

# Medical Image Processing for Diagnostic Applications

## Fan Beam – Truncation

Online Course – Unit 41

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Pattern Recognition Lab (CS 5)



# Topics

## What is Truncation?

### Summary

Take Home Messages

Further Readings

## Example: Homogeneous Cylinder

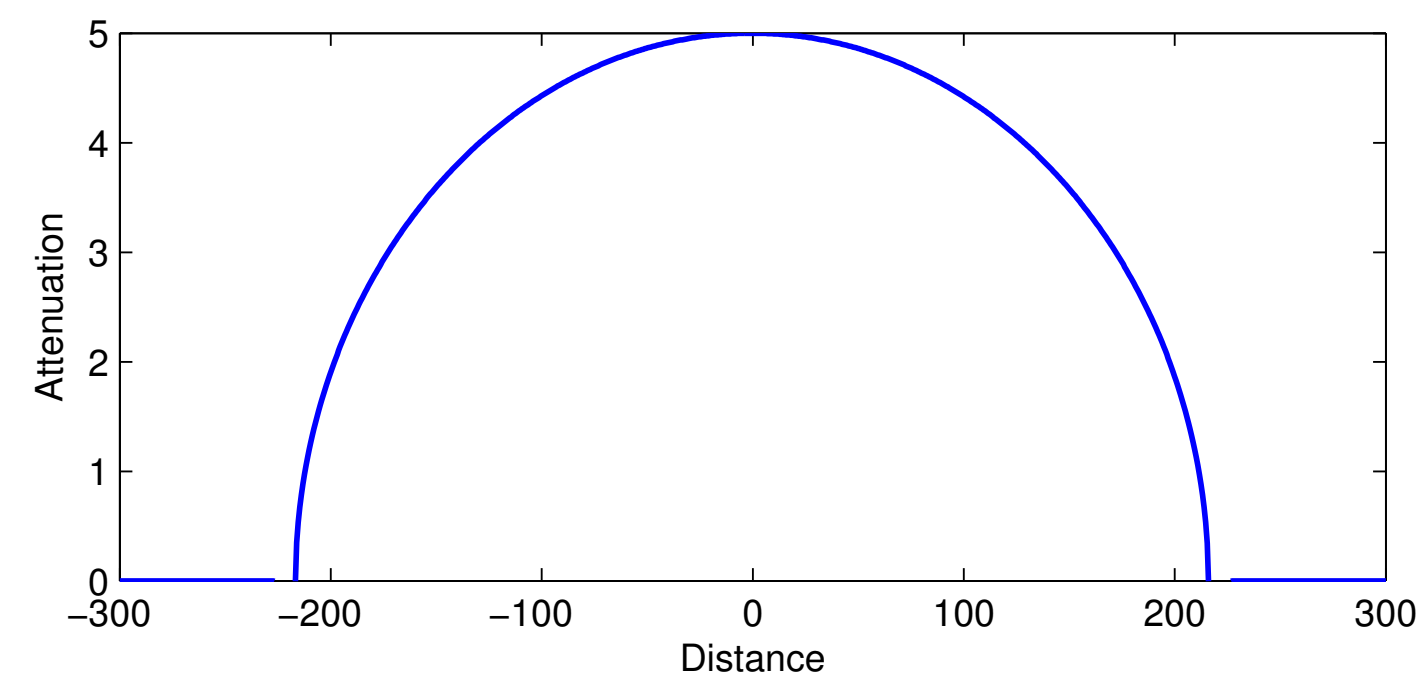
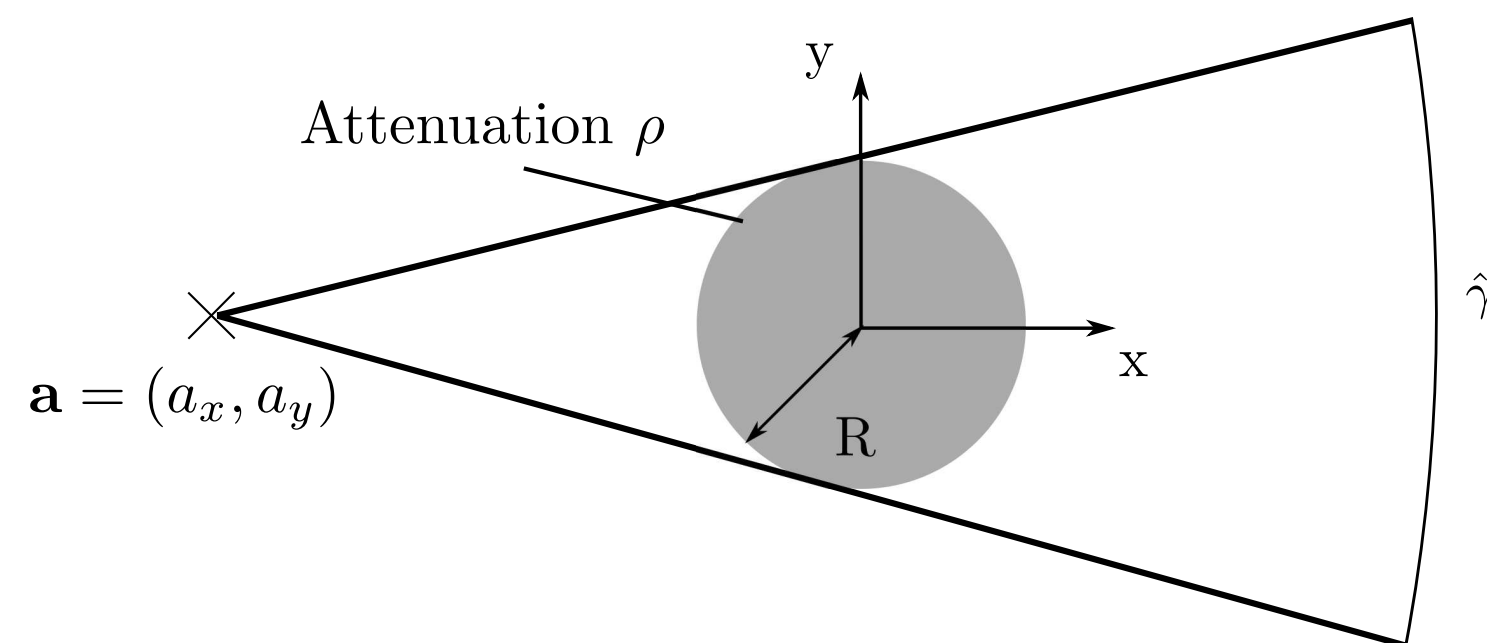


