

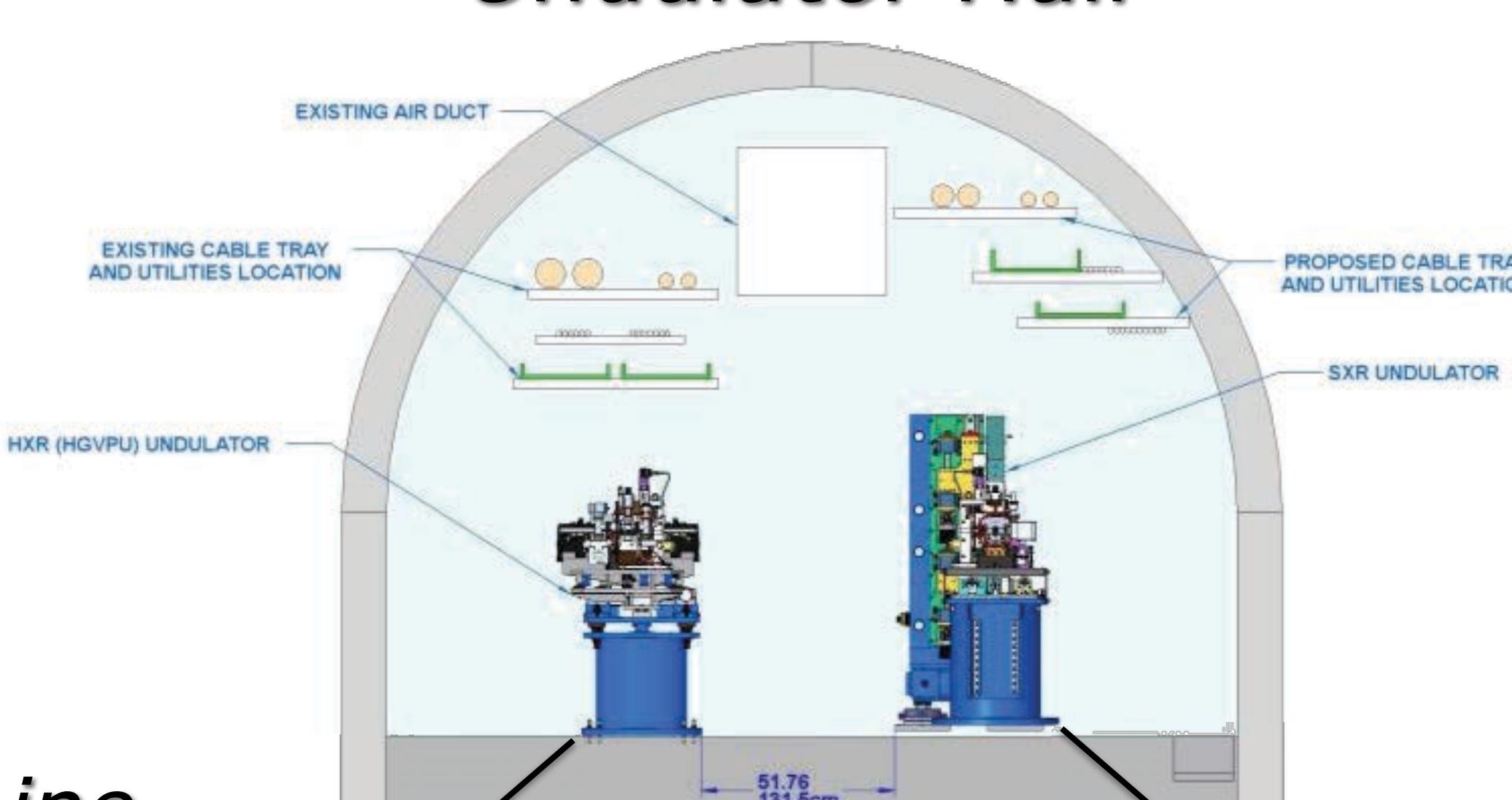
LCLS-II Undulator Motion Control

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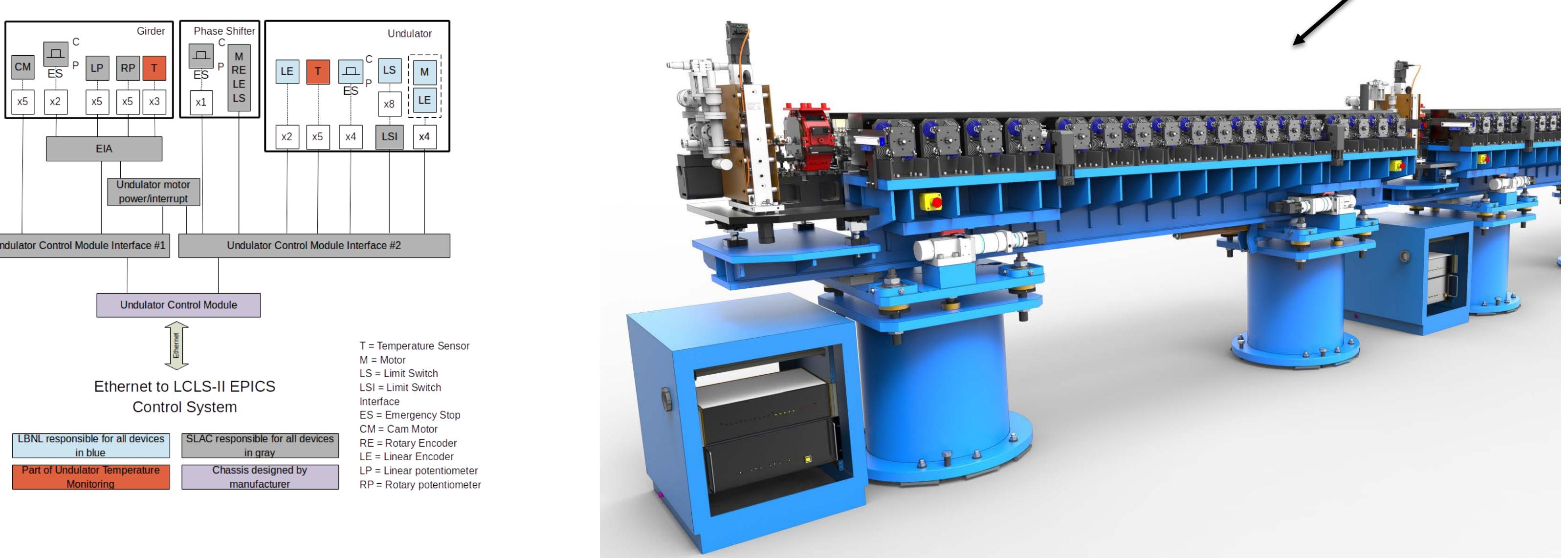
Abstract

At the heart of the LCLS-II are two undulator lines: one for generating hard x-rays (HXR) and one for generating soft x-rays (SXR). The SXR line is comprised of 21 variable-gap undulator segments separated by an interspace stand with a cam positioning system capable of positioning with 5 degrees of freedom. The HXR line is comprised of 32 undulator segments, each including an integrated interspace assembly. The girder is placed on two stands with a similar cam-positioning system as in the SXR line allowing for movement in 5 DOF.

