

Upgrades for LCLS Liquid Jet Spectrometer PLCs



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Introduction

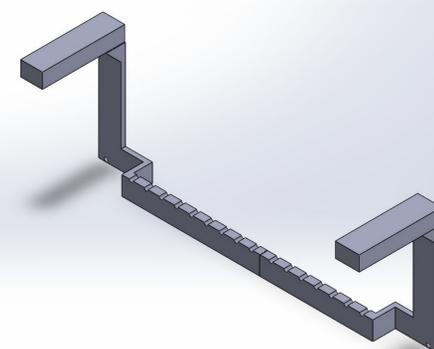
The Liquid Jets Endstation at LCLS is used to study photochemistry and biochemistry during liquid phase experiments. This is accomplished using liquid jets to ensure a quick delivery of samples to the X-ray interaction point. This system is used for X-ray solution scattering, X-ray absorption spectroscopy, and X-ray emission spectroscopy. The small von Hamos and polycapillary spectrometers are used in these experiments to collect the X-ray emission from the sample using crystal optics. The small von Hamos spectrometer is better suited for X-ray emission experiments, while the polycapillary spectrometer is used for X-ray absorption experiments at LCLS.

Small Von Hamos Software Upgrades

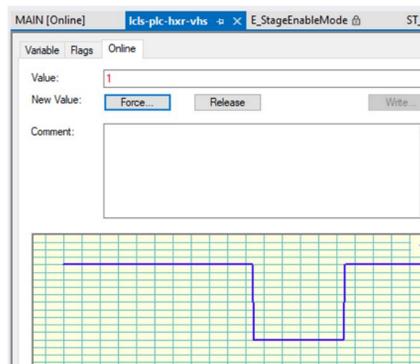
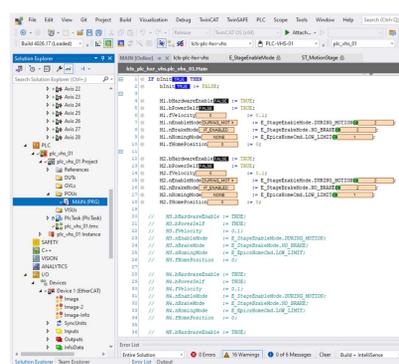
Parameter	Offline Value	Online Value	T	Unit
- Maximum Dynamics:				
Reference Velocity	0.99	0.99	F	mm/s
Maximum Velocity	0.5	0.5	F	mm/s
Maximum Acceleration	4.95	4.95	F	mm/s ²
Maximum Deceleration	4.95	4.95	F	mm/s ²
- Default Dynamics:				
Default Acceleration	4.95	4.95	F	mm/s ²
Default Deceleration	4.95	4.95	F	mm/s ²
Default Jerk	49.5	49.5	F	mm/s ³
- Manual Motion and Homing:				
Homing Velocity (Towards plc cam)	0.0099	0.0099	F	mm/s
Homing Velocity (off plc cam)	0.0099	0.0099	F	mm/s
Manual Velocity (Fast)	0.00495	0.00495	F	mm/s
Manual Velocity (Slow)	0.002475	0.002475	F	mm/s
Jog Increment (Forward)	5.0	5.0	F	mm
Jog Increment (Backward)	5.0	5.0	F	mm
- Fast Axis Stop:				
- Limit Switches:				
- Monitoring:				
- Setpoint Generator:				
- NCI Parameter:				
- Other Settings:				

- Used structured text to write PLC code, switching from an older 32-bit system to an updated 64-bit system
- Updated motor parameters for improved movement control to bring the PLC up to standard.
- Linked I/O and motors to ensure directional orders carried out successfully

Polycapillary Spectrometer



- Used SolidWorks to 3D model a removable device that would be able to stabilize connections
- To improve portability when transporting/storing the PLC and its fixture, arms were added to hold wires when not in use



Project Goals

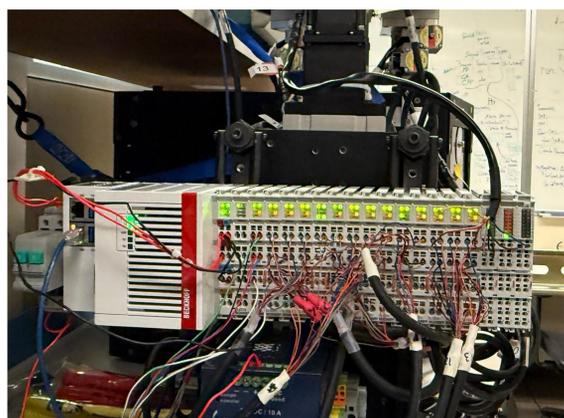
Small von Hamos Spectrometer

- Streamline the setup of motors by putting all motor controls on one Programmable Logic Control (PLC) system
- Upgrade the PLC to bring it into modern standards
- Upgrade the software to give staff increased reliability, better diagnostics, and improved network portability between hutches.

Polycapillary Spectrometer

- Design and create a fixture to improve cable management for the PLC that controls the polycapillary spectrometer
- Improve the reliability of system
- Improve the portability between storage and use

Hardware Upgrades



- Replaced Mdrive23 Motors with 2 Parker Motors for compatibility with the added EL7062 stepper motor motion control slice
- Added 2 Digital input ground switching terminals (EL1429) to fix the limit switch systems
- Added EL9184 potential distributor terminal to power added slices/motors
- Replaced CX5010 PLC with newer CX5240 PLC

Next Steps and Future Work

Small von Hamos Spectrometer

- Test and install one of the Parker Motor/Brakes
- Install and scan the slice currently in transport

Polycapillary Spectrometer

- 3D print the other half of the device
- Continue testing and redesign for better functionality

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REFERENCES

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 Beckhoff Automation
 SolidWorks
 Antolini, C.; Sosa Alfaro, V.; Reinhard, M.; Chatterjee, G.; Ribson, R.; Sokaras, D.; Gee, L.; Sato, T.; Kramer, P.L.; Raj, S.L.; et al. The Liquid Jet Endstation for Hard X-ray Scattering and Spectroscopy at the Linac Coherent Light Source. *Molecules* **2024**, *29*, 2323. <https://doi.org/10.3390/molecules29102323>