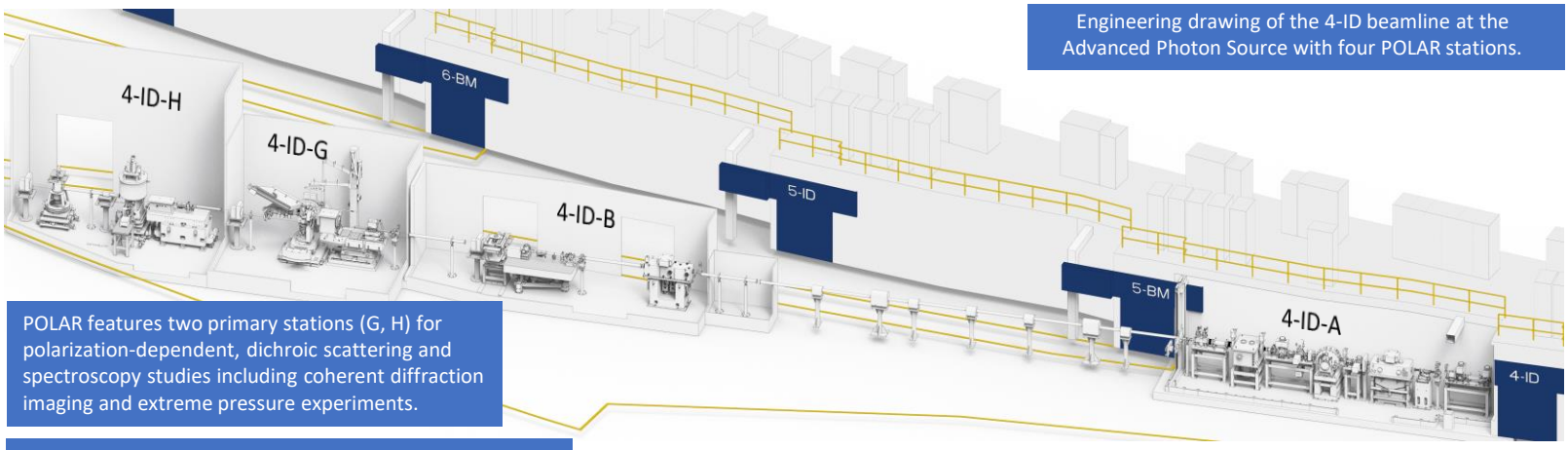
UPGRADING THE ADVANCED PHOTON SOURCE

Exploring quantum materials and new electronic states of matter with the Polarization Modulation Spectroscopy (POLAR) feature beamline



Engineering drawing of the 4-ID beamline at the Advanced Photon Source with four POLAR stations.

POLAR features two primary stations (G, H) for polarization-dependent, dichroic scattering and spectroscopy studies including coherent diffraction imaging and extreme pressure experiments.

Visual inspection of high-heat-load mirrors at the APS metrology lab (above) and their installation in POLAR's first optical enclosure (left). The G and H experiment stations include nano-focusing K-B mirrors for spot sizes as small as 100 (400) nanometers, respectively.

Discovery of new materials for quantum applications (such as quantum computing) requires measurements of their magnetic and electronic inhomogeneity at the nanoscale. That is one of the science drivers behind the POLAR beamline, under construction as part of the Advanced Photon Source Upgrade. POLAR will take advantage of the higher coherent flux of the upgraded APS to enable polarization-dependent (dichroic) coherent diffraction imaging with tens of nanometer resolution. POLAR will also leverage brilliant beams to search for new electronic and magnetic phases of matter under extreme pressure and magnetic field conditions, including room-temperature superconductors, and to image electronic matter with 100 nm resolution. The beamline is expected to be operational and ready for new experiments in 2024.

POLAR Key Specifications

Photon beam energy	2.7-27 keV
Distance from source	61-73 m
X-ray spot size	down to 100 nm
Polarization	Circular/variable linear
Techniques	X-ray circular and linear dichroism, dichroic ptychography and tomography, real-space imaging, extreme conditions (P,H,T)

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Advanced Photon Source
Bldg. 401
Argonne National Laboratory
9700 S. Cass Ave.
Argonne, IL, 60439

aps.anl.gov
aps.anl.gov/APS-Upgrade
apsinfo@aps.anl.gov

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