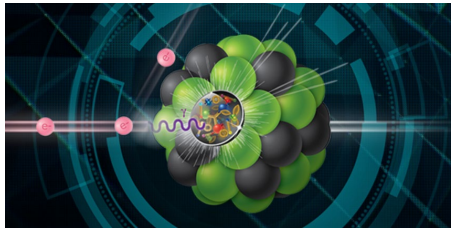


EIC Detector-1

EIC Detector Geometry Database

Tanja Horn

EIC Global geometry database

Adapted from 20 May Detector-1 WG Convener meeting

to provide consistency of detector envelopes between:

- **Sketchup**: Integration and assembly, installation, and maintenance.
- **CAD**: Detailed engineering information for construction.
- **Simulation**: Physics and detector studies using detailed GEANT-based detector simulations.
- **Analysis:** Reconstruction in simulation and physics analysis

(From discussion with EIC PM on 17 May 2022)

- **Gatekeeper**: Tanja Horn (for Detecfor-1 contacts; work together with system engineer Walt Akers for global changes and improvements)
  - Keep some info on changes and why

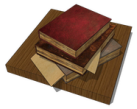
Geometry Database – https://eic.jlab.org/Geometry/Detector/

- **Legs of input:**
  - Global Detector/Integration Group:
    - Collects all information from working groups
    - Balances detector technology needs versus each other
  - Detector-1 Sim/QA Working Group:
    - Collects all trade-offs of material budget versus science performance
    - Implements version control for simulations
  - EIC Project Detector Leads:
    - Collect input from E&D process (Space needs for frames and supports, Space needs for service/cooling, Requirements of accelerator and vacuum integration)
    - Fold keep-in volumes into requirements/interface control document

