Practicum 1:
Image formation and reconstruction

GHENT
UNIVERSITY

Practical information

- Work in groups of 2
- Report due 2 weeks after session (18/10/2022 - 23:59)
- Report = notebook, both in .ipynb and .html format
- Questions during session or afterwards:
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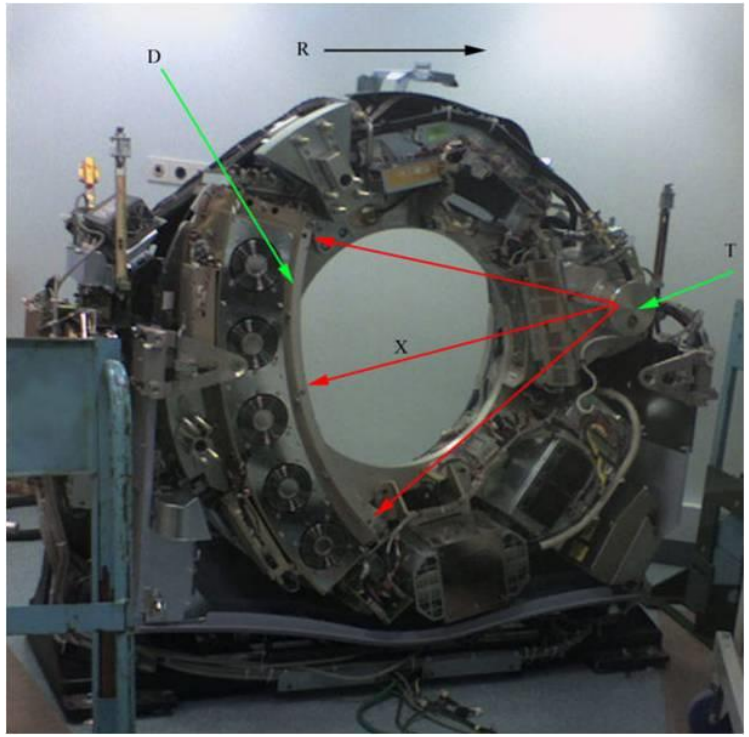
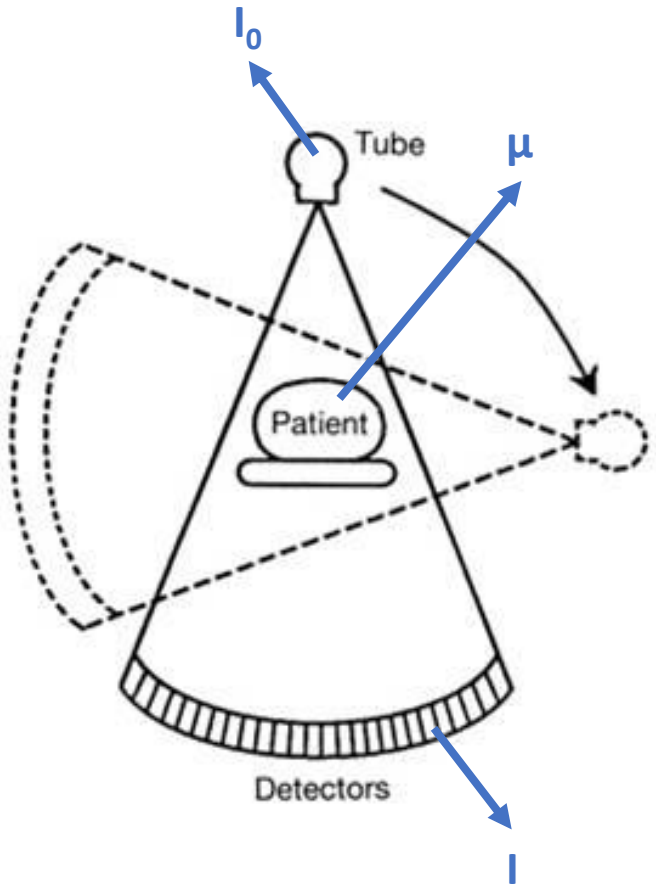
  - FlorenceMarie.Muller@UGent.be

