
# Molecular Imaging With PET

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# Definition of Molecular Imaging:

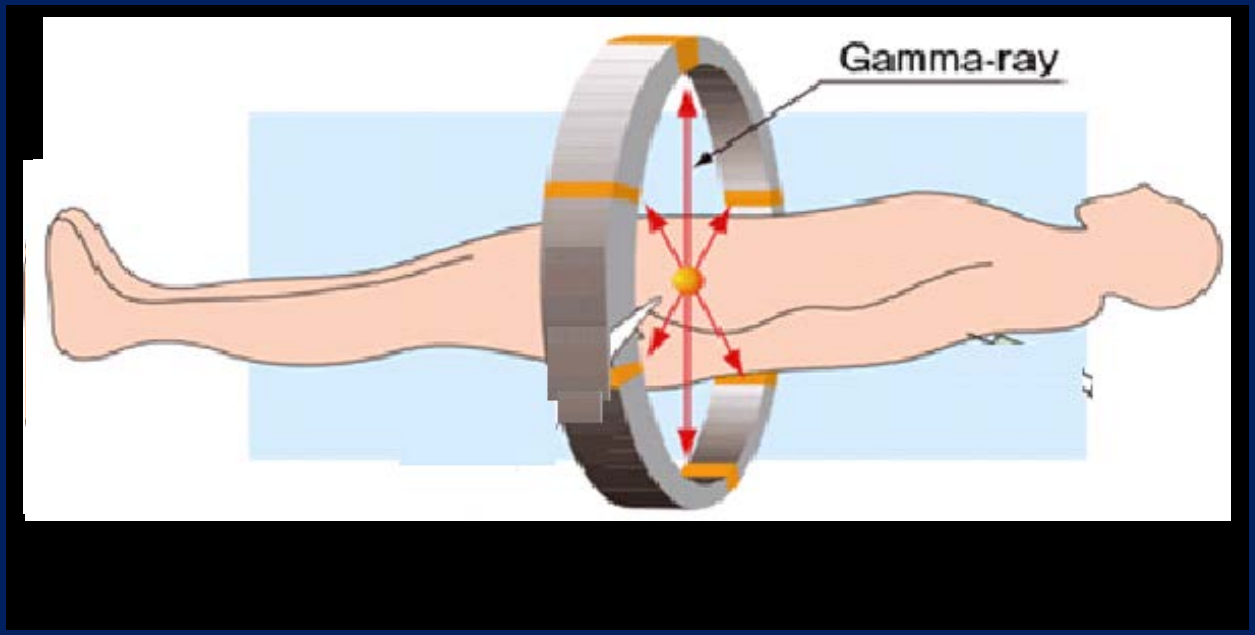
Cells function by bio-chemical reactions.

By monitoring these bio-chemical reactions we can diagnose the disease early

and monitor the effectiveness of treatment quickly

On-Set of disease starts by molecular Disorder


Anatomic Changes Appear




- Anatomic Imaging:
- X-ray, X-ray CT, MRI, Ultrasound
- You can CT a dead body and you can see anatomy!
- Anatomic Imaging does not show live chemical reactions that Molecular Imaging or PET reveals.

