Plans for a Detector-Positioning Robot at 7-ID-C

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TWG
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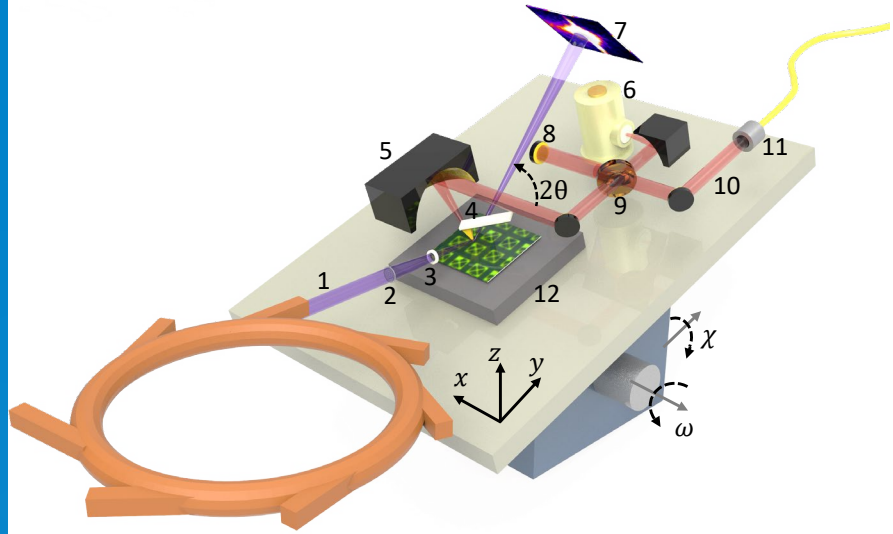
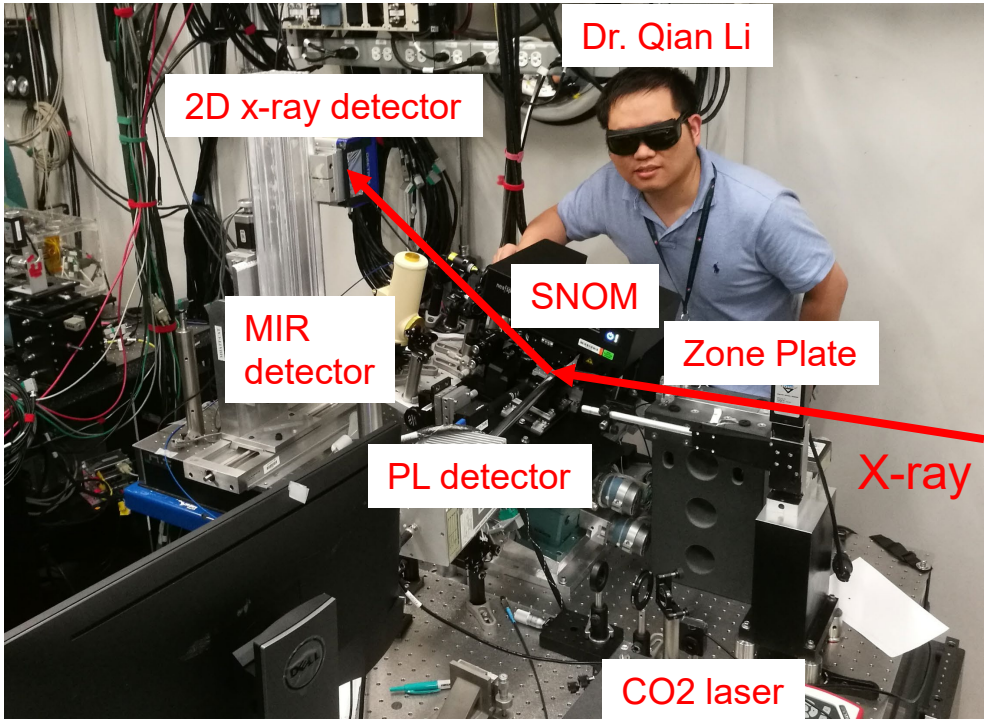
New time-resolved microscopy instrument at 7-ID-C

