



JOHNS HOPKINS

WHITING SCHOOL
of ENGINEERING

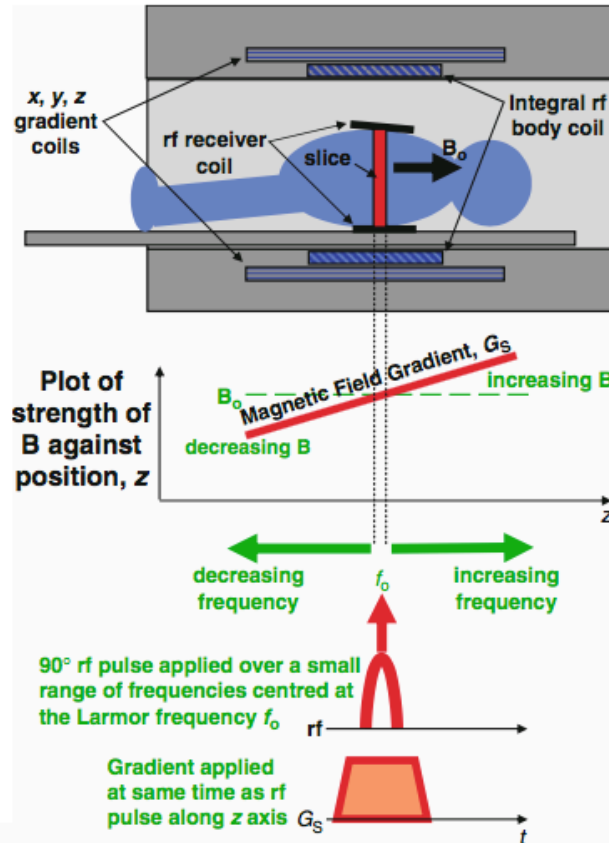
Applied Medical Image Processing

MRI K-Space

Outline

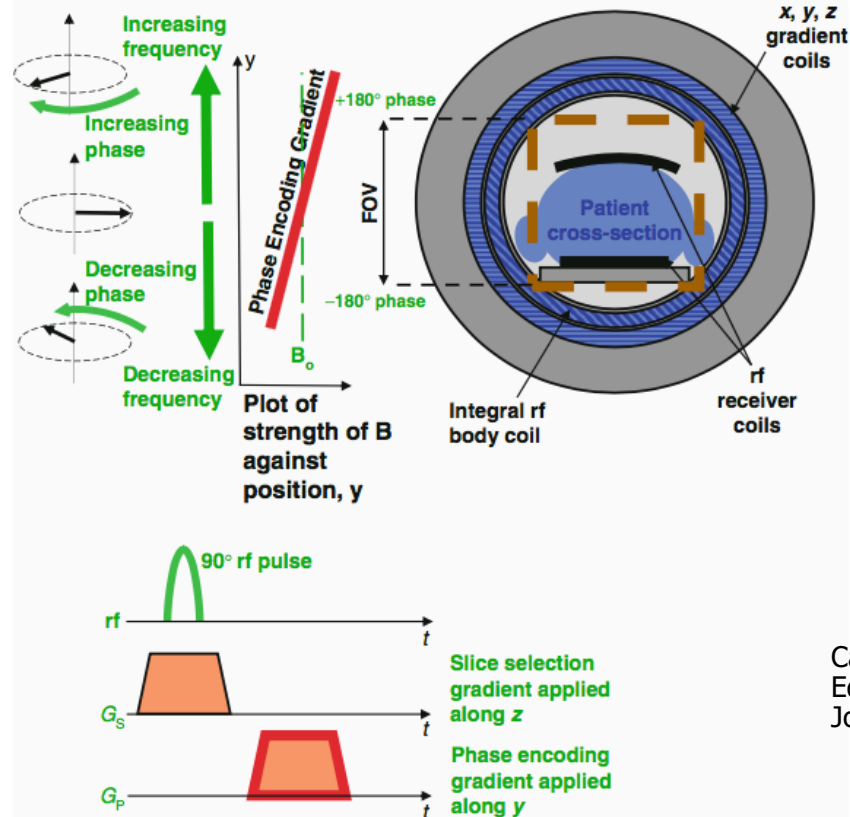
- Magnetic Resonance Imaging (MRI)
 - spatial encoding
 - imaging contrasts (T1-weighted), T2-weighted, Proton density)
- Positron Emission Tomography (PET)

Slice Encoding



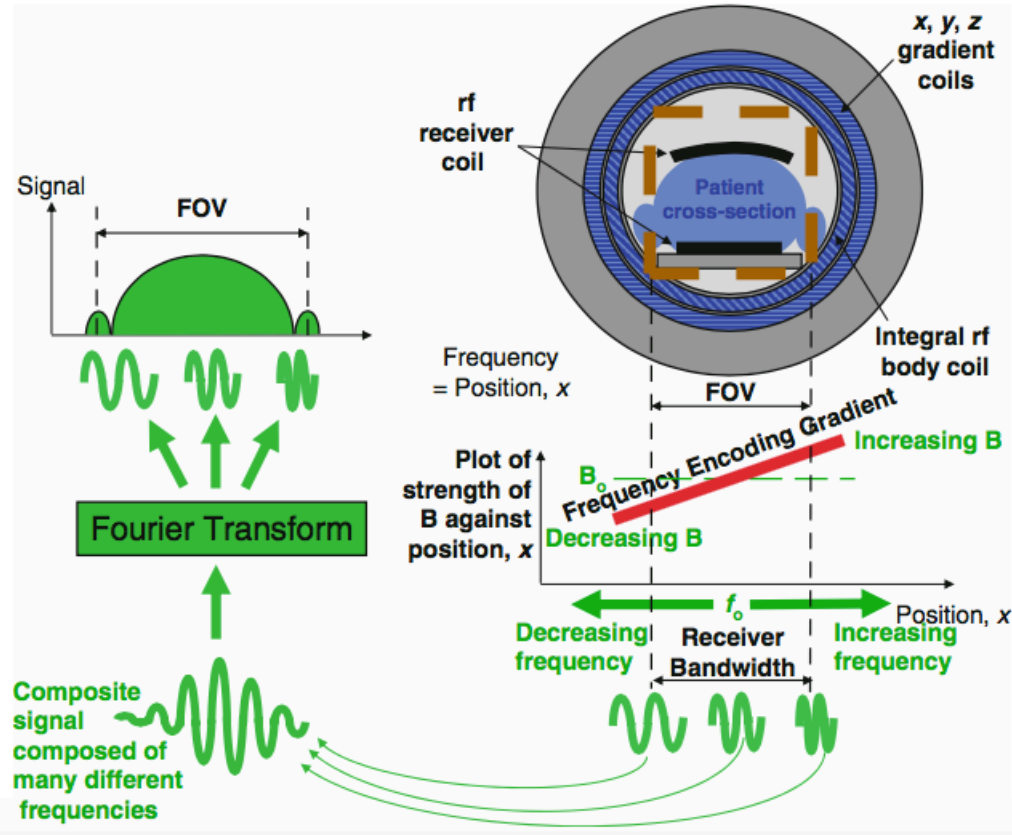
Cardiovascular MR Manual 2011
Edition by Plein, Sven, Greenwood,
John, Ridgway

