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Revision History

Revision	Date Released	Description of Change
R0	4/19/23	

Brief Summary

This document establishes a naming convention for LCLS sources as well as photon system components. This nomenclature--analogous to biological taxonomy--is intended to assign clear, unique, and logical names to photon sources, beam paths, components and end station areas that are part of the photon systems at LCLS. This document replaces LCLSII-3.5-TS-0017-R0.

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1 Purpose

This document defines a standardized approach for the naming of photon components at LCLS. The intended audience for this document is designers, engineers, scientists and technicians involved with design, installation and operation. The naming system aims for clarity, flexibility and functionality.

2 Scope

The *LCLS Photon Source and Systems Nomenclature* provides a hierarchical naming system for photon source, transport, experimental areas and end stations. This nomenclature system provides an unambiguous method for naming components in current, planned and future sources.

This document covers the following topics:

- Naming of photon sources at LCLS
- Naming of photon beamlines
- Naming of beamline functional component and their constituent devices
- Photon experimental system names and terminology

This nomenclature is not intended to be comprehensive and other naming systems are used outside the scope of this document. Reference to these systems and equivalents are discussed - in particular at interfaces. For more information see Section 11.

Photon system names have previously been defined according to the controlled document titled: Naming Convention for LCLS Photon Area (See Reference for 120-102-150-00) and those names continue to be valid. However, all new names for photon sources and systems shall follow conventions described within the current document.

3 Definitions

Photon Beamline	A photon beamline (aka beamline or beampath) describes an x-ray optical transport and manipulation system that delivers x-rays to an experiment end station.
End Station	An end station consists of equipment to introduce and manipulate samples, and all necessary detectors and spectrometers to examine particles and x-rays emitted from the sample, and may also incorporate special optics for additional manipulation, such as refocusing of the incident beam. End stations are not necessarily fixed and may move from one end station area to another. Note that in addition SLAC has two experimental halls with the names End Station A and End Station B. These buildings carry the name end station, but function as experiment halls.
End Station Area	Designated space downstream of the beamline exit flange where an end station can be located. The space is likely in convenient proximity to an interface for power, cooling water, compressed air, controls systems as well as lasers. Each beamline can have multiple end station areas.
Instrument	An instrument refers to a complete user-ready facility that includes a beamline with all required optics, an end station area with an end station, controls and data acquisitions systems.
Functional Component	An item which can directly interact with the photon beam (mirror, stopper, screen) or through which the photon beam can pass through (aperture, collimator, drift tube, gate valve, vacuum cross or chamber). The name should be derived from the primary functionality of the component.

Constituent Component	An item that does not necessarily directly interact with the beam, but rather forms the system of items that comprise a beamline component.

4 References

Prior to the release of this current document, naming conventions have been established and implemented to form many existing names--see references below. These systems are more focused on controls but applied broadly prior to this document. Other naming conventions that do not have overlap with the current document can be found in Section 11.

Link	Title
Link to Confluence	LCLS Naming Convention (Controls)
120-102-150-00	Naming Convention for LCLS Photon Area

5 Roles & Responsibilities

Naming Arbiter:	A single person recognized by the LCLS Chief Engineer as an expert in the area of naming and this document. This person is responsible for deciding ambiguous cases and granting exceptions for cases unforeseen by this document. In the event that this person plans to be unavailable, this person can temporarily delegate to another individual the authority to be sole decision-maker.
Naming Change Control Board (NCCB):	A small group of stakeholders and naming experts that are available for consultation by the Naming Arbiter when ambiguities arise. If the Arbiter has not been defined, is unavailable, or has not delegated the authority, a majority of the CCB can decide on ambiguous cases and grant exceptions.
Initial Namer:	When a set of names are generated at once--like for a beamline--they are first created by the Initial Namer. Typically, this point is reached during the mechanical design process. It is advised to consult the Naming Arbiter before finalizing the name. Furthermore, names are heavily used for controls purposes, but typically initiated by mechanical engineers. Engaging a controls engineer before names are fixed can help to provide consistent continuity in the naming roll out.

