



Motivation

SPIDER is a concept study within the PETRA IV upgrade at DESY. The idea is to find new concepts to optimize nano-tomographic imaging microscopes.

The key features of the current design status that is shown here are:

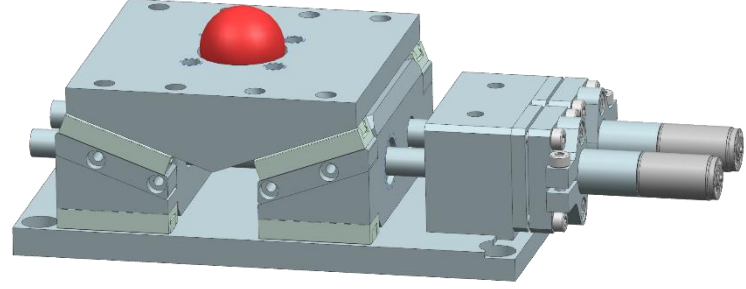
- All nano optics on one frame → easier to adjust the x-ray focus spot to the sample
- Parallel kinematics instead of stacked motors to keep vibrations low
- Main frame adjustable to get the optics frame parallel to the beam
- Stand-alone metrology frame to track the sample position

Platform alignment

The moveable optics frame must be oriented parallel to the x-ray beam, so that the focus spot of the aligned nano-optics can be moved relatively to the sample. For that purpose, an adjustable kinematic mount is foreseen for the whole platform.

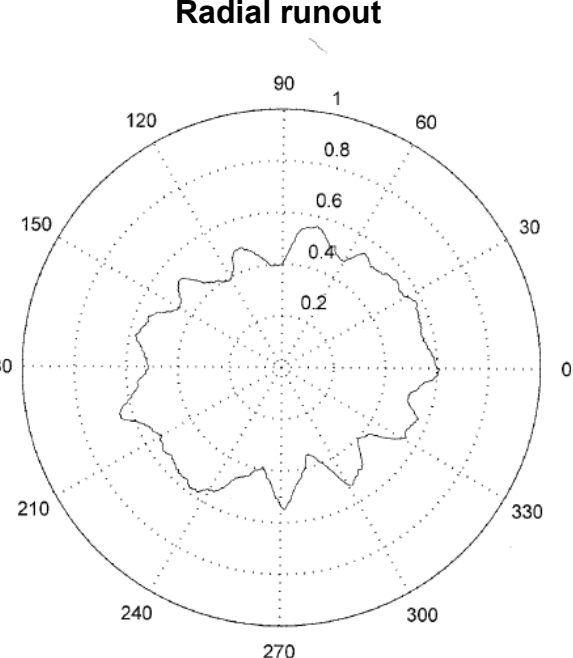
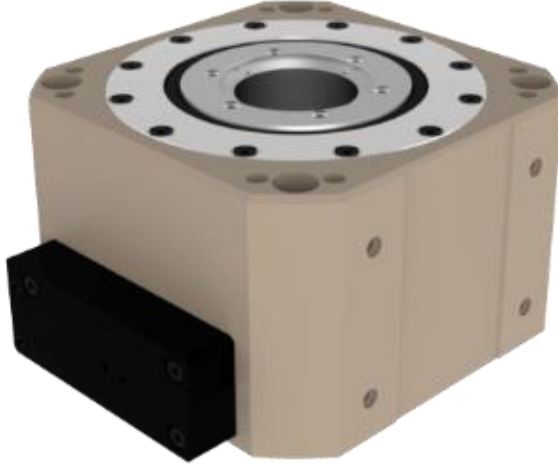
Four balls with good roundness are placed on 2D stages with a wedge-based design. The corresponding surfaces of the kinematic mount are integrated in the design of the middle frame.

The 2D stage is a special design fitting into the SPIDER setup. It is driven by 2 geared stepper motors which move the two wedges either in the same or the opposite direction, depending on the commanded moving direction (up or sideways).