Phase Encoding



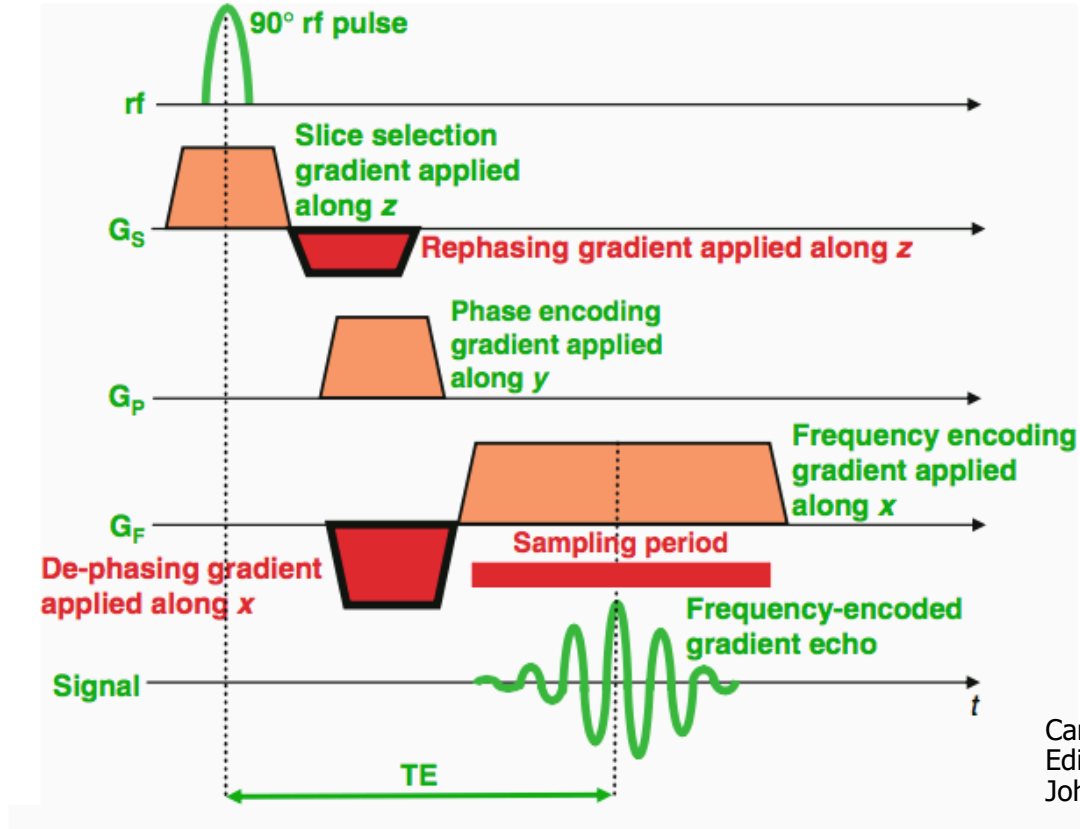
Cardiovascular MR Manual 2011
Edition by Plein, Sven, Greenwood,
John, Ridgway

Frequency Encoding



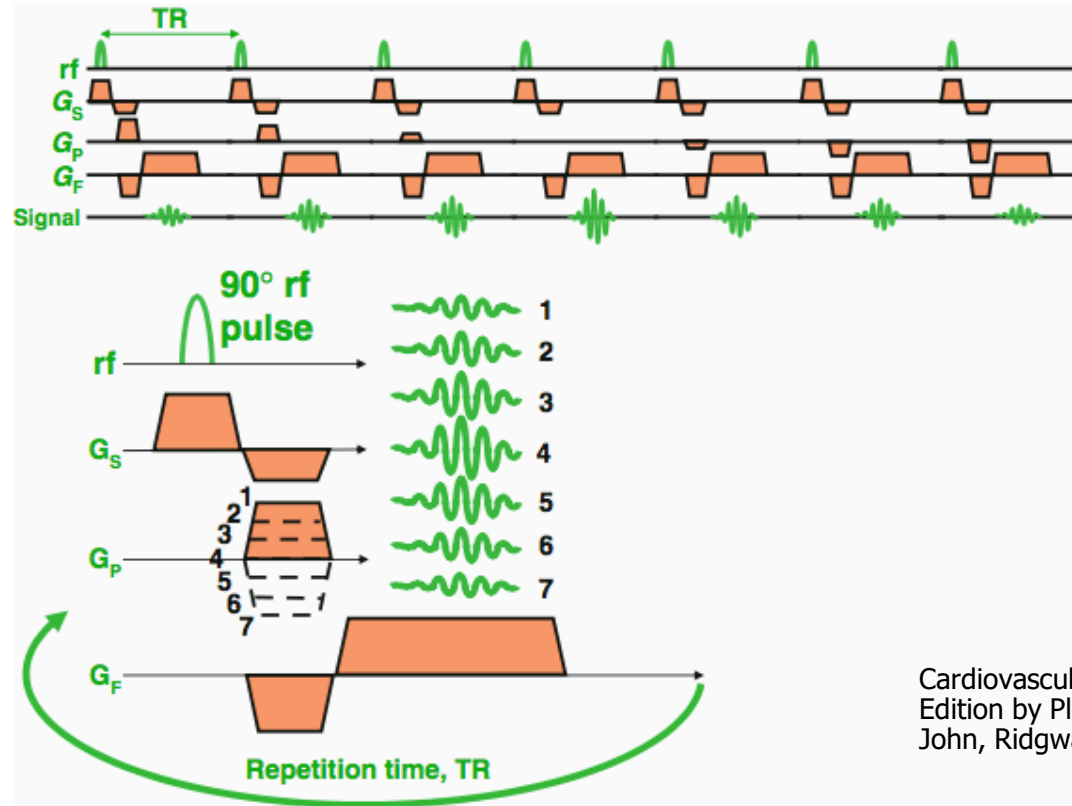
Cardiovascular MR
Manual 2011
Edition by Plein,
Sven, Greenwood,
John, Ridgway