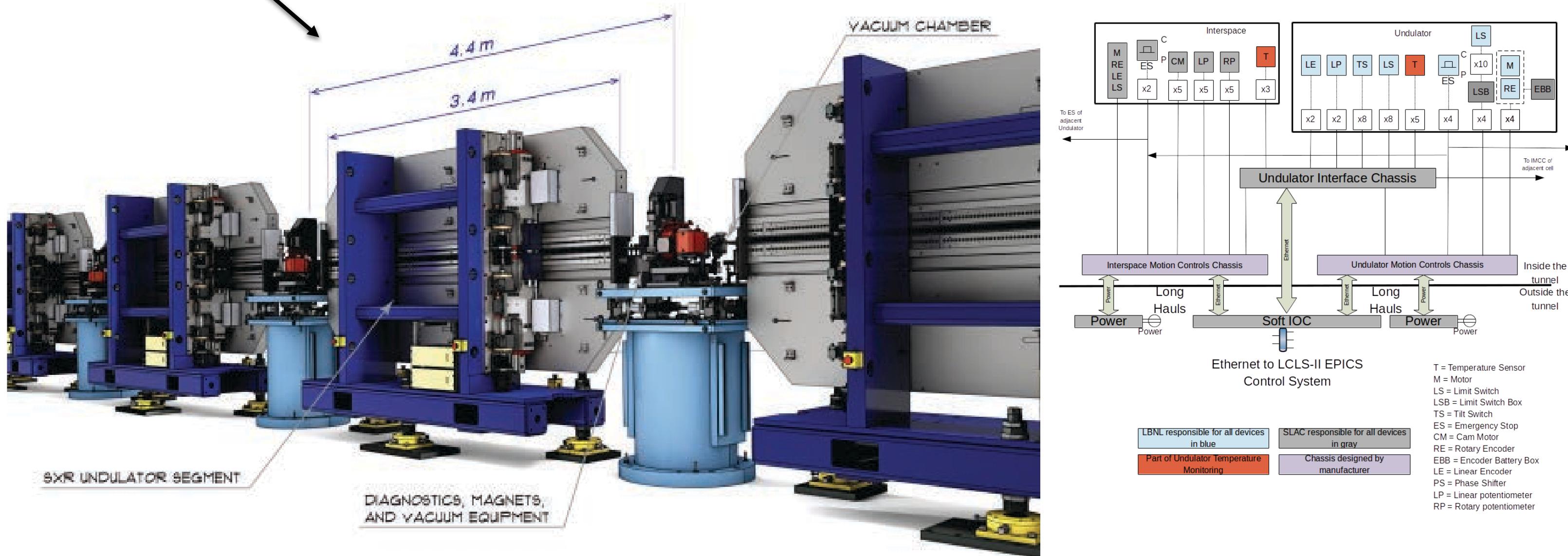
Undulator Hall



Hard X-ray Undulator Line



Soft X-ray Undulator Line



Acknowledgments

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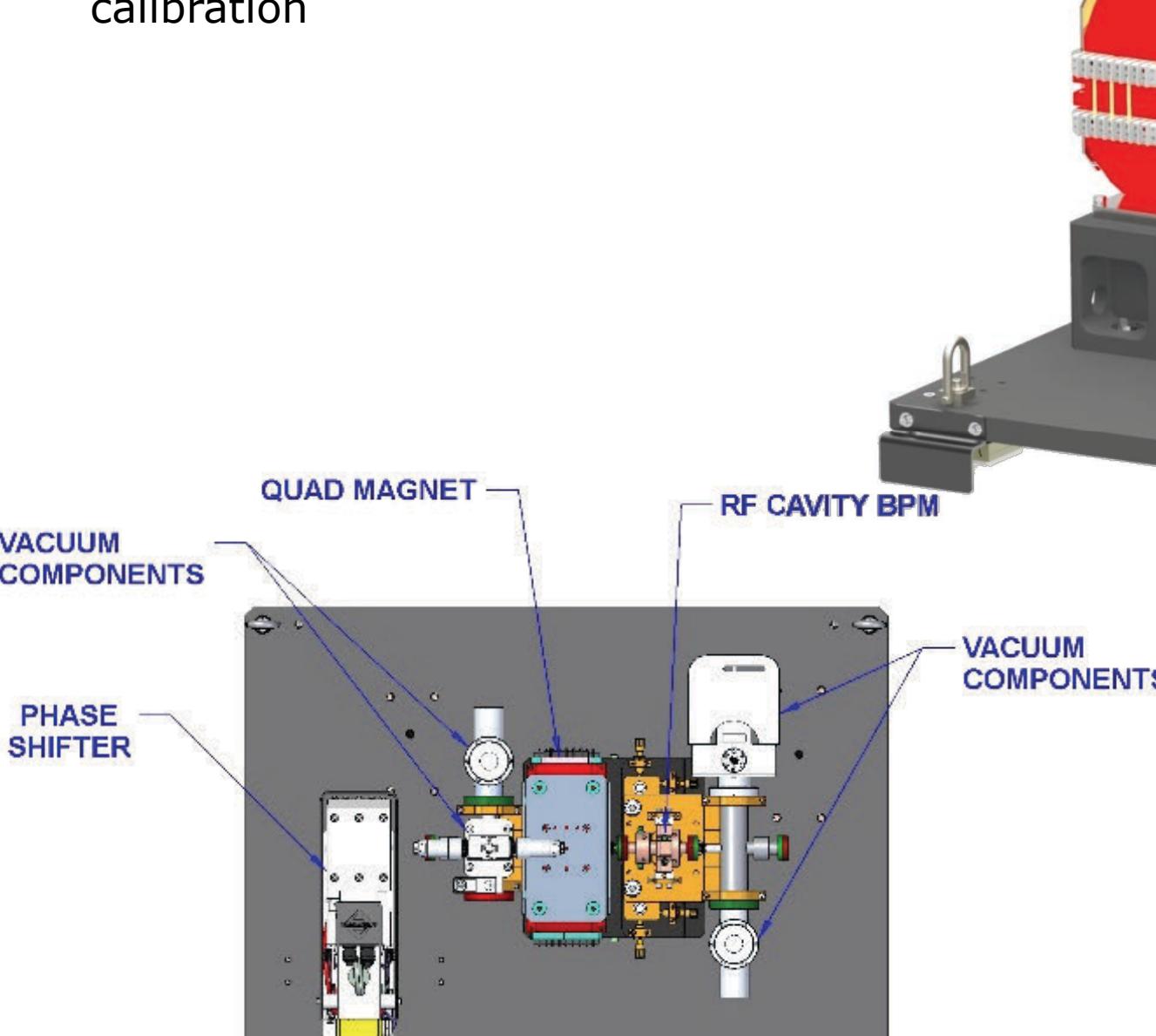
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Girder Alignment Cam System and Interspace

