

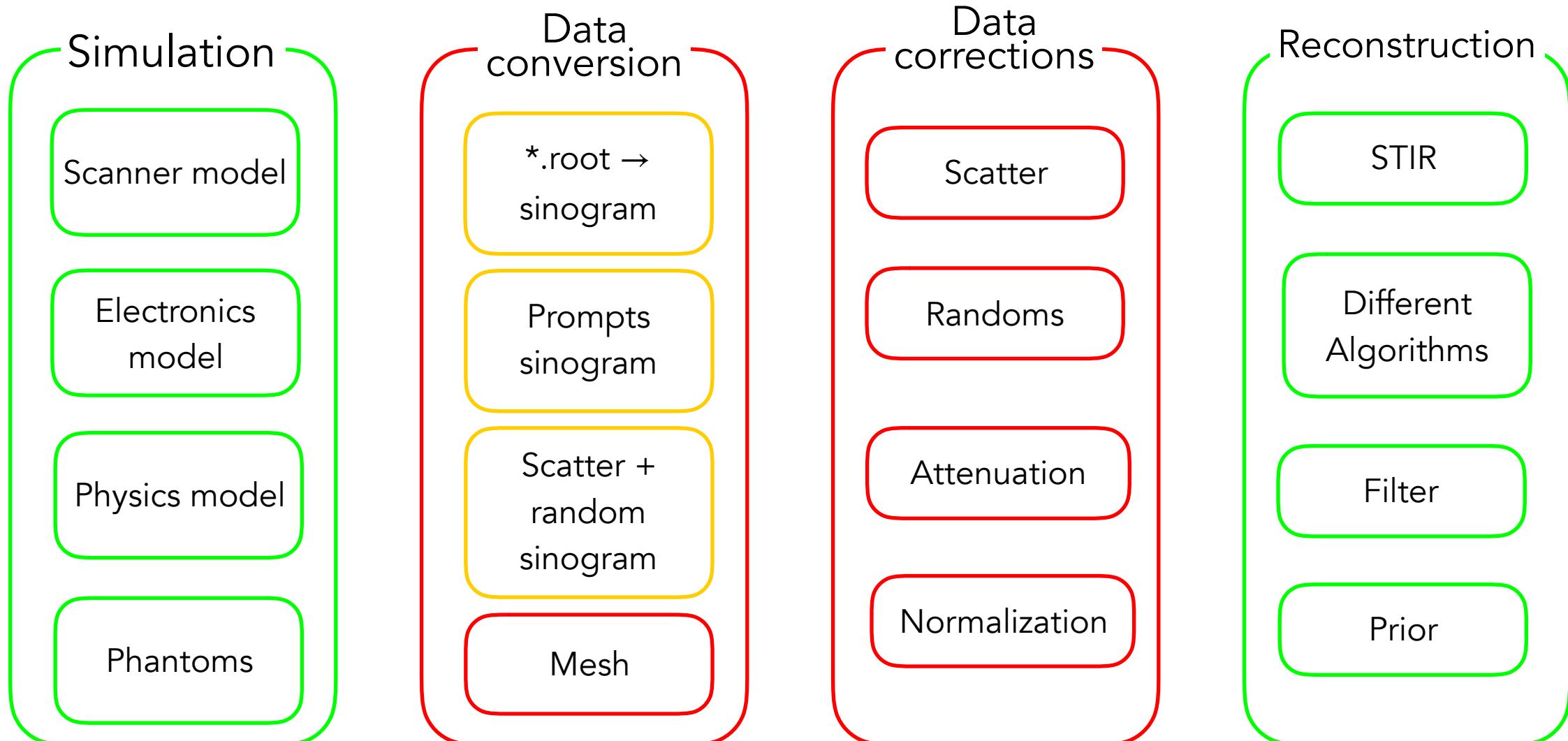
# GATE Simulation to Image Reconstruction with STIR Toolbox

H. Kertész, T. Beyer, J. Cal-Gonzalez

Quantitative Imaging and Medical Physics Group

Center for Medical Physics and Biomedical Engineering, Medical University of Vienna, Austria

# Motivation



What we want?

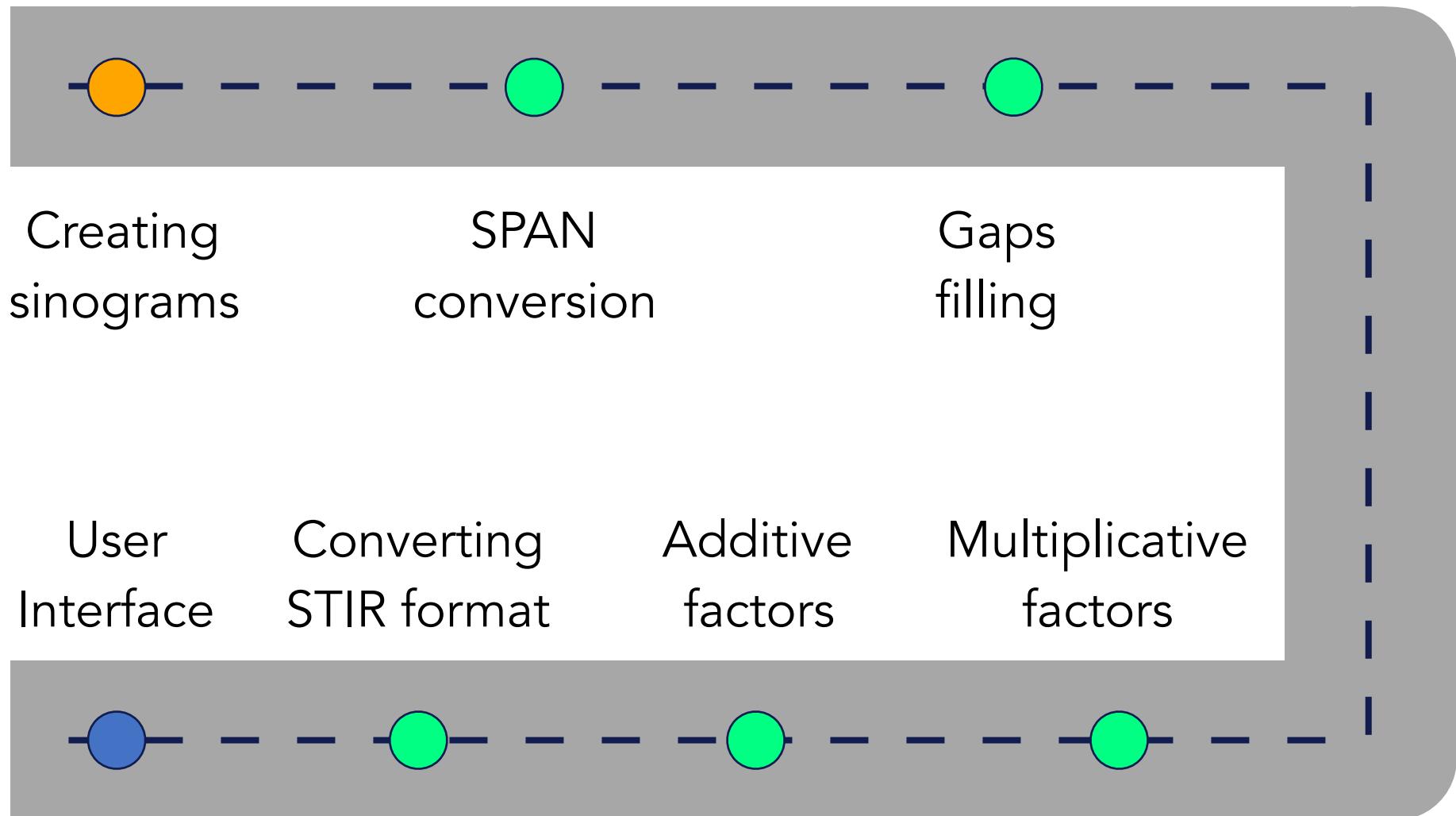
- Fully automated workflow from GATE simulations to STIR image reconstruction
  - Easy to use

