SAMPLE AND DETECTOR POSITIONING INSTRUMENTS FOR THE WIDE ANGLE XPCS END STATION AT 8-ID-E, A FEATURE BEAMLINE FOR THE APS UPGRADE

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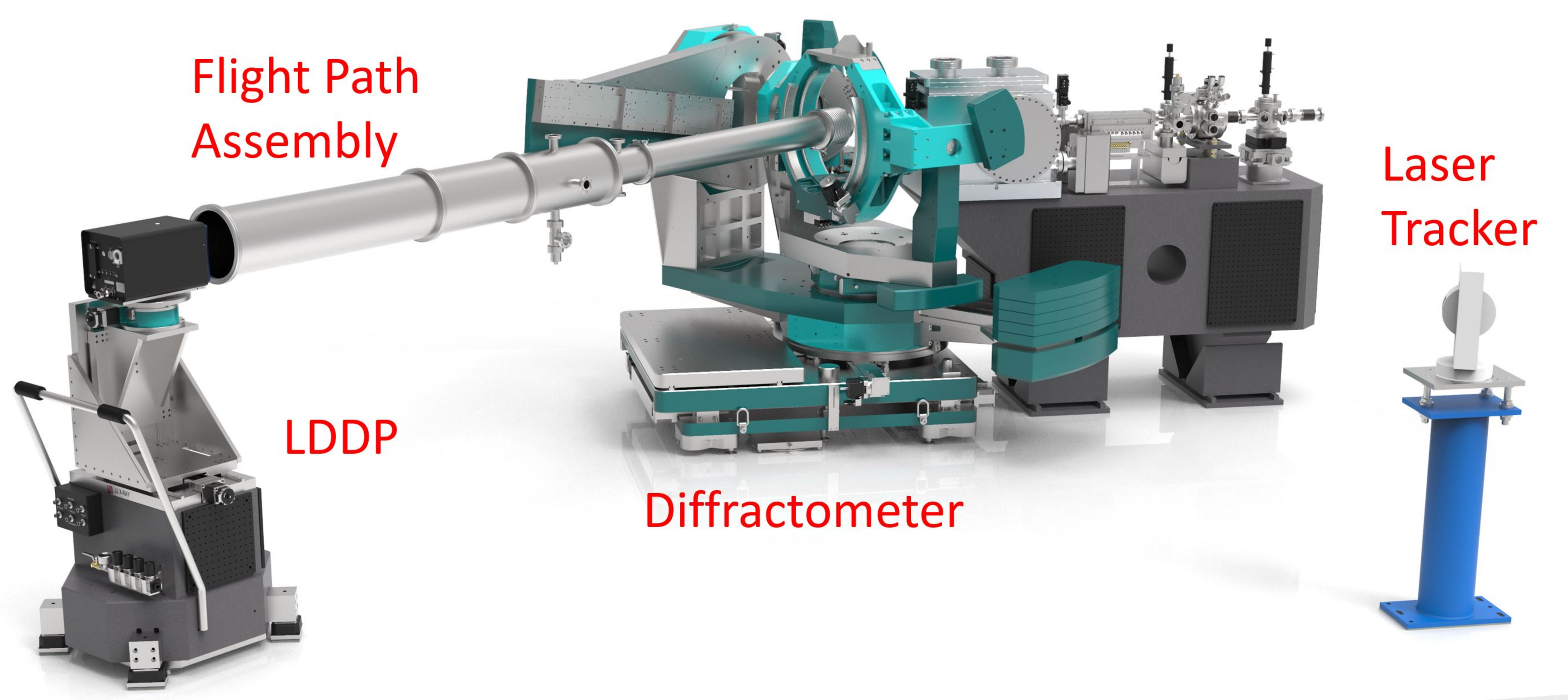
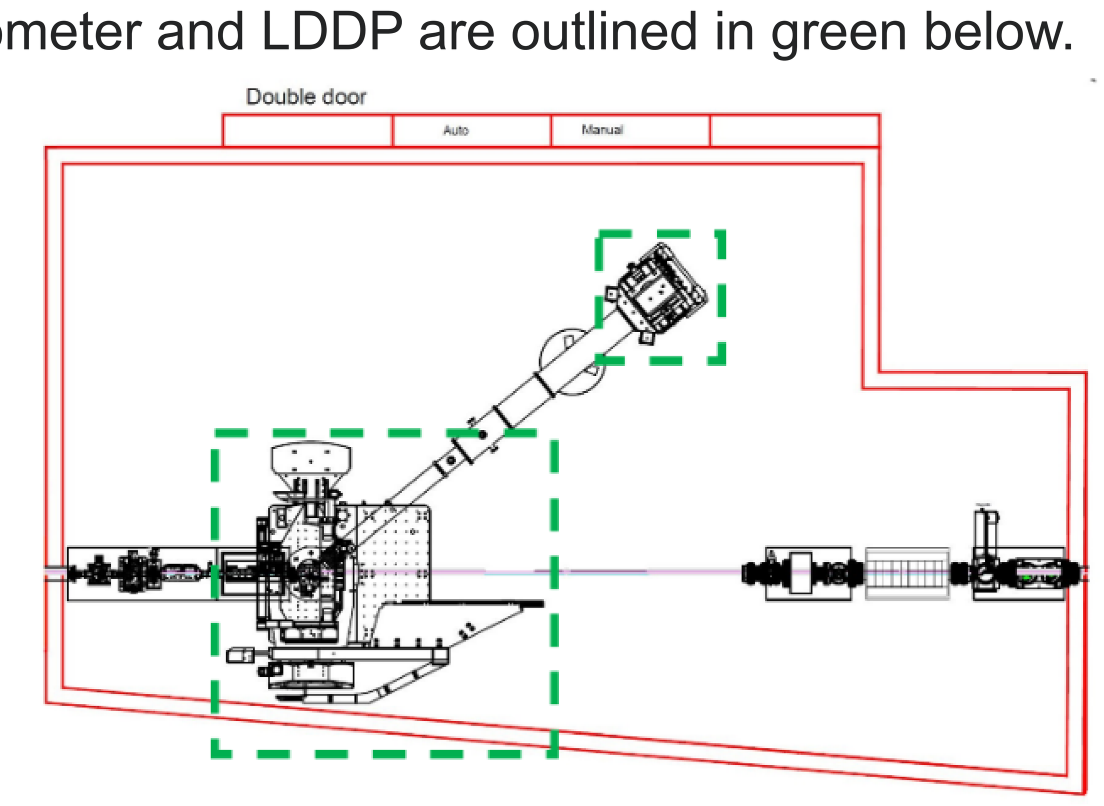
WIDE ANGLE XPCS AT 8-ID-E