Because the nomenclature depends on the number of components and the sequence of each component, the system should be defined in the most complete state before names are fixed. The Initial Namer consults with the Naming Arbiter to finalize the names of a system of functional components such as a beamline. When a single new functional component is introduced, the integrating engineer typically determines the names. However, anyone familiar with this document can provide the names and if needed the Naming Arbiter can be consulted. When the interpretation needed for a name isn't clear the Naming Change Control Board is consulted by the Arbiter.

6 Overview - Document Content

Names for components and systems in the photon area of LCLS a built by combining the following names of elements:

FFFFF:GGG:CCC:N:XXXX

Where:

Table 1: Name Formation by Elements

	Element	Description	Authority	Rules	Character Limits	Usage
FFFFF	Functional Component	-Unique -Formula used to indicate component functionality, beamline (branchline) and photon source -End station -Instrument -End Station Area	This document	-Strict -Defined in this document to ensure uniqueness and accuracy -Terminate with a colon	Will need at least 5 for x-ray components. Areas and End Stations can be three or more	To provide a clear idea of function, source, beamline and sequence. Not exactly location but enough to find it.
GGG_GGG	Fungible	A sequence of mnemonics that denote, design, hierarchy and degree(s) of freedom	Depends on usage but should conform to precedent	-Flexible -Guidance provided - Synonyms and homonyms should not be used -Delimit with an underscore - Terminate with a colon	Minimum of 3	Optional, very flexible. Use for design when it will help clarify (e.g., GMD, KBO, HOMS). Or system (e.g., VAC, MPS) or a hybrid (GMDV).
CCC	Constituent Component Type	Mnemonic for component types	PCDS	-Follows established PCDS naming convention - Terminate with a colon	Aim for 3	
NN	Increment	Number to sequence multiple identical constituent components	This document	- Optional - Starts with 1 and increments - Must be numeric -Terminate with a colon	Min. 2 character Zero-padding is required.	Useful for duplicate constituent components that don't have distinct functional purposes in the system. e.g., multiple vacuum

						pumps on a single volume
XXXX	Control system process variable	Name of the control system process variable, e.g., temperature, position, setpoint, etc.	PCDS	- Flexible - Follow PCDS naming convention for process variables		

The following are general constraints that must be observed:

1) Decimals (i.e., the period symbol, ".") are strictly forbidden in any name because they are syntactically relevant in our computing systems.
2) The overall length of a device name, including control system process variable and delimiters shall not exceed 60 characters. This rule is influenced by control system configuration and interfacing between LCLS and the accelerator systems.

7 Source and Beamline Naming

7.1 Naming of Photon Sources at LCLS

Each undulator at the Linac Coherent Light Source may be considered an independent source. While LCLS-II includes two undulators, the possibility for additional undulators remains. Here a nomenclature is presented to uniquely identify each of these sources. Each undulator source is designated by a single letter from the English language alphabet as illustrated in Figure 1.