Forward projection



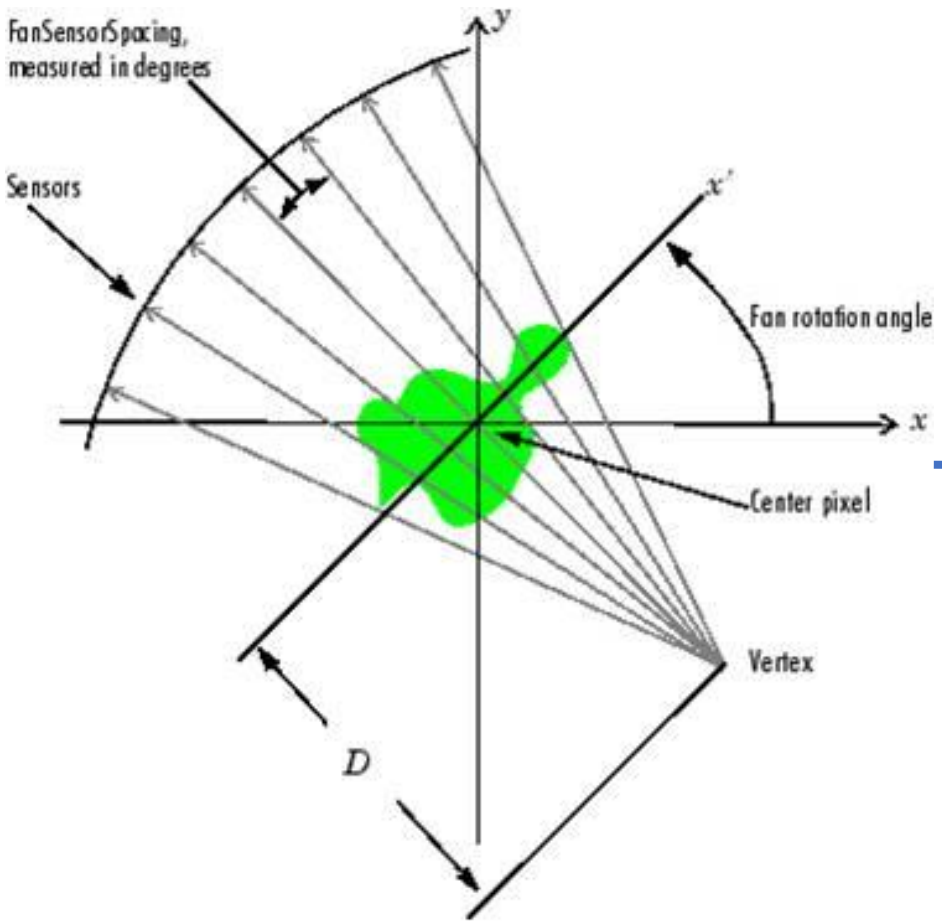


$$I = \int I_0\,(\cancel{E})\, e^{-\int_0^L \mu(\vec{x},\cancel{E})d\vec{x}}\, dE$$