Figure 1: Complete object in field of view

## Example: Homogeneous Cylinder

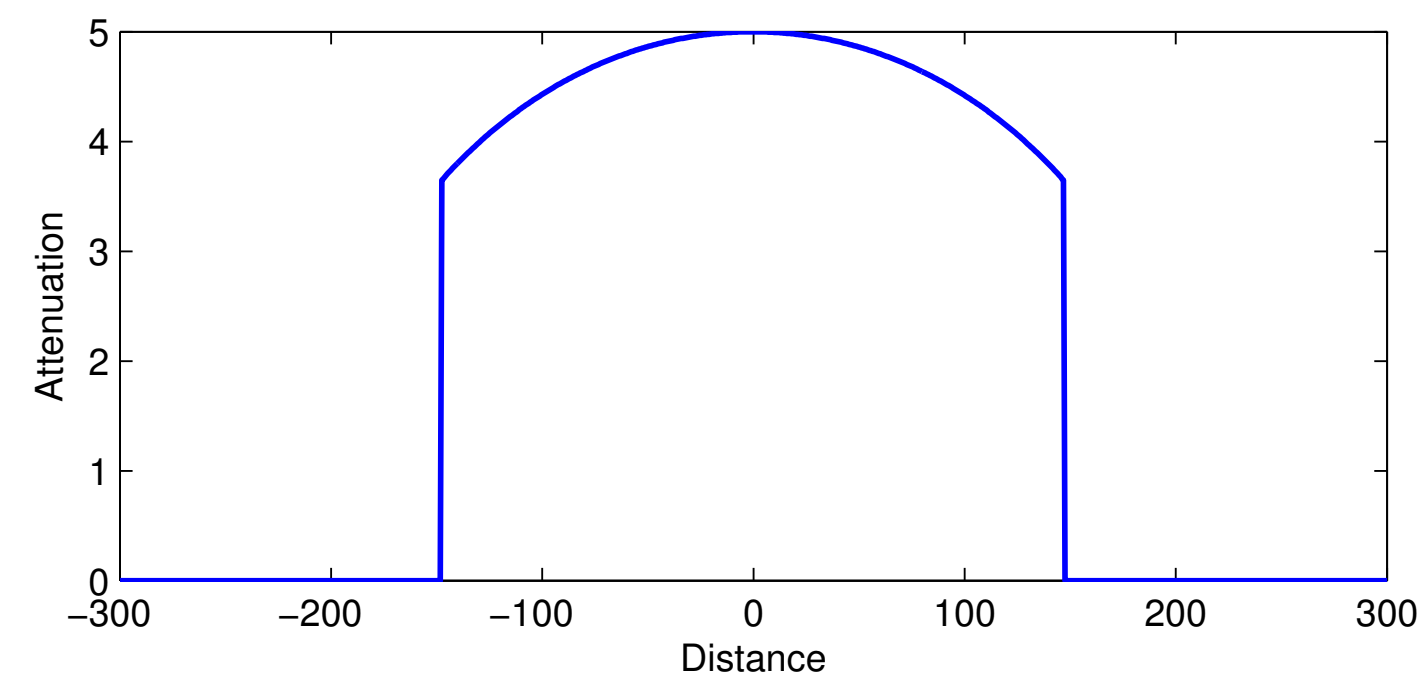
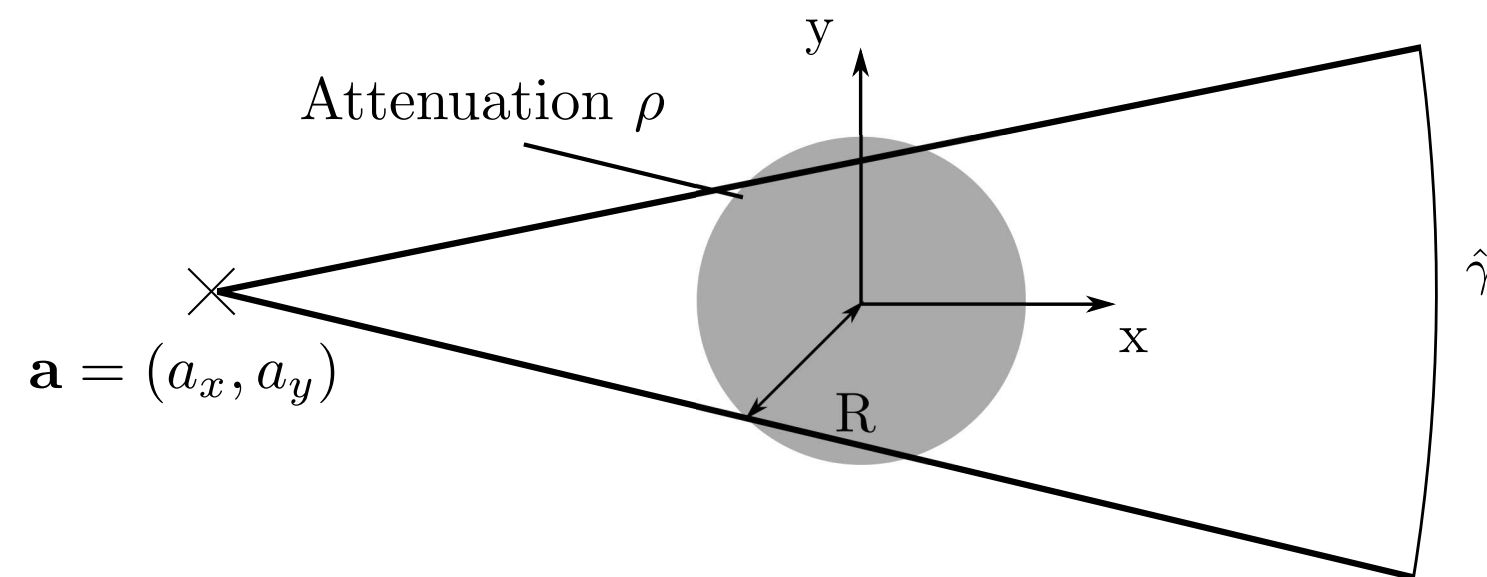