Pulse Sequence



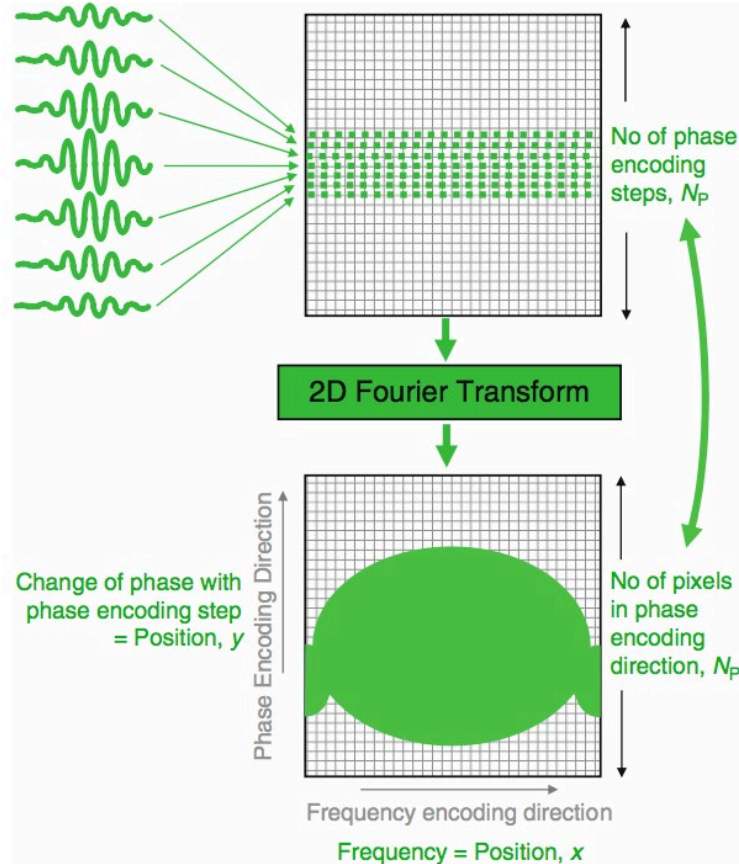
Cardiovascular MR Manual 2011
Edition by Plein, Sven, Greenwood,
John, Ridgway

TR (Repetition Time)



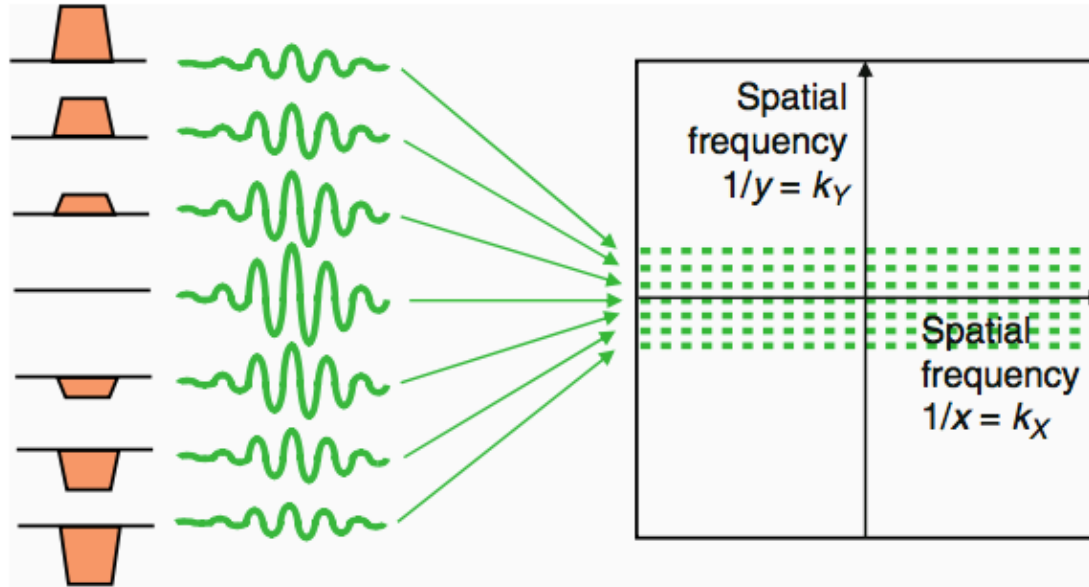
Cardiovascular MR Manual 2011
Edition by Plein, Sven, Greenwood,
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K-Space 1



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K-Space 2

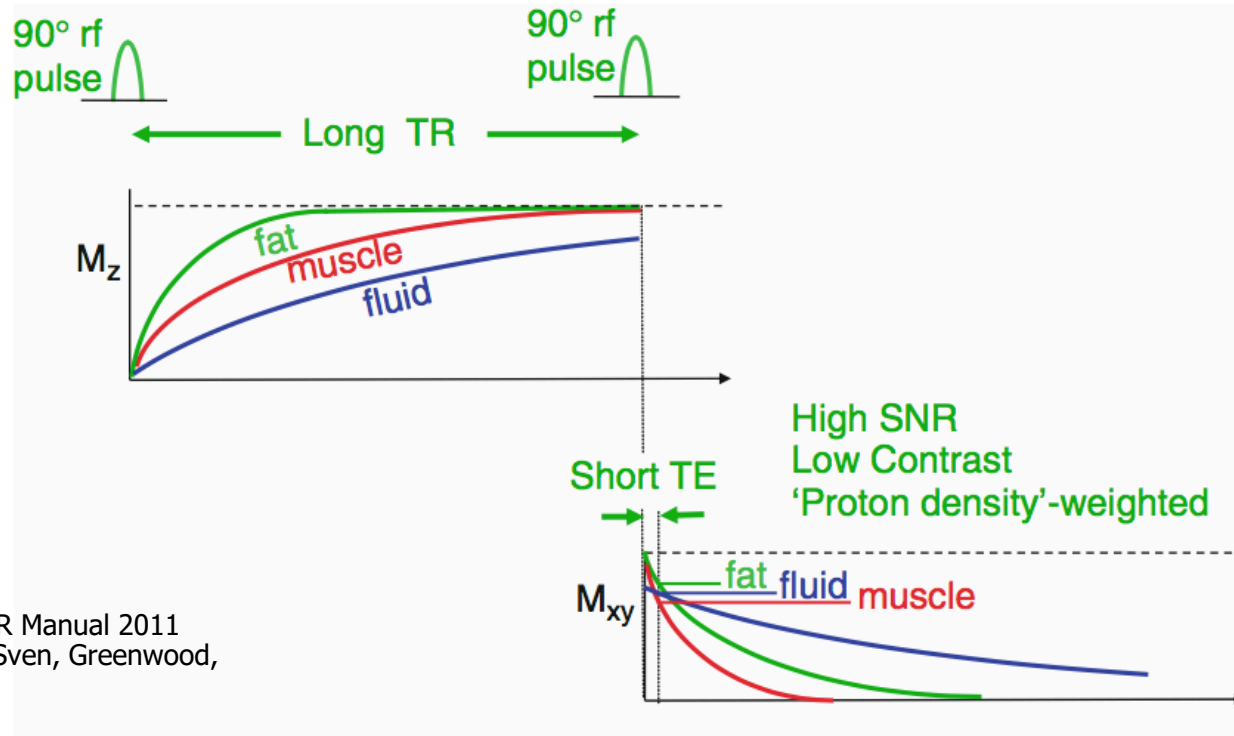


Phase encoding gradient determines the order in which each line of k-space is filled