Rotation stage

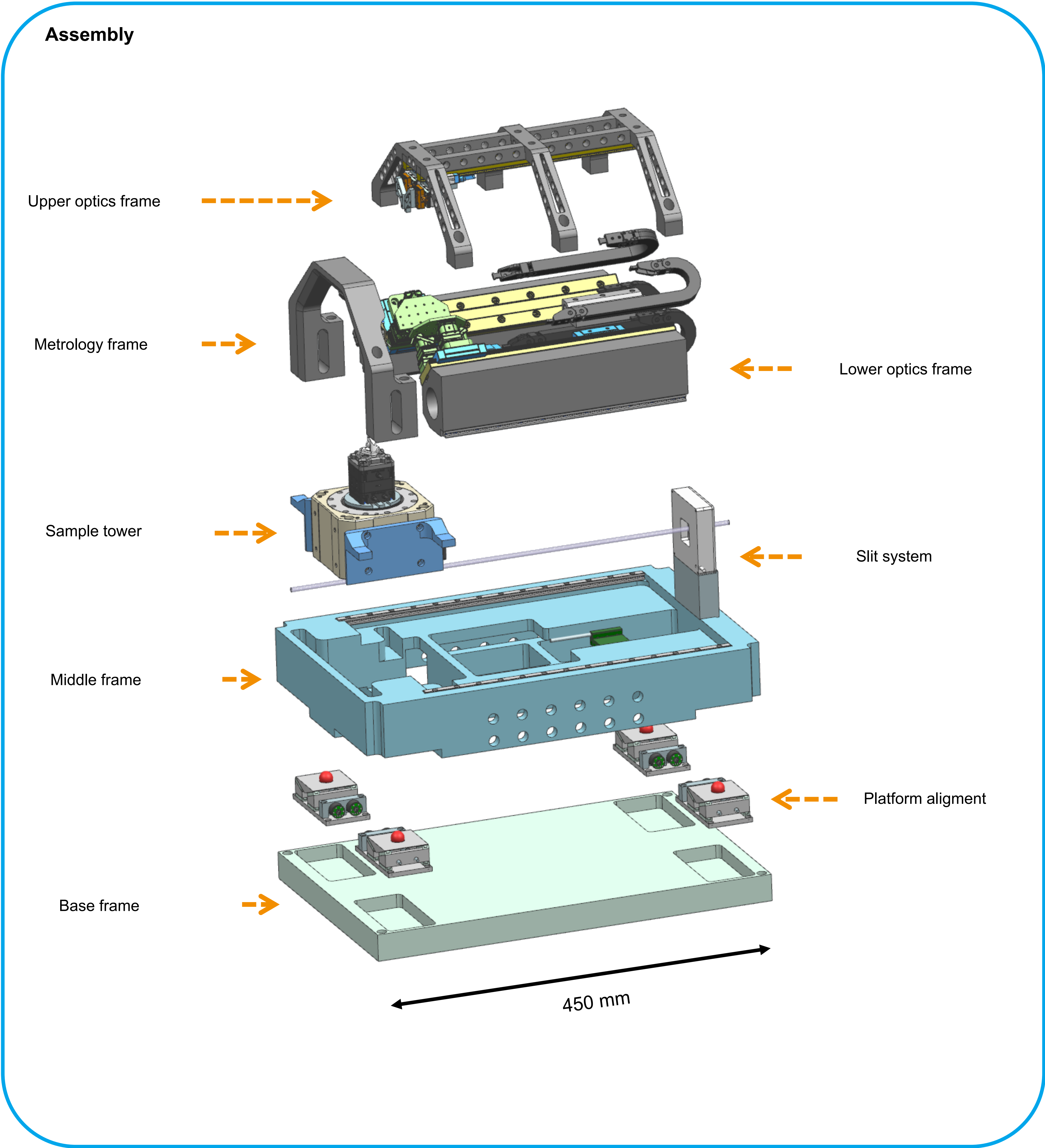
- Ball bearing stage
- Torque motor
- Radial runout < 1 μm
- Encoder resolution ~ 0.5 mdeg (~1.8 arcsec)
- Mass: 3.9 kg