What we have?

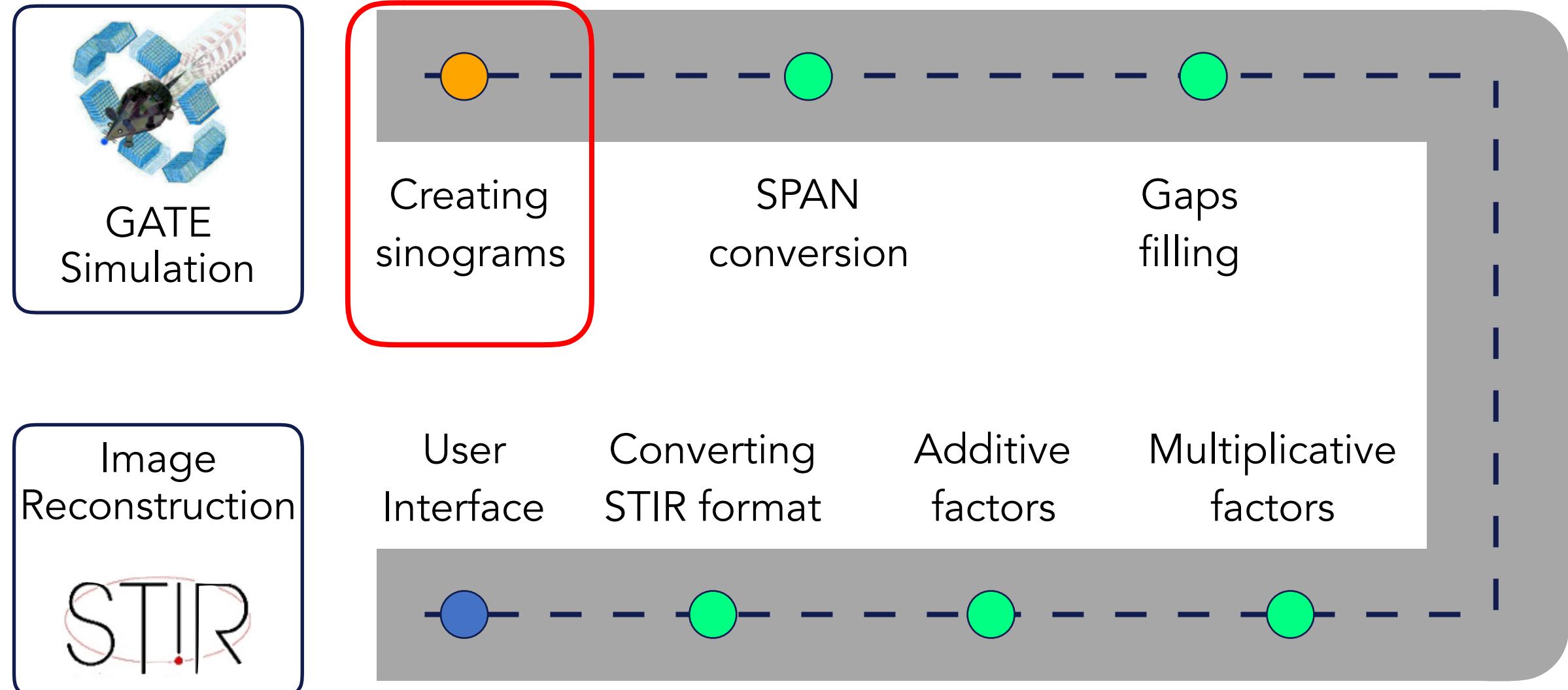
- Not a software developer
- C++, Matlab, Qt framework

	<b>Siemens Biograph mMR (PET/MRI)</b>	<b>Siemens Biograph TruePoint TrueView (PET/CT)</b>
<b>Detector ring diameter</b>	656 mm	842 mm
<b>Transaxial FOV</b>	588 mm	605 mm
<b>Axial FOV</b>	258 mm	216 mm
<b>Detector material</b>	Lutetium Oxyorthosilicate (LSO)	
<b>Crystal dimensions</b>	4 x 4 x 20 mm	
<b>Crystals per detector block</b>	64	52
<b>Number of detector rings</b>	8	4
<b>Image size</b>	344 x 344 x 127	336 x 336 x109