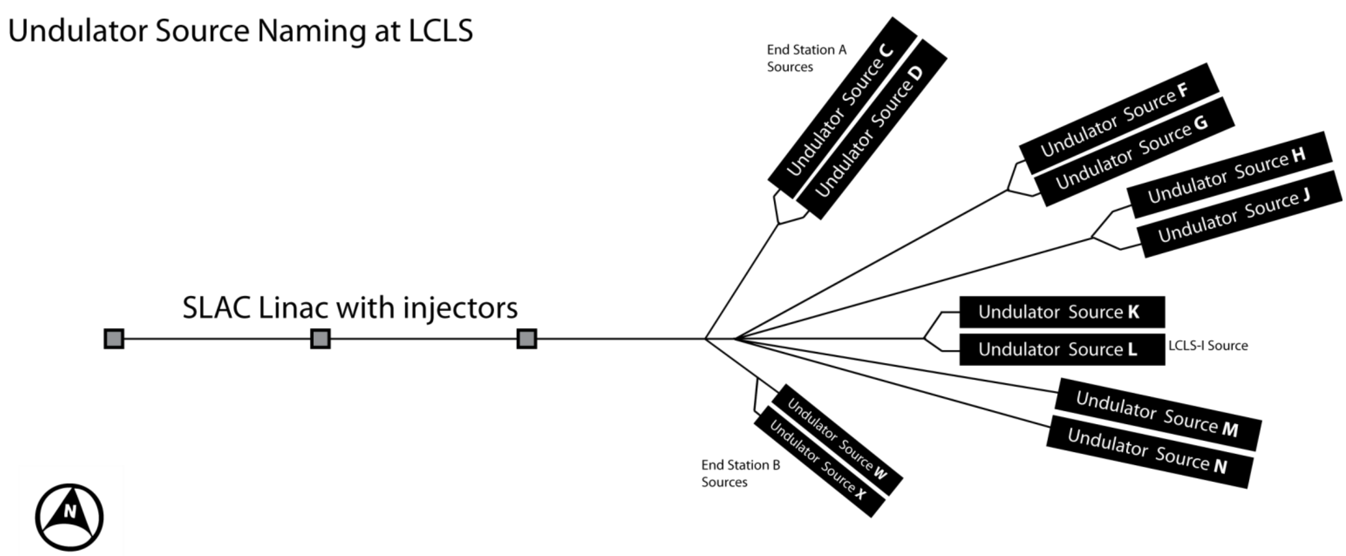

Figure 1: Photon Undulator Source Names for LCLS.
Undulator source names are independent of how electrons are transported to them. This includes the initial LCLS undulator which is named Source L as well as names for possible future expansion sources. Because End Stations A and B are possible source locations, they are given specific source assignments.

Because sources could fan both north and south of the current beamline, letters for expansion are necessary. The letter sequence descends (clockwise about the BSY) from northwest to east and from east to southwest using all consonants. We shall register the alphabetic naming system by designating the original, LCLS-I, undulator source with the letter "L". End Station A and End Station B represent possible locations for undulator sources. These undulator source names are reserved as shown in the drawing. Two sources in End Station A will be C and D and two sources in End Station B will be W and X.

We introduce the following redefinitions and cross references in Table 2.

Table 2: Adaptations to Source Names

Legacy Source Name	Legacy Abbreviations	Photon Source Name
Soft X-ray Undulator in LCLS tunnel (north side)	[redacted]	K
Hard X-ray Undulator in LCLS tunnel (south side)	LCLS	L

7.2 Photon Beamline Nomenclature

Here we define beamlines with the concatenation of:

(Source Letter) (Beampath Number)

Example: N0 is the beampath (0) originating at the undulator source named N.

The source letter is described above. The beampath number is a single sequential digit beginning with zero from the photon source. The beampath originating at the reflection of the first insertable element (mirror, crystal or grating) is assigned the number one. A mirror is considered insertable if it can be fully removed from a beam path or commanded into a beampath in such a way that the reflection from the mirror is intended for use. Beampaths originating from subsequent insertable mirrors are designated with values that increment monotonically with the z-coordinate. When a single mirror can be inserted, such that it may deflect the beam into multiple beam paths, it shall take the number of the beampath reached with the smallest (angular or translation) motion upon insertion. The beampath selected upon further motion of the mirror shall take the next incremental value. Insertable mirrors may be placed into any beampath to form a new beampath. Each of these beampaths originates at the point of insertion and terminates at the photon beam dump for the beampath. The originating beampath (zero) that is reflected by a fixed (that is to say non-insertable mirror) remains beampath zero. When two beampaths are coincident, the beampath brought together in coincidence with the lower sequence value takes precedence. This nomenclature is demonstrated for the circa 2022 LCLS source in Figure 2.

Sometimes beams are deflected on trajectories that are only slightly different from the nominal beam path. This can happen, for example when a low-density grating is used to generate a fan of beams or when a mirror has two different reflecting surfaces simultaneously. For these cases where the beam will remain in the same beam transport pipe and arrive at the same instrument as defined for the primary beam the new deflected beams carry the same beampath number as the primary beam.

Per section 5 names are best defined in the most complete state of design when components aren't expected to move. Having said this, upgrades will occur after the original system is complete. When this occurs, the sequence number for the beampath shall be continued with the next available sequence number. That is to say, once the original sequence is set, additional numbers are assigned chronologically. If the number of beampaths exceeds nine an extra character will be needed to indicate the tenth element and so on.