https://eic.jlab.org/Geometry/Detector/

EIC DETECTOR GEOMETRY

INTERACTION POINT 6



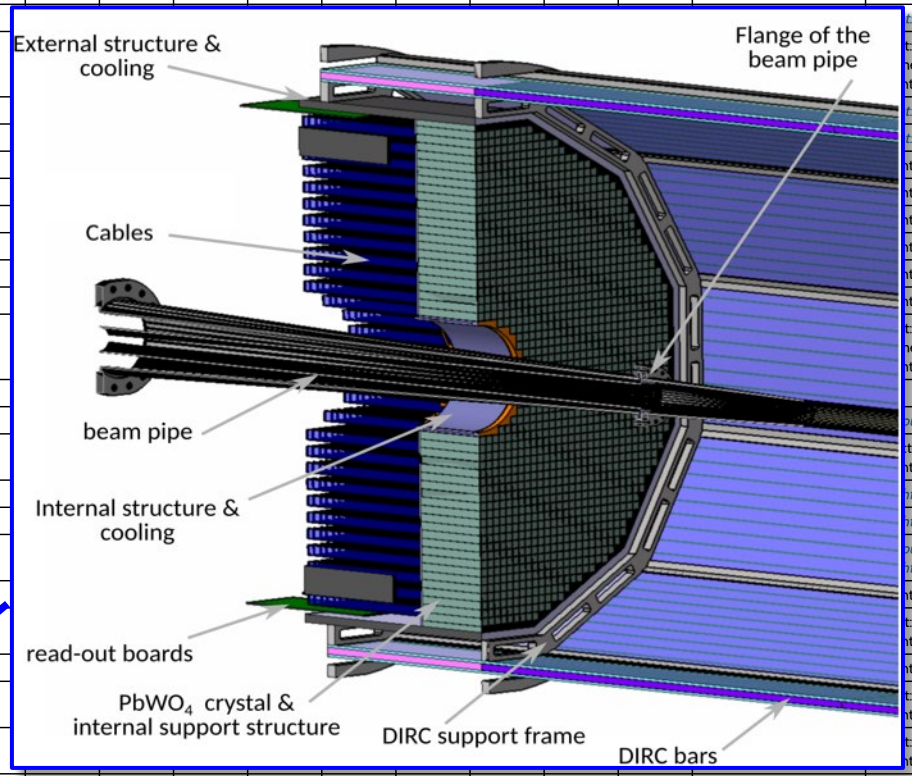
Detector Geometry Matrices - IP 6

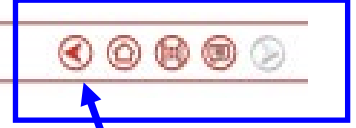
The following is a date-oriented table of matrices that contain the configuration parameters for the EIC detector at interaction point 6. The current matrix provides a description of the volumetric envelope for all of the sub-detectors, a description of their technology, their estimated weights, and additional configuration notes. Requests for revisions or updates to these matrices should be sent to Tanja Horn.

Name	Author	Date	Description
Detector-20220624102507	Tanja Horn	06/24/2022 10:25:07	Fixed inconsistencies in DIRC frame, hpDIRC and MPGD: Iterated hpDIRC position as balance between phi-coverage and frame engineering strength need; added 2-cm space for MPGD tracker (muRWell or MM) on top of DIRC bar boxes --> now 5cm slot for both together; added slots for service needs in frame.
Detector-20220623172941	Tanja Horn	06/23/2022 17:29:41	Initial Detector-1 database posted in the EIC geometry management system.