**k-Space filled line by line
"Cartesian" data acquisition**

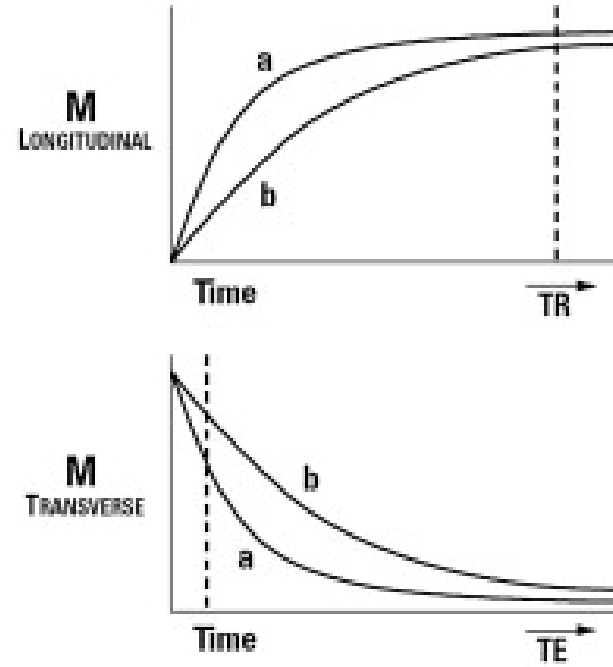
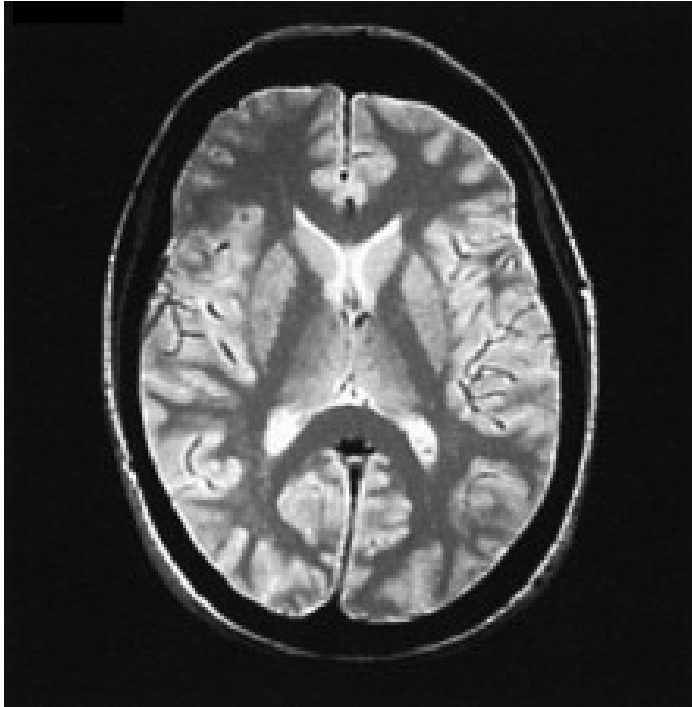
Cardiovascular MR Manual 2011
Edition by Plein, Sven, Greenwood, John, Ridgway

Proton Density Weighted Image Concept



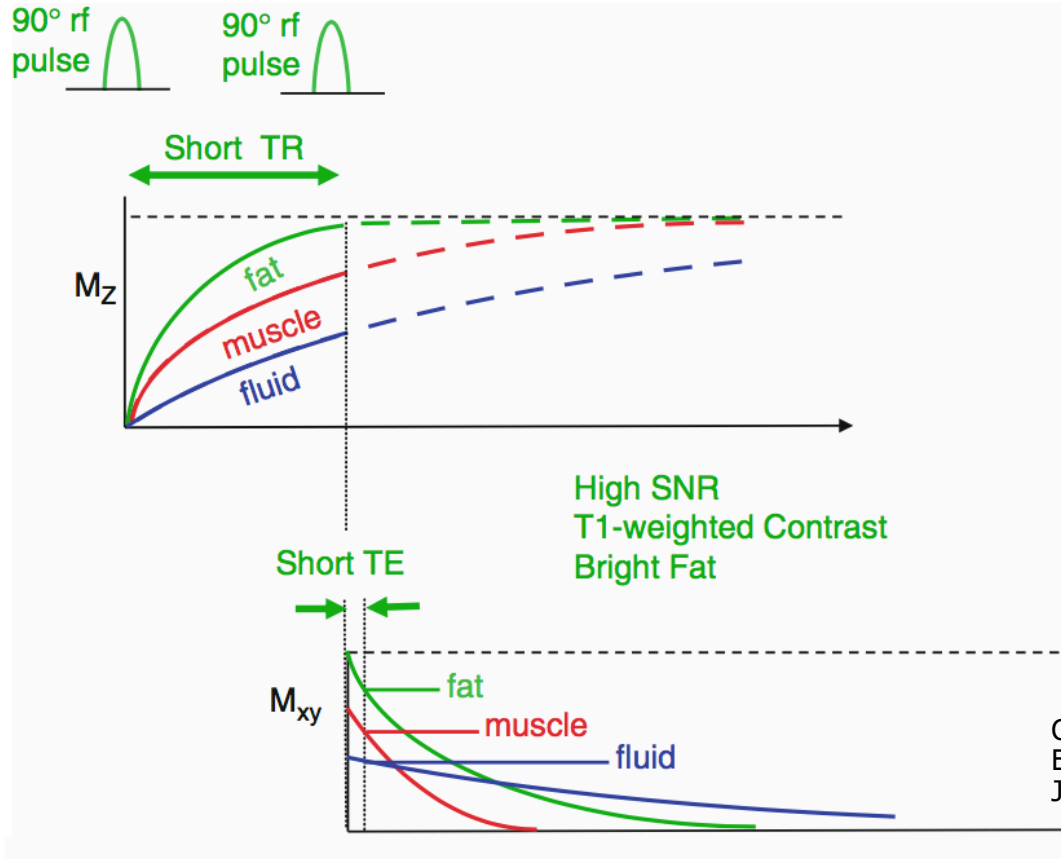
Cardiovascular MR Manual 2011
Edition by Plein, Sven, Greenwood,
John, Ridgway