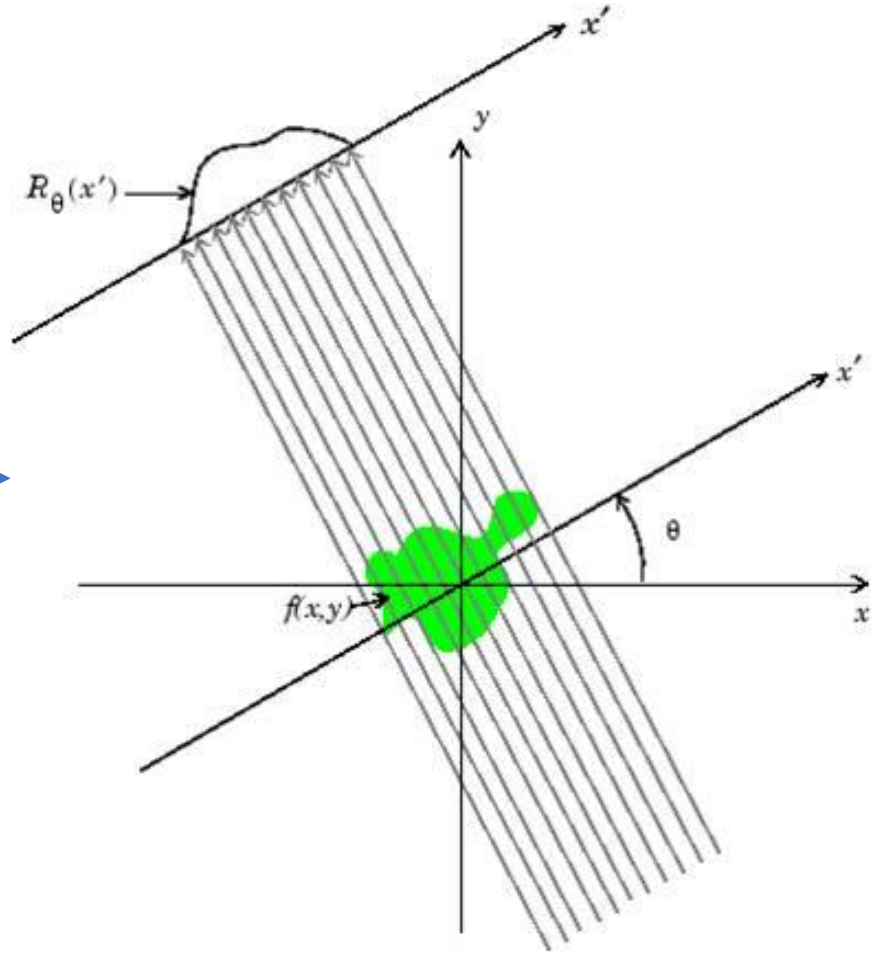
$$\int_0^L \mu(\vec{x})d\vec{x} = \log\left(I_0\right) - \log\left(I\right)$$