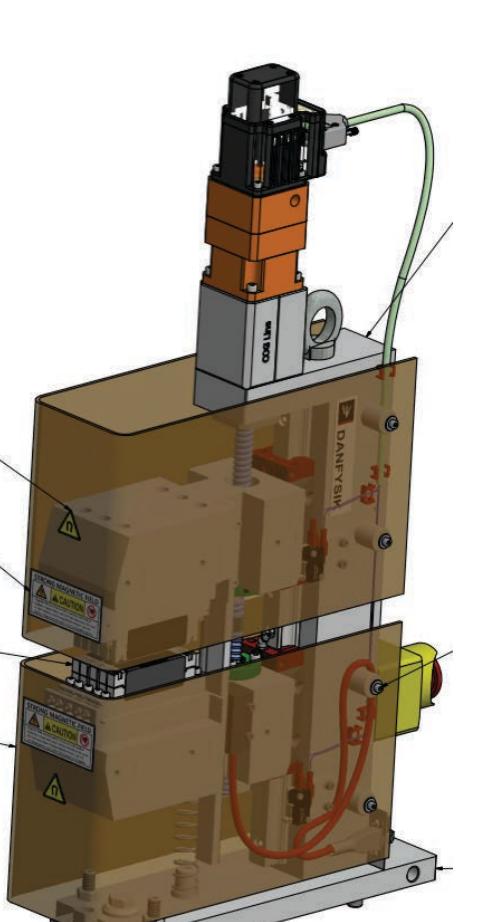
As the HXR interspace is on the same girder as the HXR undulator, the alignment cam system is shared. Additional non-motion control components on the interspace are quad magnets, RF cavity BPMs, and vacuum valves.