Proton Density Weighted Image Example



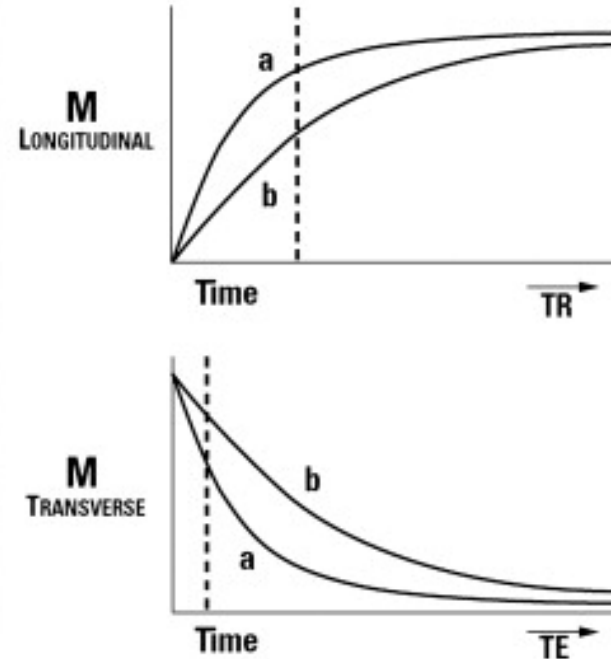
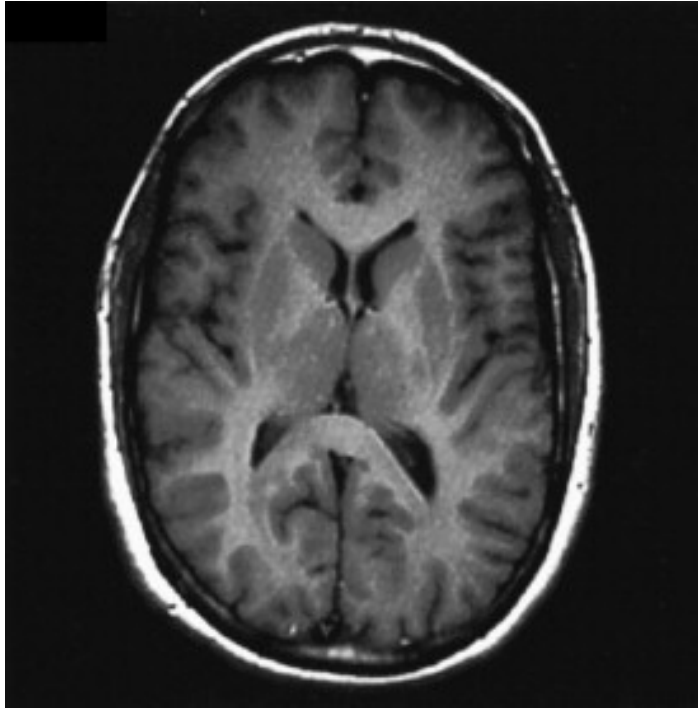
Magnetic Resonance Imaging Clinics of North America, Volume 19, Issue 1, 2011, 1–22

MRI (T1 Weighted) Concept



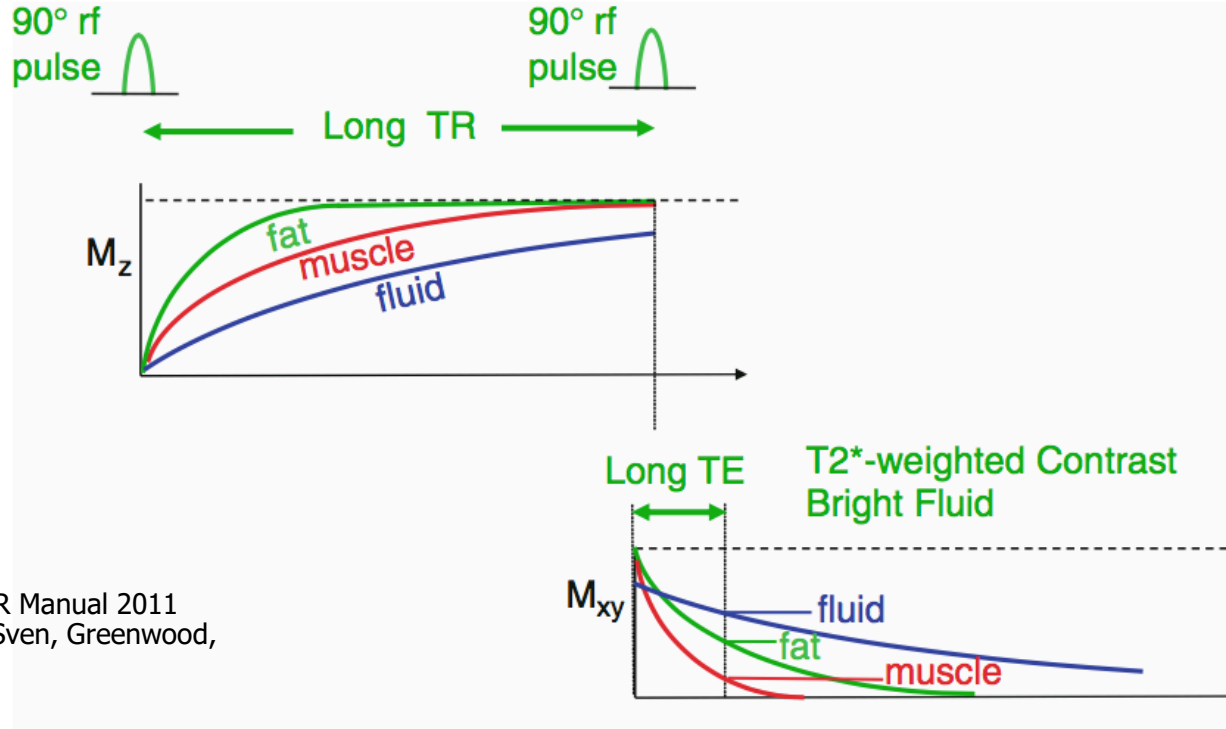
Cardiovascular MR Manual 2011
Edition by Plein, Sven, Greenwood,
John, Ridgway

MRI (T1 Weighted) Example



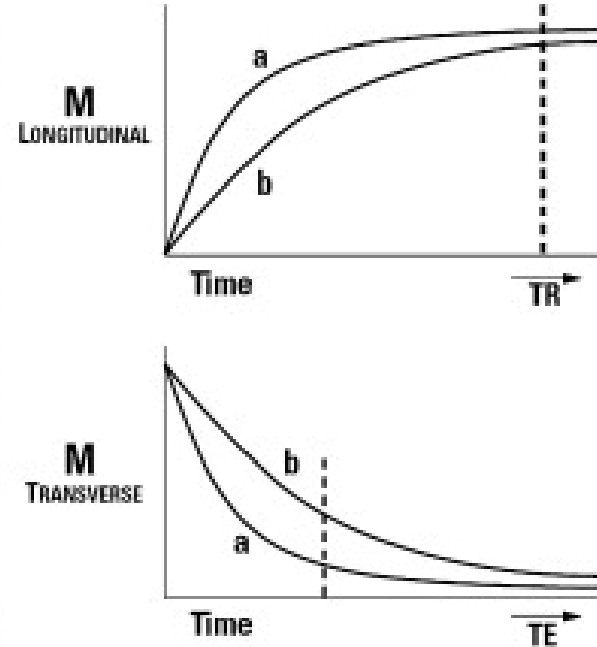
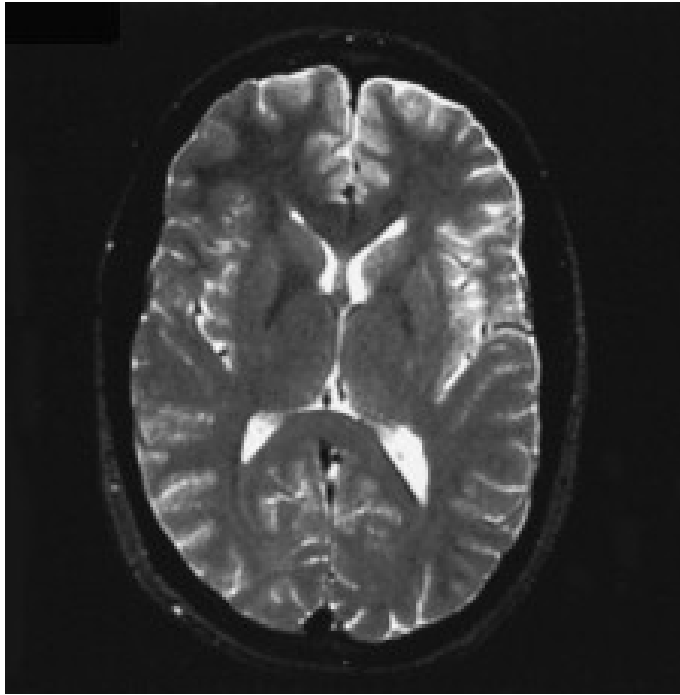
Magnetic Resonance Imaging Clinics of North America, Volume 19, Issue 1, 2011, 1–22