Figure 2: Truncated object projection

## Example: Homogeneous Cylinder

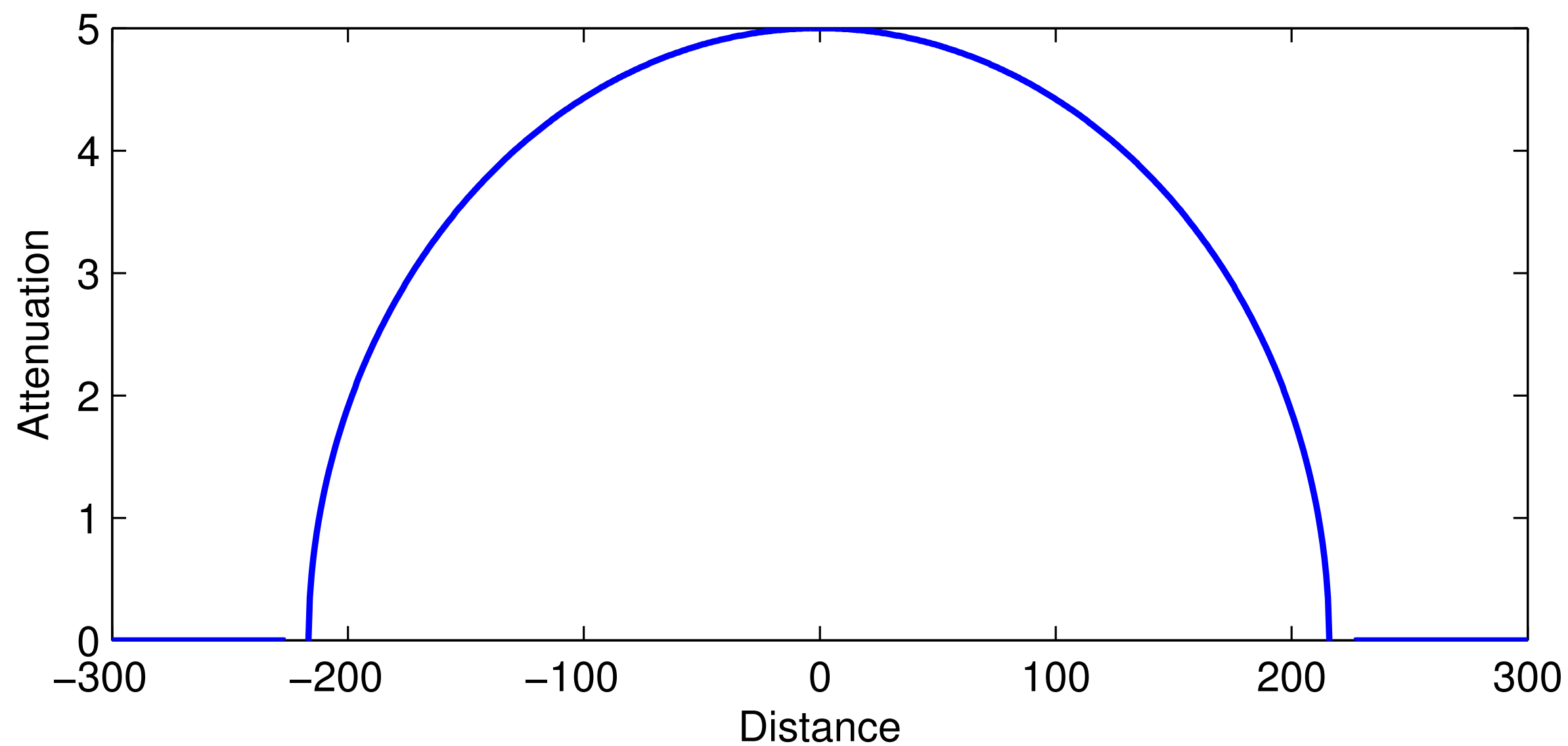


Figure 3: Full projection of the cylinder