***Local* and *in situ* structural characterization and control**

Imaging modality	*Material properties*
SNOM:	**Optical**
XRD:	**Structural**
cAFM:	**Electronic transport**



Li, et al. J. Synchrotron Rad. **26**, 1790 (2019)



Our need and requirements

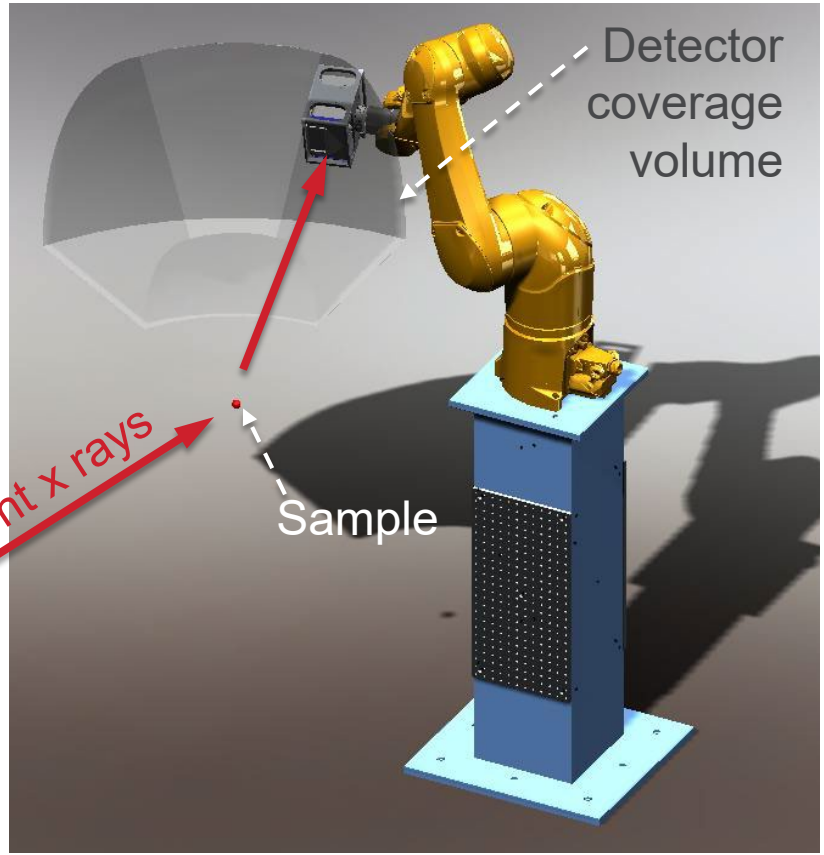
- Conceptual needs:
  - Move moderately sized area detector
  - Cover large 3D range of reciprocal space (pitch, yaw, sample-to-detector distance) while facing square to sample
  - Fully decouple motion from nanodiffractometer stages

- Desired diffraction operation:
  - Give pitch, yaw (delta, nu) and sample-detector distance and robot just goes there

- Robot Requirements:
  - DOF: 6 axis
  - Sample payload: 10 kg
  - Reach: 500 to 2000 mm