MRI (T2 Weighted) Concept



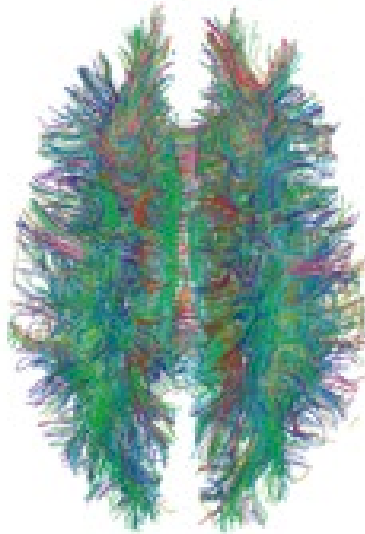
Cardiovascular MR Manual 2011
Edition by Plein, Sven, Greenwood,
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MRI (T2 Weighted) Example



Magnetic Resonance Imaging Clinics of North America, Volume 19, Issue 1, 2011, 1–22

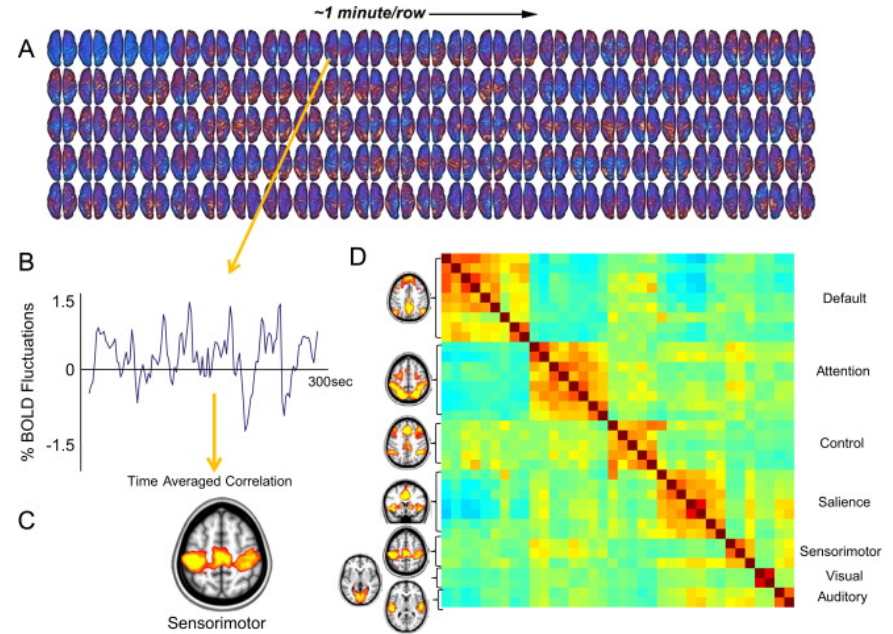
MRI Examples



PLoS ONE 3(12): e4006



Neuroradiology May 2015, Volume
57, Issue 5, pp 441–467

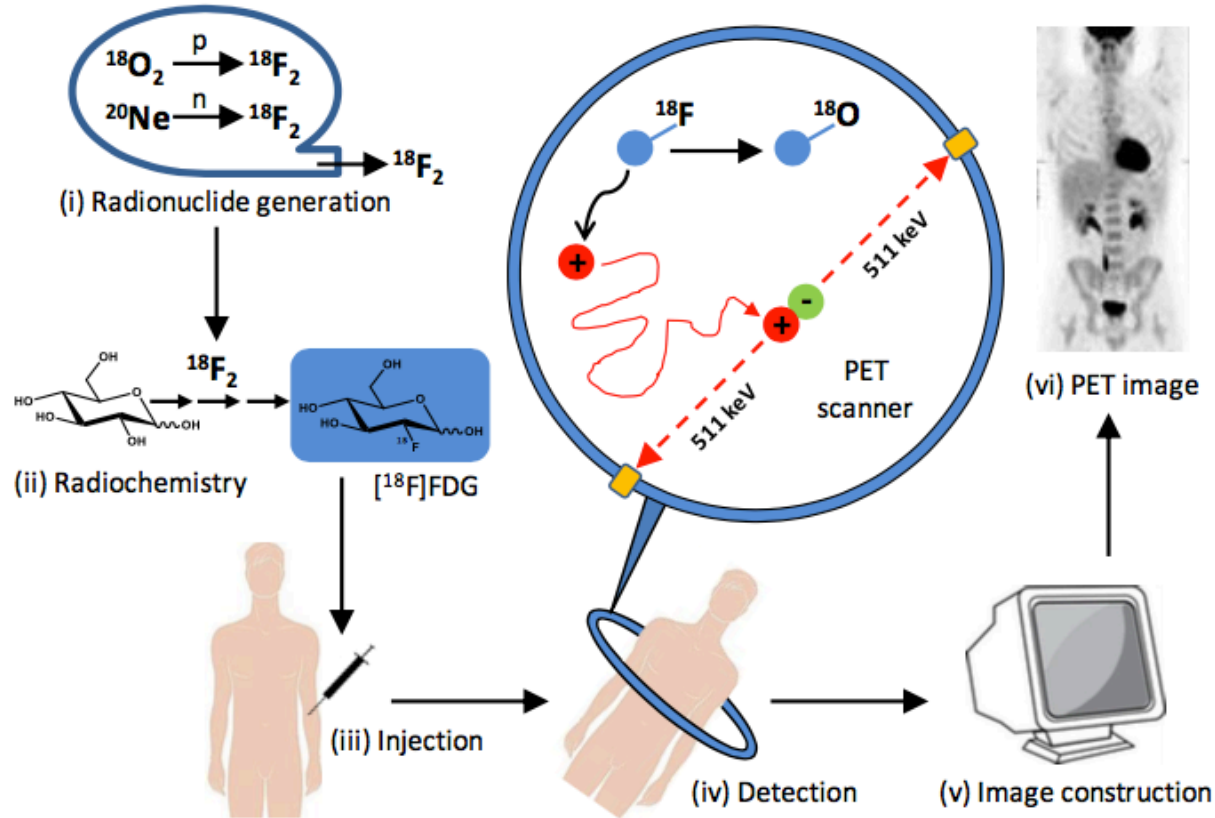


Biological Psychiatry, Volume 74, Issue 5, 2013, 340–347

Nuclear Medicine