## Example: Homogeneous Cylinder

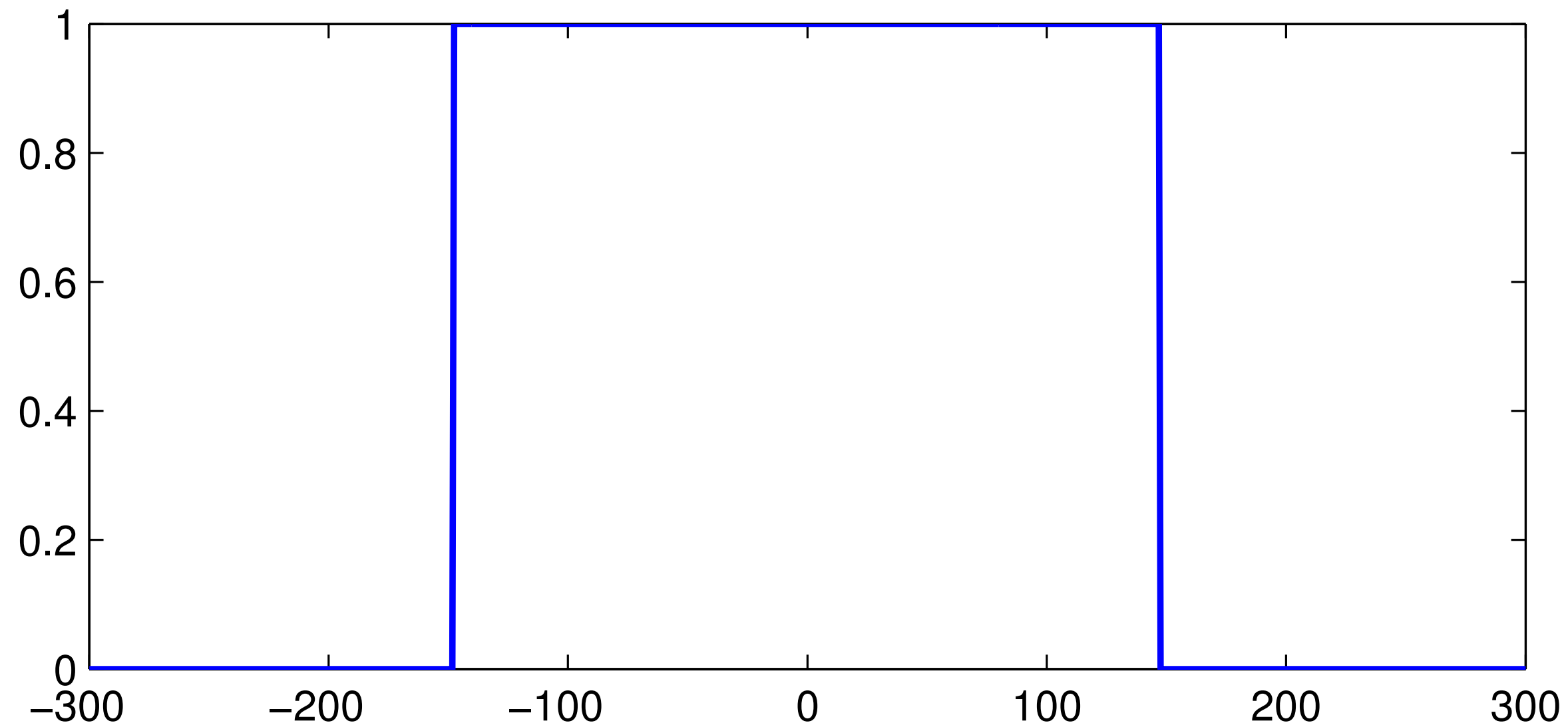


Figure 4: Truncation function

## Example: Homogeneous Cylinder

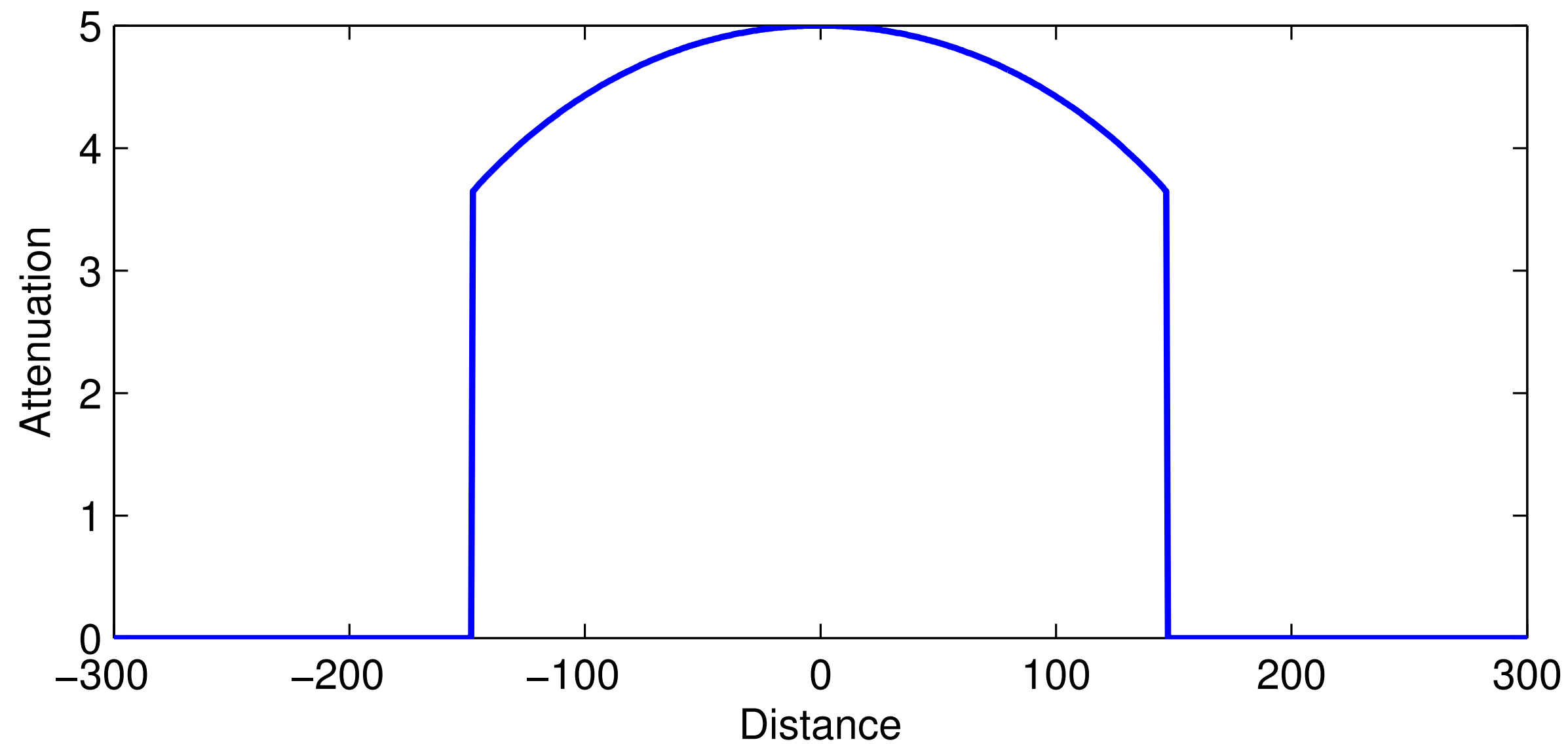