- The X-ray Photon Correlation Spectroscopy (XPCS) beamline at the Advanced Photon Source (APS) has been selected as one of nine feature beamlines being designed to take advantage of the increase in coherent flux provided by the APS Upgrade. The 8-ID-E enclosure at the beamline will have a dedicated instrument for performing Wide Angle XPCS (WA-XPCS) measurements across a range of length and time scales. Two key elements to the instrumentation required to perform these measurements are a large 6-circle diffractometer for precise positioning of samples in 3 spatial and 3 angular co-ordinates, detectors, and a Long Distance Detector Positioner (LDDP) that will allow x-ray detectors to be positioned up to 4 m away from the sample location and will span an angular range of 3-55 degrees. The WA-XPCS instrument has been designed with user science in mind and will allow them to carry out novel science facilitated by the APS Upgrade.



INSTRUMENT LOCATION

- The WA-XPCS instrument will be located in the new 8-ID-E enclosure. The diffractometer and LDDP are outlined in green below.

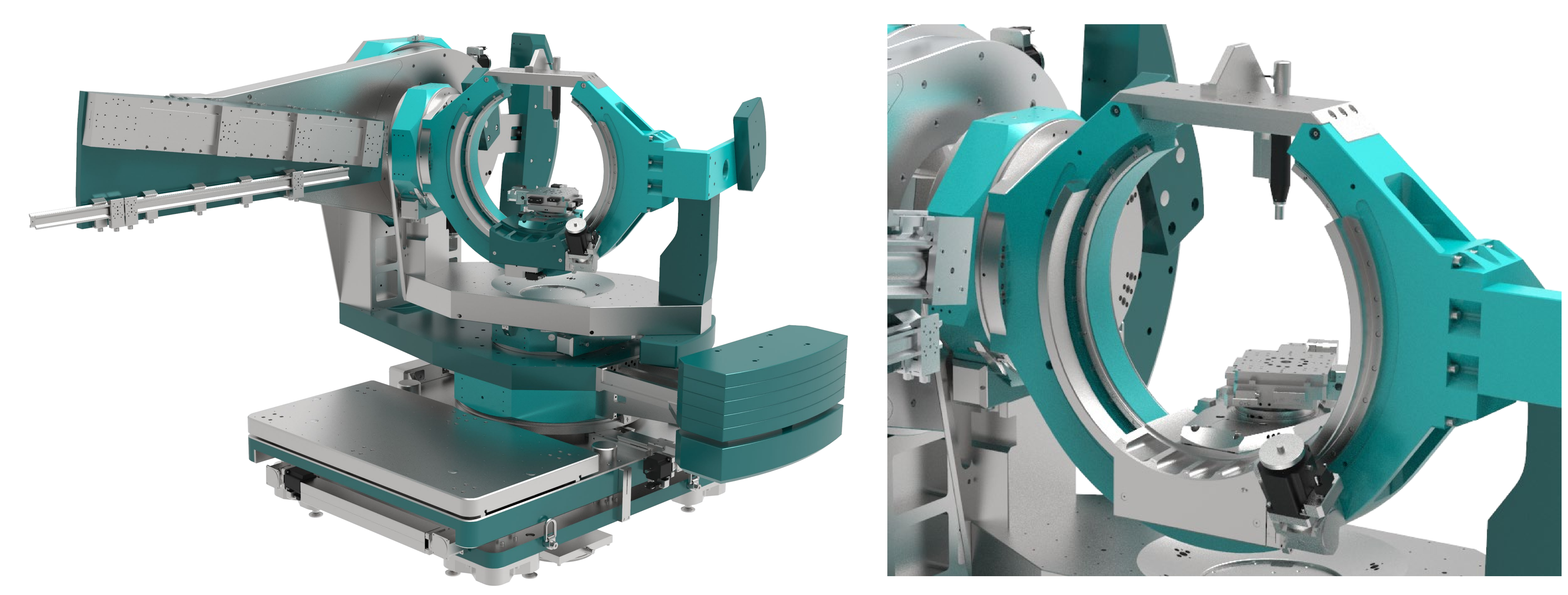


OPERATING MODES

- The WA-XPCS instrument at 8-ID-E facilitates a variety of operating modes and experimental methods. The 3 primary configurations of the instrument will be the following:
  1. **Short sample-to-detector WA-XPCS (horizontal and vertical scattering geometry):** In this configuration, a pixel array detector will be positioned on the diffractometer detector arm at a sample-to-detector distance of 1.5-2 m.
  2. **Long sample to detector WA-XPCS (horizontal scattering geometry):** In this configuration, a second large area detector will be positioned using the LDDP at a sample-to-detector distance of up to 4 m, spanning an angular range of 3-55 degrees.
  3. **Pinhole Ultra-Small XPCS (US-XPCS):** In this configuration the sample will be mounted on the WA-XPCS diffractometer and the detector will be positioned in the 8-ID-I shielded enclosure with a sample to detector distance of up to ~22 m

SAMPLE AND DETECTOR POSITIONING

- The instrument will feature a high-stability 6-circle diffractometer for accommodating a wide range of samples in a variety of scattering geometries. The diffractometer will have a "split" detector arm with two mounting rails for mounting detectors near the sample as well as supporting flight paths for use with the LDDP. The base positioning table of the diffractometer will have an extension in the down-stream direction for mounting large additional pieces of instrumentation.



*Design and 3D model of the diffractometer provided by Huber Diffraktionstechnik GmbH & Co. KG.