Cam system hardware is re-used from the LCLS-I undulator system:

- 5 Animatics SmartMotor SM2320D axes controlled by UCMI-1 in UIR
- Novotechnik rotary potentiometers
- Novotechnik linear potentiometers for calibration



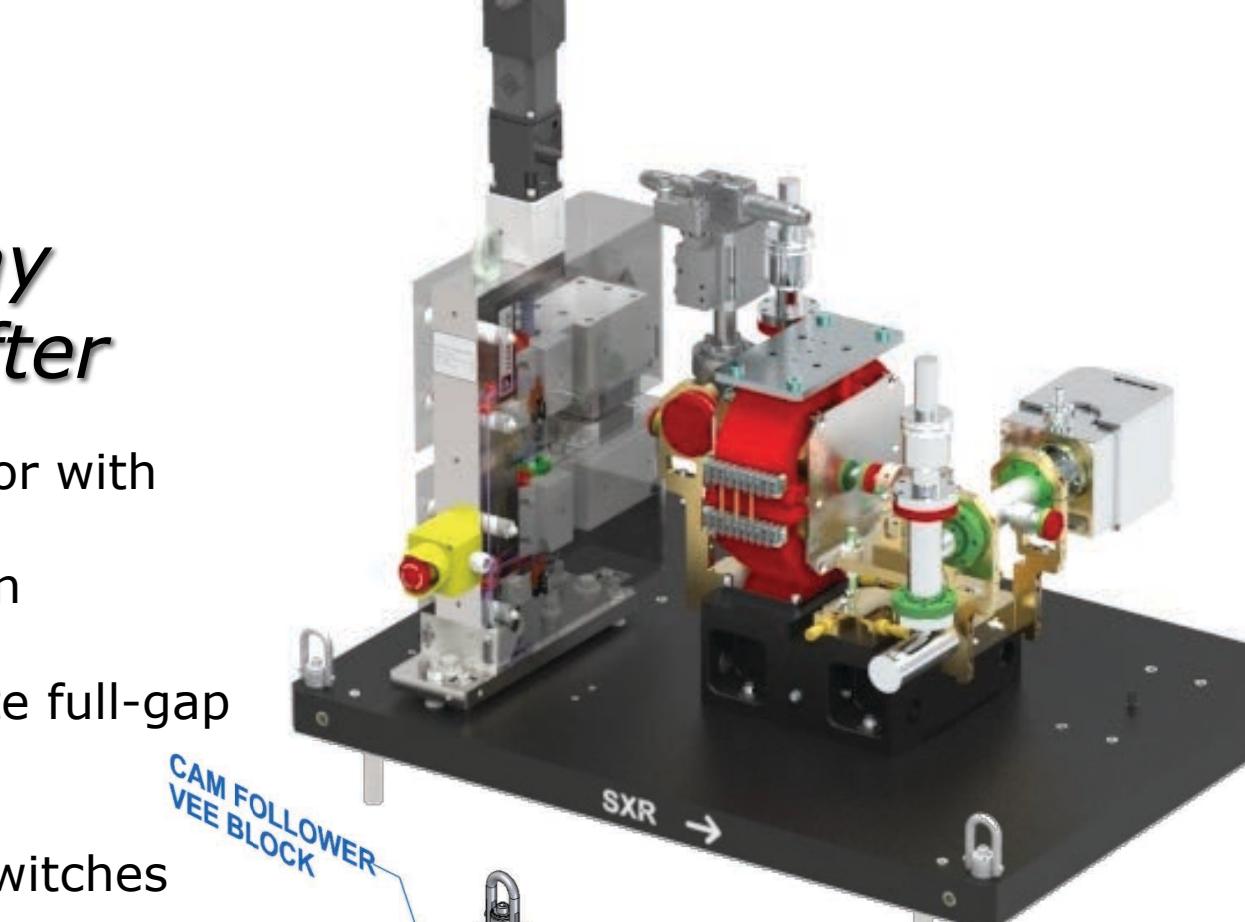
Hard X-ray Phase Shifter



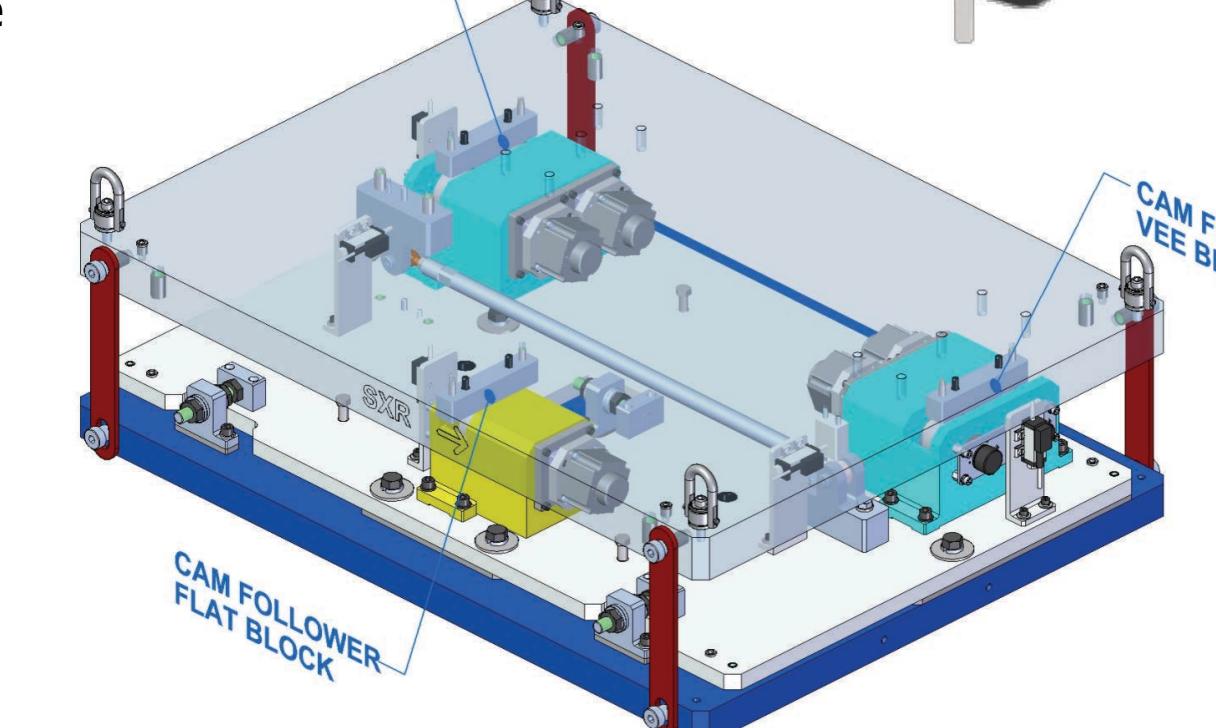
- Single servo motor with integrated controller, drive, and brake (SM23165DT)
- AMO absolute full-gap SSI encoder
- End-of-travel and overtravel limit switches
- E-stop interface

Requirement / Undulator	HXR	SXR	Unit
Minimum Undulator Gap	7.2	7.2	mm
Minimum Full Open Undulator Gap	120	200	mm
Taper Accuracy	± 1.5	± 2	μrad
Gap Repeatability	<1.5	<5	μm
Long term gap stability (24hr)	± 1	± 1	μm
Maximum available full gap speed	≥ 1.0	≥ 1.0	mm/s