Figure 5: Truncated object in the projection

## Example: Filter Results

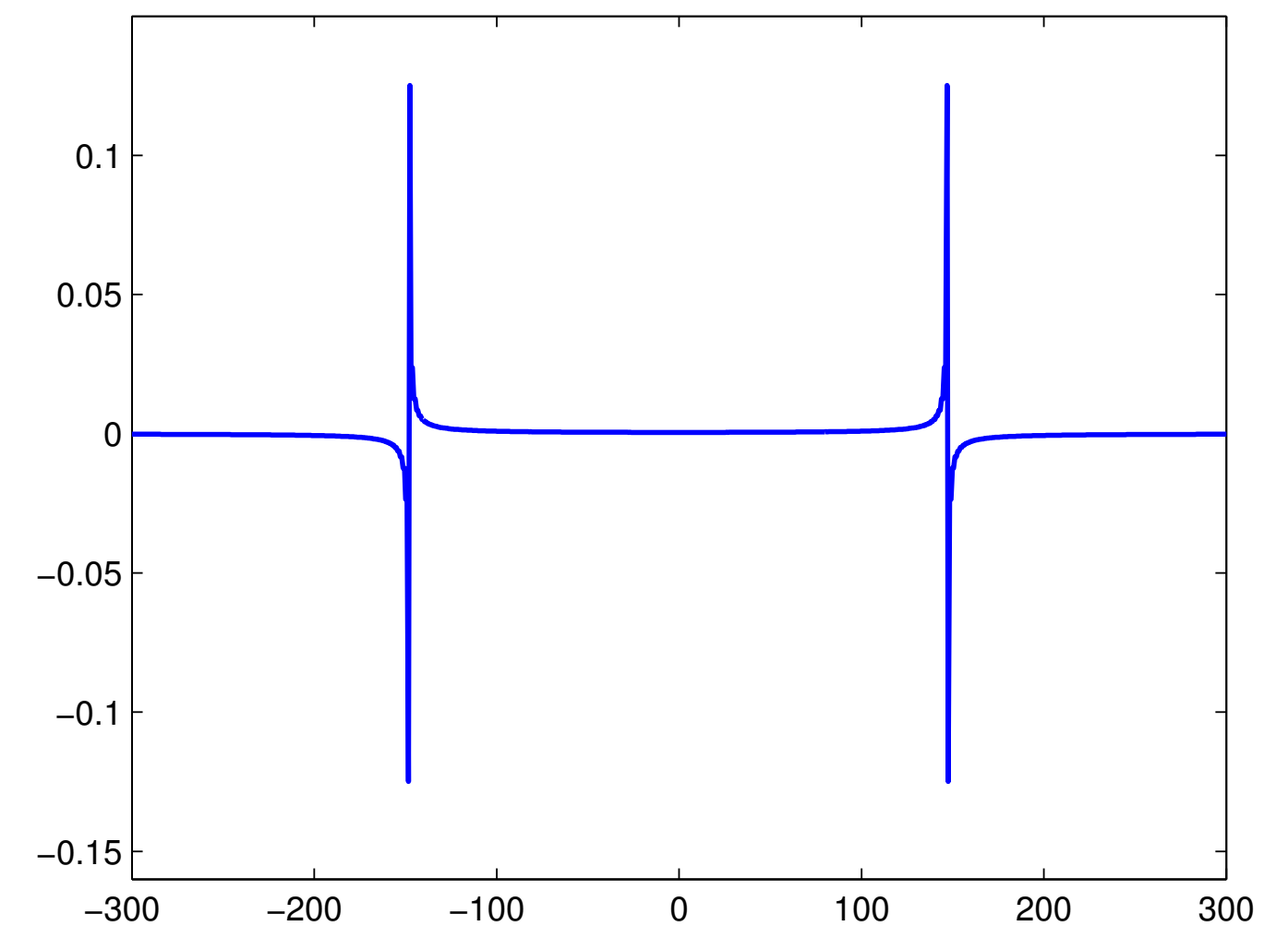
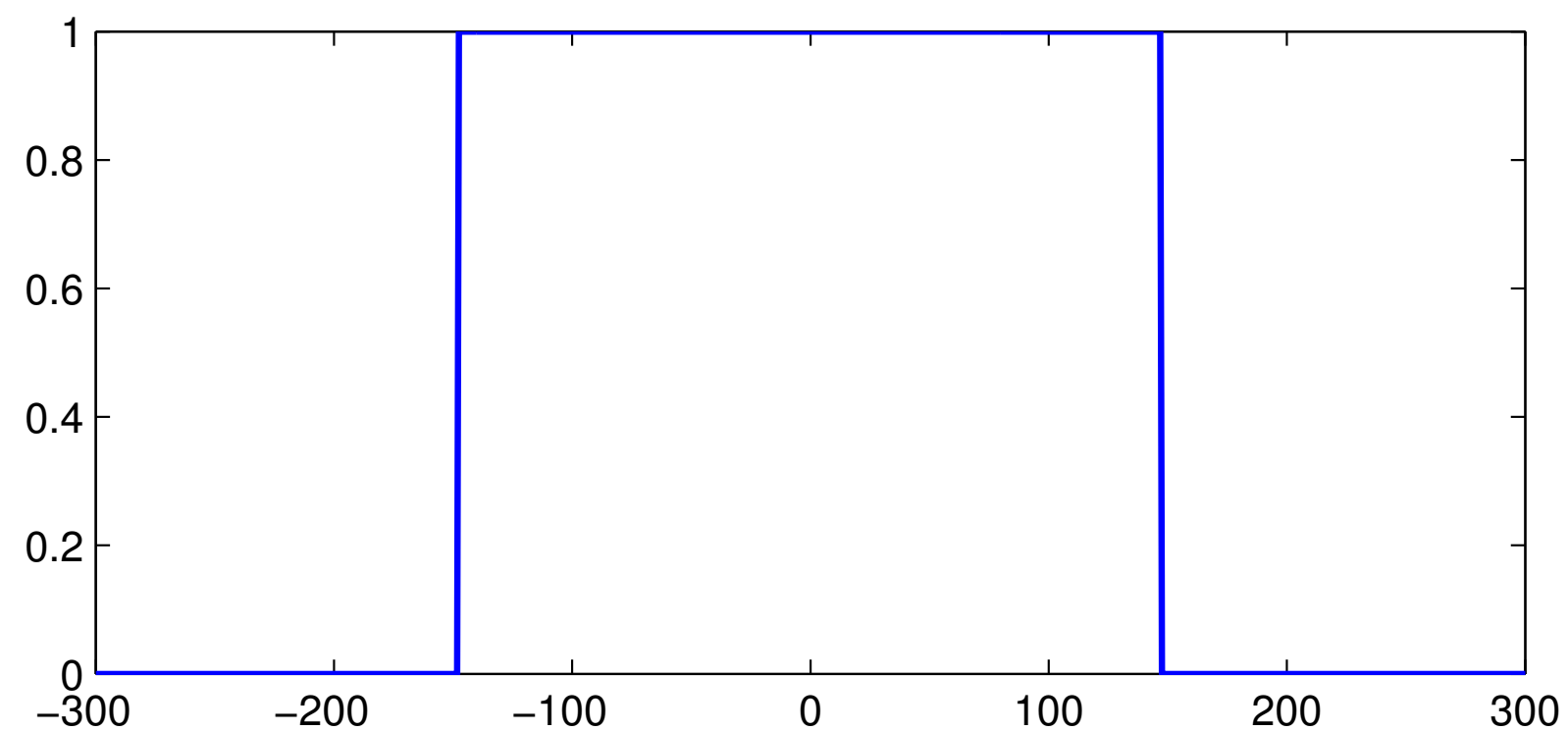