# Workflow

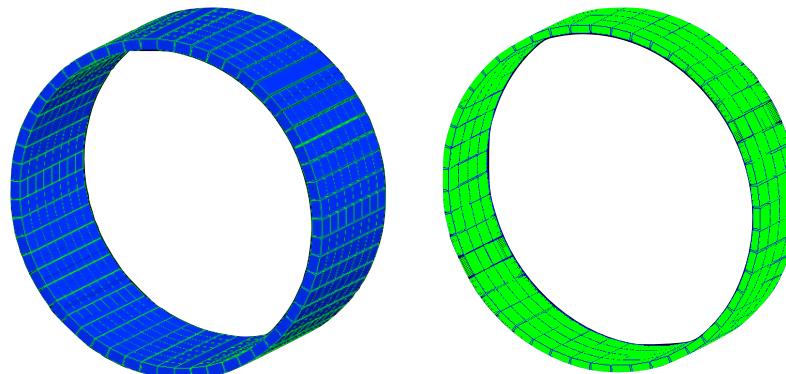


# Workflow



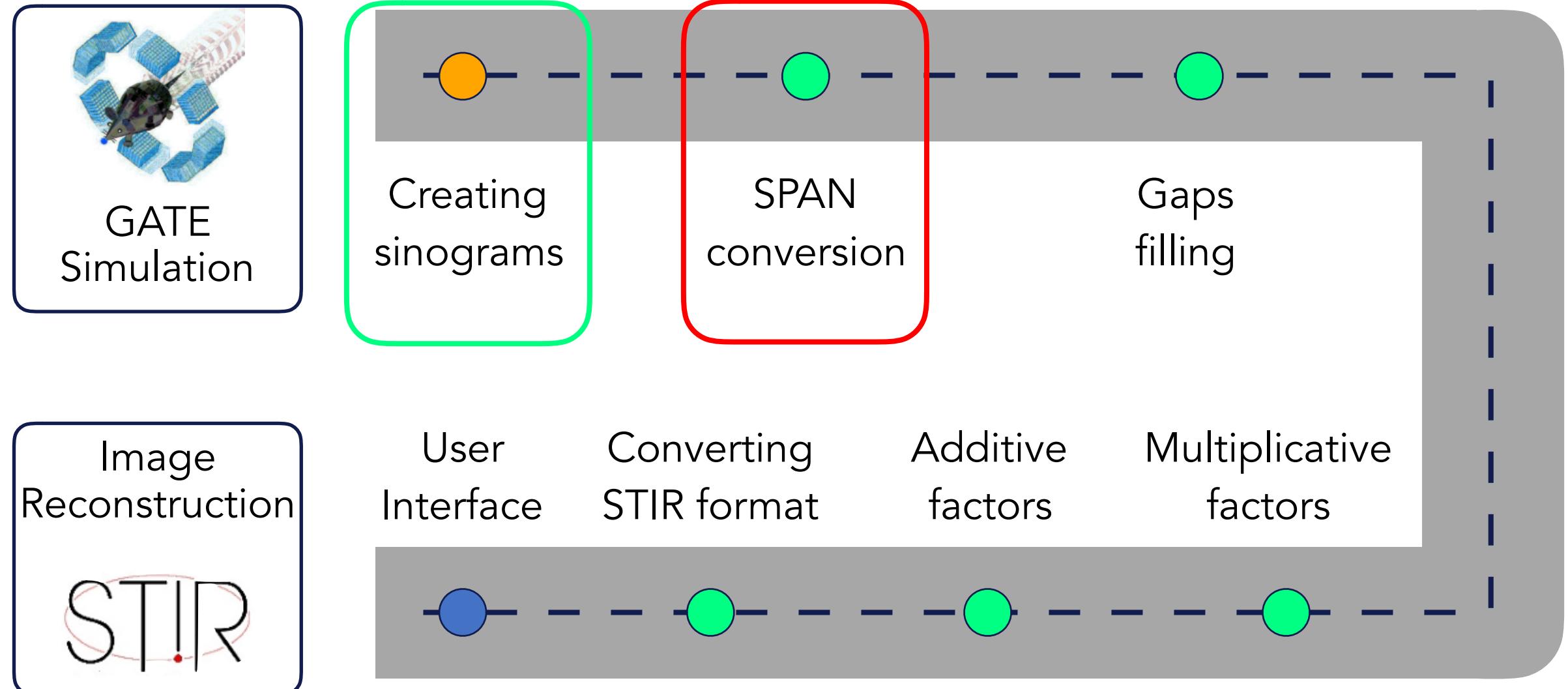
# Creating sinograms

- Ross Schmidlein and Sadek Nehmeh
  - [http://www.opengatecollaboration.org/sites/default/files/Bin\\_GATE\\_v1.0.c](http://www.opengatecollaboration.org/sites/default/files/Bin_GATE_v1.0.c)
- Nikos Eftimiou
  - <https://sourceforge.net/projects/gatepet2stir/>
- Michelogram and Sinograms
  - Prompts sinogram | Randoms + Scatter Sinogram



- Siemens Biograph TruePoint TrueView PET/CT
- Siemens Biograph mMR PET/MRI

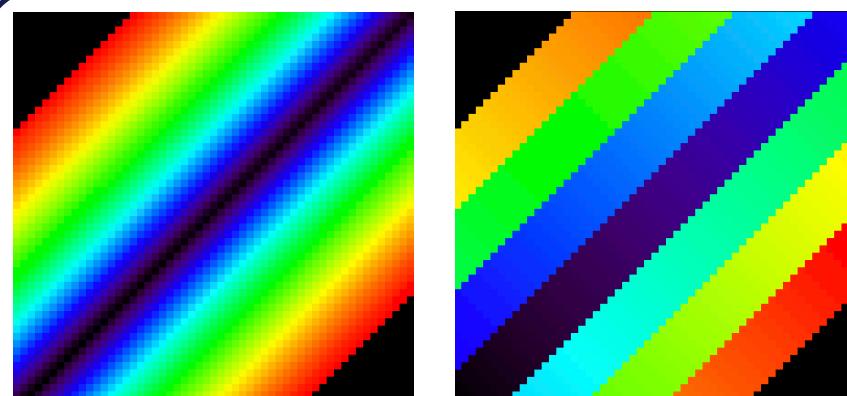
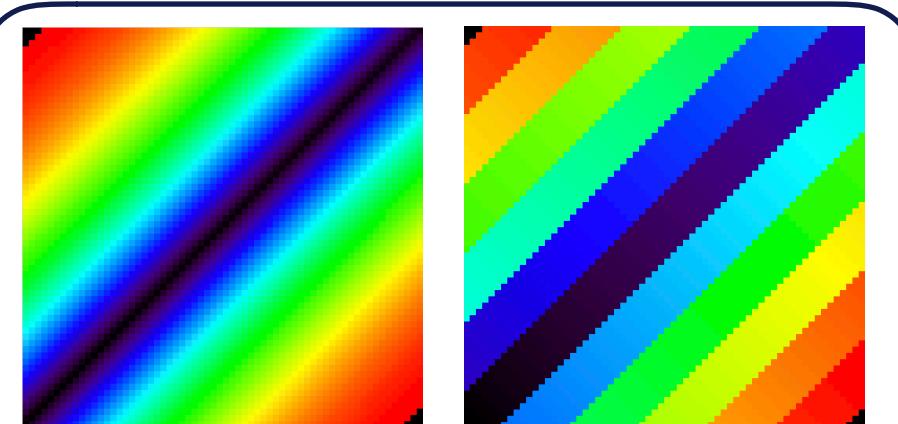
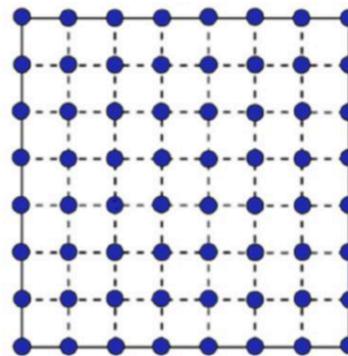
# Workflow