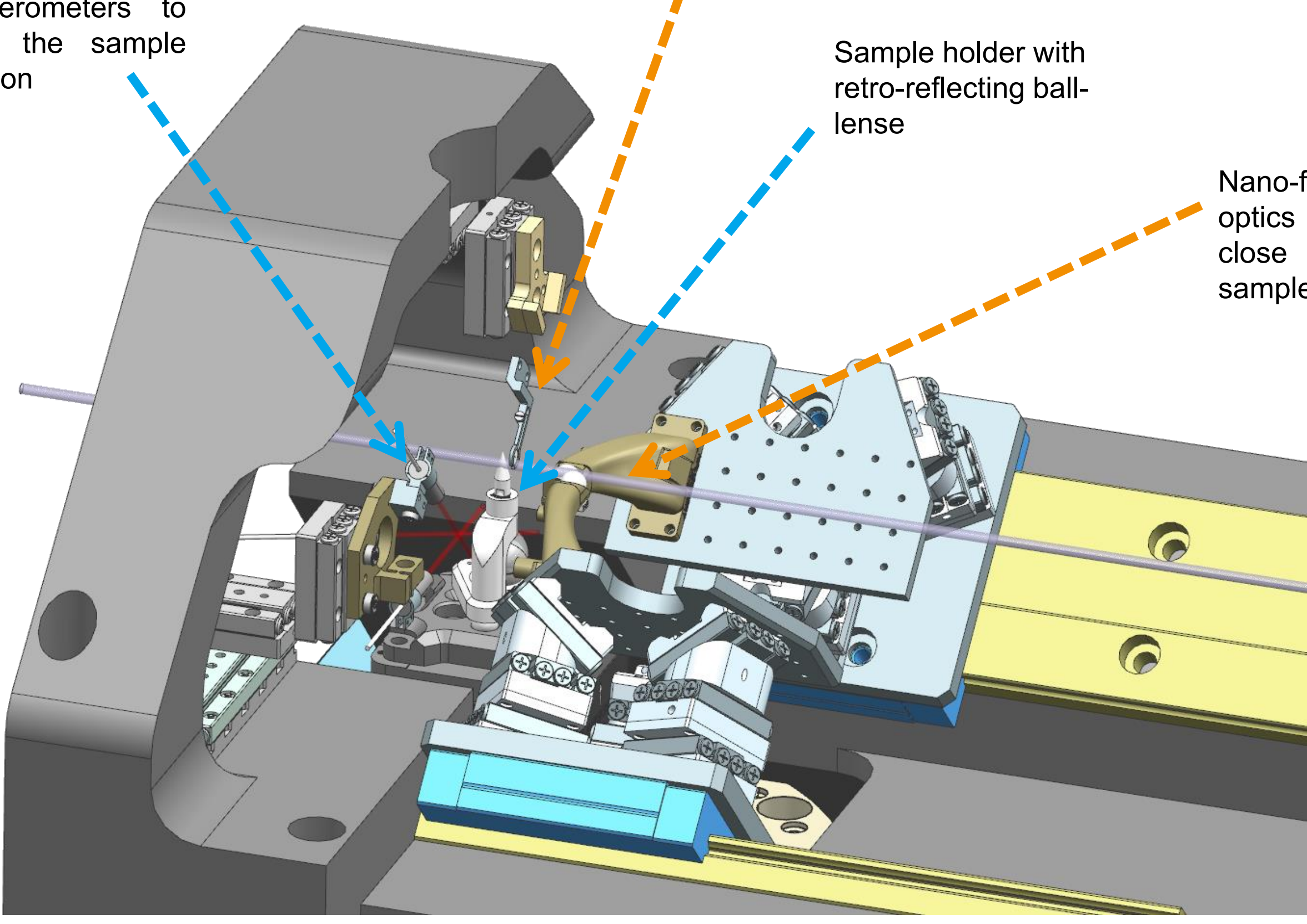
Source: <https://www.labmotionsystems.com/> and measurement report

Current status

- General CAD design almost finished
- Rotation stage set up in the lab for runout tests
- Prototype of 2D alignment stage will be built and tested in the lab
- Prototype of linear motor drive ready for tests in the lab
- Sample tower alignment to be designed
- Interferometer based position tracking to be designed
- All frames to be optimized
- Cable routing to be designed