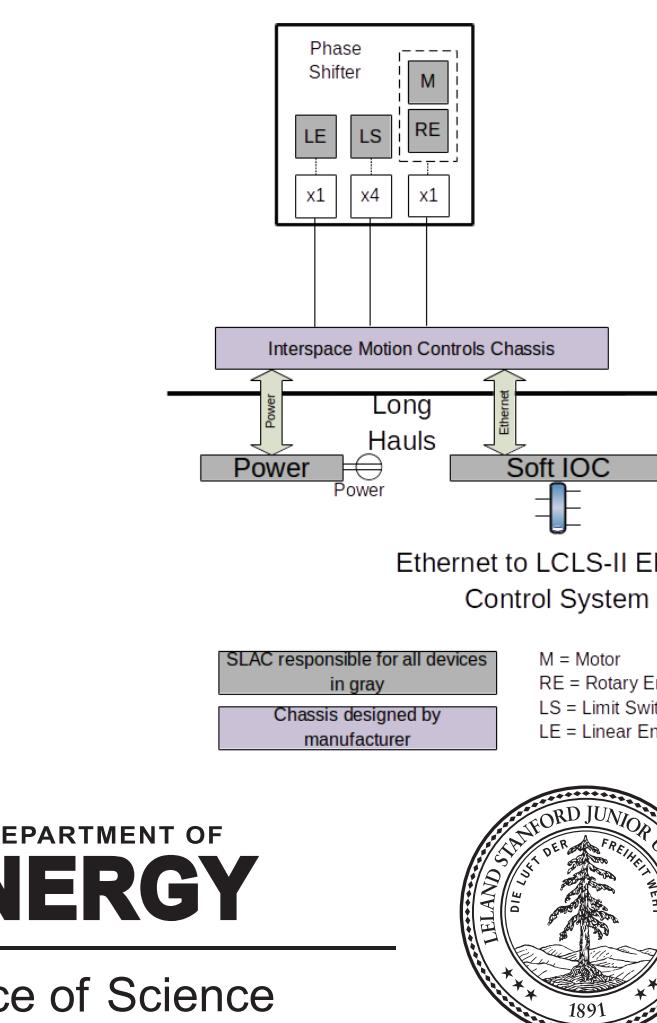
Soft X-ray Phase Shifter



- Single servo motor with brake
- Interspace motion controller
- Renishaw absolute full-gap encoder
- End-of-travel and overtravel limit switches
- E-stop interface

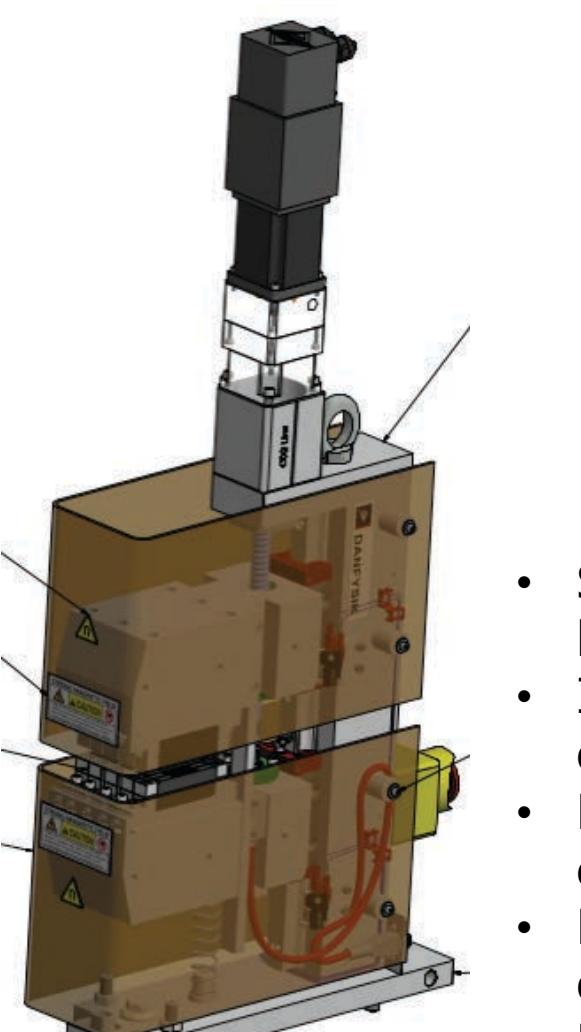


- Cam system hardware
- 6 axis Aerotech motion controller for cam motors and phase shifter servo
 - 5 Applied Motion HT23-601DC stepper motors
 - Novotechnik rotary potentiometers
 - Novotechnik linear potentiometers for calibration