# SPAN conversion

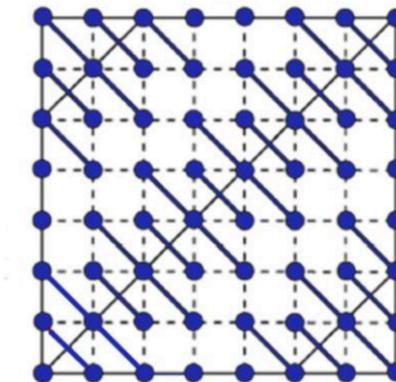
Original

span	1
# segments	121
# sinograms	4084
MRD	60

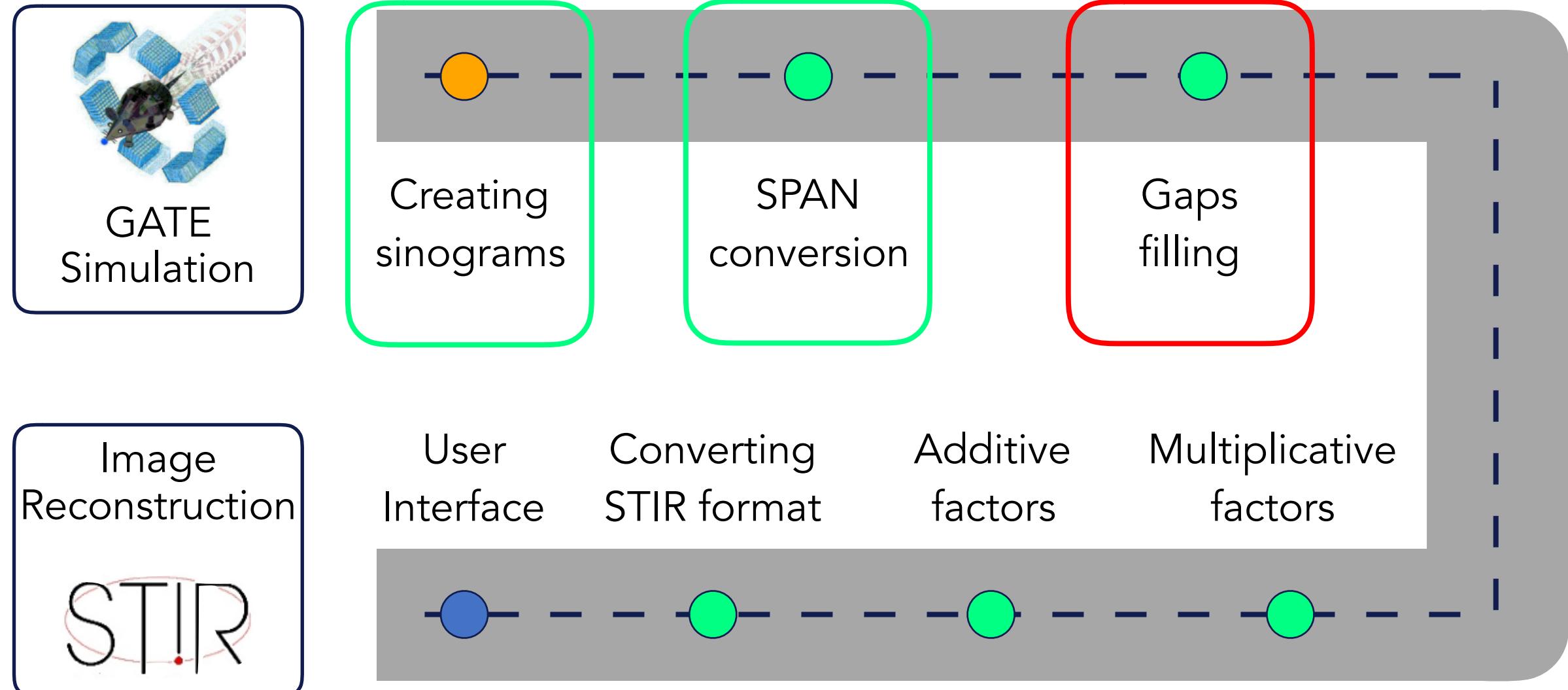


With axial compression

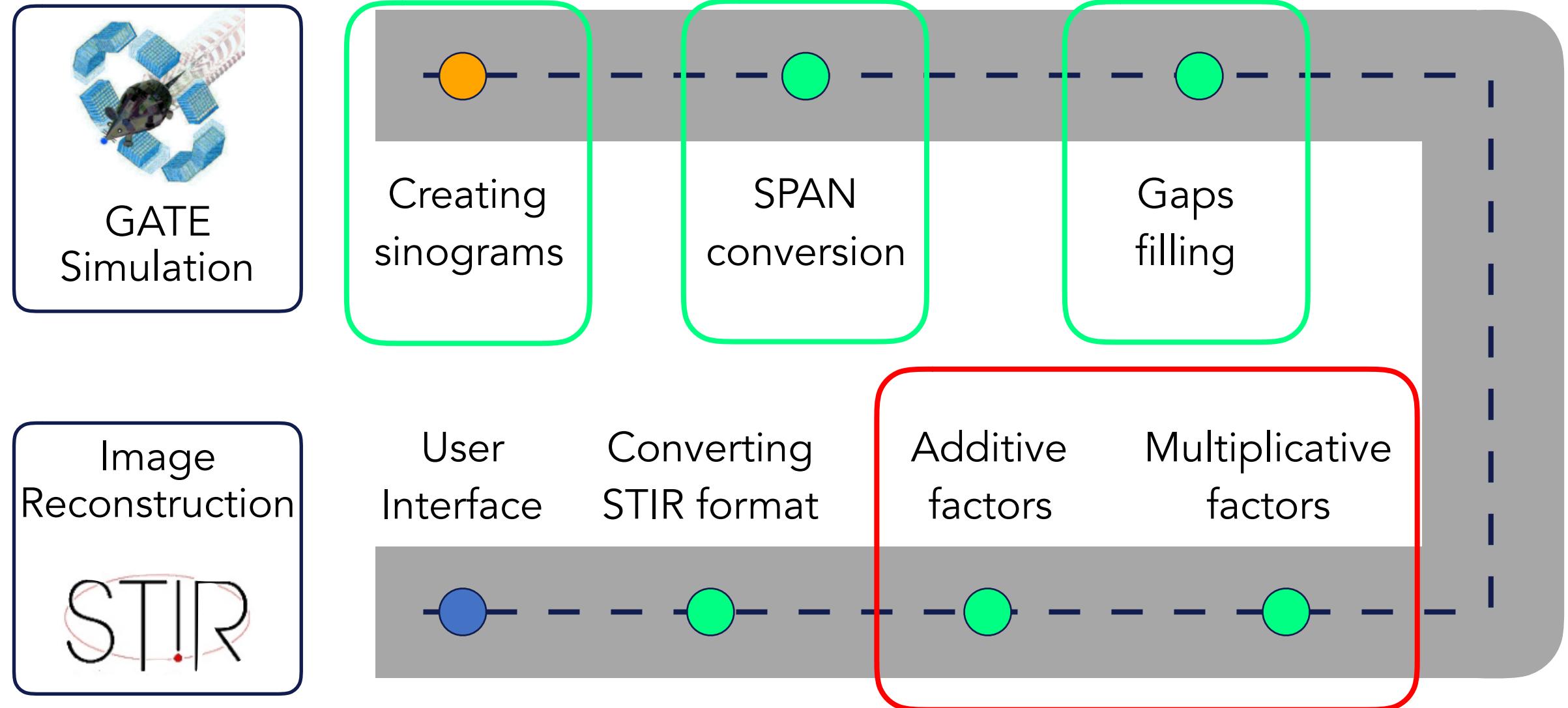
span	11
# segments	11
# sinograms	837
MRD	60