Region	Component	Sub-Component	WBS	Length (cm)	Inner Radius (cm)	Outer Radius (cm)	Offset from Center (cm)	Physical Start (cm)	Physical End (cm)	Volume (m^3)	Weight (kg)	Technology	Notes
HADRON DIRECTION END CAP	Hadron Calorimeter		6.10.06	171	30	267	328	499	328	33.61	215,210	FeSc, WSc last segment	Tower size: 5cm x 5cm x 140cm, 20cm readout Offset: measured from face nearest to interaction point Volume: calculated as cylindrical volume minus the volume of the embedded ECAL Weight: estimated as 79% iron and 21% plastic
	Electromagnetic Calorimeter		6.10.05	38	30	190	328	366	328	4.20	27,165	Pb/Sc	Tower size: 1cm (1.65cm) x 1cm(1.65cm) x 37.5cm, 5cm readout Offset: measured from face nearest to interaction point Weight: estimated as 85% lead glass and 15% steel
	Service Gap			8			320	328	320				Offset: measured from location nearest to interaction point
CENTRAL DETECTOR	Barrel Hadron Calorimeter		6.10.06	640		267	0	320	-320	72.60	464,834	FeSc	Offset: measured from center of detector Volume: calculated as sum of the sub-sections Weight: estimated as 79% iron and 21% plastic
		HD Section		*170*	*194*	*267*	*150*	*320*	*150*	*17.97*			*Offset: measured from face nearest to interaction point*
		Central Section		*300*	*180*	*267*	*0*	*150*	*-150*	*36.65*			*Offset: measured from center of detector*
		LD Section		*170*	*194*	*267*	*-150*	*-150*	*-320*	*17.97*			*Offset: measured from face nearest to interaction point*
	Dual RICH		6.10.04	100	10		180	280	180	10.29	1,911	Aerogel/Gas	Offset: measured from face nearest to interaction point Volume: calculated as sum of the sub-sections Weight: based on parametric estimate from CLAS LTCC
		Detector Section		*80*	*10*	*195*	*200*	*280*	*200*	*9.53*			*Offset: measured from face nearest to interaction point*
		Aerogel Section		*20*	*10*	*110*	*180*	*200*	*180*	*0.75*			*Offset: measured from face nearest to interaction point*
	Solenoid Magnet		6.10.07	384	142	177	0	192	-192	13.47	45,956	Solenoid	Weight: based on parametric estimate from CLEO II
	EMCal Outer Support			445	134	141	-30	192.5	-252.5	2.69	4,225	Steel, Instrumented	Weight: calculated as 20% of total volume as steel (balance is air)
	EMCal Outer Surface			480	133	134	-45	195	-285	0.40	1,091	Aluminum	Weight: calculated as 100% Aluminum
	EMCal Electronics			480	125.5	133	-45	195	-285	2.92	5,737	Near eta=0	Weight: calculated as 25% silicon (balance is air)
	Barrel EMCal		6.10.05	480	79.5	125.5	-45	195	-285	14.22	49,885	Sci Glass	Weight: based on parametric estimate from CMS EMCal
	EMCal Inner Surface			480	79	79.5	-45	195	-285	0.12	324	Aluminum	Weight: calculated as 100% Aluminum
	DIRC Support			455	65	79	-257	168	-287	2.60	1,019	Steel	Offset: measured from point where DIRC bar connects to the readout Volume: calculated as sum of sub-sections Weight: estimated as 5% of total volume as steel (balance is air & detector)
		Bar Support		*425*	*65*	*77*	*-257*	*168*	*-257*	*2.28*			
		Readout Support		*30*	*65*	*105*	*-257*	*-257*	*-287*	*0.32*			*Readout support is triangular frame, therefore volume is halved.*
	Integrated DIRC/MPGD Detector		6.10.04		71.5	76.5	-257	168	-287	0.86	662	Fused silica bars	Detector is totally enclosed by DIRC Support. Weight: calculated as sum of sub-components
		MPGD Tracker		*340*	*74.5*	*76.5*	*-5*	*165*	*-175*	*0.32*	*65*	*muRWell (plane type)*	*Weight: based on parametric estimate from SBS Gem*
		DIRC Bar Box		*425*	*71.5*	*74.5*	*-257*	*168*	*-257*	*0.58*	*407*		*Weight: calculated as 30% quartz (balance is air & support system)*
		DIRC Readout		*30*	*71.5*	*104.4*	*-257*	*-257*	*-287*	*0.27*	*191*		*Readout is triangular, therefore volume is halved.* *Weight: Calculated as 30% silicon(balance is air & support system)*
	Barrel Time of Flight/Tracker		6.10.03	270	63	65	15	150	-120	0.22	43	AC/LGAD	Weight: based on parametric estimate from SBS Gem
	HD Time of Flight/Tracker		6.10.03	15	12	62	155.5	170.5	155.5	0.17	35	AC/LGAD	Offset: measured from face nearest to interaction point Weight: based on parametric estimate from SBS Gem
	Silicon Tracker		6.10.03	228	3	45.9	0	126	-102	1.50	227	MAPS	Weight: calculated as 3% aluminum and 3% silicon (balance is air)
	Modular RICH		6.10.04	25	10	64	-135	-135	-160	0.31	58	Aerogel	Offset: measured from face nearest to interaction point Weight: based on parametric estimate from CLAS LTCC
	LD Time of Flight/Tracker		6.10.03	10	12	64	-161	-161	-171	0.12	25	AC/LGAD	Offset: measured from face nearest to interaction point Weight: based on parametric estimate from SBS Gem
	LD EMCal		6.10.05	60	9	63	-175	-175	-235	0.73	4,738	PbWO4	Offset: measured from face nearest to interaction point Weight: estimated as 85% lead glass and 15% steel
	Service Gap			10			-320	-320	-330	0.00			Offset: measured from location nearest to interaction point
LEPTON DIRECTION ENDCAP	Backward Field Return		6.10.06	20.32			-330	-330	-350.32	5.18	40,649	Iron	Offset: measured from face nearest to interaction point Weight: calculated as 100% iron.
		Return Cylinder		*20.32*	*20*	*270*	*-330*	*-330*	*-350.32*	*4.63*			
		Support Panel		*7.62*	*454*	*664*	*-336.35*	*-336.35*	*-343.97*	*0.55*			*Height: specified in outer radius* *Width: specified in inner radius*

