# Computed Tomography (CT) Images

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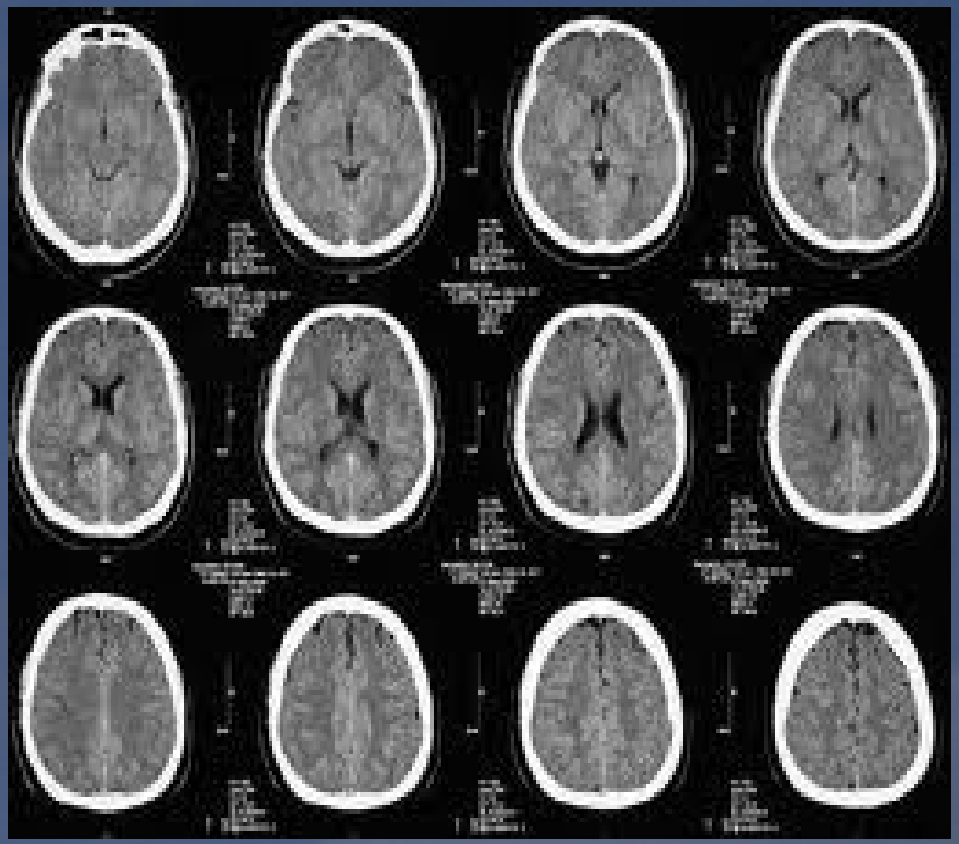
# CT Images

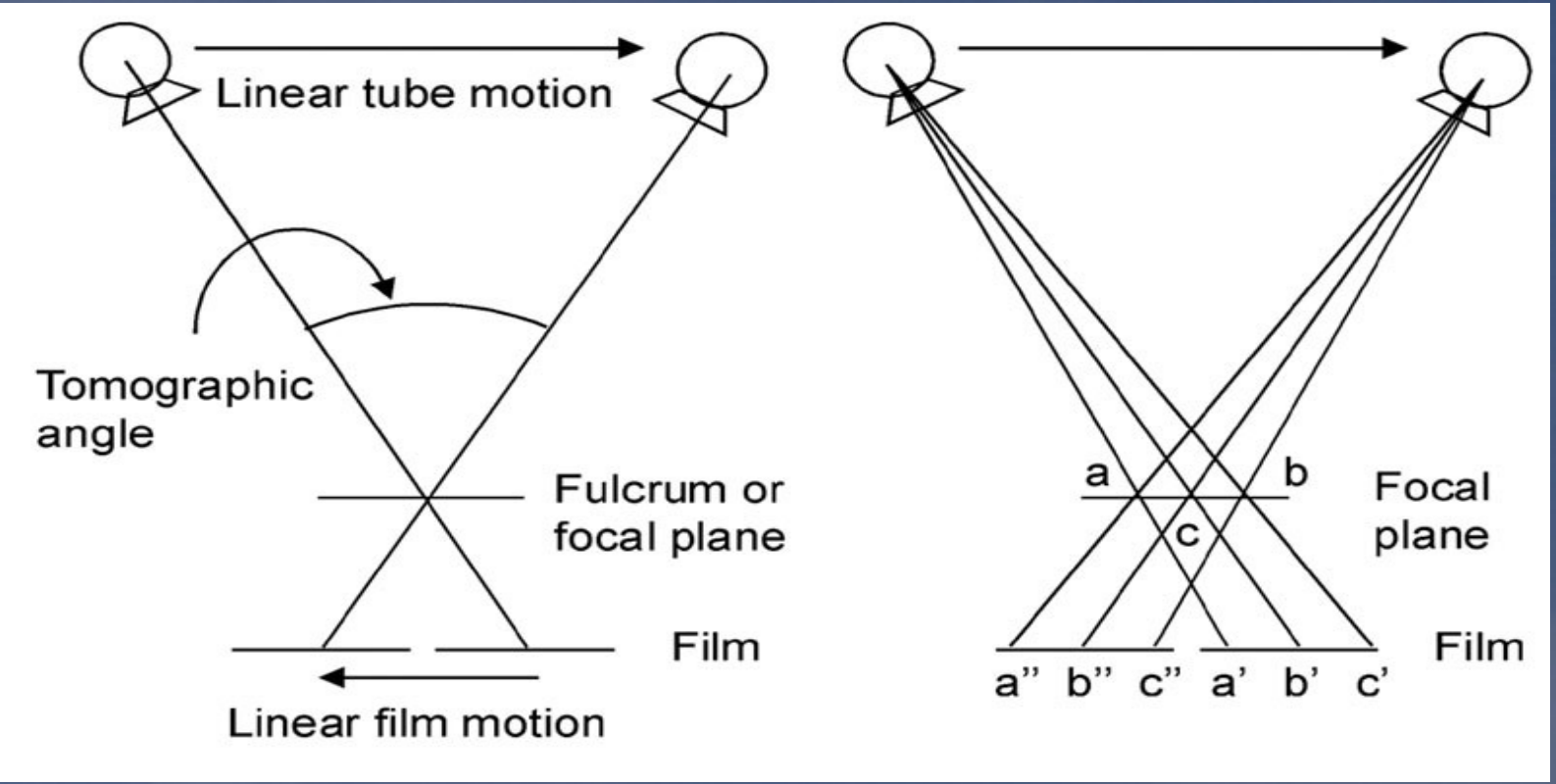


www.pbs.org

# CT Images

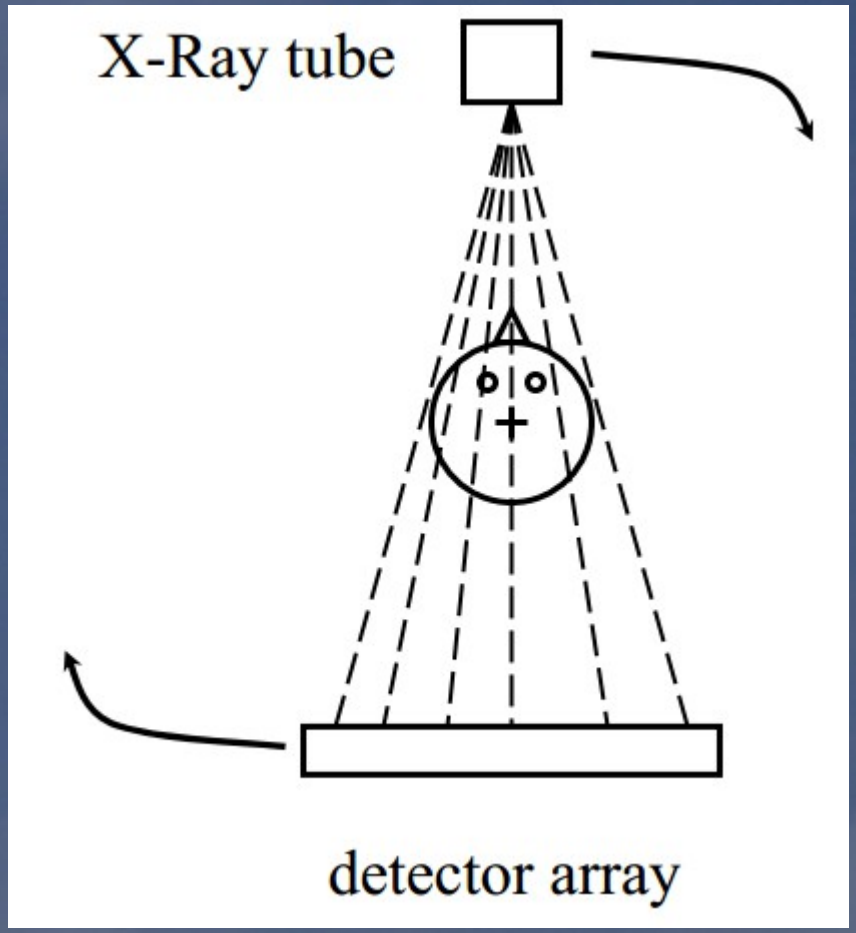
- History:
  - Based in the X-rays;
  - CT was the revolution in medicine;
  - Word “Tomography” is derived from the Greek words:
    - “Tomos” means to cut;
    - “Graphein” means to write;
  - Linear Tomography was the first step (1958).