Example of Mirror and Beampath Naming from Undulator Source L

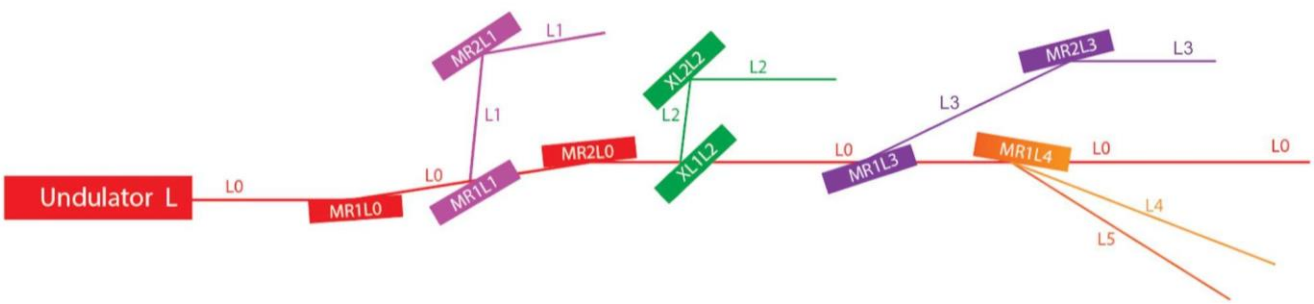

Figure 2: This example applies the naming convention described in this document to the current (as of 2022) LCLS HXR photon transport system. Note that MR1L4 mirror can deflect to two beam paths, but it takes the path letter of the lower angle path.

Exception Note on the K4 beampath
The K4 beampath begins with the first non-insertable offset mirror along the K0 beampath. Note that the MR1K4 mirror originates the K4 beampath even though it is not an insertable mirror.
Further exceptions will be maintained in a special controlled document that once released will be referenced here.

8 Name Formation

This section describes the formation of names as outlined in Table 1.

8.1 Functional Component Element (FFFFF)

Here we define beamline components with *unique names* by concatenating:

(Component Prefix) (Component Sequence Number) (Source Letter) (Beampath Number)

Example: MR2N1 is the second (2) mirror (MR) along the first beampath (1) from the undulator name N.

The functional component name is formed by prepending a two-letter component mnemonic prefix and sequence number to the beam path designation from Section 7.2. Table 3 shows the complete list of functional photon components and their associated prefixes. Beamline components can be identified as having a two-character prefix based on their function and not a specific design or vendor.

Following the component prefix, a sequence number is assigned to each component increasing monotonically along the beam path beginning with one for the initial appearance of each specific component. When a component has more than nine elements the increment will require two digits (starting with 10) and thus the overall Functional Component Element will have six characters. This would extend to three digits in the unlikely event that there were 99 components. Keep in mind that zero padding is not used in this case. Use 1 and 10, not 01 and 010.

By definition of beampath, the insertable mirror at the origin of the beampath takes the component sequence of one and the beampath number of the path it is originating.

Each functional component must form an upstream and downstream interface. Gate valves form a natural interface between components with the upstream valve belonging to the functional component. When multiple components are located between gate valves, a common vacuum flange can form an interface boundary. If two or more non x-ray optical components reside between common vacuum flanges (i.e. in the same vacuum vessel or chamber volume) the component prefix name should be assigned based on the following order:

1. Primary functionality (if neither is primary see 2)
2. Upstream most functionality (if both are in the same place see 3)
3. Functionality closest to the beam center.

For x-ray optical elements that are part of a system and thus reside on the same stand or within a common vacuum system, the prefix name should be assigned based on the following order:

1. Each optical element (MR, RL, XL) should also be named
2. The overall system should be named by its functionality. For example, a system of optics within common vacuum volume functioning as monochromator would be SP.
    a. Such that the optical elements would take their names, and anything connected to them would be given the name associated with the optical element.
    b. Things associated with the system like the stand or vacuum system take the overall functionality name.
3. When the functionality is the same as the optical element (e.g., multiple mirrors within a vacuum tank) the name should take the lowest functional component sequence. If both functional component sequence numbers are the same the system name takes the name of the functional component with the first alphabetical source letter.

An example of this is illustrated in Figure 3. The system level components take the name of the overall monochromator functionality (for example vacuum pumps, gate valve, etc.), but controls for the individual optical elements follow the name of the optic they serve.