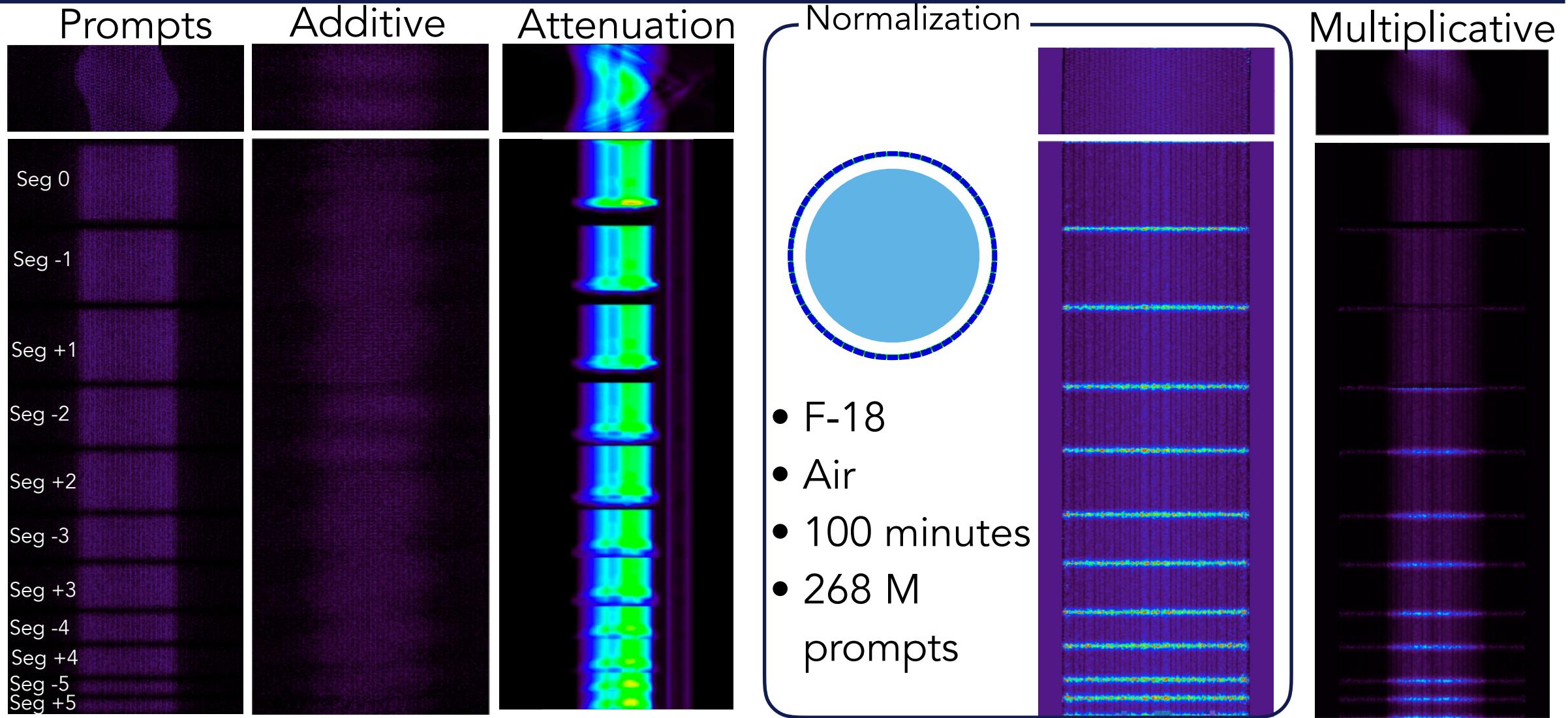
# Workflow



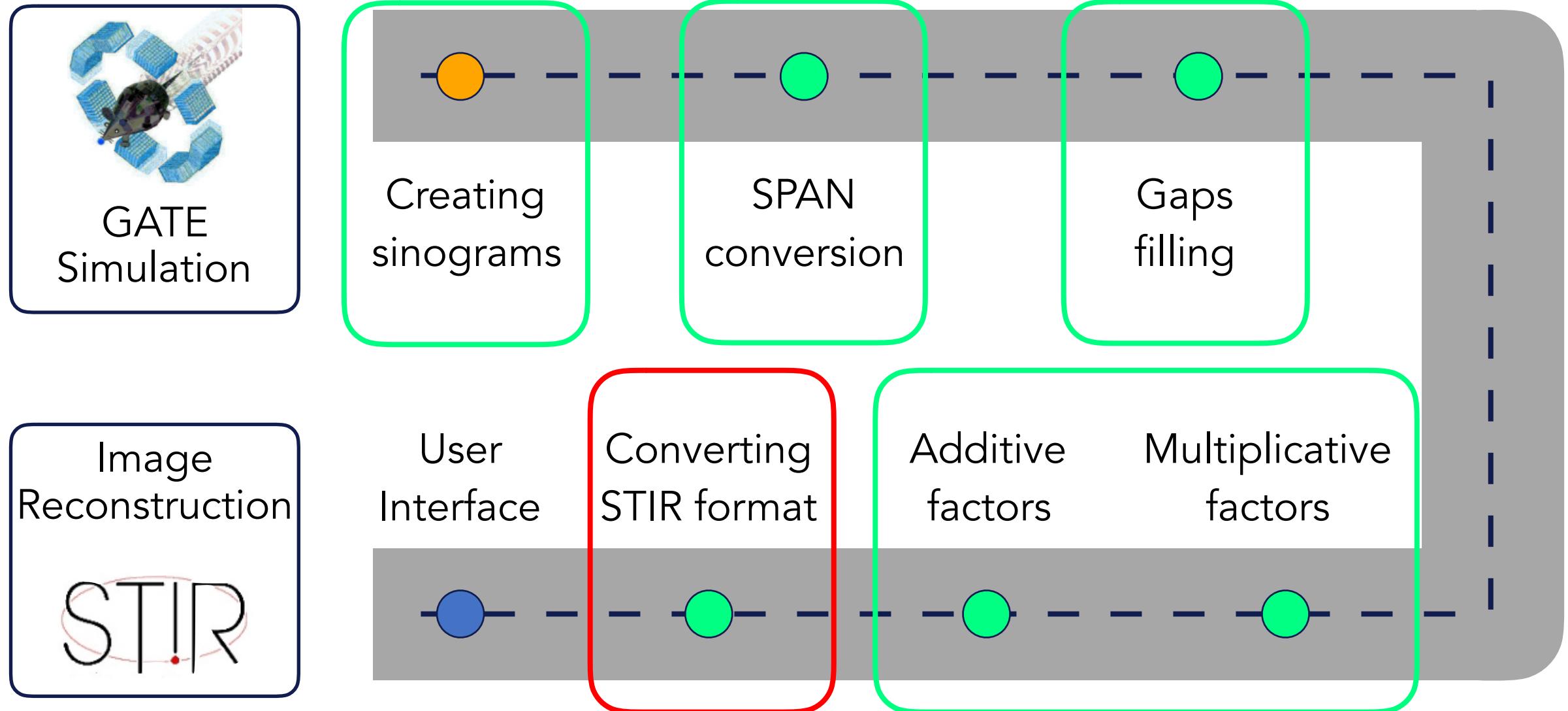
# Workflow



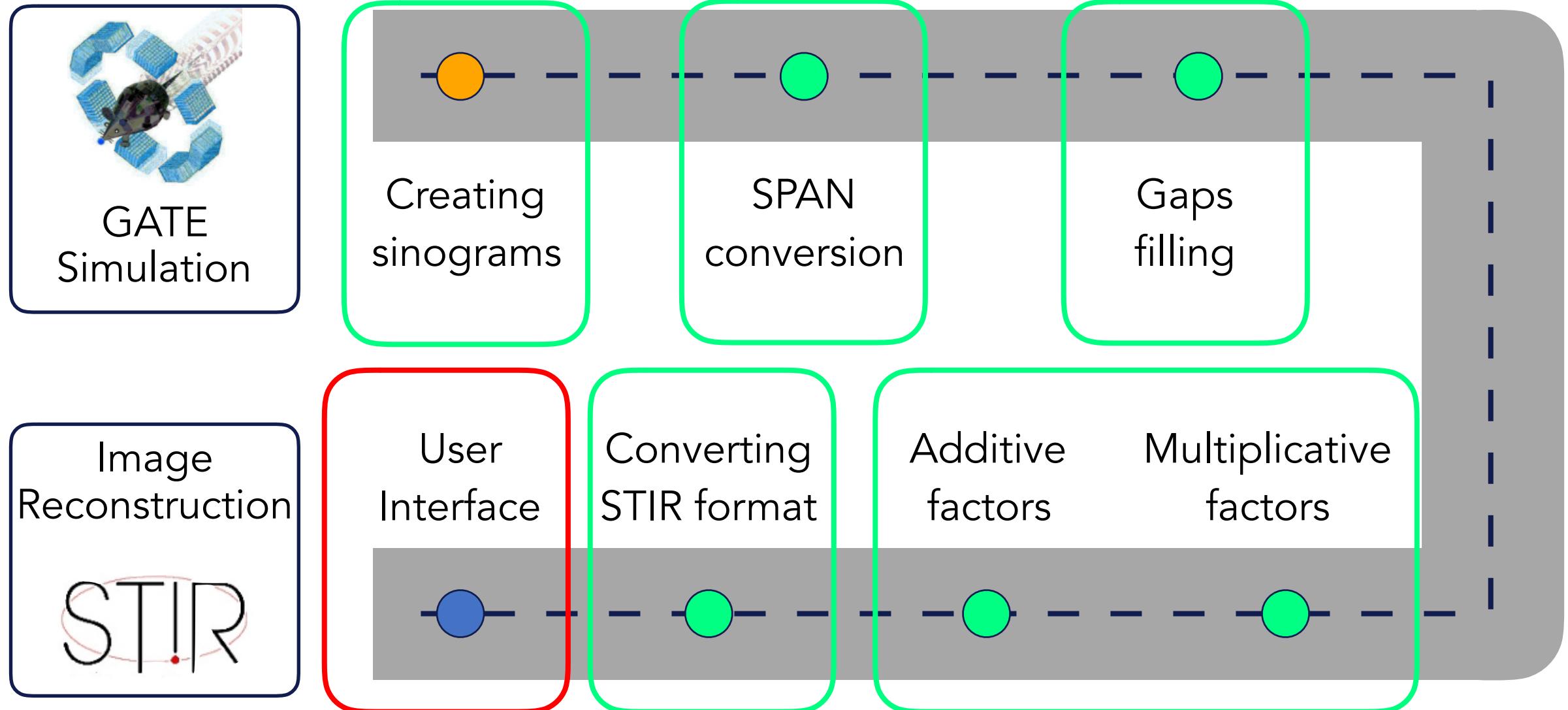
# Multiplicative and Additive factors



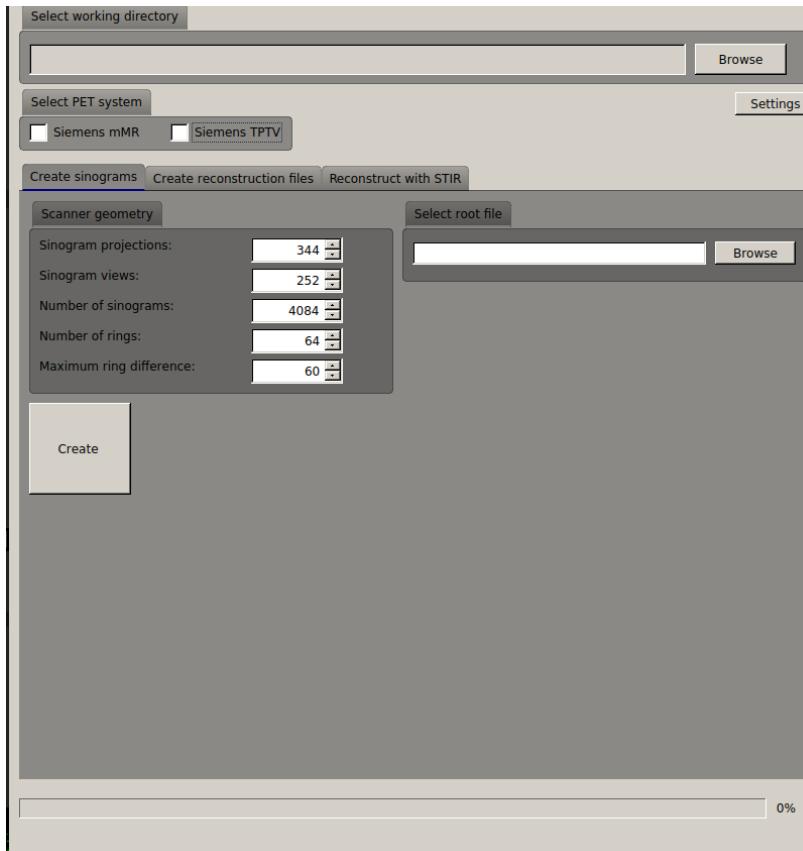
# Workflow



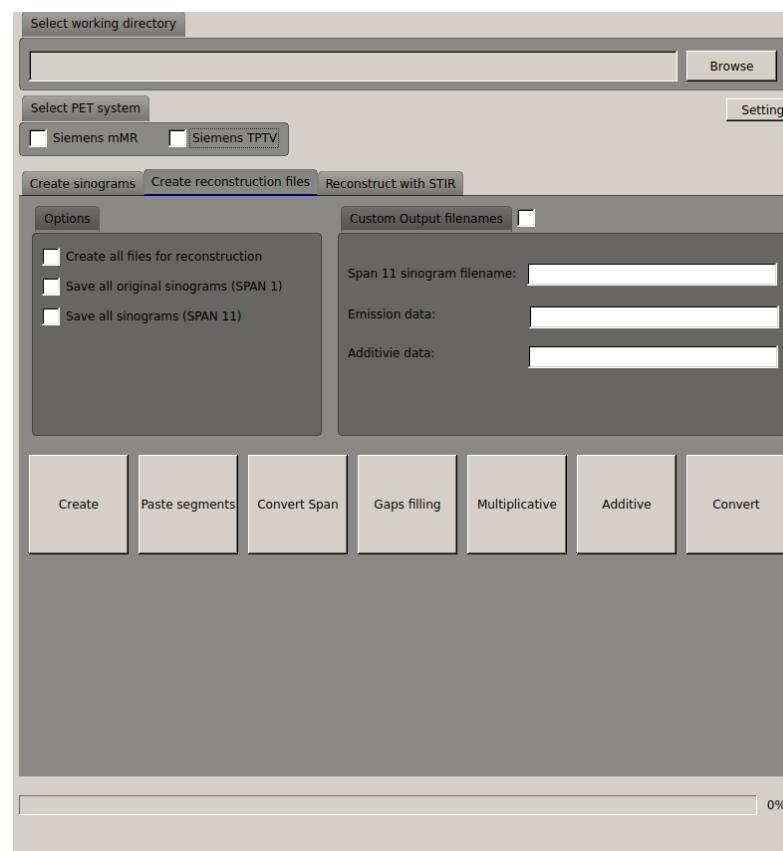
# Workflow



# GATE simulation → Image reconstruction



Creating sinograms



Data preprocessing

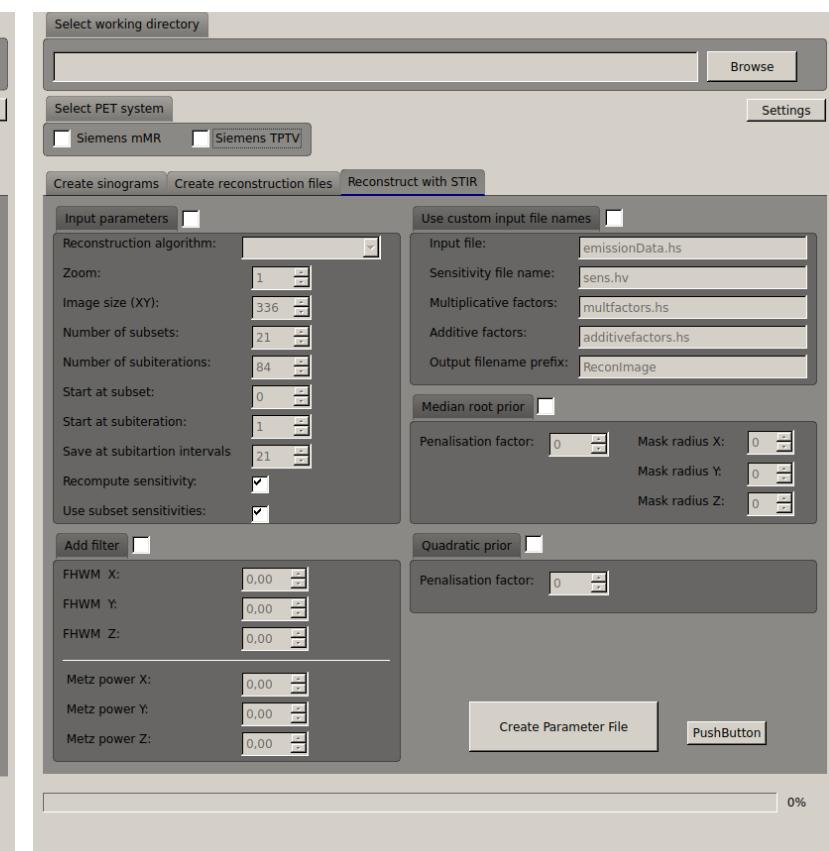