# CT Images




http://ksaenz921.blogspot.com.br/2009/03/linear-tomography_19.html

# CT Images



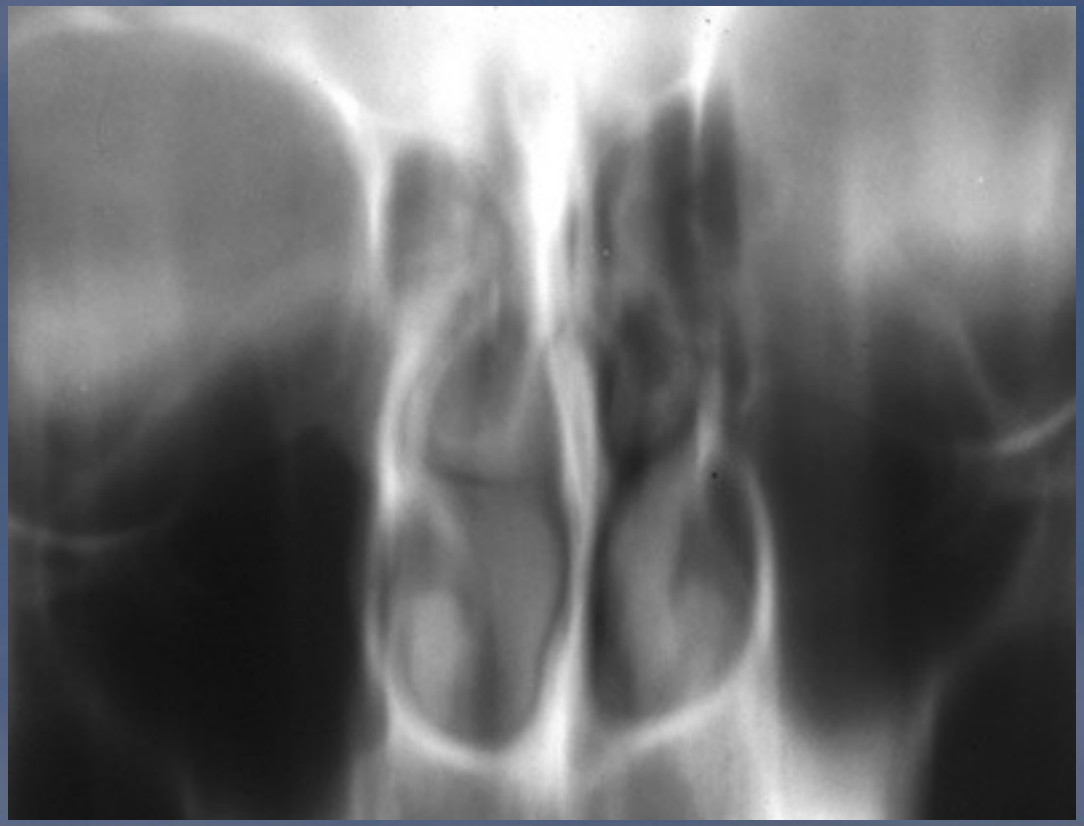

William (Sandy) Wells. Course materials for HST.582J / 6.555J / 16.456J, Biomedical Signal and Image Processing, Spring 2007.
MIT OpenCourseWare (http://ocw.mit.edu), Massachusetts Institute of Technology. Downloaded on 15 September 2014.

# CT Images

http://ksaenz921.blogspot.com.br/2009/03/linear-tomography_19.html

# CT Images

- Example:



http://ctscans.hawkelibrary.com/Intoduction-to-CT-Scans/Conv_Tomography

# CT Images

- CT Equipments Generations:
  - 1st Generation;
  - 2nd Generation;
  - 3rd Generation;
  - 4th Generation;
  - 5th Generation – EBCT;
  - Helical;
  - Multislice.

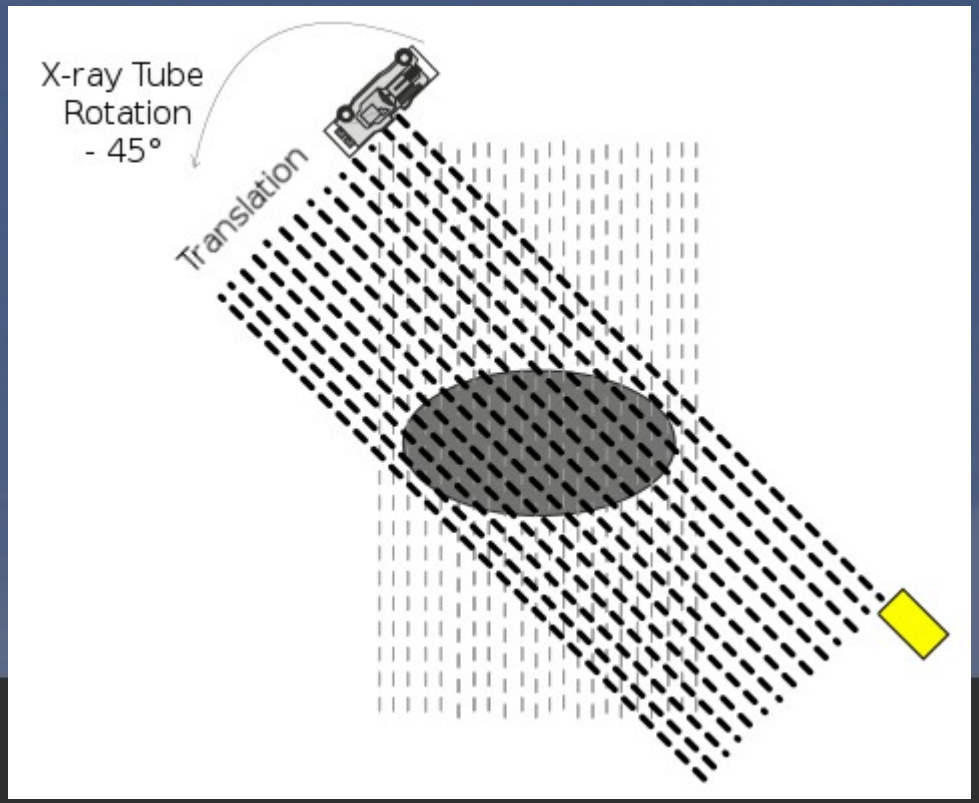
# CT Images

- CT Equipments Generations:
  - 1st Generation:
    - Translation and rotation (1° each time);
    - High collimated (pencil beam);
    - One or two detectors;
    - Five minutes.

http://rle.dainf.ct.utfpr.edu.br/hipermidia/images/documentos/Tomografia_computadorizada_tecnologia_e_funcionamento_equipamentos.pdf

# CT Images

- CT Equipments Generations:
  - 1st Generation:




http://rle.dainf.ct.utfpr.edu.br/hipermidia/images/documentos/Tomografia_computadorizada_tecnologia_e_funcionamento_equipamentos.pdf

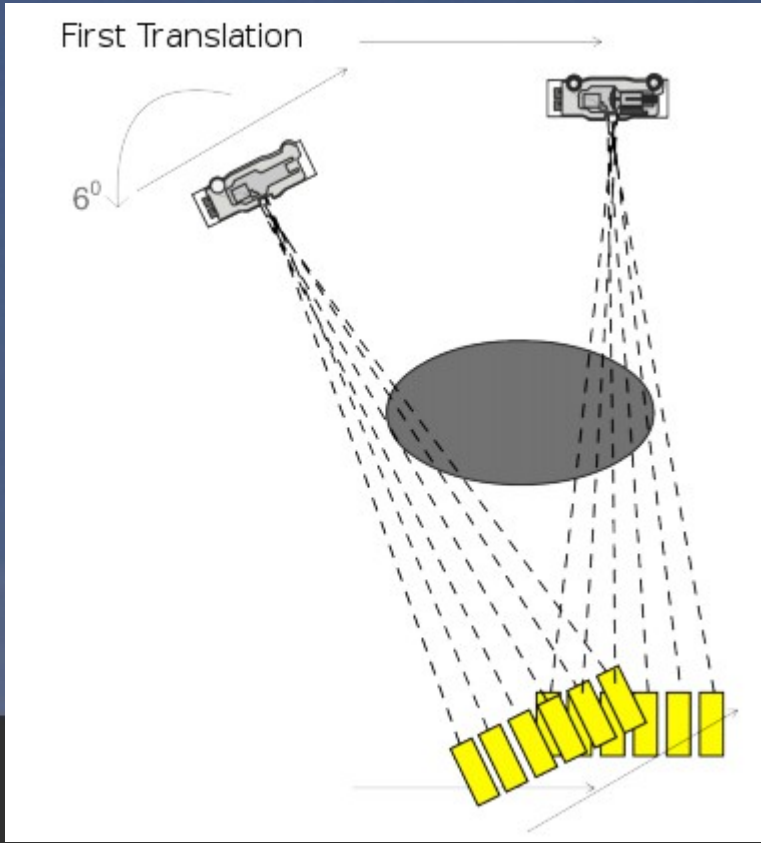
# CT Images

- CT Equipments Generations:
  - 2nd Generation:
    - Translation and rotation (6° each time);
    - Divergent (fan beam);
    - 30 detectors;
    - Twenty seconds.

