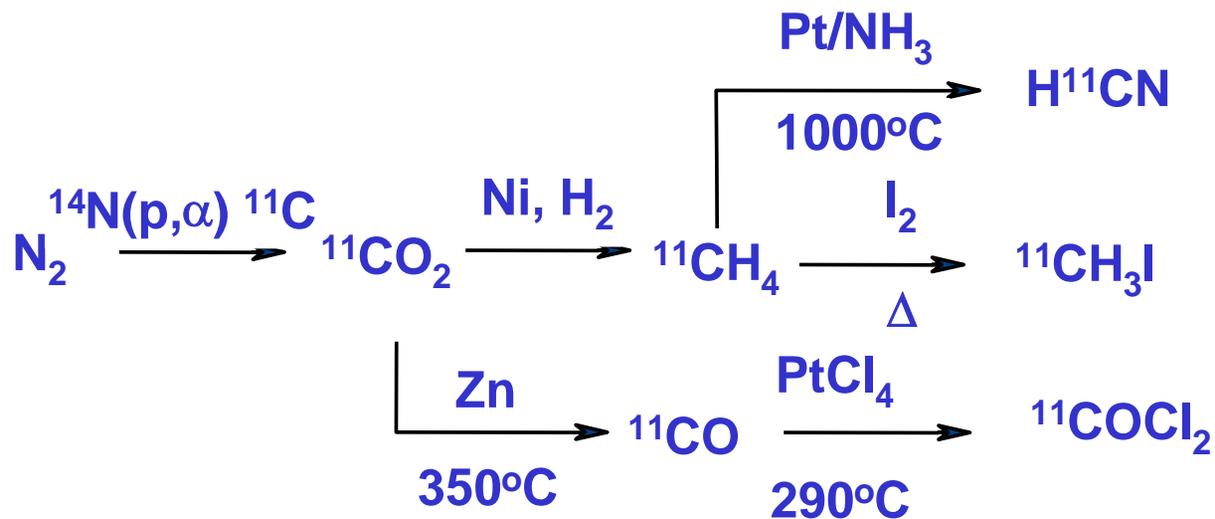
Evaluation of a New PET Radiotracer by PET Study

- Derivation of Pharmacokinetics from PET Image
- PET Image Analysis by Saturability, Specificity, and Selectivity Tests

Radioisotopes for PET

Isotope	Half-Life $t_{1/2}$ (min)	Decay Product	Typical Production	Theoretical Specific Activity (Ci/mmol)
^{18}F	110	^{18}O	$^{18}\text{O}(p,n)^{18}\text{F}$ $^{20}\text{Ne}(d,\alpha)^{18}\text{F}$	1.71×10^6
^{11}C	20.4	^{11}B	$^{14}\text{N}(p,\alpha)^{11}\text{C}$	9.22×10^6
^{15}O	2.1	^{15}N	$^{14}\text{N}(d,n)^{15}\text{O}$	9.08×10^7
^{13}N	9.96	^{13}C	$^{16}\text{O}(p,\alpha)^{13}\text{N}$	1.89×10^7

C-11 Chemistry



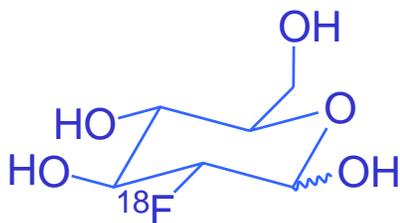
C-11 Advantage: The radiotracer gets labeled without modifying original structure.

F-18 Chemistry

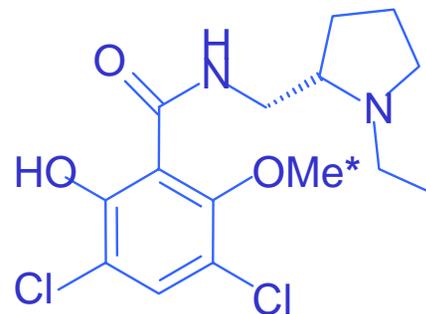
Nuclear Reaction	Target Material	Beam energy (MeV)	Product
$^{20}\text{Ne}(d, \alpha)^{18}\text{F}$	0.1% F_2/Ne	18 or 23	$[^{18}\text{F}]\text{F}_2$
$^{20}\text{Ne}(d, \alpha)^{18}\text{F}$	15% H_2/Ne	14	$[^{18}\text{F}]\text{HF}$
$^{18}\text{O}(p, n)^{18}\text{F}$	H_2^{18}O	15	$[^{18}\text{F}]\text{F}^-$

- Advantage
 - Multi-step synthesis due to longer half-life
 - Higher resolution image than other isotopes
- Disadvantage
 - Original property is modified by fluorine molecule.

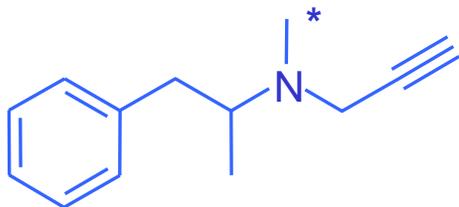
Important PET Radiotracer



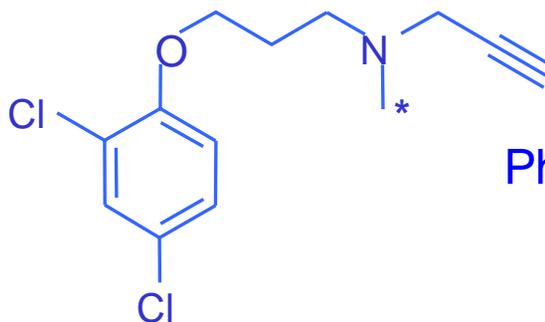
[^{18}F]-fluoro-deoxyglucose (FDG)



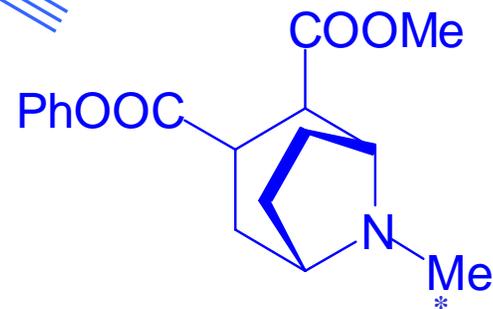
[^{11}C]-Raclopride



[^{11}C]-Deprenyl



[^{11}C]-Clorgyline



[^{11}C]-Cocaine

These radiotracers play a role as agonist or antagonist for specific enzyme
These radiotracers are designed based on drugs

Process of Cooperation



Isotope Generation
(Physicist)



Labeling (Isotope Attachment)
(Radiochemist)



PET Scanning



Image Analysis



Micro-PET