- **Molecular or Bio-chemical Imaging = PET**

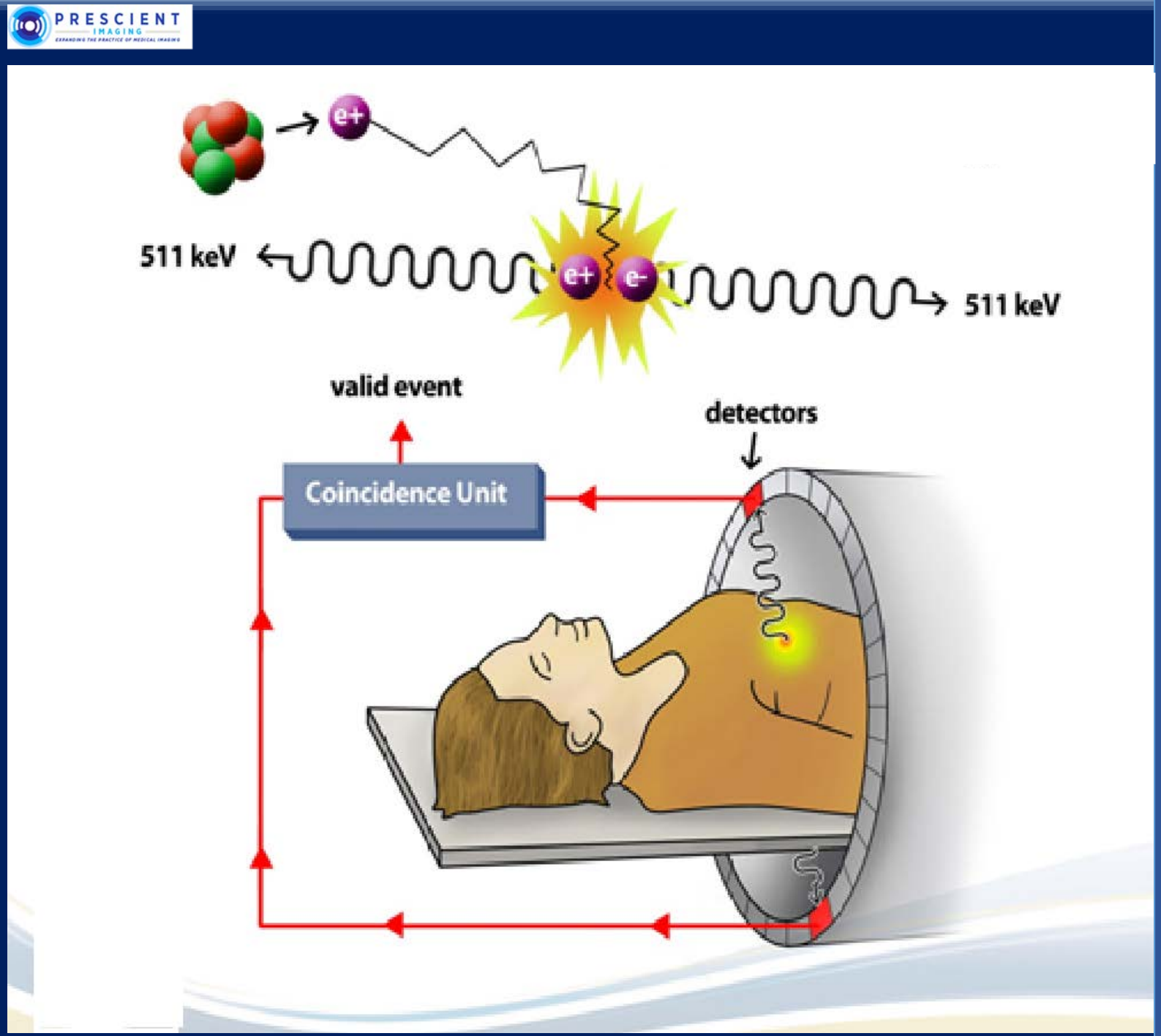
- **PET is based on uptake of abnormal cells of tagged tracer compounds. Pico-mole sensitivity**
- **Specific tracers with uptake in cancer, infection, endocrine, Heart disease, Brain disorders….**
- **Metabolic markers, Neuro-receptor , antibodies, DNA synthesis, Gene reporter…….**

**Hybrid Imaging: PET-CT, PET-MRI to correlate molecular image with anatomy**

# PET Provides:

- Early detection
- early knowledge of effectiveness of therapy
- pre-knowledge of which therapy is the most effective for a particular patient
- 37% of cancer treatments in USA has been changed based on PET results
- Gold Standard of Blood Perfusion into the heart's muscle and Brain
- Gold Standard of Imaging Aging Brain- Amyloid and tau protein

***PET Imaging Is an essential part of modern Medicine***




## The main elements of biological molecules have positron emitting isotopes:

O-15
C-11
N-13
F-18 (replacing H in molecules)