Region	Component	Sub-Component	WBS	Length (cm)	Inner Radius (cm)	Outer Radius (cm)	Offset from Center (cm)	Physical Start (cm)	Physical End (cm)	Volume (m^3)	Weight (kg)	Technology	Notes
HADRON DIRECTION END CAP	Hadron Calorimeter		6.10.06	171	30	267	328	499	328	33.61	215,210	FeSc, WSc last segment	Tower size: 5cm x 5cm x 140cm, 20cm readout Offset: measured from face nearest to interaction point Volume: calculated as cylindrical volume minus the volume of the embedded ECAL Weight: estimated as 79% iron and 21% plastic
	Electromagnetic Calorimeter		6.10.05	38	30	190	328	366	328	4.20	27,165	Pb/Sc	Tower size: 1cm (1.65cm) x 1cm(1.65cm) x 37.5cm, 5cm readout Offset: measured from face nearest to interaction point Weight: estimated as 85% lead glass and 15% steel
	Service Gap			8			320	328	320				Offset: measured from location nearest to interaction point
CENTRAL DETECTOR	Barrel Hadron Calorimeter		6.10.06	640		267	0	320	-320	72.60	464,834	FeSc	Offset: measured from center of detector Volume: calculated as sum of the sub-sections Weight: estimated as 79% iron and 21% plastic
		HD Section		*170*	*194*	*267*	*150*	*320*	*150*	*17.97*			*Offset: measured from face nearest to interaction point*
		Central Section		*300*	*180*	*267*	*0*	*150*	*-150*	*36.65*			*Offset: measured from center of detector*
		LD Section											*t: measured from face nearest to interaction point*
	Dual RICH												t: measured from face nearest to interaction point ne: calculated as sum of the sub-sections nt: based on parametric estimate from CLAS LTCC
		Detector Section											*t: measured from face nearest to interaction point*
		Aerogel Section											*t: measured from face nearest to interaction point*
	Solenoid Magnet												nt: based on parametric estimate from CLEO II
	EMCal Outer Support												nt: calculated as 20% of total volume as steel (balance is air)
	EMCal Outer Surface												nt: calculated as 100% Aluminum
	EMCal Electronics												nt: calculated as 25% silicon (balance is air)
	Barrel EMCal												nt: based on parametric estimate from CMS EMCal
	EMCal Inner Surface												nt: calculated as 100% Aluminum
	DIRC Support												t: measured from point where DIRC bar connects to the readout ne: calculated as sum of sub-sections nt: estimated as 5% of total volume as steel (balance is air & detector)
		Bar Support											
		Readout Support											*out support is triangular frame, therefore volume is halved.*
	Integrated DIRC/MPGD Detector												tor is totally enclosed by DIRC Support. nt: calculated as sum of sub-components
		MPGD Tracker											*nt: based on parametric estimate from SBS Gem*
		DIRC Bar Box											*nt: calculated as 30% quartz (balance is air & support system)*
		DIRC Readout											*out is triangular, therefore volume is halved.* *nt: Calculated as 30% silicon(balance is air & support system)*
	Barrel Time of Flight/Tracker												nt: based on parametric estimate from SBS Gem
	HD Time of Flight/Tracker												t: measured from face nearest to interaction point nt: based on parametric estimate from SBS Gem
	Silicon Tracker												nt: calculated as 3% aluminum and 3% silicon (balance is air)
	Modular RICH												t: measured from face nearest to interaction point nt: based on parametric estimate from CLAS LTCC
	LD Time of Flight/Tracker												t: measured from face nearest to interaction point nt: based on parametric estimate from SBS Gem
	LD EMCal		6.10.05	60	9	63	-175	-175	-235	0.73	4,738	PbWO4	Offset: measured from face nearest to interaction point Weight: estimated as 85% lead glass and 15% steel
	Service Gap			10			-320	-320	-330	0.00			Offset: measured from location nearest to interaction point
LEPTON DIRECTION ENDCAP	Backward Field Return		6.10.06	20.32			-330	-330	-350.32	5.18	40,649	Iron	Offset: measured from face nearest to interaction point Weight: calculated as 100% iron.
		Return Cylinder		*20.32*	*20*	*270*	*-330*	*-330*	*-350.32*	*4.63*			
		Support Panel		*7.62*	*454*	*664*	*-336.35*	*-336.35*	*-343.97*	*0.55*			*Height: specified in outer radius* *Width: specified in inner radius*