Sample environment



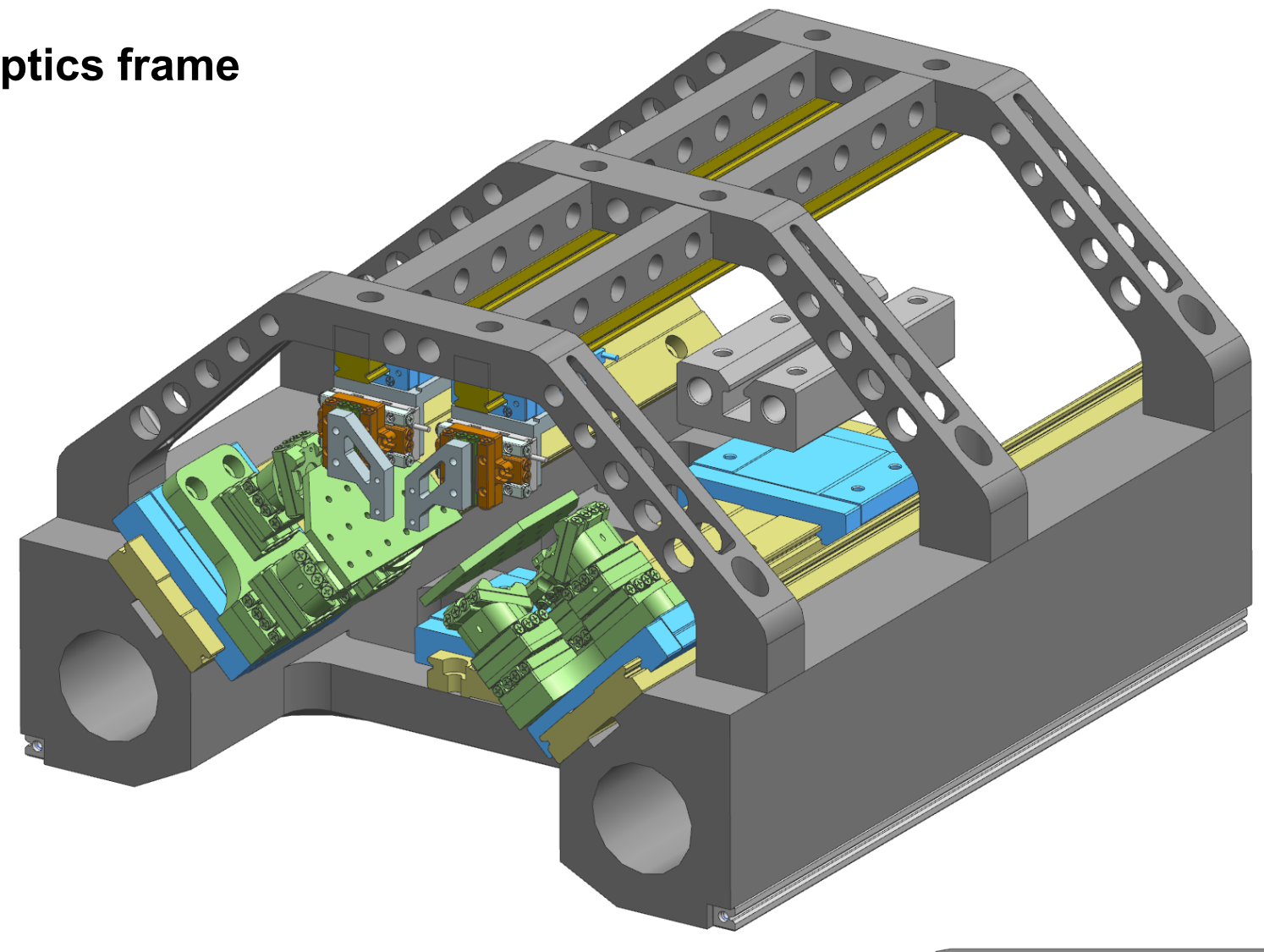
Interferometers to track the sample position

Pinhole directly in front of the sample

Sample holder with retro-reflecting ball-lense

Nano-focusing optics can get as close to the sample as needed

Optics frame



Optics from above the beam like phase plates, diodes, etc.

Custom hexapods to align the nano-focusing optics

Space for additional optics below the beam

Cross-roller bearing

Linear motor