Example of Multiple Optical Elements Sharing the Same Stand or Vacuum Volume

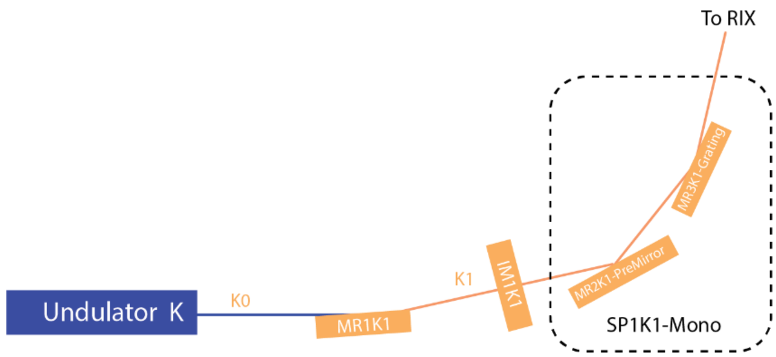

Figure 3: This is an example of how to name multiple optics within a single vacuum volume. In this case the optics each have their own individual names. The overall system takes the name of the function which is a spectrometer and thus SP1K1-Mono. The upstream gate valve is thus named SP1K1-Mono-VGC-01

There are exceptions to this rule originating from names developed before the convention was established. These exceptions will be captured in a controlled document of noncompliance--that once released will be referenced from this document. For noncompliance the name is explained to provide clarity.

As with the beampath numbering, the nomenclature depends on the number and sequence of components. Therefore, the systems should be named in their most complete state. If, however, there is a need to insert a component after the number has been defined, the number shall continue with the next available sequence number. Once the original sequence is set, additional numbers are assigned chronologically.

Table 3: Photon Beamline Component list with corresponding prefixes.

Prefix*	Component
AT	Attenuator
AL	Alignment Laser
BS	Bremsstrahlung Collimator
BT	Burn Through Monitor
CL	Calorimeter
EM	Photon Beam Energy Monitor
IM	Imaging System
LI	Laser Incoupling (or outcoupling) Mirror
MR	X-ray Mirror

PA	Differential Pumping Aperture (Includes differential pumps)
PC	Photon Collimator
PF	Photon Filters (includes, isolation and wave front target)
RL	Refractive Lens (element or stack)
SH	Shutter or Pulse Picker
SL	Slits or Adjustable Aperture
SP	Spectrometer or Monochromator
ST	Photon Stoppers (mechanically movable)
SF	Fixed Photon Stopper
SM	Machine Protection System Photon Stopper
TM	Arrival Time Monitor
TV	Transport (Vacuum) tube or cross (Used when vacuum elements are not clearly associated with an adjacent component)
VV	Vacuum Valve (Uncommon: Used only when valve is a functional component such as a fast valve)
XL	Crystal

8.2 Fungible Element (GGG_GGG)

This element is the least prescribed, but care should be taken to avoid generating different names with the same meaning or different mnemonic spellings of the same name. This element is named Fungible because it is intended to provide flexibility and detail when needed. Unlike the other elements the Fungible element does not follow a strict formula for length and can include multiple mnemonic terms separated by underscores. While flexible the following guidelines should be followed:

1. If a specific design (e.g., GMD) will be helpful to clarify the overall name it should be used. This is appropriate even if the fungible element provides information that might be redundant to the functional component element.
2. If the functional component is complex (e.g., an end station) the fungible element can specify an area or subsystem. For example, DET for a detector area or VAC for a vacuum subsystem.
3. If both of the aforementioned are desired as is the case for very complex subsystems the fungible element can include a hierarchical structure (From least specific to most specific) with each term separated by an underscore. For example: the vacuum system on the GMD could be FFF:GMD_VAC. There is no limit to the depth of the hierarchy (so long as the total length including control system PV is less than 60 characters).
4. A sequence number can be added to the above mnemonic terms when identical design, areas or subsystems are repeated.
5. The final term in the element may be a descriptive degree of freedom for control or measurement. For example, _X,_Y,_Z for motion, _T for temp and _P for pressure. These terms should be connected to the rest of the fungible element by an underscore.
6. For very simple systems with a clear functional element the fungible element could be unnecessary, difficult to form or even confusing. In these cases, the fungible element is optional.