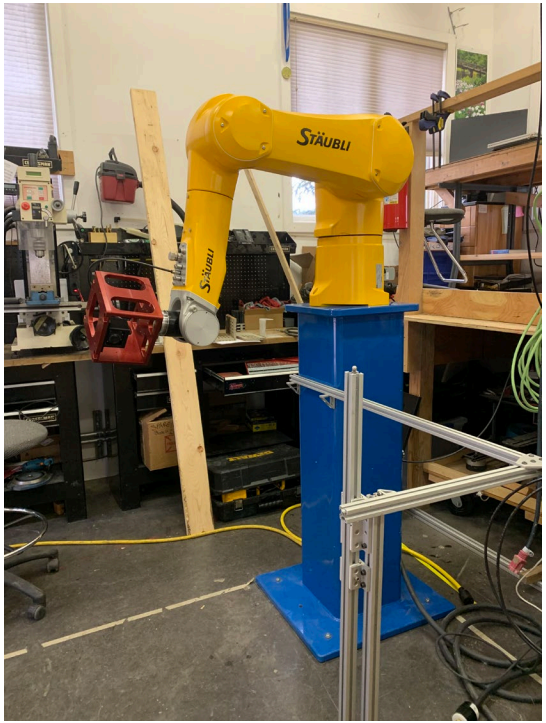
Chosen Solution

Vendor: Stäubli TX90L
Integrator: Square One Systems Design



The robot

Model	TX2-90L
Degrees of freedom	6
Nominal load capacity	5 kg
Maximum load capacity*	15 kg
Reach at wrist	1200 mm
Repeatability	±0.035 mm
Protection class (*wrist)	IP65 (*IP67)
Attachment methods	360° mounting possibility



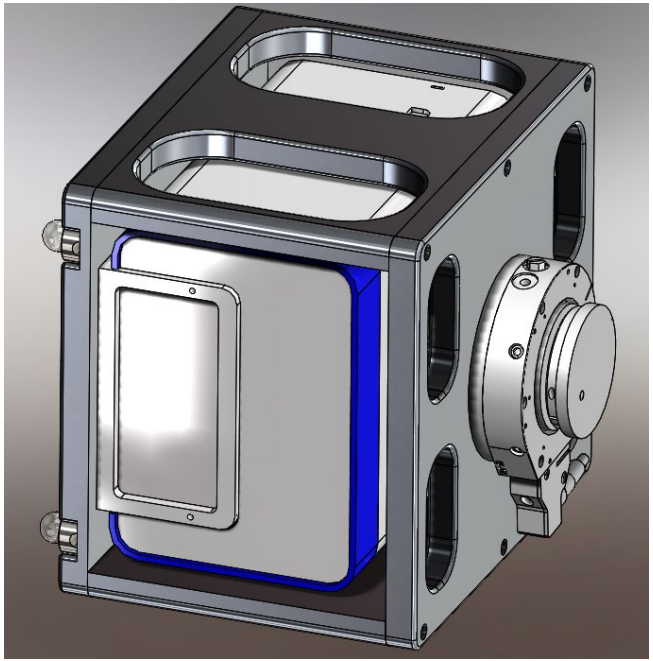
Safety

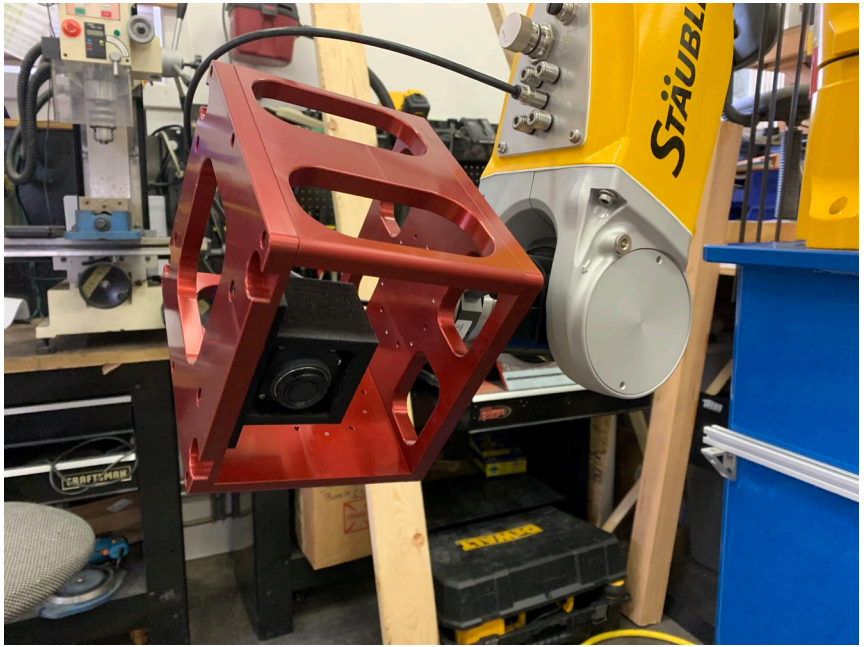
- Keep out sensors/light curtains not feasible in this crowded hutch