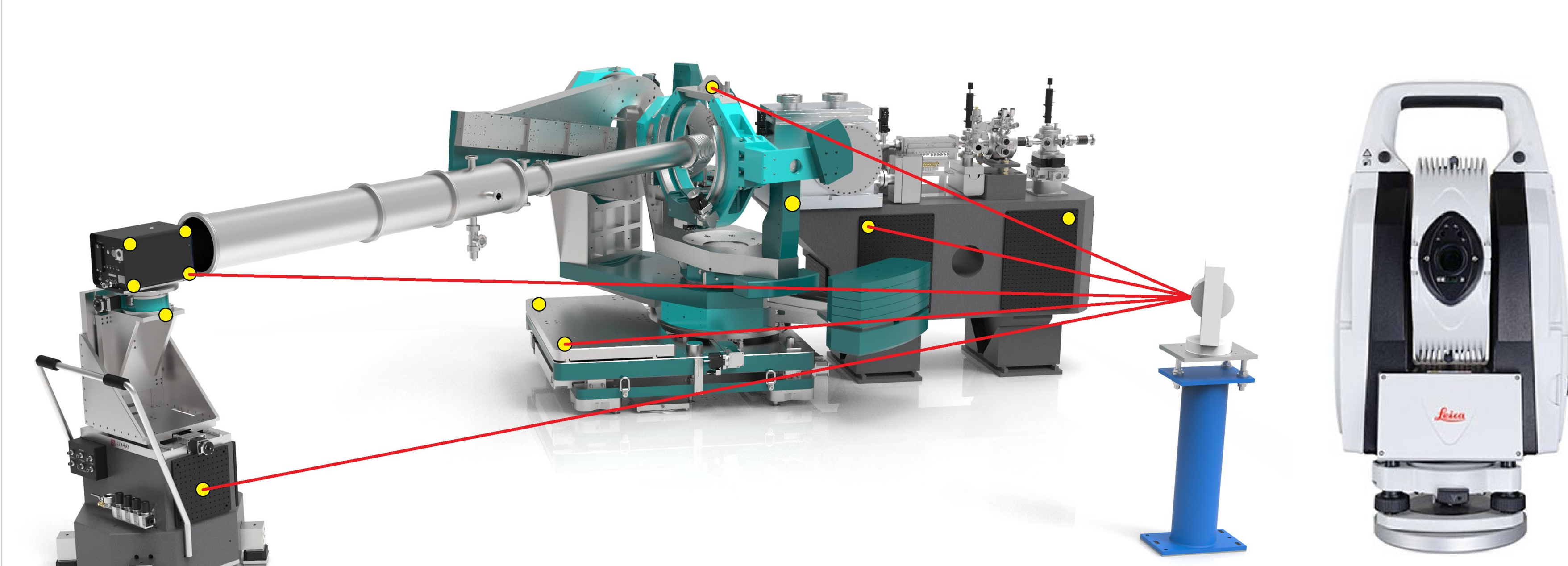
LONG DISTANCE DETECTOR POSITIONING

- For scattering in the horizontal geometry, a detector will be positioned at distances from 2.5 m to 4 m using a moveable Long Distance Detector Positioner (LDDP)* to cover an angular range of 3-55 degrees. The LDDP will consist of a large granite base on which sits a combination of motorized stages. The base will sit on air casters that allow the LDDP to be coarsely positioned manually within the enclosure. Final fine positioning of the detector will be achieved with the mounted motorized stages. The spatial relationship between the sample and the free moving LDDP will be monitored using a laser tracking system. A moveable flight path will be supported by the diffractometer arm and a mobile floor support to minimize air scattering while using the LDDP.

*Design and 3D model of the LDDP instrument provided by JJ X-ray.

LASER TRACKING

- Once the LDDP has been positioned, a laser tracker will be used to determine the location of carefully chosen fixed reflectors on the base of the diffractometer and on the LDDP. This information along with the known motion of the stages on the LDDP and the diffractometer will be used to determine the distance and angle between the sample and the detector. The yellow dots in the figure below show potential locations for mounting laser reflectors. The precise configuration of the reflectors will be optimized once all the components have been installed.



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