To avoid the deleterious effects of generating fungible elements with different names but the same meaning or different mnemonic spellings for the same name a best effort to find previous occurrences is required before creating an unprecedented name. Previously used names will be recorded for future reference and to establish precedent on the PCDS Naming Convention Confluence page.

8.3 Constituent Component Nomenclature (CCC+)

A three-letter acronym is used for constituent devices that are part of the overall functional component. These three letter acronyms are based on those developed by PCDS and available from the confluence page titled "LCLS Naming Convention".

Constituent components are copious, and prefixes may already exist so name originators should check for precedence in the references section.

8.4 Delimiters

Name elements shall be separated by colons. Separations within the fungible element shall be delimited by underscores. Different delimiters may be used, but at the namer's risk of incompatibility and peer consternation.

9 End Station Area Naming System and Nomenclature

Here we define end station area by concatenating:

(Source Letter) (Beam path Number)(End Station Letter) (3 LETTER FUNCTIONAL COMPONENT NAME)

or as a functional component name? (End Station Letter/identifier) (Source Letter) (Beam path Number) e.g., AK2, IP1K2, or EA1K2? EAK2A

Example: N1A is the upstream end station (A) on the first insertable mirror beampath (1) from the undulator named N.

The end station area name begins with the beamline name followed sequentially by a letter beginning with A for the upstream end station and progressing to the downstream stations. Here we refer to the area where the end station can be placed after the exit port of the beamline or sequential hutches on hard x-ray beamlines. An example of the full naming convention for: sources, beampaths, components and end station areas are provided in Figure 4.

The end station area refers to the physical location of the end station and not the end station itself. This name should be used for services that support and end station and would remain in place even if the end station were to move. This would include components such as patch panels, utility connections, floor anchors, etc. The end station area is fixed and thus is not portable, however the end station is as covered in the next section.

Example of Mirror, Beampath and End Station Area Naming from Undulator Source N

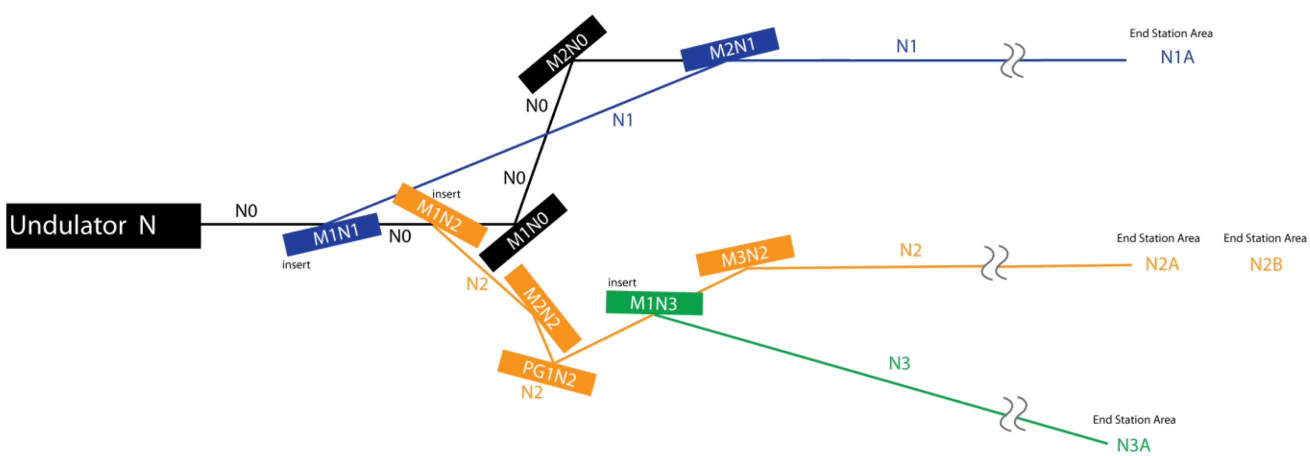

Figure 4: Example of a beampath and component layout for undulator source N. Mirrors that can be inserted are labeled "insert" and are the source for new beamlines. Note that the End Station Areas are also named.