- Software-designed exclusion zones
  - To not hit hutch walls, etc.
- Current sensors in joints and collision sensor on end of arm
- Robot will only move “full speed” when hutch is searched and secured
  - Actually quite slow for a robot
- When hutch door open, motion possible only when controlled by a “teach pendant” at greatly reduced speed

Detector cage

Securely hold and protect detector

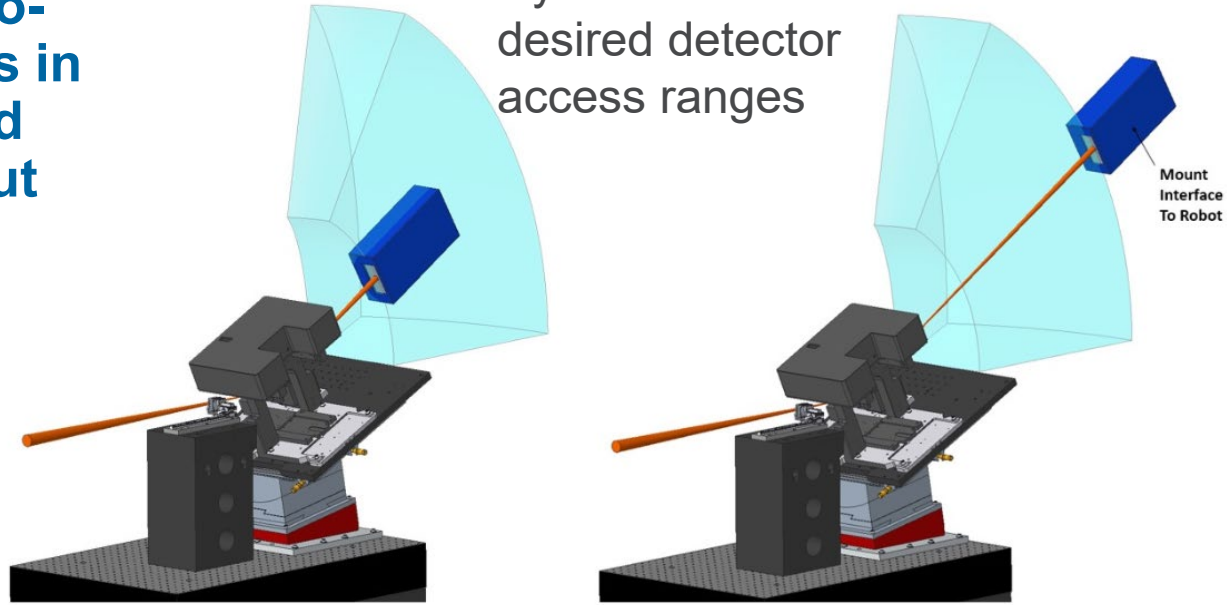




Primary remaining challenge

Access widest range of angles at widest range of sample-to-detector distances in highly constrained space of a built-out hutch