Figure 6: Filter result for the truncation function



## Example: Filter Results

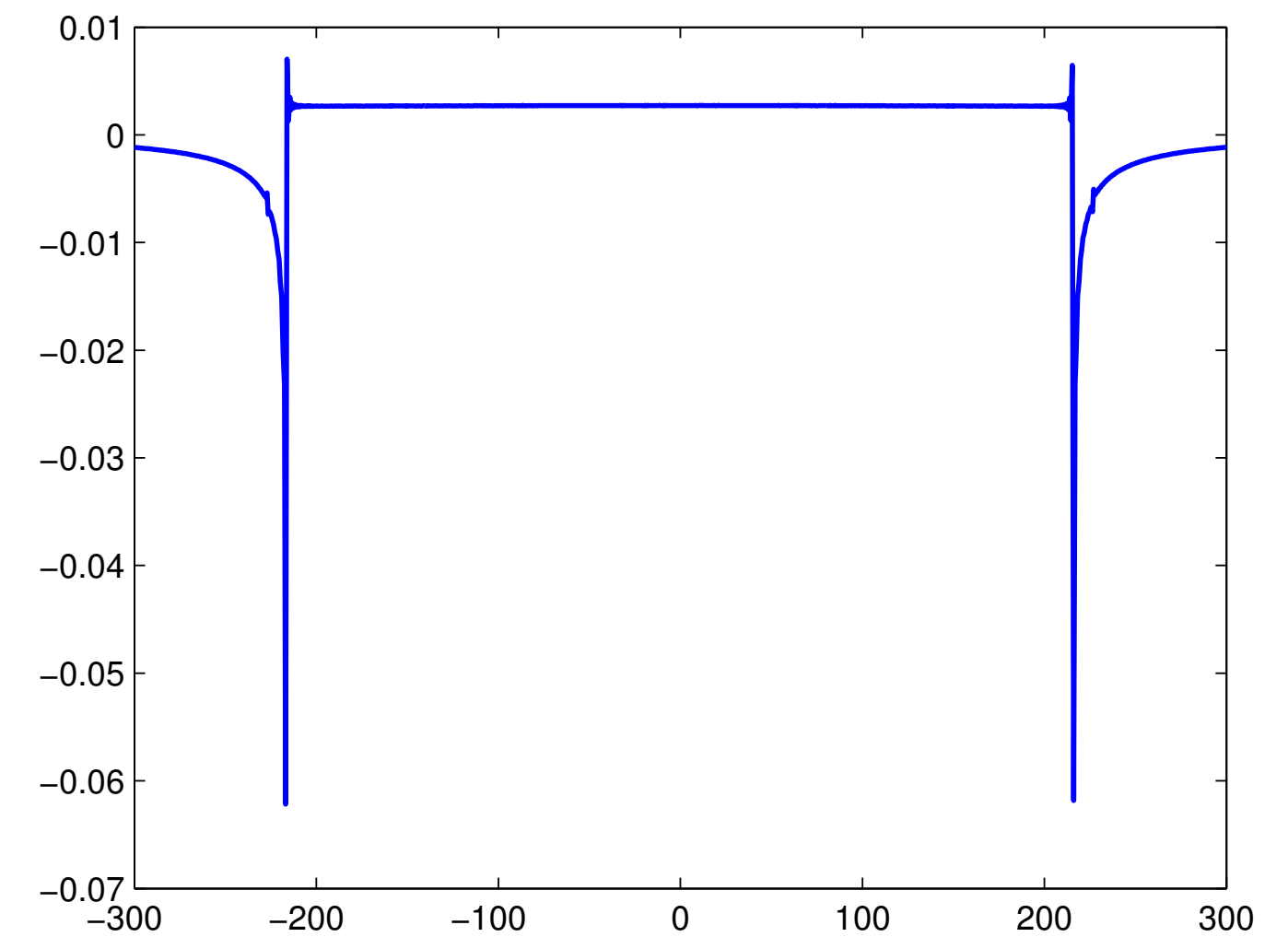
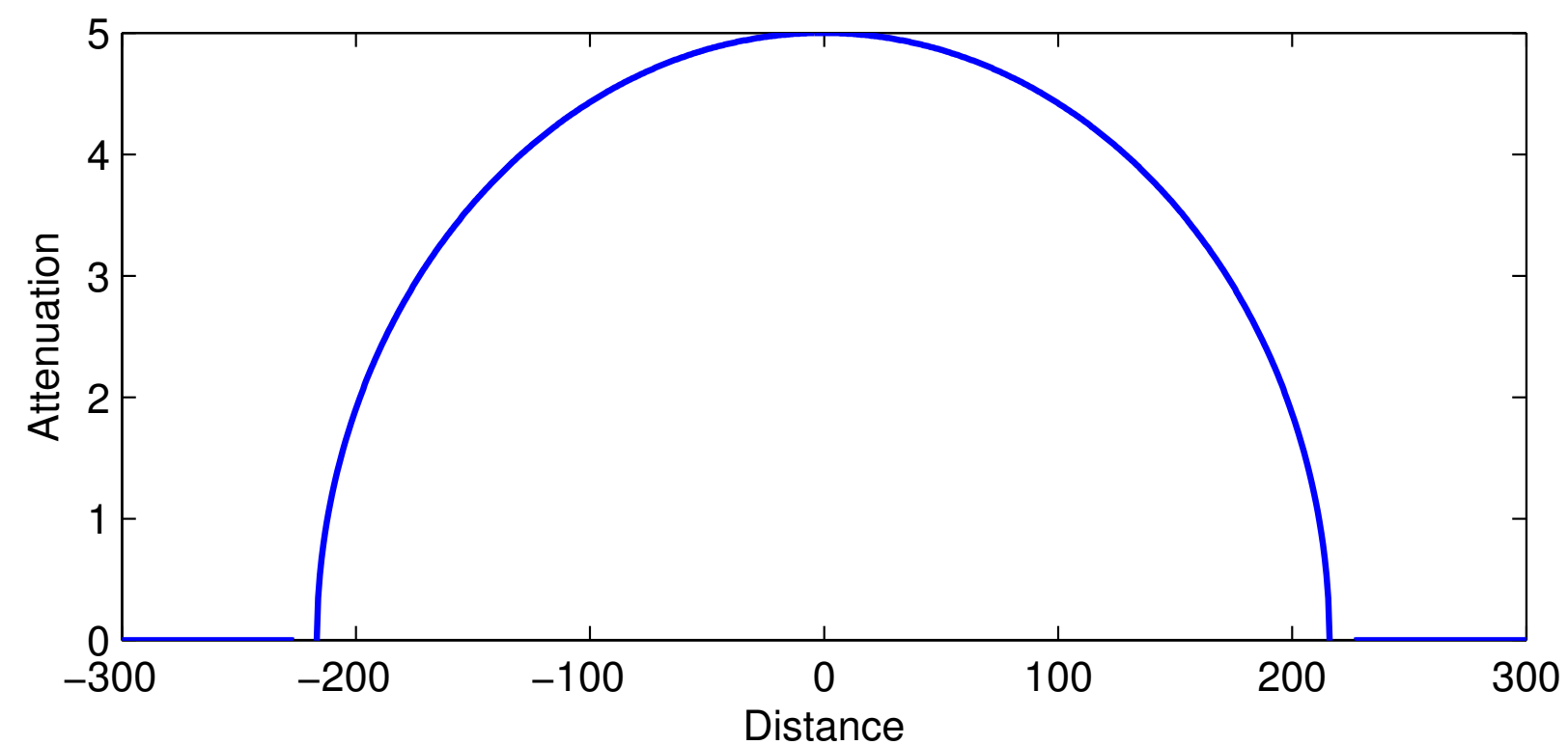