EIC DETECTOR GEOMETRY

INTERACTION POINT 6

Region	Component	Sub-Component	WBS	Length (cm)	Inner Radius (cm)	Outer Radius (cm)	Offset from Center (cm)	Physical Start (cm)	Physical End (cm)	Volume (m^3)	Weight (kg)	Technology	Notes
HADRON DIRECTION END CAP	Hadron Calorimeter		6.10.06	171	30	267	328	499	328	33.61	215,210	FeSc, WSc last segment	Tower size: 5cm x 5cm x 140cm, 20cm readout Offset: measured from face nearest to interaction point Volume: calculated as cylindrical volume minus the volume of the embedded ECAL Weight: estimated as 79% iron and 21% plastic
	Electromagnetic Calorimeter		6.10.05	38	30	190	328	366	328	4.20	27,165	Pb/Sc	Tower size: 1cm (1.65cm) x 1cm(1.65cm) x 37.5cm, 5cm readout Offset: measured from face nearest to interaction point Weight: estimated as 85% lead glass and 15% steel
	Service Gap			8			320	328	320				Offset: measured from location nearest to interaction point
CENTRAL DETECTOR	Barrel Hadron Calorimeter		6.10.06	640		267	0	320	-320	72.60	464,834	FeSc	Offset: measured from center of detector Volume: calculated as sum of the sub-sections Weight: estimated as 79% iron and 21% plastic
		HD Section		*170*	*194*	*267*	*150*	*320*	*150*	*17.97*			*Offset: measured from face nearest to interaction point*
		Central Section		*300*	*180*	*267*	*0*	*150*	*-150*	*36.65*			*Offset: measured from center of detector*
		LD Section		*170*	*194*	*267*	*-150*	*-150*	*-320*	*17.97*			*Offset: measured from face nearest to interaction point*
	Dual RICH		6.10.04	100	10		180	280	180	10.29	1,911	Aerogel/Gas	Offset: measured from face nearest to interaction point Volume: calculated as sum of the sub-sections Weight: based on parametric estimate from CLAS LTCC
		Detector Section		*80*	*10*	*195*	*200*	*280*	*200*	*9.53*			*Offset: measured from face nearest to interaction point*
		Aerogel Section		*20*	*10*	*110*	*180*	*200*	*180*	*0.75*			*Offset: measured from face nearest to interaction point*
LEPTON DIRECTION ENDCAP	Backward Field Return	*Return Cylinder*		*20.32*	*20*	*270*	*-330*	*-330*	*-350.32*	*4.63*			
		Support Panel		*7.62*	*454*	*664*	*-336.35*	*-336.35*	*-343.97*	*0.55*			*Height: specified in outer radius* *Width: specified in inner radius*

Region	Component	Sub-Component	WBS	Length (cm)	Inner Radius (cm)	Outer Radius (cm)	Offset from Center (cm)	Physical Start (cm)	Physical End (cm)	Volume (m^3)	Weight (kg)	Technology	Notes
HADRON DIRECTION END CAP	Hadron Calorimeter		6.10.06	171	30	267	328	499	328	33.61	215,210	FeSc, WSc last segment	Tower size: 5cm x 5cm x 140cm, 20cm readout Offset: measured from face nearest to interaction point
CENTRAL DETECTO													
LEPTON DIRECTION ENDCAP	Backward Field Return	Return Cylinder		20.32	20	270	-330	-330	-350.32	4.63			Weight: calculated as 100% iron.
		Support Panel		7.62	454	664	-336.35	-336.35	-343.97	0.55			Height: specified in outer radius Width: specified in inner radius

EIC GEOMETRY MANAGEMENT SYSTEM

EIC GEOMETRY MANAGEMENT SYSTEM

GEOMETRY AND MASTER PARAMETER TABLES FOR THE ELECTRON-ION COLLIDER

Overview and General Documents

This section contains instructions and general documentation associated with the EIC Geometry Management System.