http://rle.dainf.ct.utfpr.edu.br/hipermidia/images/documentos/Tomografia_computadorizada_tecnologia_e_funcionamento_equipamentos.pdf

# CT Images

- CT Equipments Generations:
  - 2nd Generation:




http://rle.dainf.ct.utfpr.edu.br/hipermidia/images/documentos/Tomografia_computadorizada_tecnologia_e_funcionamento_equipamentos.pdf

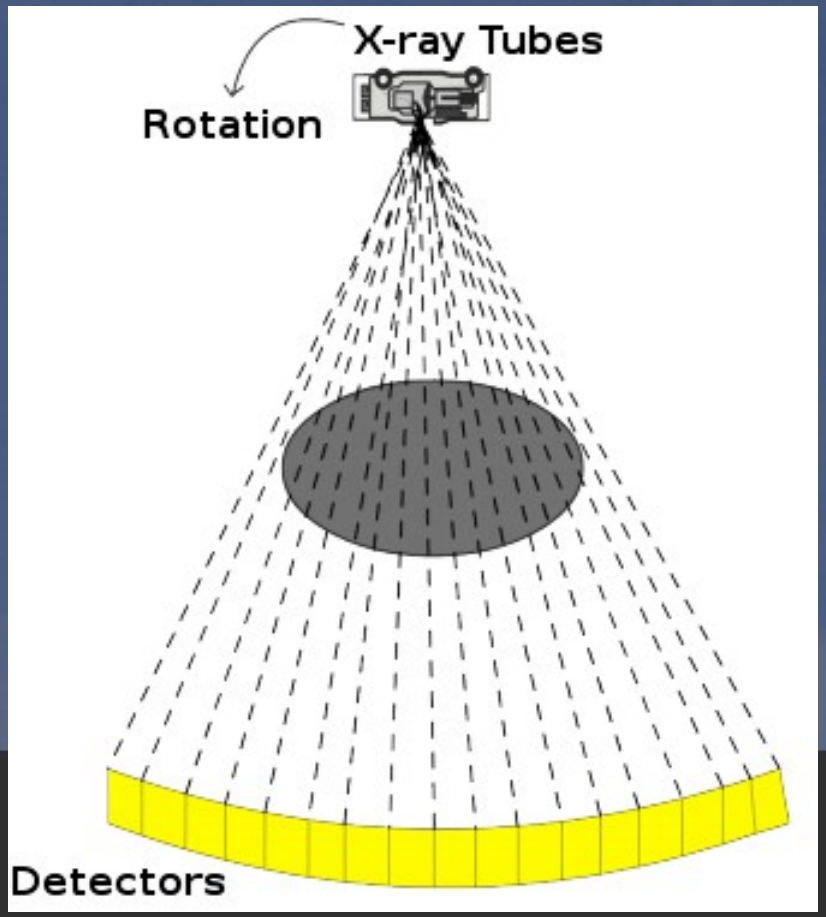
# CT Images

- CT Equipments Generations:
  - 3rd Generation:
    - Rotation-rotation (360°);
    - Divergent (fan beam);
    - Detectors: arc-shaped (30° to 40°);
    - ~ one second;
    - Limitations: High voltage cables.

http://rle.dainf.ct.utfpr.edu.br/hipermidia/images/documentos/Tomografia_computadorizada_tecnologia_e_funcionamento_equipamentos.pdf

# CT Images

- CT Equipments Generations:
  - 3rd Generation:




http://rle.dainf.ct.utfpr.edu.br/hipermidia/images/documentos/Tomografia_computadorizada_tecnologia_e_funcionamento_equipamentos.pdf

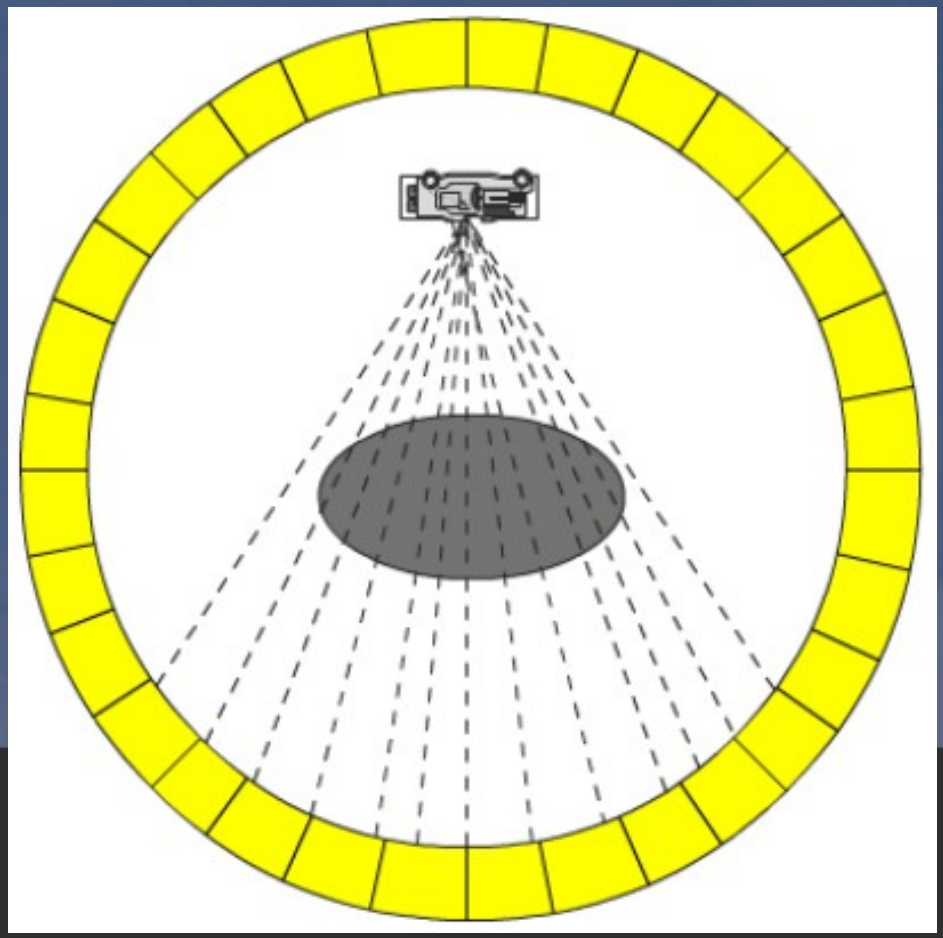
# CT Images

- CT Equipments Generations:
  - 4th Generation:
    - Rotation-stationary (360°);
    - Divergent (fan beam);
    - Detectors: arc-shaped 360° (400 detectors);
    - Lower than one second.

http://rle.dainf.ct.utfpr.edu.br/hipermidia/images/documentos/Tomografia_computadorizada_tecnologia_e_funcionamento_equipamentos.pdf

# CT Images

- CT Equipments Generations:
  - 4th Generation:



http://rle.dainf.ct.utfpr.edu.br/hipermidia/images/documentos/Tomografia_computadorizada_tecnologia_e_funcionamento_equipamentos.pdf