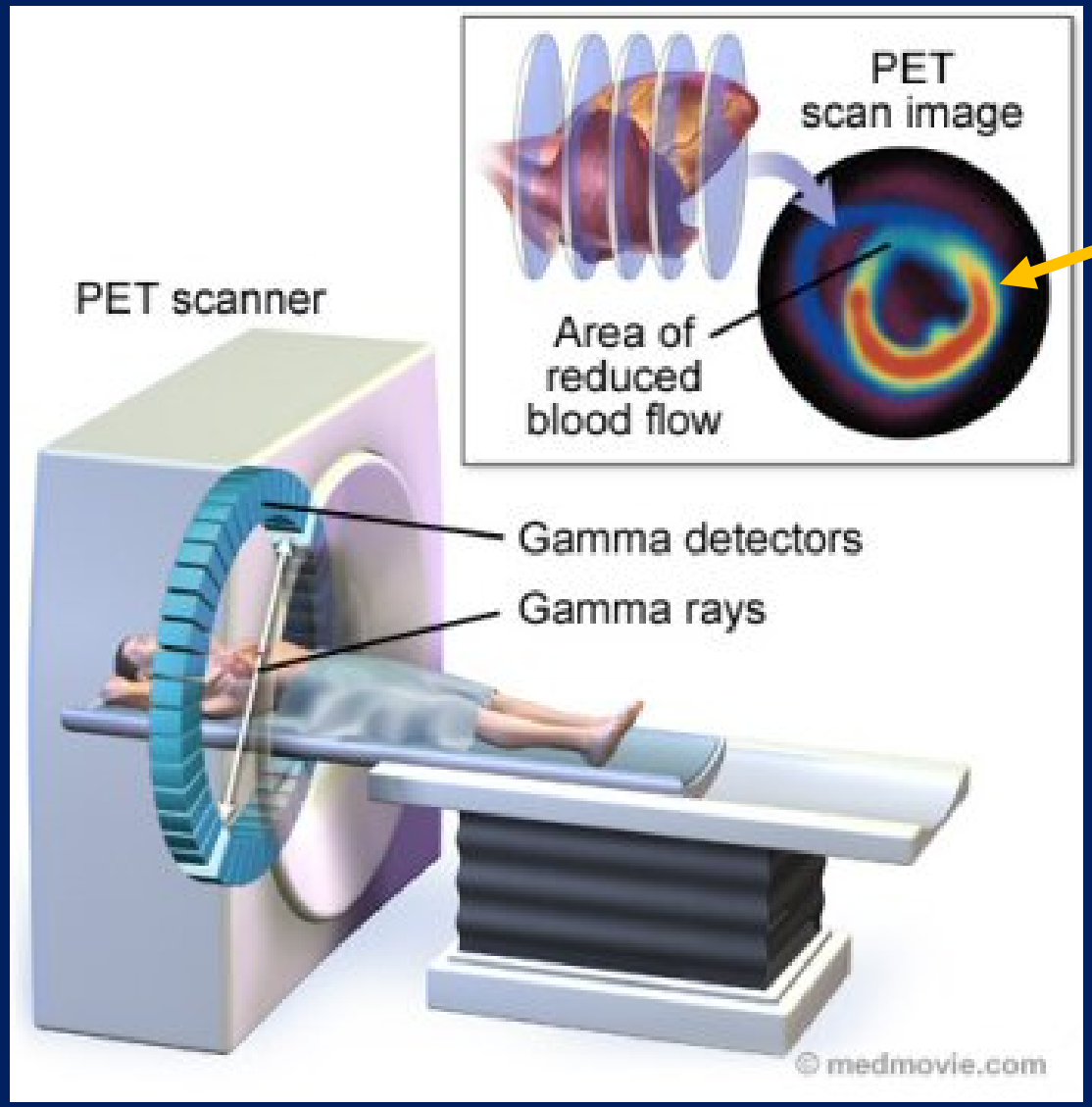
molecules can be radiolabeled

↓

injected into the
Body in small quantities

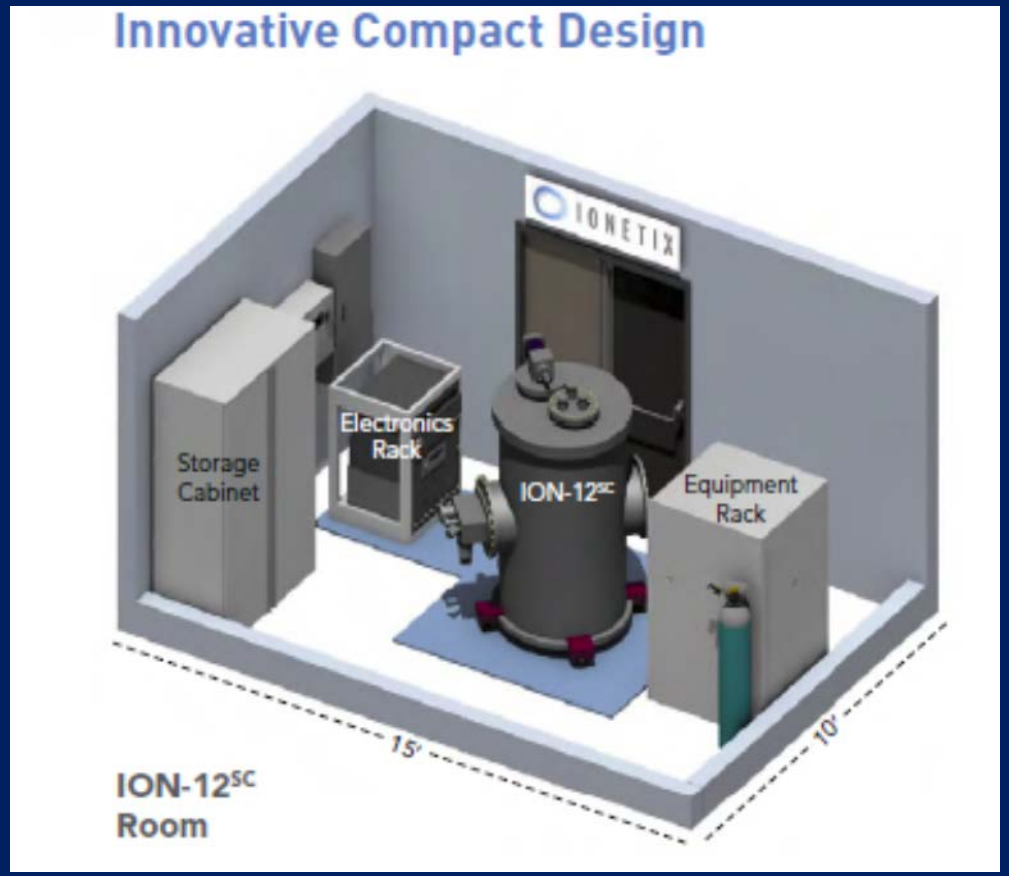
↓

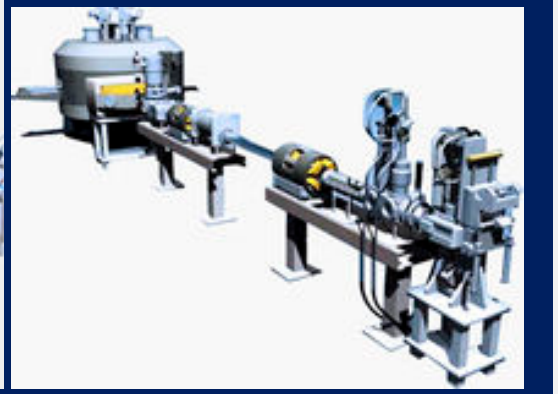
trace the physiologic functions




**N-13 Labeled NH3**
**Showing Blood Perfusion**

# Cyclotron and Medical Isotope Production



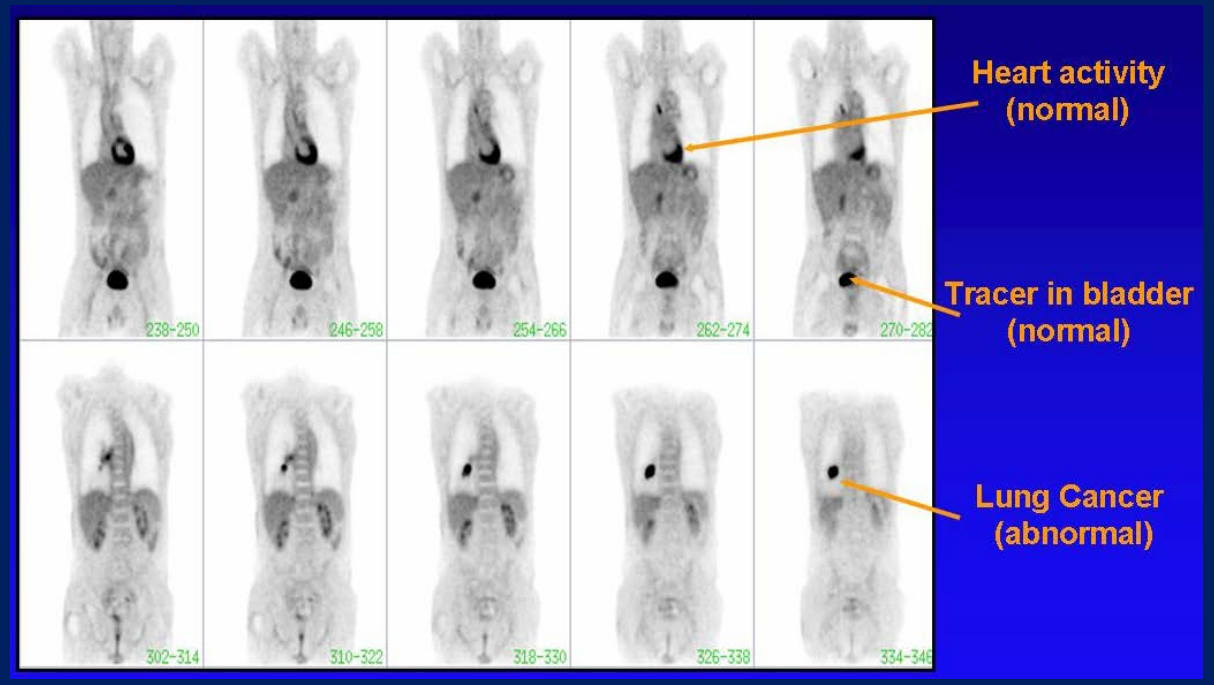



# All Isotopes for PET are Produced by Cyclotrons

| | | Particle beam | | |
|---|---|---|---|---|
| | | Type | Energy MeV | Current MicroA |
| CTI | RDS-111 | H+ | 11 | 50 |
| CTI | RDS-112 | H+ | 11 | 50 |
| IBA | Cyclone 10/5 | H+ / H- | 10/5 | 60/35 |
| IBA | Cyclone 18/9 | H+ / H- | 18/9 | 80/35 |
| GE | MINItracer | H+ | 9.6 | 50 |
| GE | PETtracer | H+ / H- | 16.5/8.5 | 75/60 |
| EBCO | TR 13/19 | H+ / H- | 13, 19/9 | 150 |

| Isotope | reaction | Yield mCi/microA |
|---|---|---|
| F-18 | O-18 (p, n) F-18 | 110 |
| F-18 | Ne-20 (d, $\alpha$) F | 51 |
| C-11 | N-14 (p, $\alpha$) C-11 | 40 |
| N-13 | O-16 (p, $\alpha$) N-13 | 7 |
| O-15 | N-14 (d, n) O-15 | 50 |
| O-15 | N-15 (p, n) O-15 | 47 |

**Most of applications of PET are for detection of cancer with injection of F-18 Flourodeoxy-glucose.**




Fixed to Floor