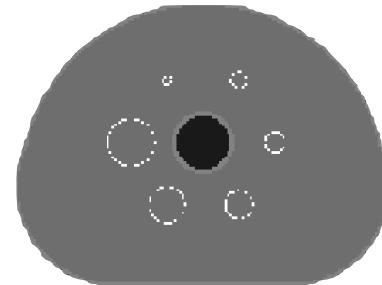
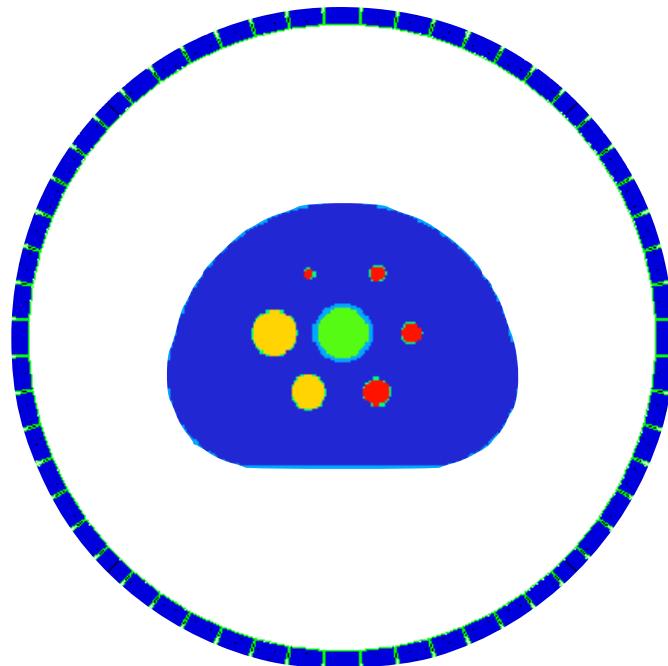


Image reconstruction

# Test: NEMA Image Quality

## Image quality



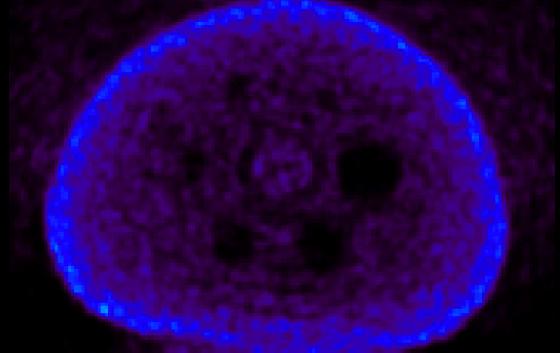
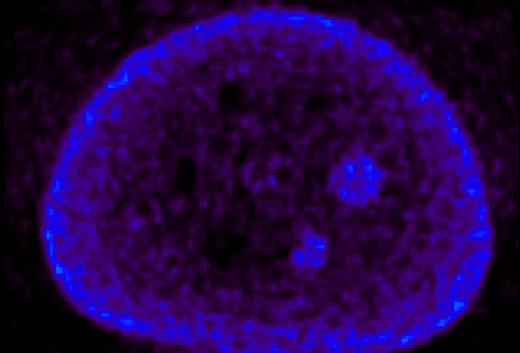
Attenuation map

- 6 spherical inserts
- LBR 1:4 (4 small)
- Cold spheres
- F-18
- PMMA, Lung, Glass, Water
- Cold spheres: 54 M prompts
- 2 hot: 12 M prompts

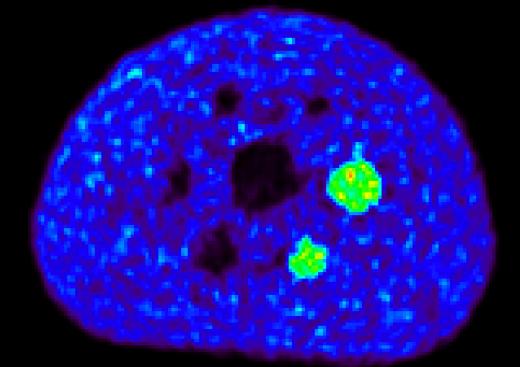