9.1 End Stations

End Stations are the self-contained apparatus hosting the sample environment and detection systems. They may be fixed or move between end station areas. Because they are unique systems their names are not prescribed here. That said, their names should not take a form where they could be confused with a beamline component. Furthermore, end station names need to be suitable for abbreviation as a process variable. Examples:

RIXS: Resonant Inelastic X-ray Scattering End Station

DREAM: Dynamic REAction Microscope

ChemRIXS: Chemistry RIXS

RTDSL: Rapid Turn Around Diagnostic on the hard x-ray beamline.

9.2 Experimental Systems/Instruments

The experimental systems/instruments, beamline, components, and end station areas may take extended or branded names. These names may be suited to serve a user or external audience. Such names are operationally important and should be encouraged, but they should not be considered as replacements for this nomenclature formalism.

10 Examples of Names

The examples below provide a background for how actual component names are formed.

Name: **SL1L0:POWER:PIP:1**		
Functional	**SL1L0**	This component is part of the first Slit or Adjustable Aperture along the L0 beamline. L-source and zero (0) meaning the beam has not been deflected by an insertable mirror
Fungible	**POWER**	Power slit design
Constituent Component	**PIP**	Ion Pump
Increment	**1**	The first (possibly only) ion pump installed on the SL1L0

Name: **EM2L0:GEM**		
Functional	**EM2L0**	The second energy monitor along the L0 beampath.
Fungible	**GEM**	The energy monitor design is “Gas Energy Monitor”
Constituent Component		Because no constituent component is provided the name is in reference to the entire functional component system
Increment		Not applicable without a constituent component

Name: **MR1L0:HOMS:VGC:1**		
Functional	**MR1L0**	This component is part of the first mirror along the L0 beampath.
Fungible	**HOMS**	The design of the mirror system is called HOMS. While the original HOMS acronym stood for Hard x-ray Offset Mirror System that meaning does not necessarily apply.
Constituent Component	**VGC**	Controlled Gate Valve
Increment	**1**	The first controllable gate valve on the MR1L0

Name: **PC3L1:L2SI**		
Functional	**PC3L1**	This is the third photon collimator along the L1 beampath.
Fungible	**L2SI**	The photon collimator uses the L2SI design
Constituent Component		Because no constituent component is provided the name is in reference to the entire functional component system
Increment		Not applicable without a constituent component

Name: **EM1K0:GMD**		
Functional	**EM1K0**	This is the first Energy Monitor along the K0 beampath. It is therefore the first energy monitor downstream of the undulator.
Fungible	**GMD**	This energy monitor takes the Gas Monitor Detector Design
Constituent Component		Because no constituent component is provided the name is in reference to the entire functional component system
Increment		Not applicable without a constituent component

Name: **TV1K0:GAS:GPI:1**		
Functional	**TV1K0**	This component is part of the first named transport vacuum section of the K0 beampath.
Fungible	**GAS**	The component is near the gas attenuator system
Constituent Component	**GPI**	The component is a pirani vacuum gauge
Increment	**1**	It is the first (and possibly only) such gauge within the TV1K0

Name: **MR3K1:GRATING**		
Functional	**MR3K1**	This is the third mirror along the K1 beampath
Fungible	**GRATING**	This mirror is actually a ruled grating for a monochromator.
Constituent Component		Because no constituent component is provided the name is in reference to the entire functional component system
Increment		Not applicable without a constituent component

Name: **IM2K4:XTES**		
Functional	**IM2K4**	This is the second imager along the K4 beampath
Fungible	**XTES**	This imager takes the XTES design
Constituent Component		Because no constituent component is provided the name is in reference to the entire functional component system

Increment		Not applicable without a constituent component

11 Other Naming Systems used at LCLS and SLAC

While thorough, the scope of this document **does not** address the following areas.

Naming scope not included in this document	For more information see:
Electron Beam Components and Beam Containment	
Control rack naming	
Controller location/placement in racks	This naming formula is owned and maintained by PCDS. It is published on the PCDS confluence website.
Cooling and power systems	
Sample delivery system elements: gas bottles and lines, control valves, etc.	This naming convention takes over at the injector
Laser safety systems	
Timing systems	
Treaty Point	Location in space for coordinate systems