Forward projection

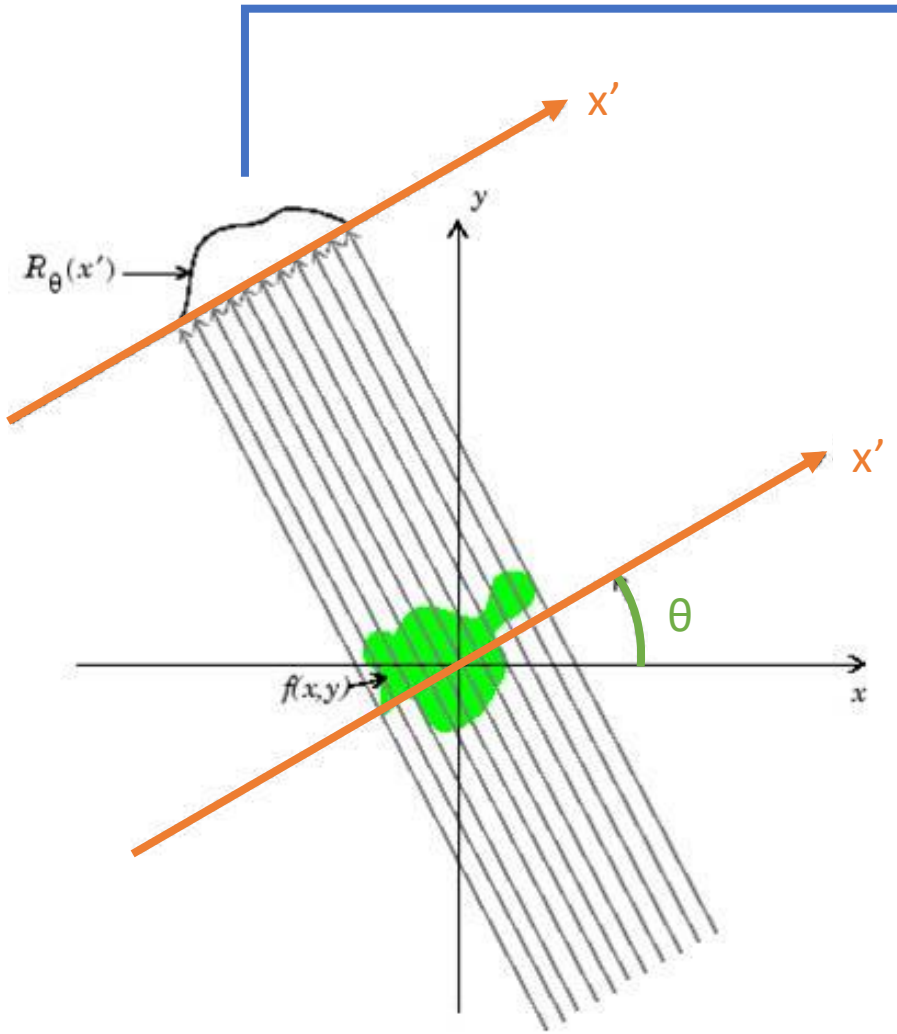
fanbeam

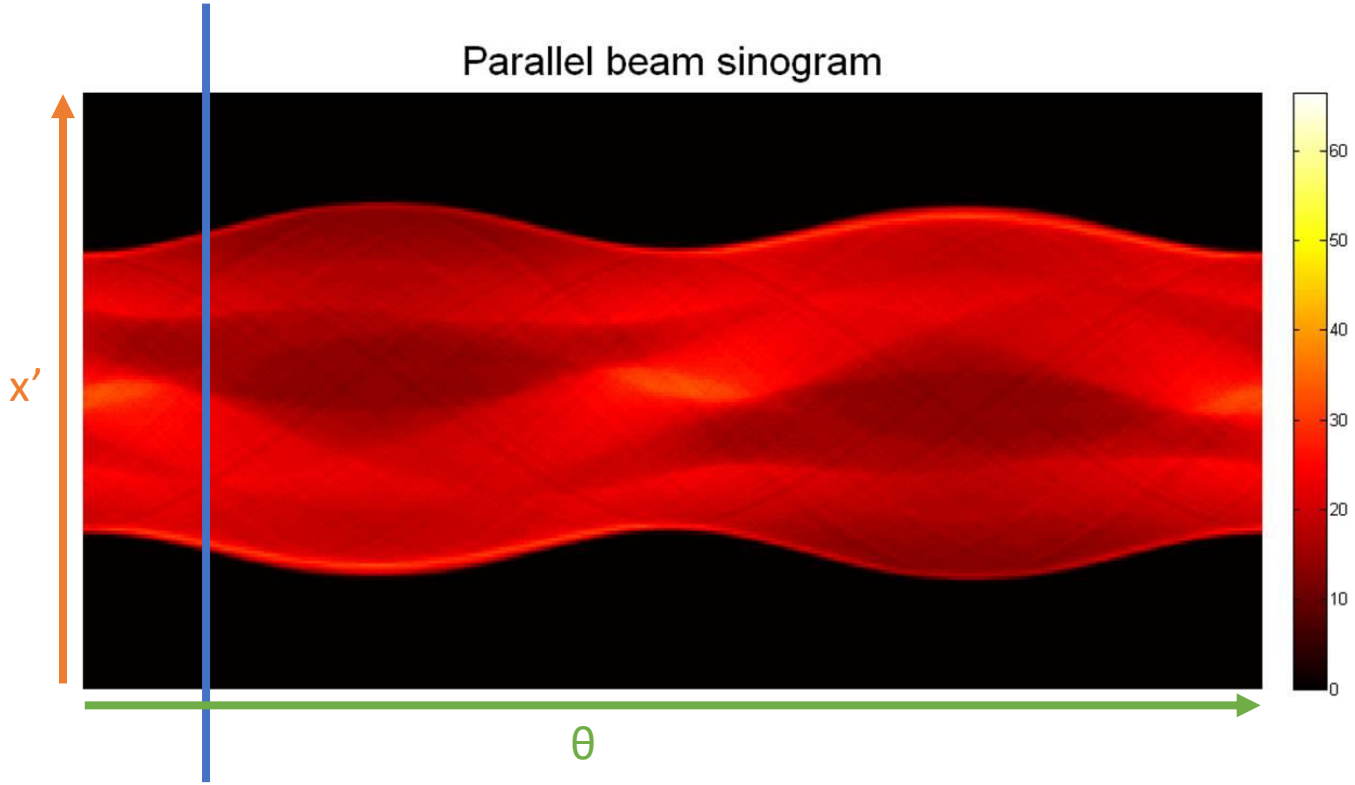


parallel beam



Forward projection

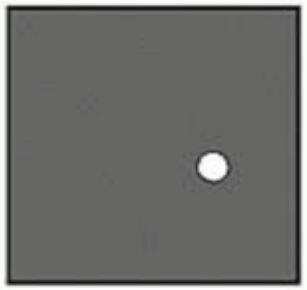


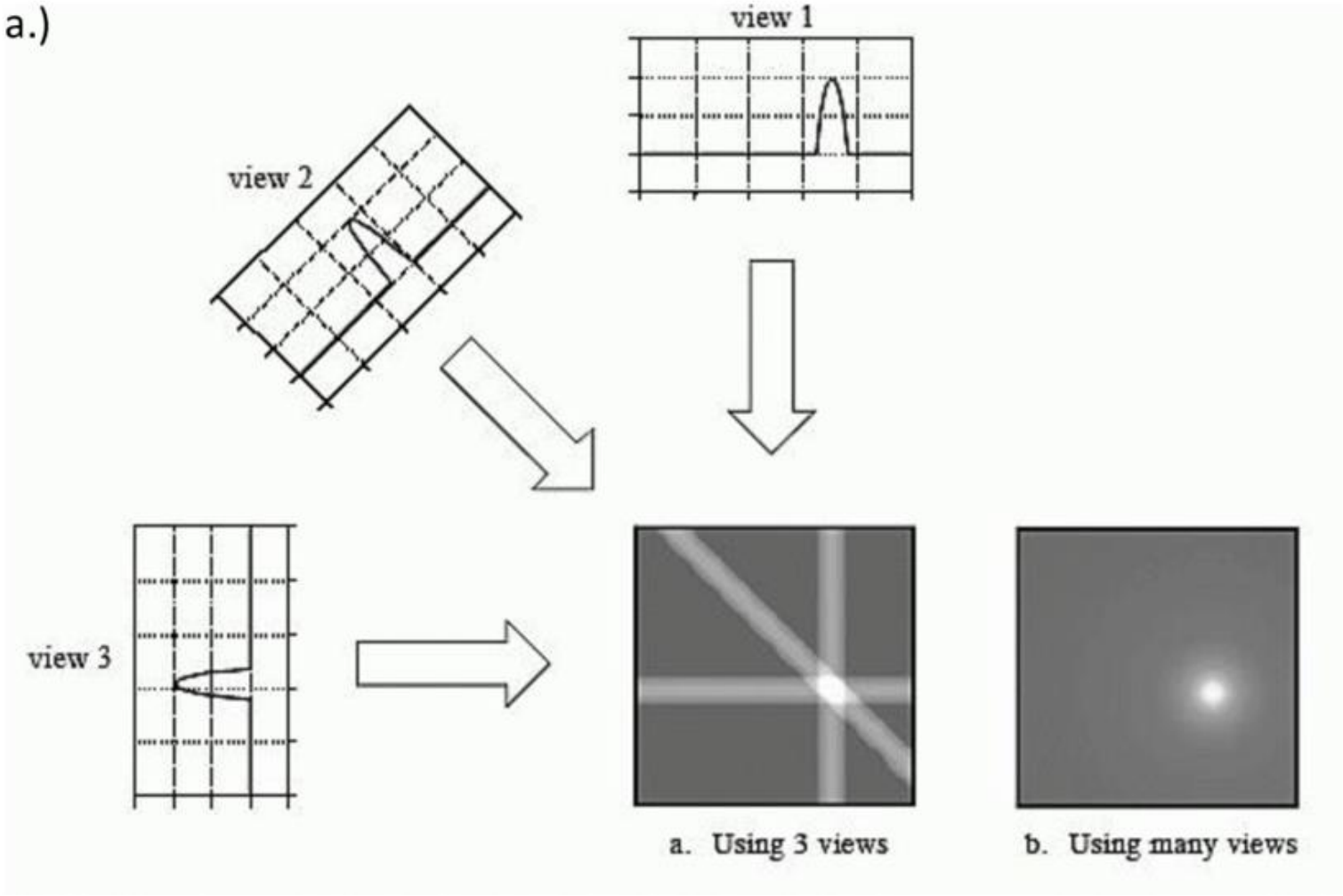


Forward projection: exercises

- Ex. 1-2: generate sinogram with scikit-image package
- Ex. 3: remove artefact from sinogram and reconstruct with scikit-image
- Ex. 4: build your own forward projector