# Test: Image reconstruction

- OSEM
  - 4 iteration 21 subsets
  - 2 mm FWHM inter-iteration filter
  - With and without AC and random + scatter correction
  - No prior applied

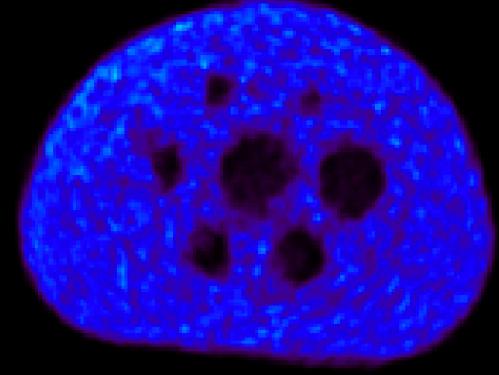
No AC and no scatter + random correction



With AC and scatter + random correction



12 M prompts



54 M prompts

- GATE Monte Carlo simulations → STIR Image reconstruction
  - Qt interface
  - Siemens Biograph TPTV PET/CT
  - Siemens Biograph mMR PET/MRI

## Future work

- Will be shared (open source)
- Add other scanners?



[hunor.kertesz@meduniwien.ac.at](mailto:hunor.kertesz@meduniwien.ac.at)

# Acknowledgments



Supported by the Austrian Science Foundation (FWF):I3451-N32

The computational results presented have been achieved using the Vienna Scientific Cluster (VSC).

[hunor.kertesz@meduniwien.ac.at](mailto:hunor.kertesz@meduniwien.ac.at)