Cyan volumes: desired detector access ranges



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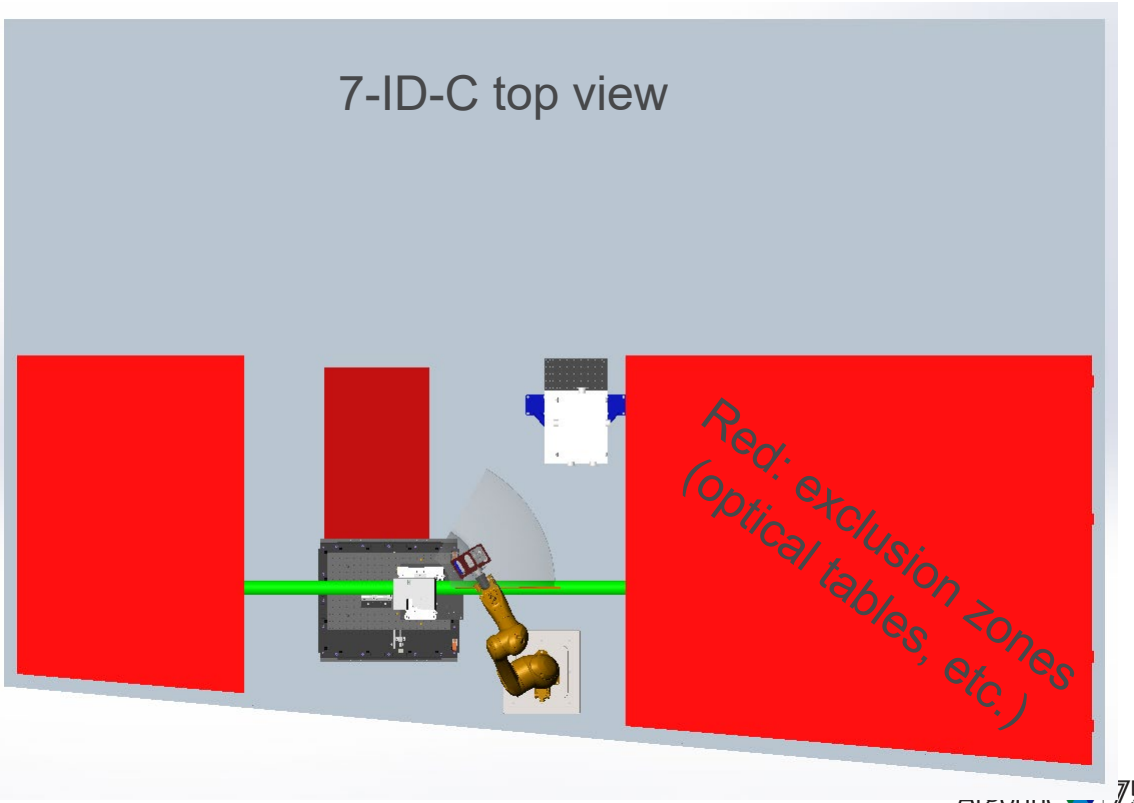

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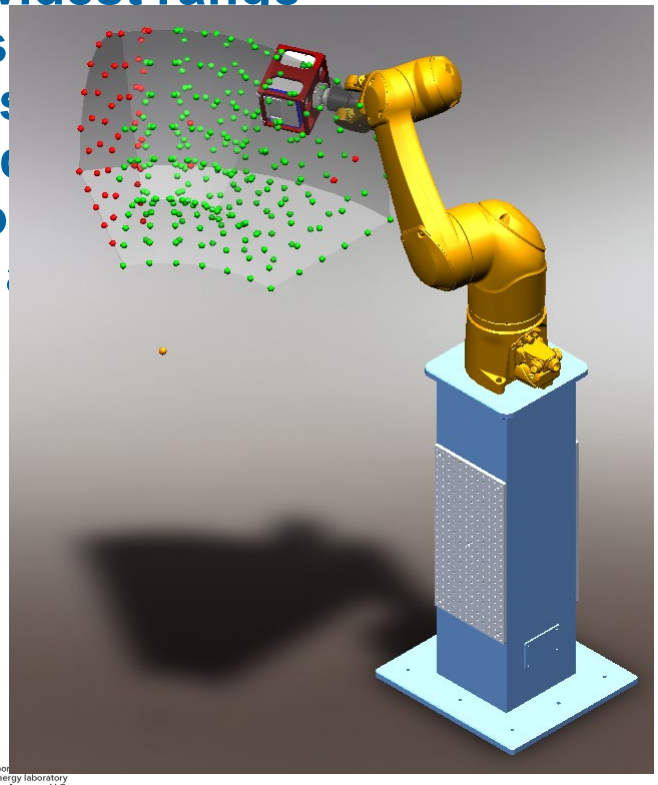