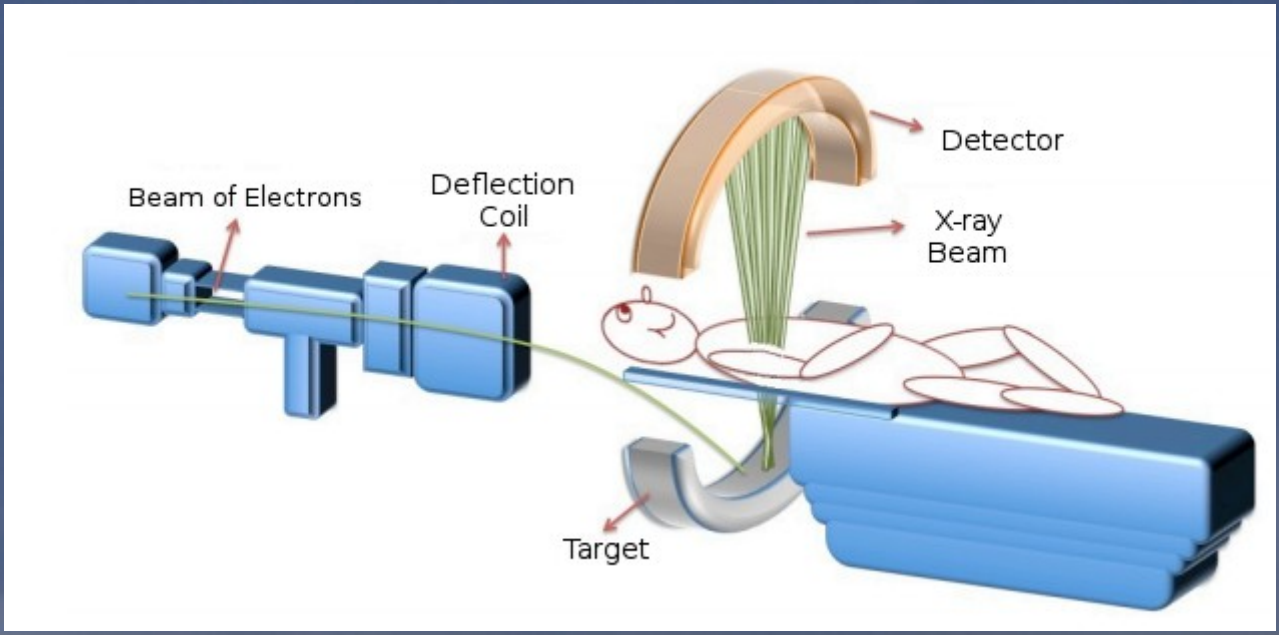
# CT Images

- CT Equipments Generations:
  - 5th Generation - EBCT:
    - Stationary-stationary;
    - Electron beam (photons);
    - Tungsten rings;
    - 50 milliseconds;
    - Cardiac images.

http://rle.dainf.ct.utfpr.edu.br/hipermidia/images/documentos/Tomografia_computadorizada_tecnologia_e_funcionamento_equipamentos.pdf

# CT Images

- CT Equipments Generations:
  - 5th Generation - EBCT:




http://rle.dainf.ct.utfpr.edu.br/hipermidia/images/documentos/Tomografia_computadorizada_tecnologia_e_funcionamento_equipamentos.pdf

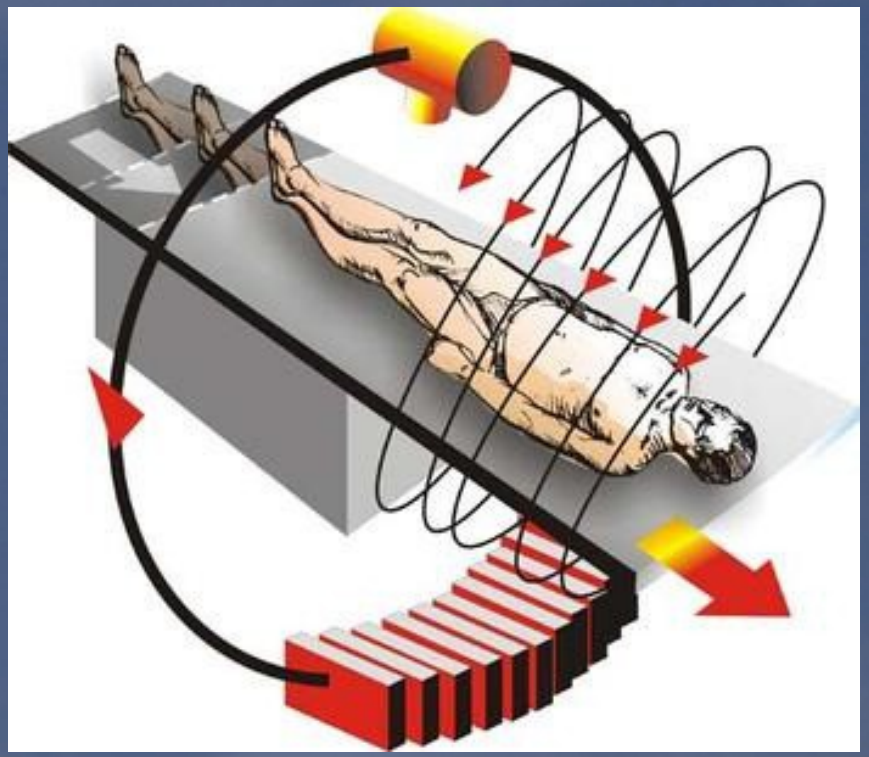
# CT Images

- CT Equipments Generations:
  - Helical:
    - Rotation-rotation;
    - Cone beam;
    - Single row;
    - Lower than 1 second;
    - Many anatomical regions.

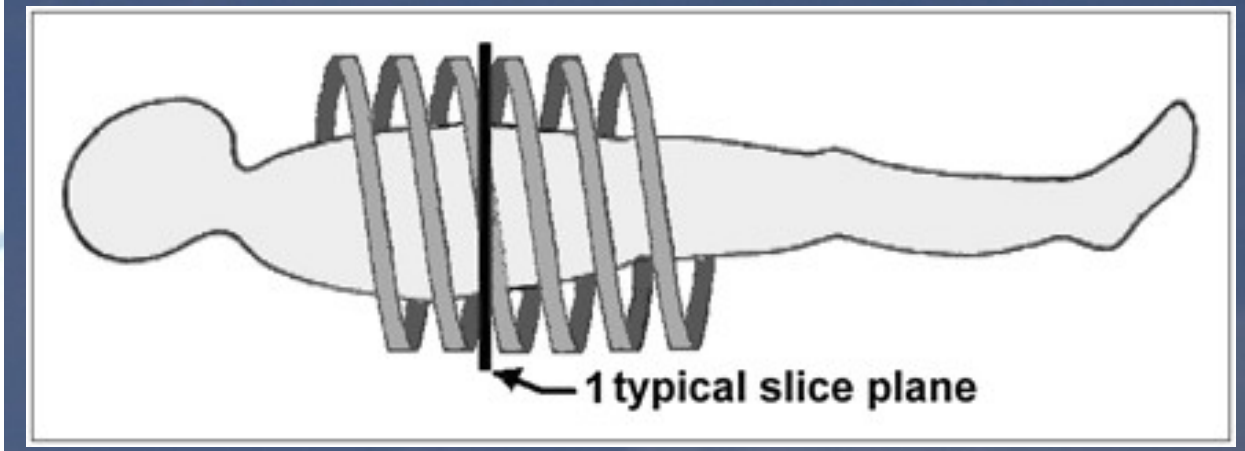
http://rle.dainf.ct.utfpr.edu.br/hipermidia/images/documentos/Tomografia_computadorizada_tecnologia_e_funcionamento_equipamentos.pdf

# CT Images

- CT Equipments Generations:
  - Helical:



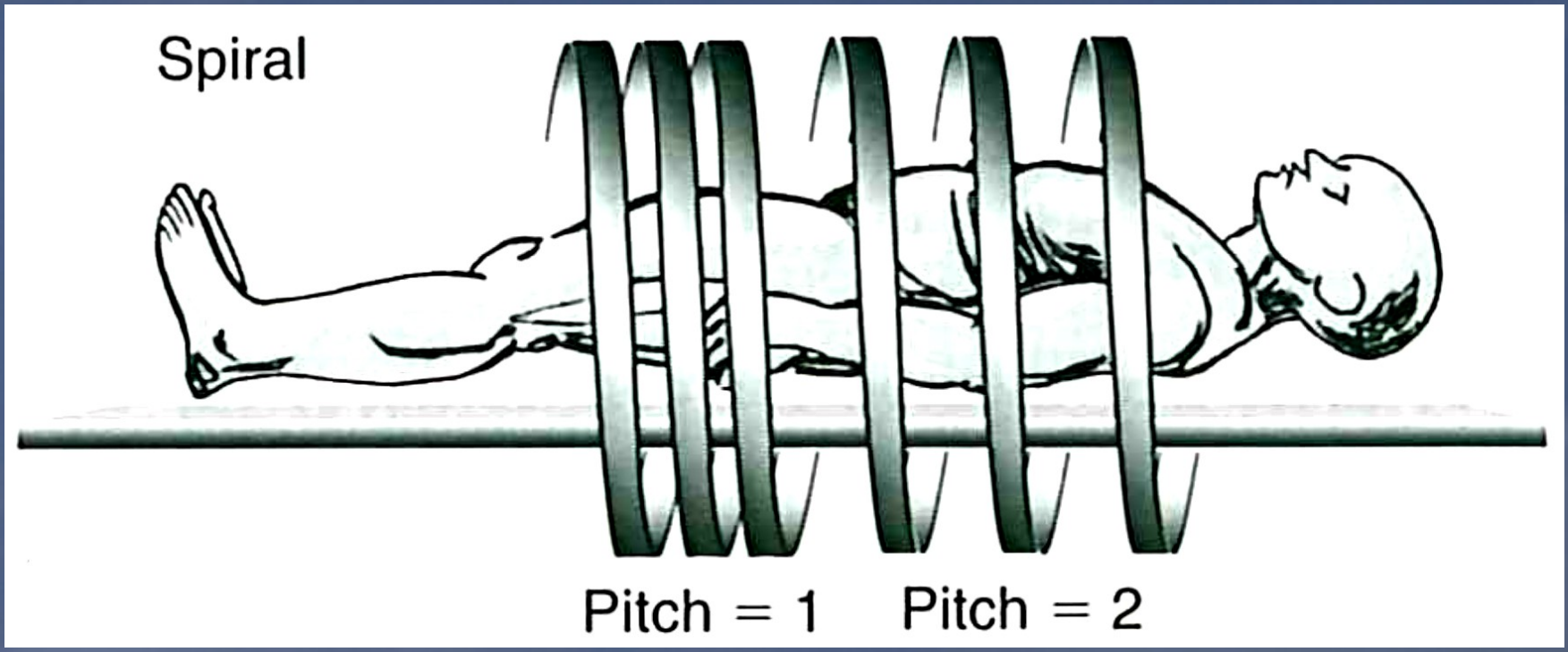
http://www.personal.psu.edu/afr3/blogs/SIOW/2011/12/helical-ct-lung-cancer.html