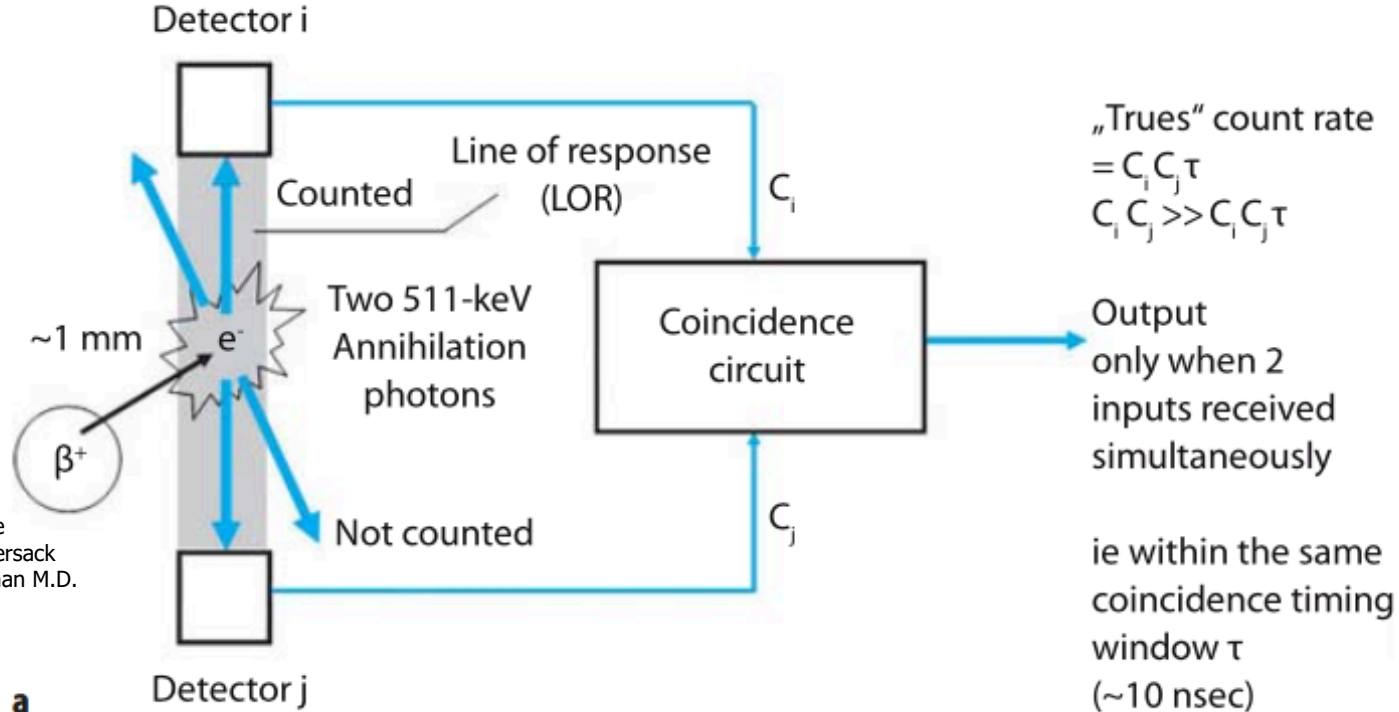
- Radioactive nuclide is bounded to a chemical complex (radio-tracer) is injected into patient.
- Tracer is picked up by target organ.
- Transition of tracer from excited to basic state results in emission of gamma-quanta (electromagnetic radiation emitted by decay of nucleus).
- Gamma-rays originated from inside body are detected and presented as image intensity values.

Positron Emission Tomography (PET) 1



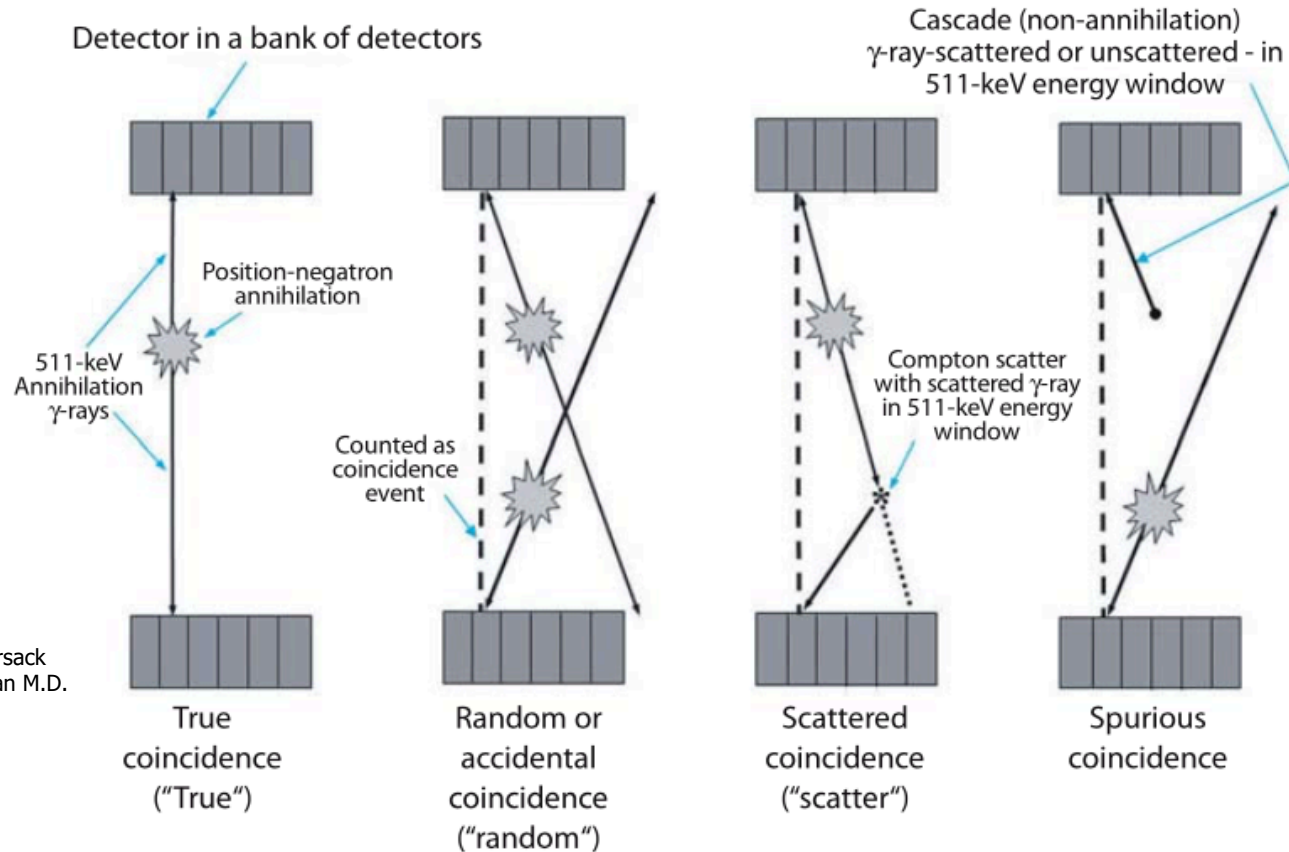
Journal of
Diagnostic Imaging
in Therapy 2015; 2
(1): 30-102