Figure 7: Filter result for the full projection

## Example: Filter Results

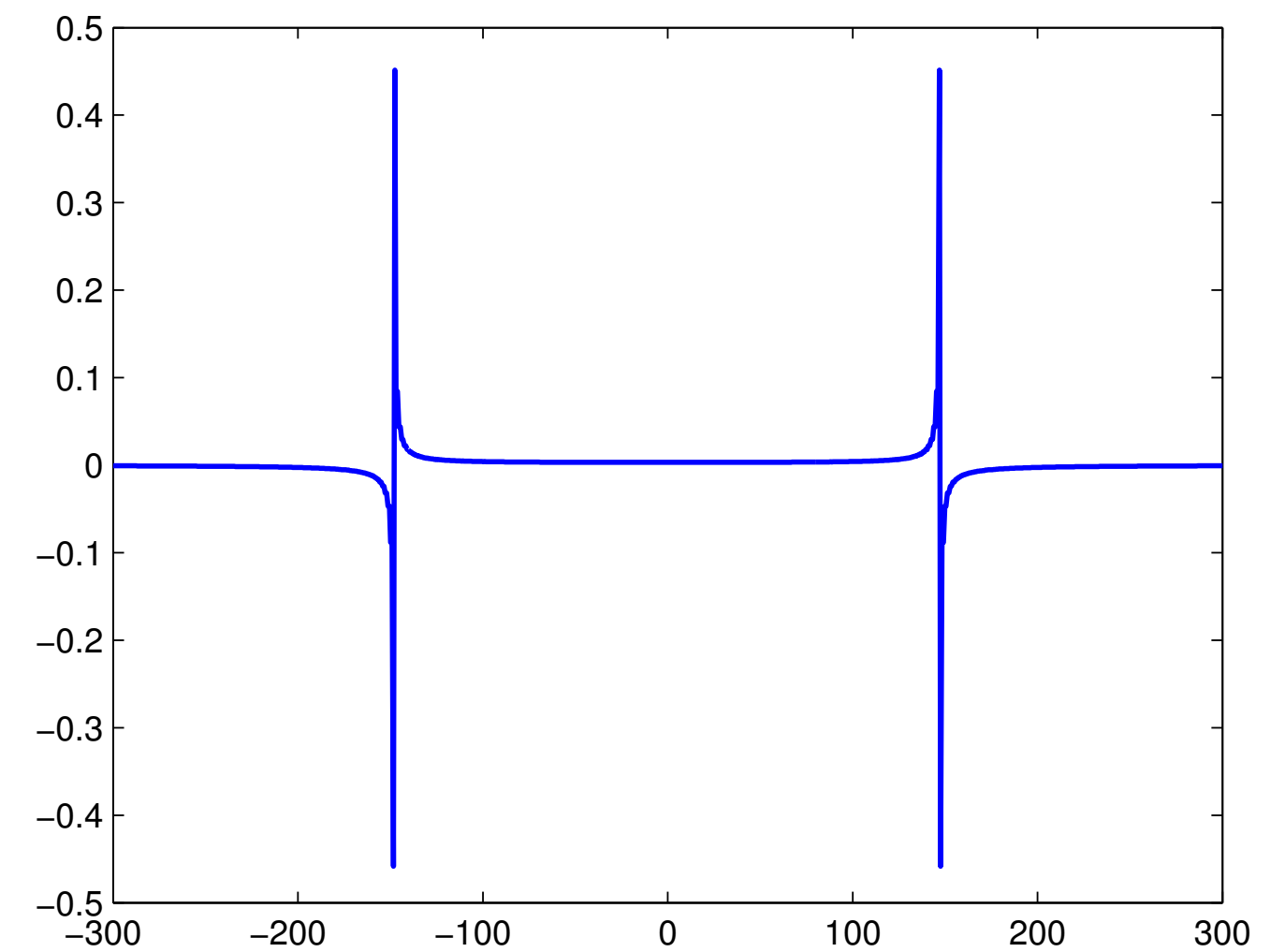
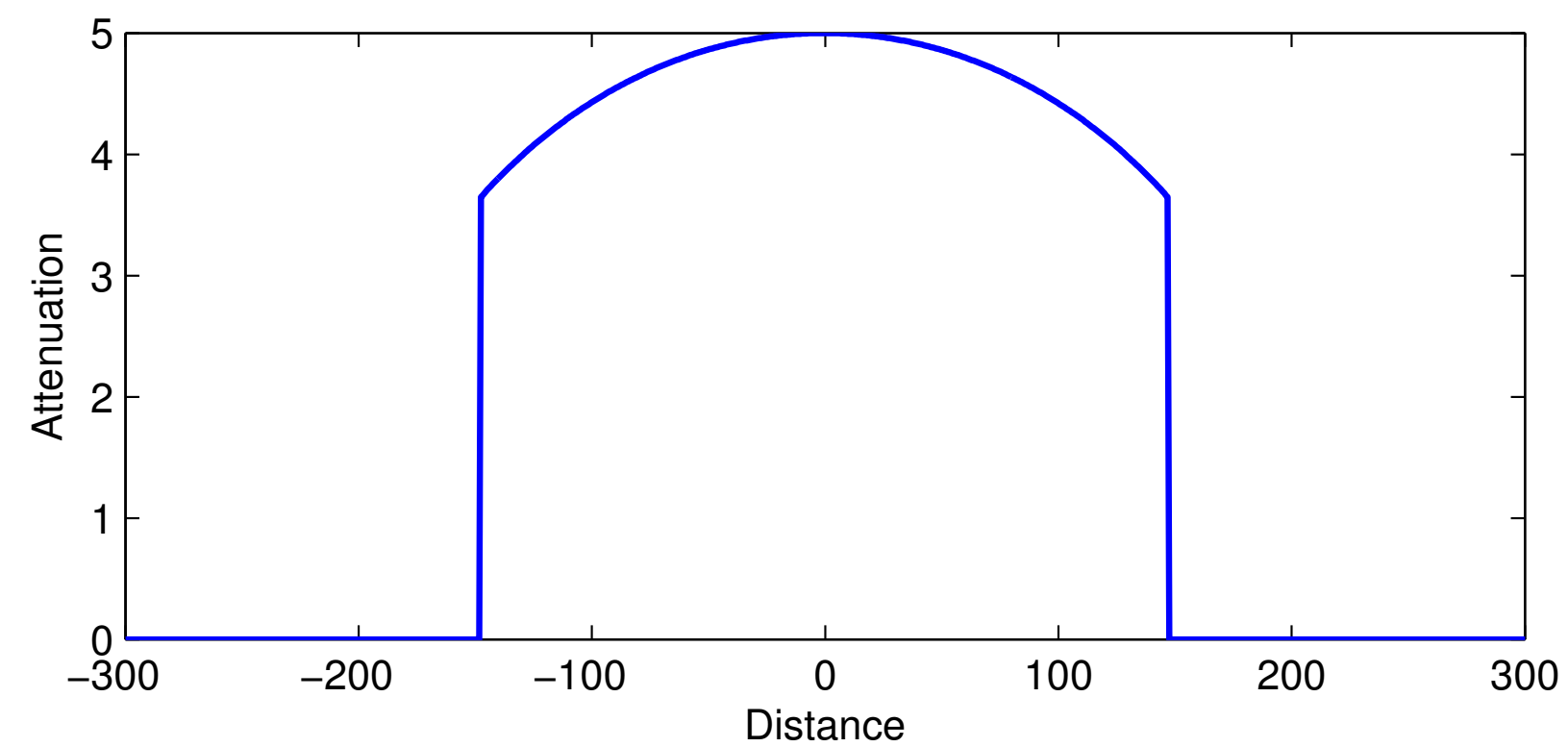