Requires a 300 sq.ft. room
Weigh > 5000 lb

There are 5000 PET scanners worldwide,
rate of increase of this number ~ 8% per year
World Health Organization requires 1 PET scanner per 0.5 million people.

There are ~ 700 medical Cyclotrons worldwide.

Most of applications are for detection of cancer with F-18 Flourodeoxy-glucose.

F-18 has 109 min half life
it can be distributed to a radius of 50 miles from the cyclotron

This is not possible for O-15 (2 min), N-13 (10 min), and C-11 (20 min).
Requiring the Cyclotron and PET being in the same building
Many important biochemical are labeled with these short lived isotopes

**Routine application of PET is hampered by:**

**Large footprint**
**Heavy weight**
**high cost of PET scanners**
**High cost of cyclotrons**

**Almost All PET Scanners And All Cyclotrons**

**Are Installed In the Basements of Hospitals!**

**To Harness Full Potential of PET**

**Both PET Scanner and Isotope-Producing Accelerator**

**Should Be Portable and affordable**

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EXPANDING THE PRACTICE OF MEDICAL IMAGING

# Mission of *Prescient Imaging LLC*

## Expand The reach of PET Imaging

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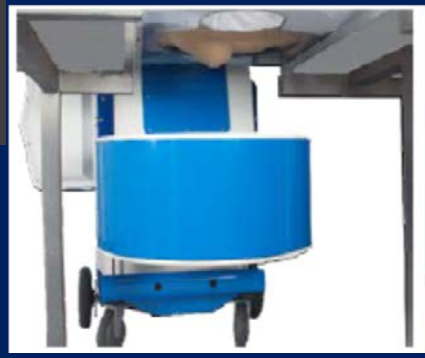

**BBX™ :** portable PET scanner designed for breast, brain, and extremity imaging.

**Vertical-PET™ :** whole-body PET scanner ideal for cardiac imaging on patients in seated position. It can image patient for accurately and increase patient throughput.

**P-Arm™ :** portable and open-able PET scanner ideally suited for use in an operating room, radiation therapy monitoring, and minimally invasive procedures.


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## The Mission of the Prescient Imaging LLC:

**Harness the Full Potential of Molecular Imaging.**

**Future**

**PET and Isotope-Producing Accelerators Must be Readily Accessible**

# To Harness Full Potential of PET
# Isotope-Producing Accelerator Should Be Portable and Affordable

## *Specification of the desired proton accelerator*

## *for production of short-lived isotopes*

- **Proton Energy:** between 8 to 15 MeV
- **Current of the proton Beam:** from 1 to 40 micro-Amp
- **Continuous Operation for at least 5 min.**
- **Electric input:** 110 V AC, 20 Amp Max.
- **Size:** less than 8x8x8 ft. or 2.5x2.5x2.5 m
- **Cost of parts and labor:** less than $100,000.

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