Backprojection



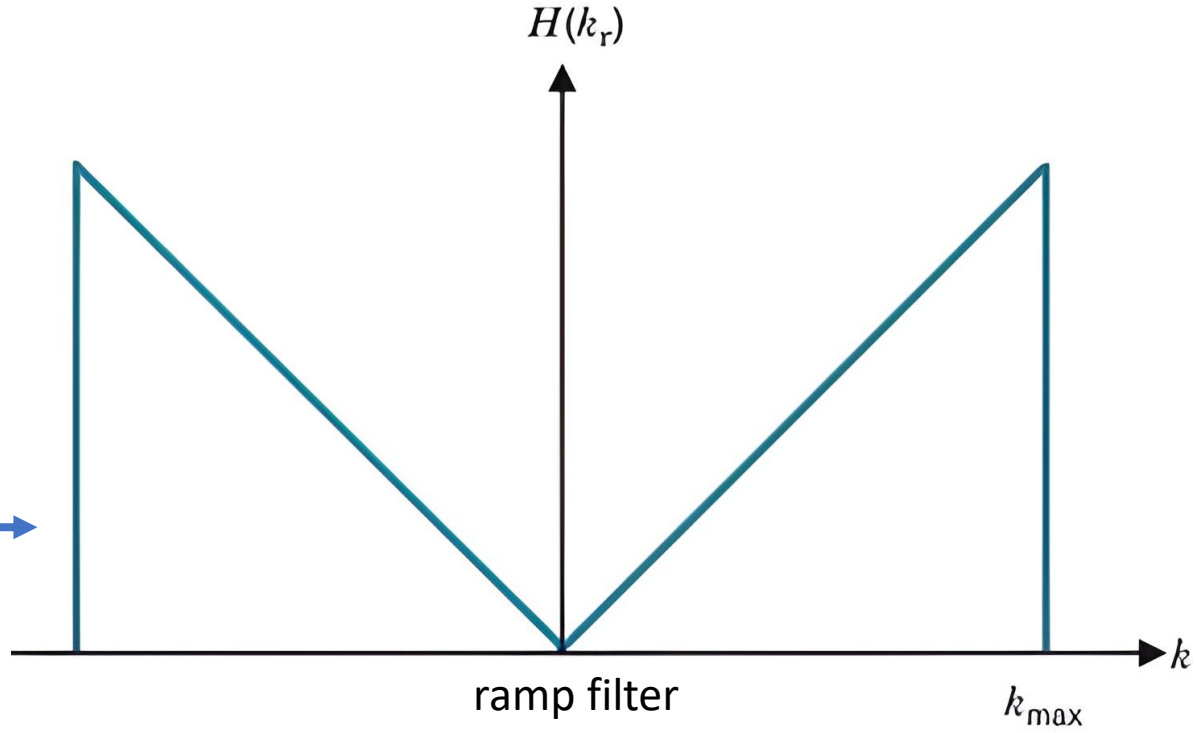


$$h_{BP}(r) = \frac{1}{r} \longrightarrow f_{BP}(x,y) = f(x,y) * \frac{1}{r}$$

Backprojection

$$f_{BP}(x,y) = f(x,y) * \boxed{\frac{1}{r}}$$

FT

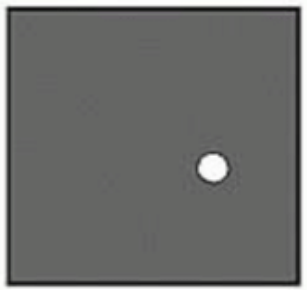


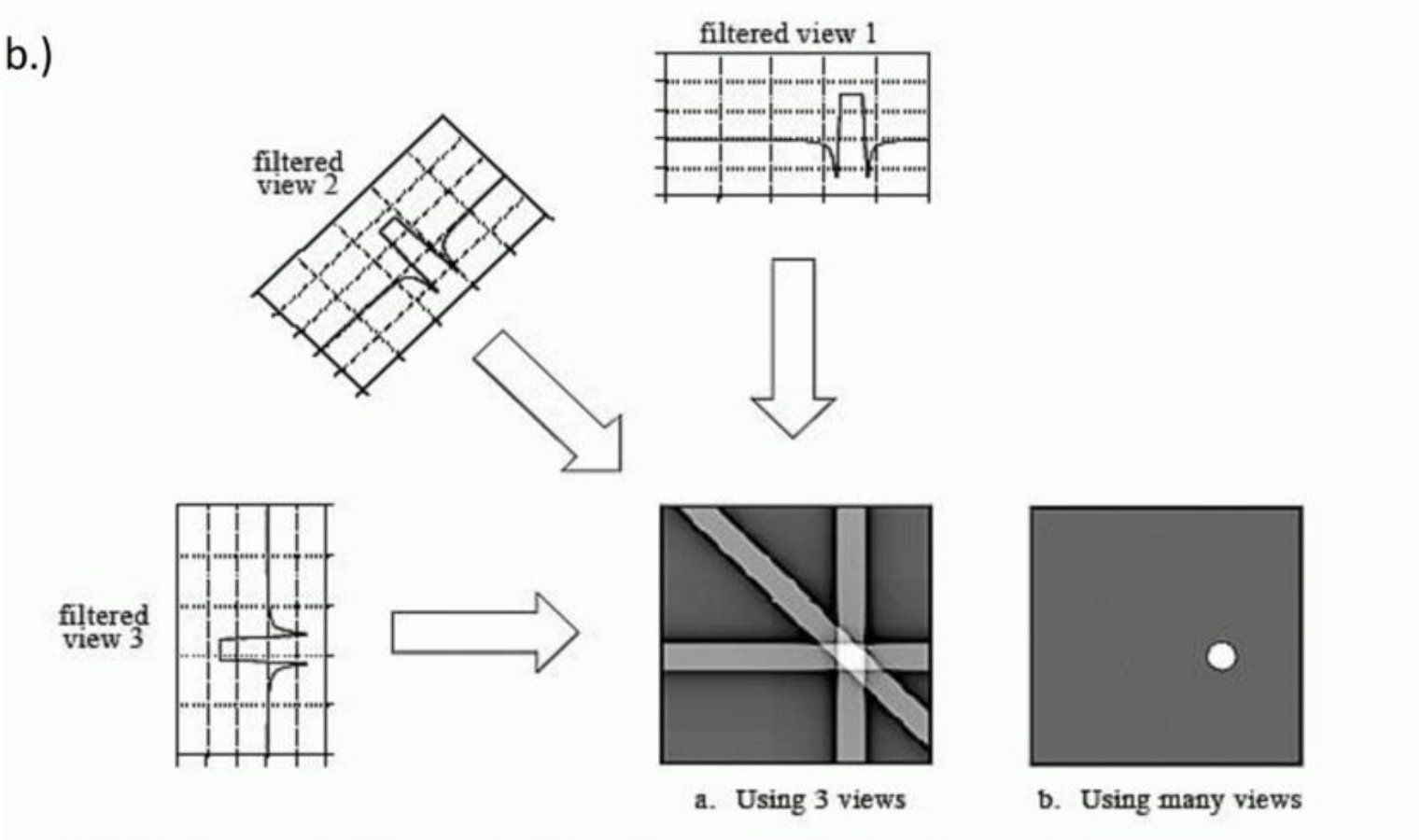
- **Projections** → backproject → 2D FT → 2D ramp filter → 2D IFT → **reconstructed image**

Central slice theorem:

- **Projections** → 1D FT → 1D ramp filter → 1D IFT → backproject → **reconstructed image**

Backprojection





Backprojection: exercises

- Ex. 5: Build your own backprojector
- Ex. 6: Build your own filtered backprojector

DICOM: exercises

- Ex. 7-8: Reading/visualizing DICOM images with pydicom