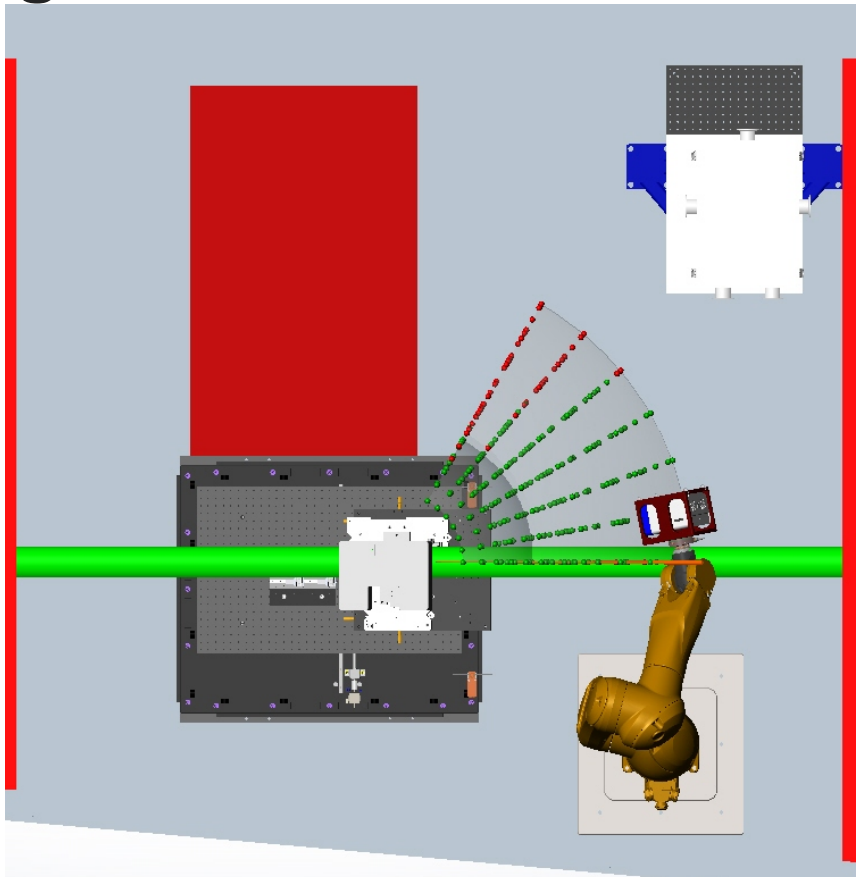

Video of robot in action

Left: view of robot
Right: view of “detector” (video camera) pointed at “sample” (tooling ball)

Detector Robot and Sample Tracking.MOV

Disclaimers:

- Video from December, so there have been further improvements
- Video camera attached with only one screw so may have shifted slightly during filming

Remaining tasks

- Finalize robot position to optimize range of motion
- EPICS integration
- Installation
- Commission
- Use!

Thank you’s

- APS
  - Sunil Bean
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  - Haidan Wen
  - Alec Sandy, Xiaoyi Zhang, XSD management
  - …
- Square One
  - Echo Miller
  - Robert Viola
  - Jace Walsh

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