http://tech.snmjournals.org/content/35/3/115/F11.large.jpg

# CT Images

- CT Equipments Generations:
  - Helical:




https://miac.unibas.ch/PMI/03-ComputedTomography.html

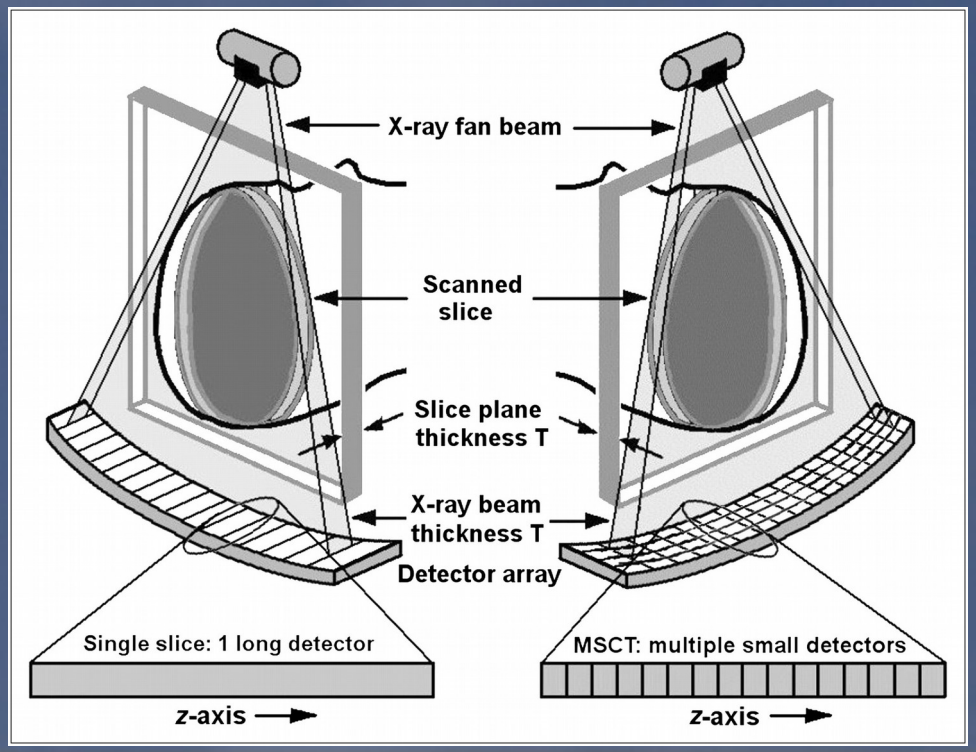
# CT Images

- CT Equipments Generations:
  - Multislice:
    - Rotation-rotation;
    - Cone beam;
    - Multiple - simultaneous acquisition;
    - Fractions of seconds;
    - Many anatomical regions.

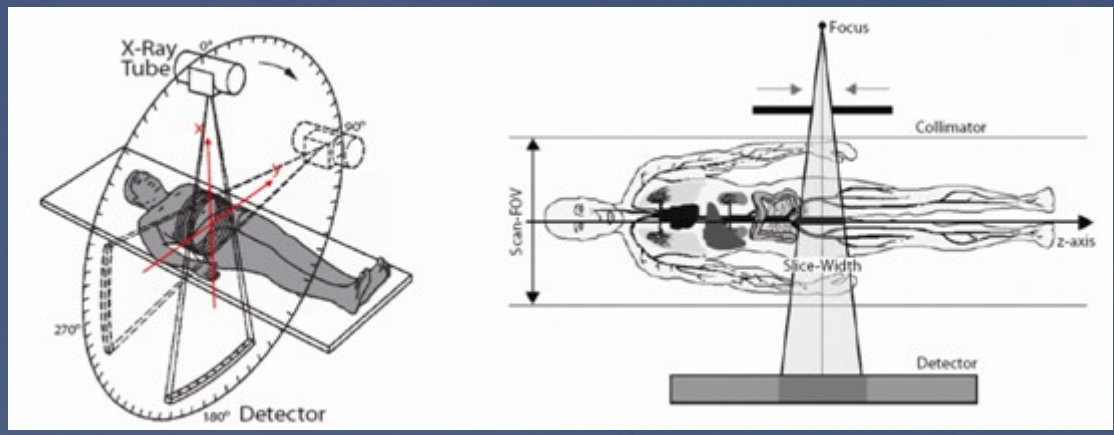
http://rle.dainf.ct.utfpr.edu.br/hipermidia/images/documentos/Tomografia_computadorizada_tecnologia_e_funcionamento_equipamentos.pdf

# CT Images

- CT Equipments Generations:
  - Multislice:



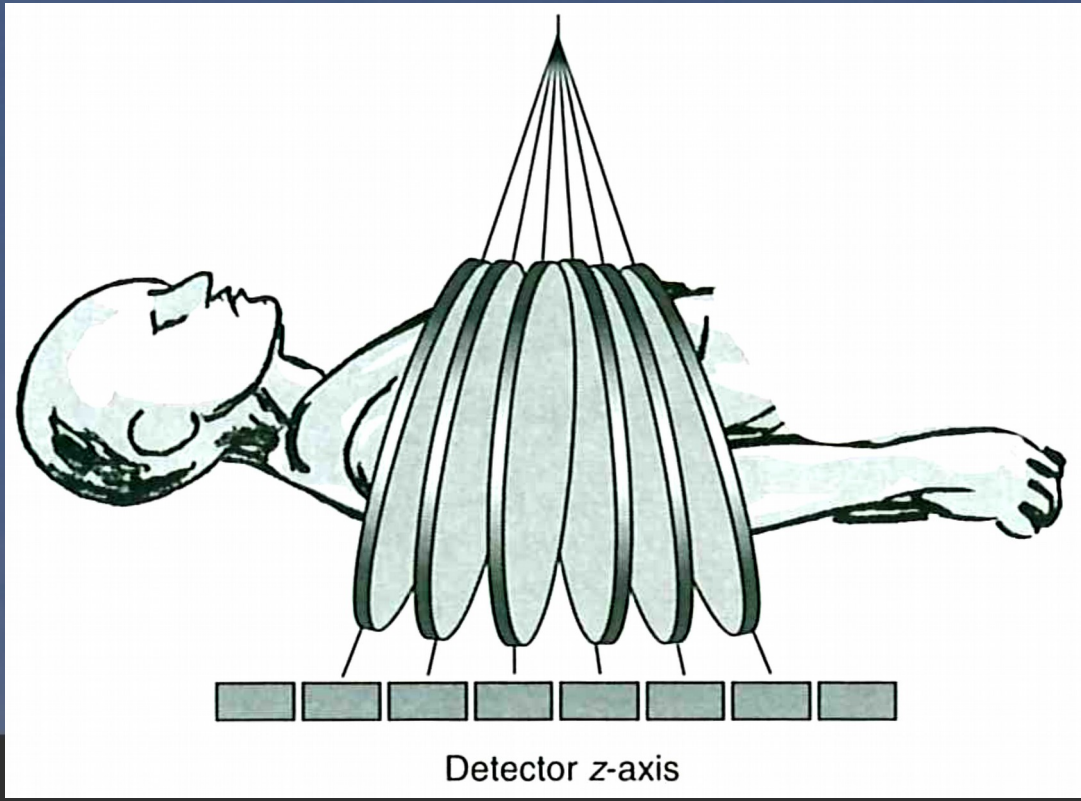

http://tech.snmjournals.org/content/36/2/57/F1.expansion.html




http://mixic.ece.ust.hk/images/research/CMOS_imaging_detector_for_computed_tomography.jpg