Positron Emission Tomography (PET) 2



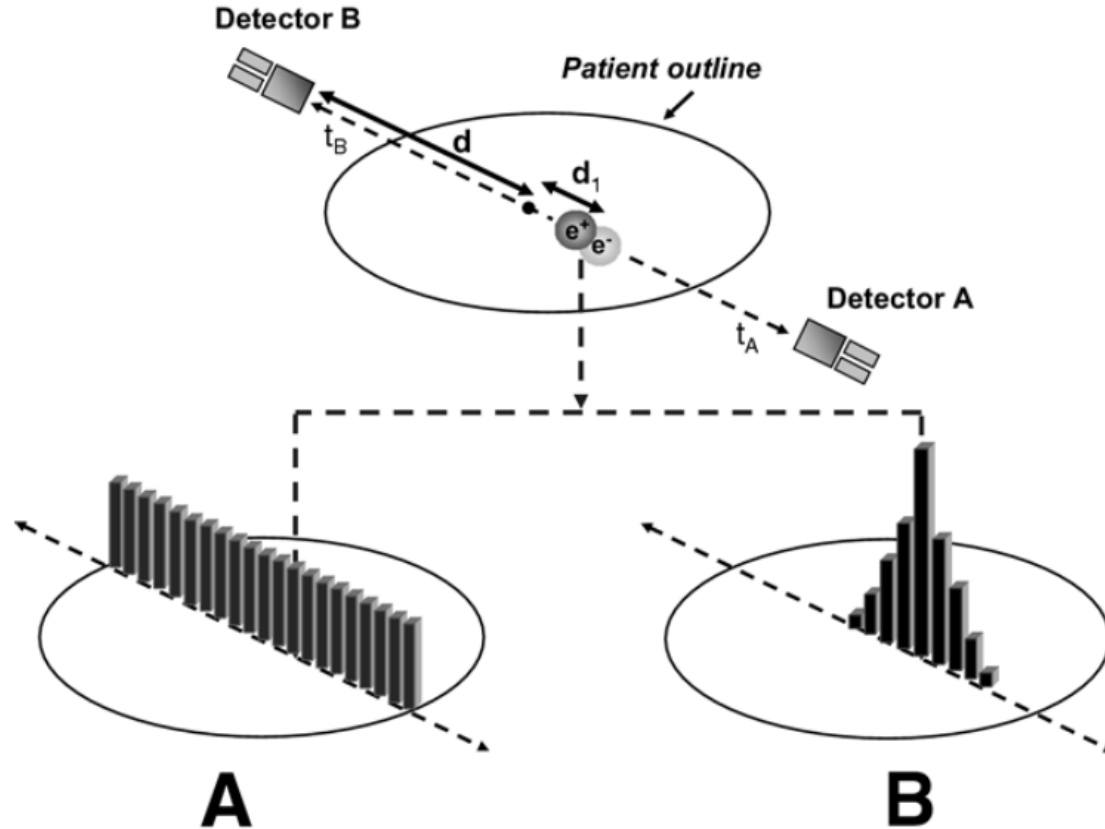
Clinical Nuclear Medicine
Editors: Hans-Jürgen Biersack
M.D., Leonard M. Freeman M.D.

PET (Detection Problems)



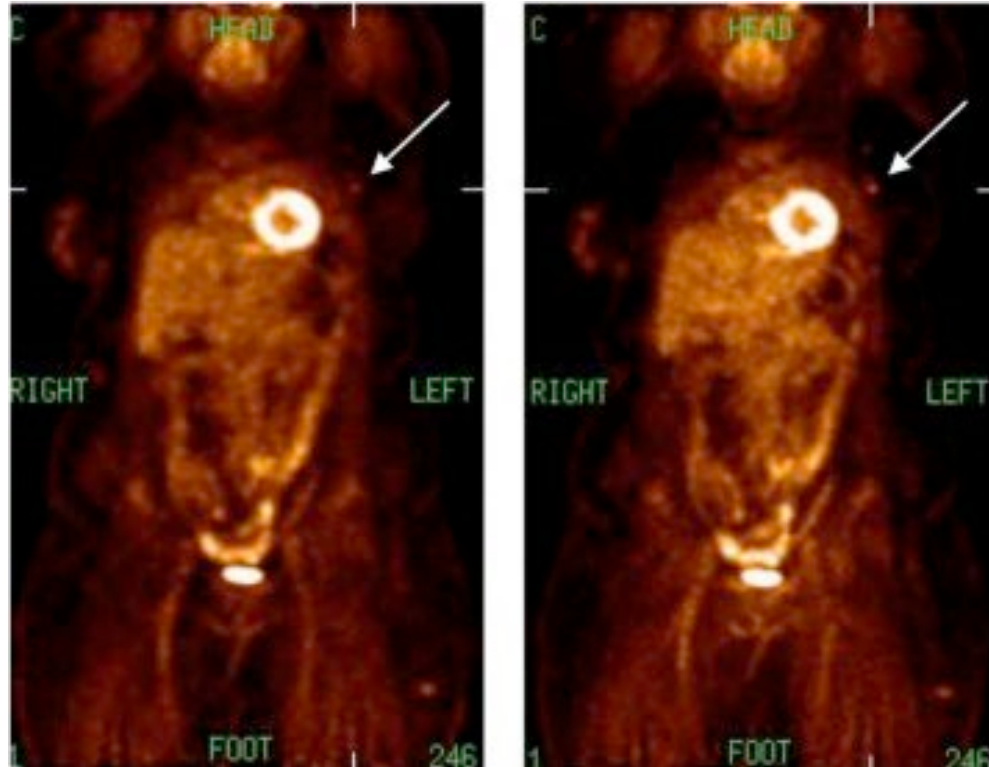
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PET (Time of Flight)



Semin Nucl Med
38:152-166

PET (Time of Flight Example)





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