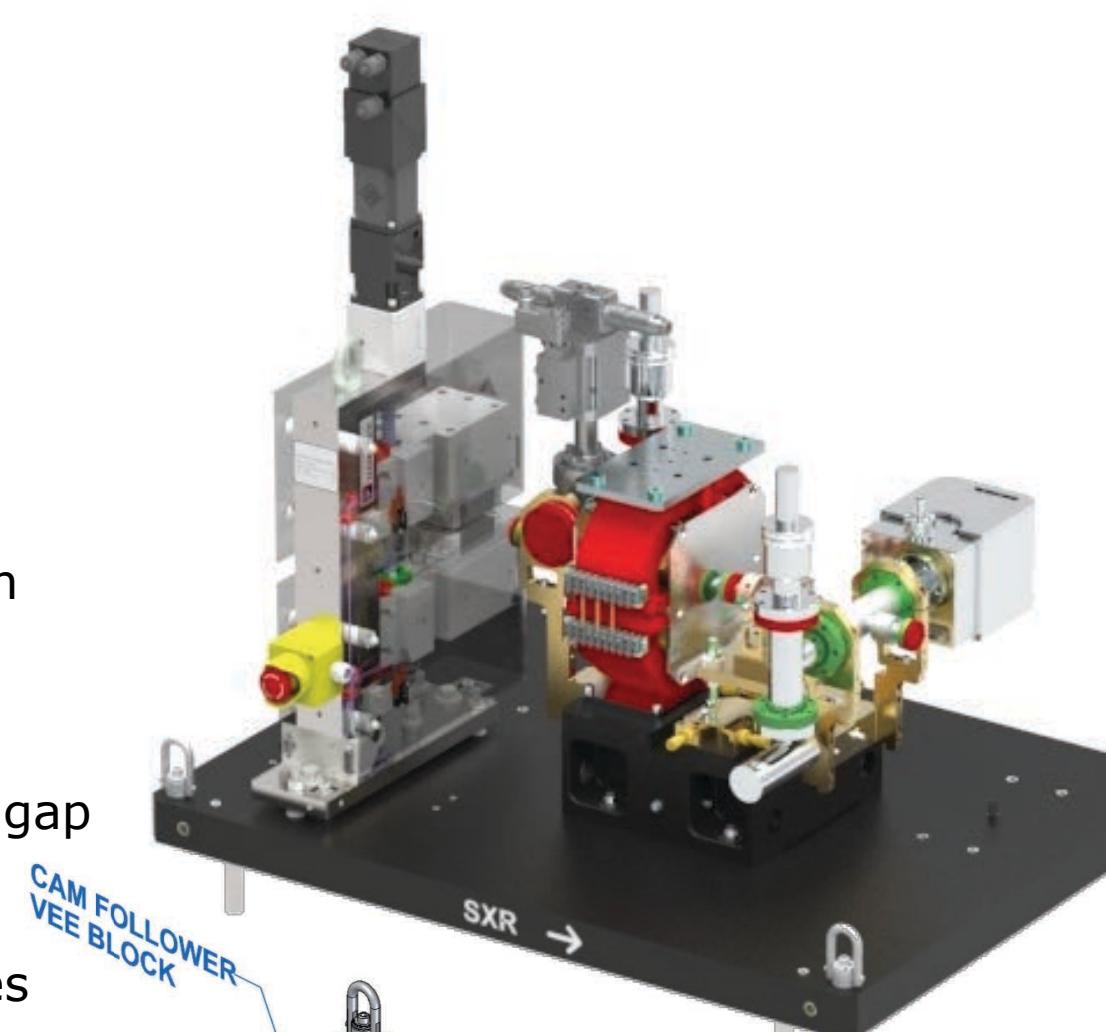


Interspace

The SXR interspace is on a separate pedestal from the SXR undulator and thus requires a separate cam positioning system. Similar to the HXR interspace, the SXR interspace also supports quadrupole magnets, RF cavity BPMs, and vacuum hardware.



Soft X-ray Interspace



- Single servo motor with brake
- Interspace motion controller
- Renishaw absolute full-gap encoder
- End-of-travel and overtravel limit switches
- E-stop interface