# CT Images

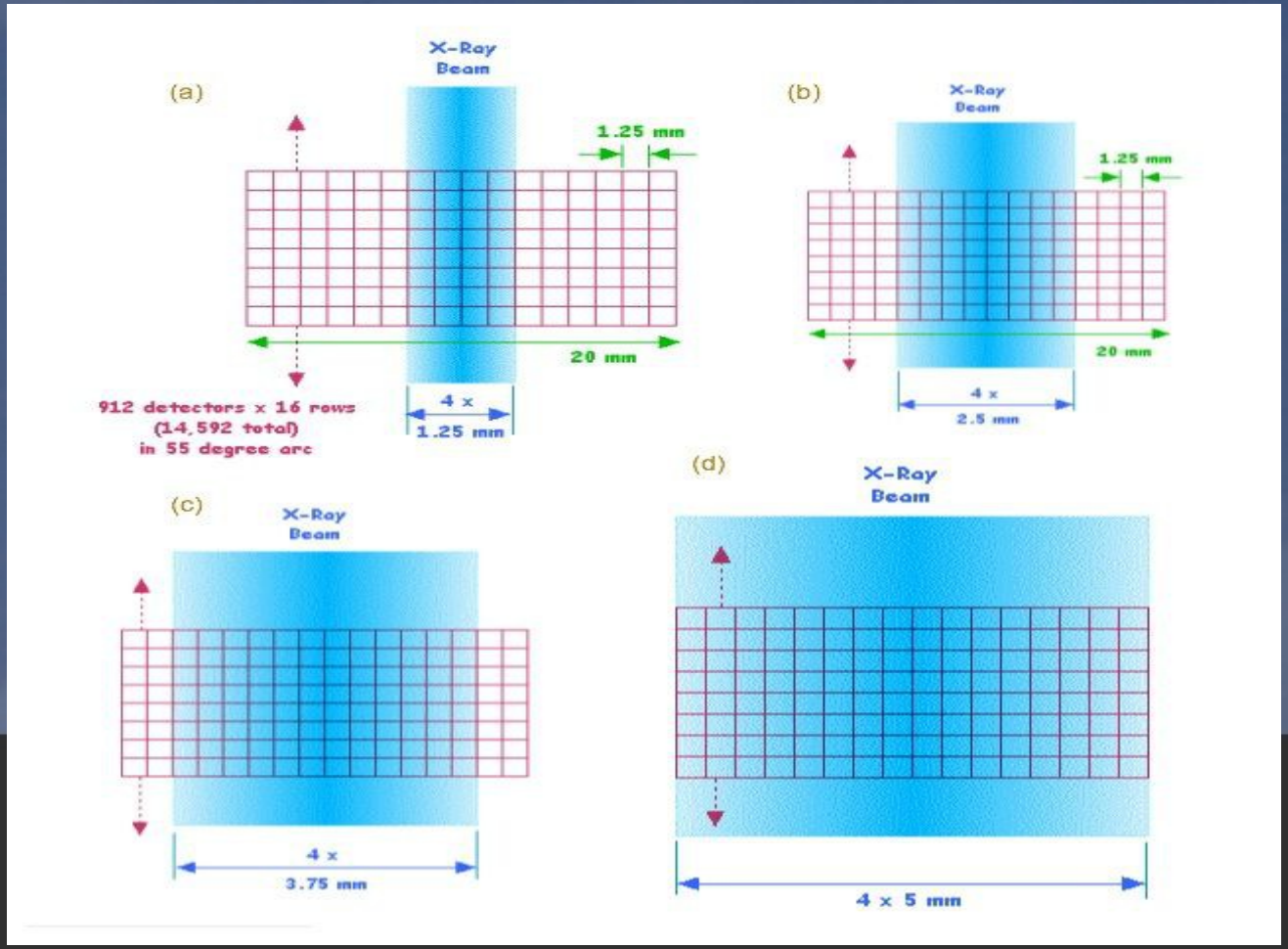
- CT Equipments Generations:
  - Multislice:




https://miac.unibas.ch/PMI/03-ComputedTomography.html

# CT Images

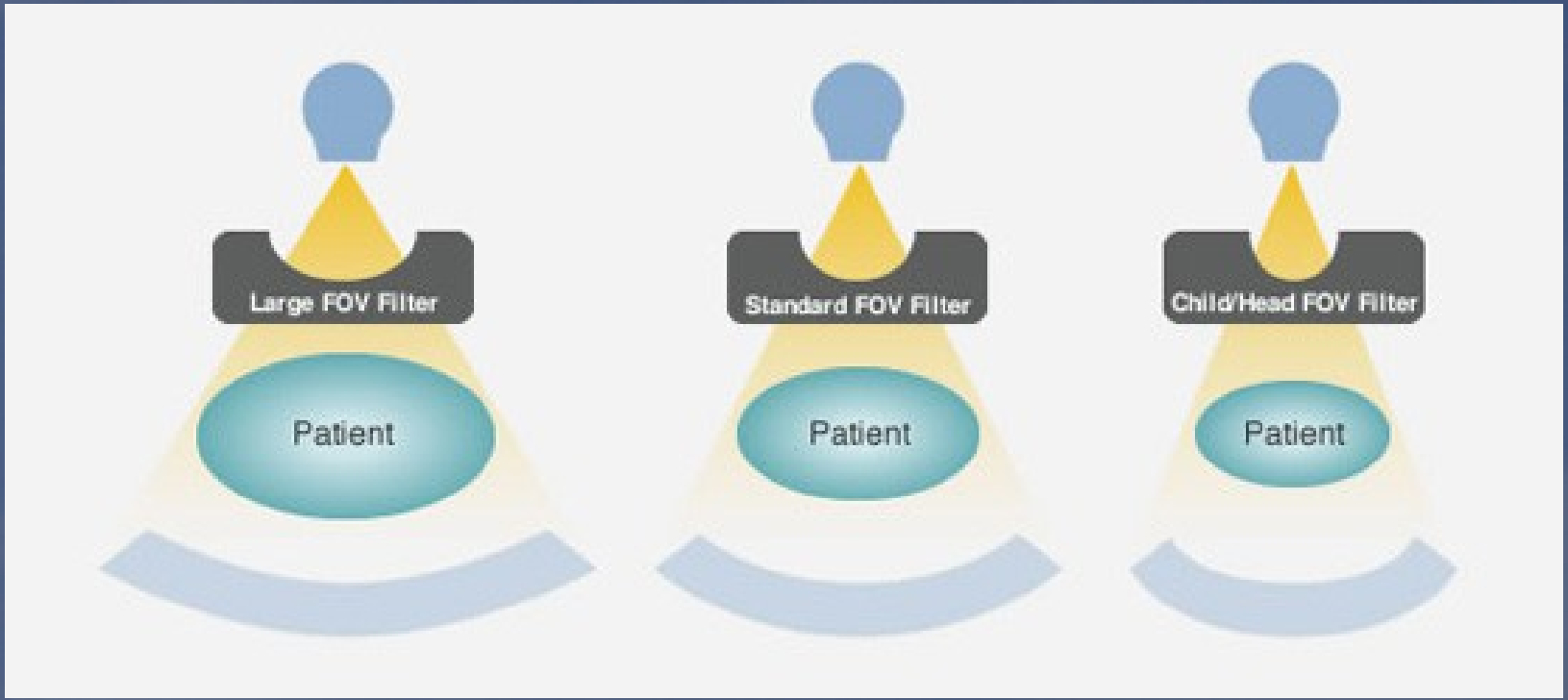
- CT Equipments Generations:
  - Multislice:




http://commons.wikimedia.org/wiki/File:Matrix_array_multi-slice_CT_detector.jpg

# CT Images

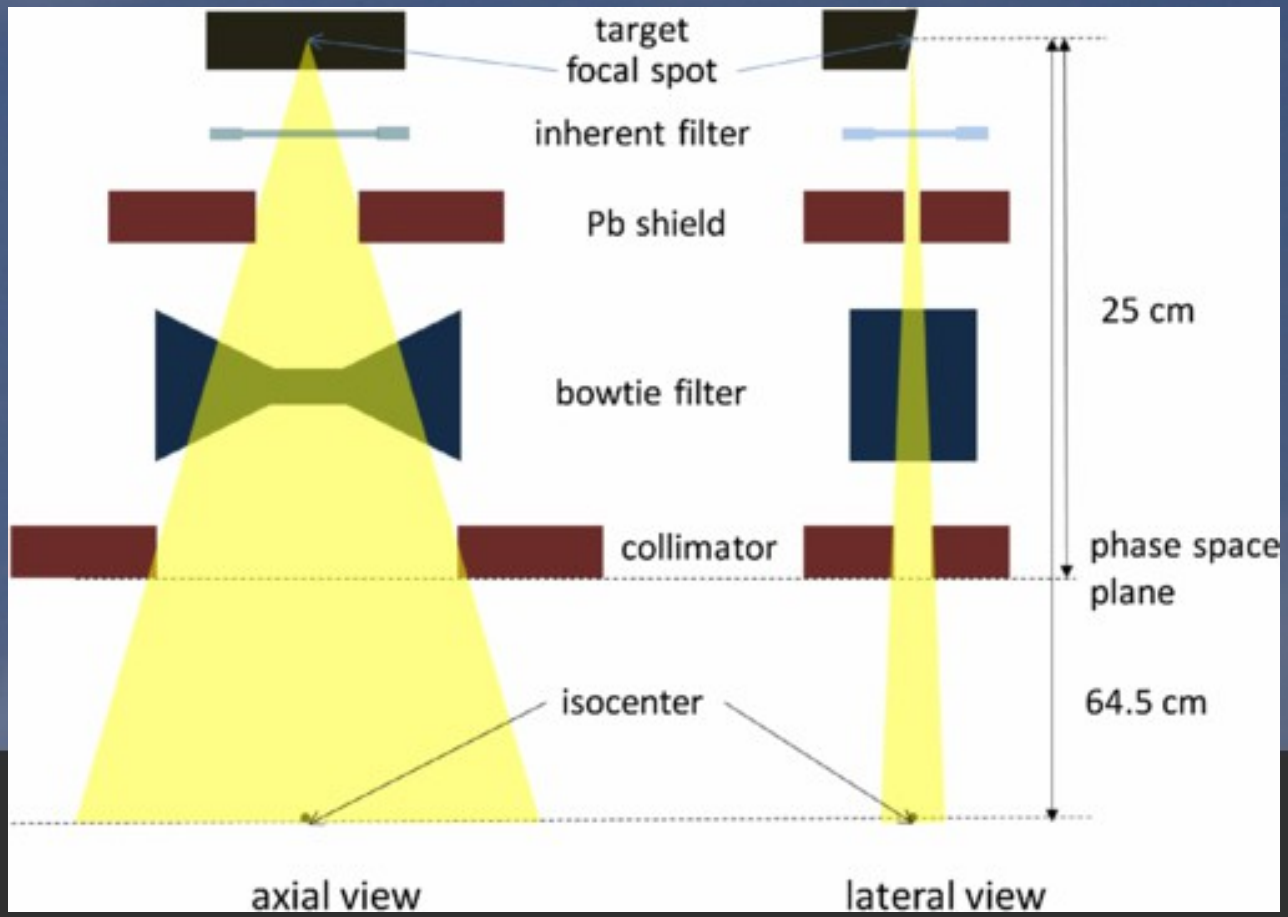
- CT Filters
  - Bow tie Filter:




http://www.toshibamedicalsystems.com/tmd/english/products/dose/lowdose/img/imgmachine02.jpg

# CT Images

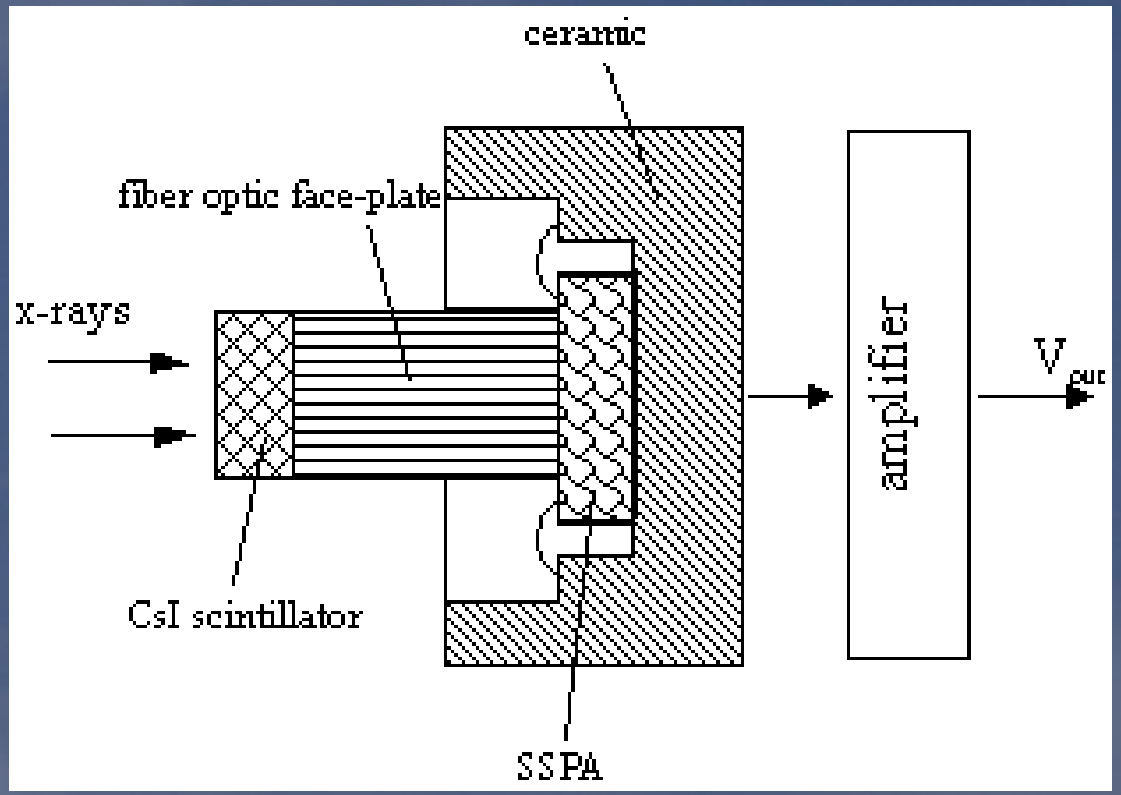
- CT Filters
  - Bow tie Filter:




http://iopscience.iop.org/0031-9155/58/8/2609/article

# CT Images

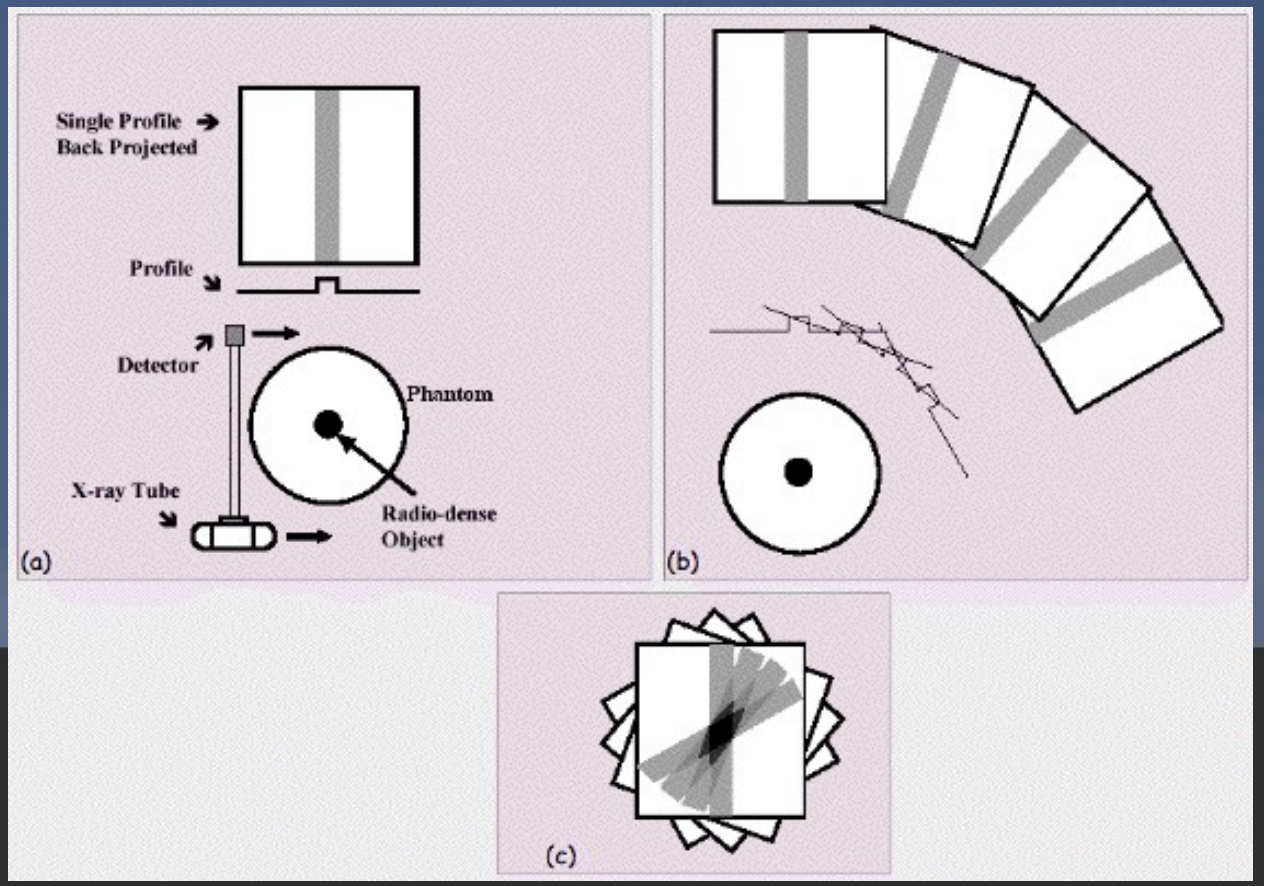
- CT Detectors:




http://www.ndt.net/article/wcndt00/papers/idn754/idn754.htm

# CT Images

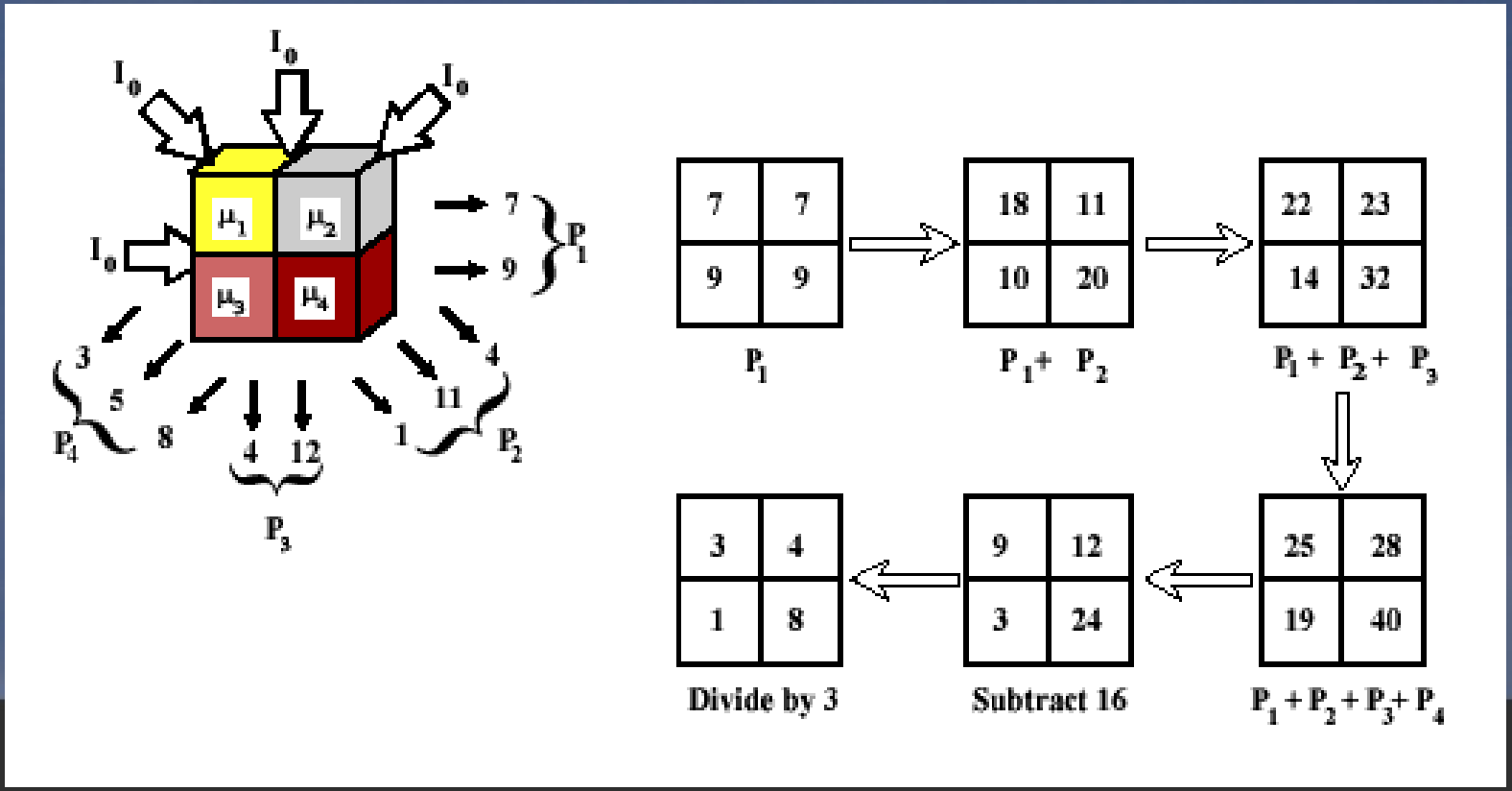
- Image Reconstruction:
  - Many projections;
  - Back projection technique.




http://en.wikibooks.org/wiki/Basic_Physics_of_Nuclear_Medicine/X-Ray_CT_in_Nuclear_Medicine

# CT Images

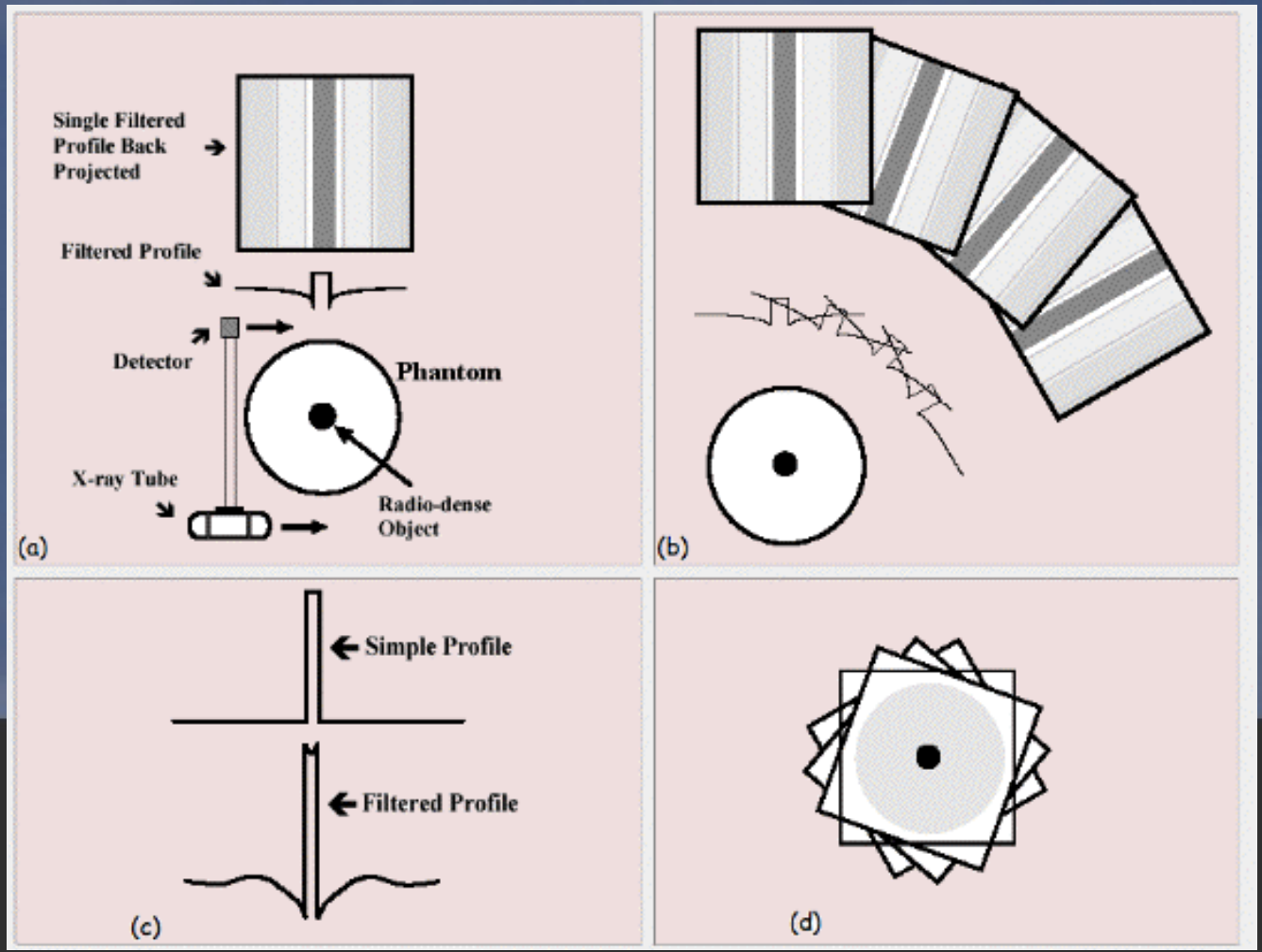
- Image Reconstruction:
  - Back projection.




http://en.wikibooks.org/wiki/Basic_Physics_of_Nuclear_Medicine/X-Ray_CT_in_Nuclear_Medicine

# CT Images

- Image Reconstruction:
  - Back projection Filter.

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