Figure 8: Filter result for the truncated projection

## Example: Shepp-Logan Phantom

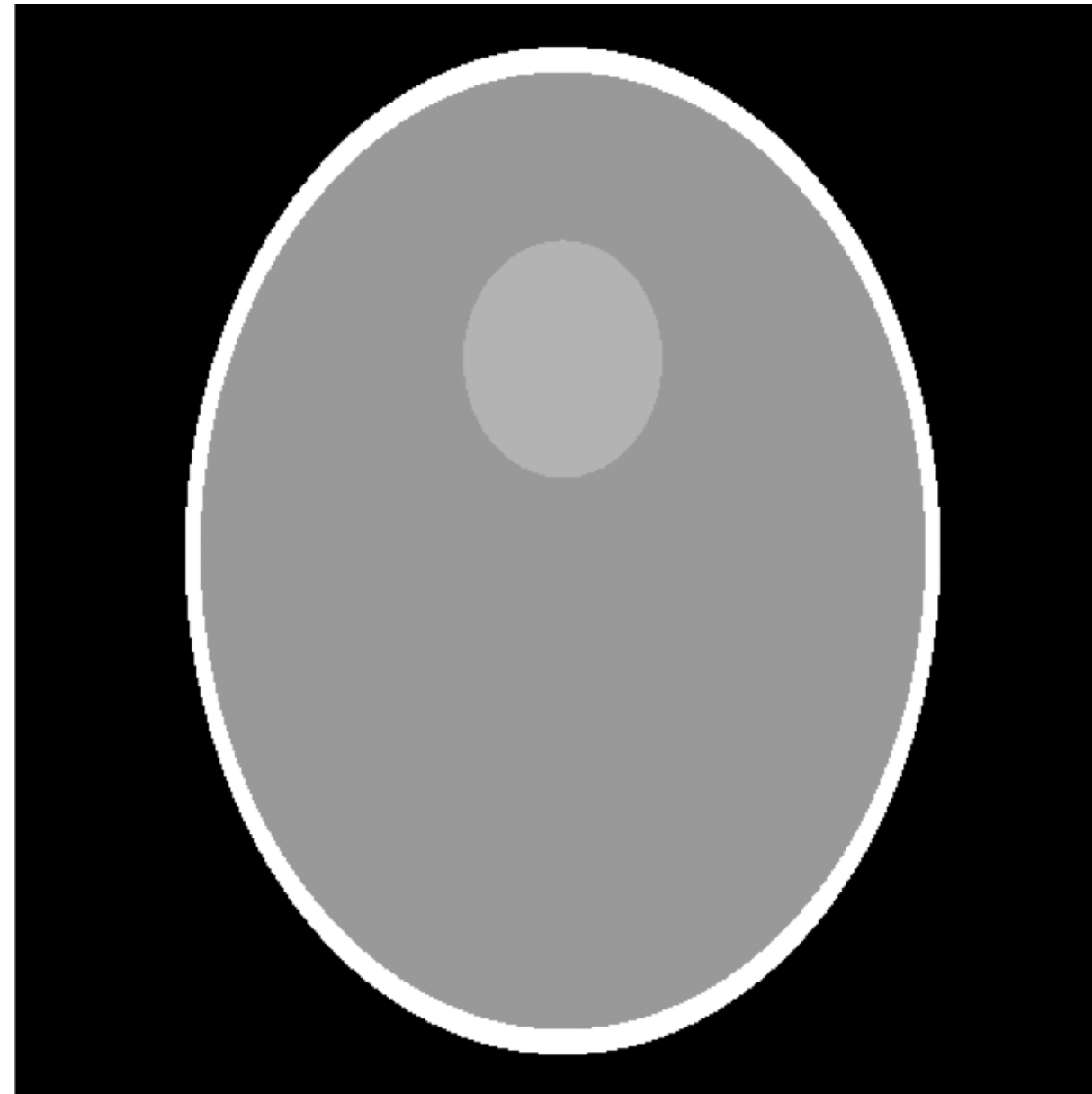


Figure 9: Original Shepp-Logan phantom

## Example: Shepp-Logan Phantom

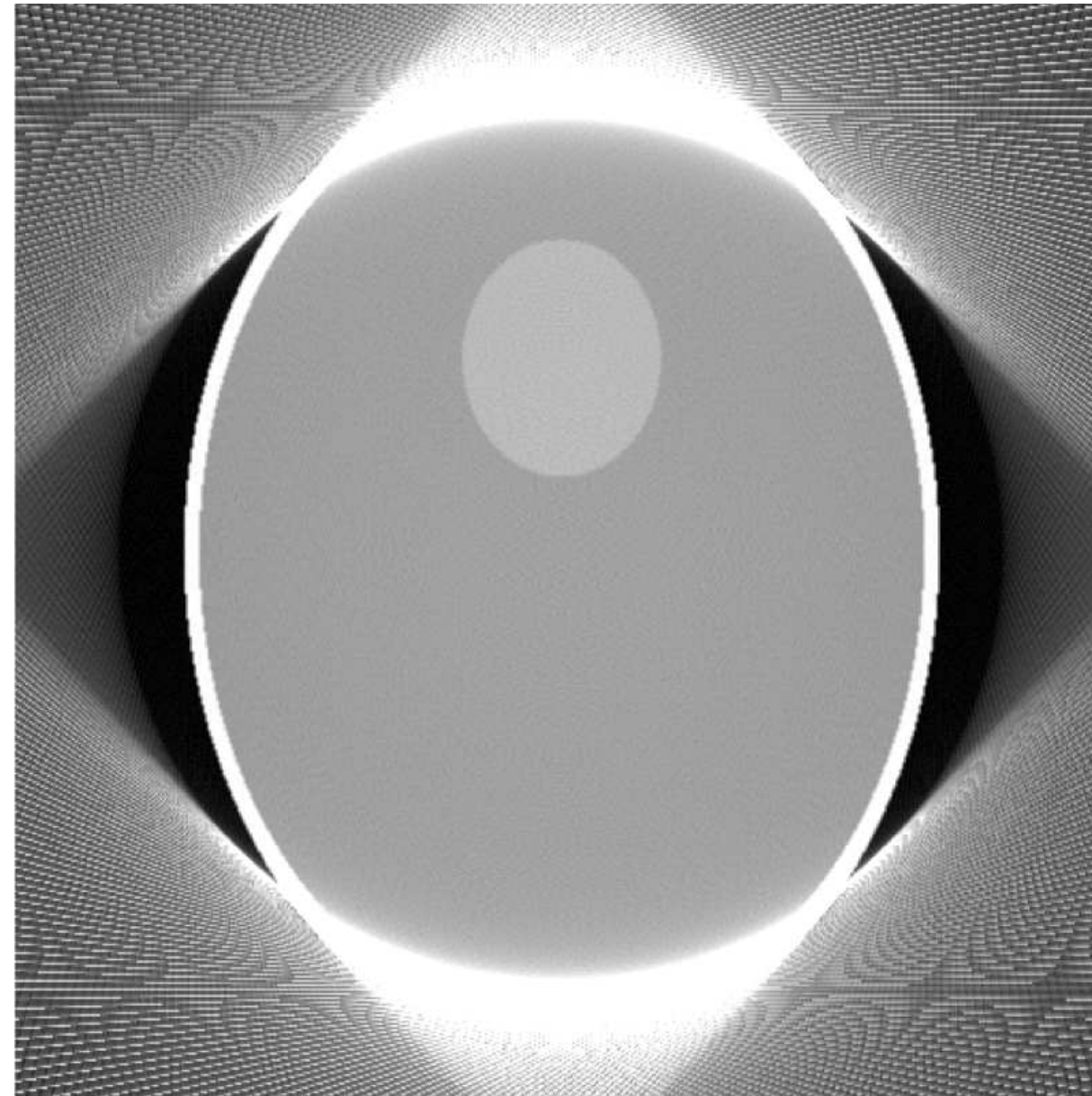


Figure 10: Shepp-Logan phantom with truncation artifact

## Truncation ...

- ... happens when the imaged object extends the field of view.
- ... can be modeled as a multiplication with a rectangular window function in spatial domain.
- ... introduces artificial frequencies into the reconstruction.
- ... causes a typical artifact at the end of the field of view.

# Topics

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Further Readings

## Take Home Messages

- If the field of view is too small for the scanned object (or the source too closely positioned), truncation takes effect on the projections and therefore on the reconstruction result.
- Truncation artifacts can heavily degrade the image quality of a reconstruction output.

## Further Readings

Helpful reads for the current unit:

- B. Ohnesorge et al. “Efficient Correction for CT Image Artifacts Caused by Objects Extending Outside the Scan Field of View”. In: *Medical Physics* 27.1 (Oct. 2000), pp. 39–46. DOI: 10.1118/1.598855
- L. A. Shepp and Logan B. F. “The Fourier Reconstruction of a Head Section”. In: *IEEE Transactions on Nuclear Science* 21.3 (June 1974), pp. 21–43. DOI: 10.1109/TNS.1974.6499235
- W. P. Segars et al. “Realistic CT Simulation Using the 4D XCAT Phantom”. In: *Medical Physics* 35.8 (Aug. 2008), pp. 3800–3808. DOI: 10.1118/1.2955743