Name	Date	Description
Documents and Specifications		
TBD 1	April 28, 2022	Text here included for example purposes only.
TBD 2	April 28, 2022	Text here included for example purposes only.
TBD 3	April 28, 2022	Text here included for example purposes only.
Instructional Videos		
TBD 1	April 28, 2022	Text here included for example purposes only.
TBD 2	April 28, 2022	Text here included for example purposes only.
TBD 3	April 28, 2022	Text here included for example purposes only.

Detector and Interaction Region

This section contains references to the Detector Geometry Matrix and the individual parameter tables for the Forward and Backward Interaction Regions.

Name	Date	Description
Detector Matrices		
Detector Matrix for Interaction Point 6		This links contains a date-oriented table of matrices that contain the configuration parameters for the EIC detector at interaction point 6. The current matrix provides a description of the volumetric envelope for all of the sub-detectors, a description of their technology, their estimated weights, and additional configuration notes. Requests for revisions or updates to these matrices should be sent to Tanja Horn.

Region	Component	Sub-Component	WBS	Length (cm)	Inner Radius (cm)	Outer Radius (cm)	Offset from Center (cm)	Physical Start (cm)	Physical End (cm)	Volume (m^3)	Weight (kg)	Technology	Notes
HADRON DIRECTION END CAP	Hadron Calorimeter		6.10.06	171	30	267	328	499	328	33.61	215,210	FeSc, WSc last segment	Tower size: 5cm x 5cm x 140cm, 20cm readout Offset: measured from face nearest to interaction point Volume: calculated as cylindrical volume minus the volume of the embedded ECAL
CENTRAL DETECTOR		*Readout Support*		*30*	*65*	*105*	*-257*	*-257*	*-287*	*0.32*			*Readout support is triangular frame, therefore volume is halved.*
	Integrated DIRC/MPGD Detector		6.10.04		71.5	76.5	-257	168	-287	0.86	662	Fused silica bars	Detector is totally enclosed by DIRC Support. Weight: calculated as sum of sub-components
		MPGD Tracker		*340*	*74.5*	*76.5*	*-5*	*165*	*-175*	*0.32*	*65*	*muRWell (plane type)*	*Weight: based on parametric estimate from SBS Gem*
		DIRC Bar Box		*425*	*71.5*	*74.5*	*-257*	*168*	*-257*	*0.58*	*407*		*Weight: calculated as 30% quartz (balance is air & support system)*
		DIRC Readout		*30*	*71.5*	*104.4*	*-257*	*-257*	*-287*	*0.27*	*191*		*Readout is triangular, therefore volume is halved.* *Weight: Calculated as 30% silicon(balance is air & support system)*
	Barrel Time of Flight/Tracker		6.10.03	270	63	65	15	150	-120	0.22	43	AC/LGAD	Weight: based on parametric estimate from SBS Gem
	HD Time of Flight/Tracker		6.10.03	15	12	62	155.5	170.5	155.5	0.17	35	AC/LGAD	Offset: measured from face nearest to interaction point Weight: based on parametric estimate from SBS Gem
	Silicon Tracker		6.10.03	228	3	45.9	0	126	-102	1.50	227	MAPS	Weight: calculated as 3% aluminum and 3% silicon (balance is air)
	Modular RICH		6.10.04	25	10	64	-135	-135	-160	0.31	58	Aerogel	Offset: measured from face nearest to interaction point Weight: based on parametric estimate from CLAS LTCC
	LD Time of Flight/Tracker		6.10.03	10	12	64	-161	-161	-171	0.12	25	AC/LGAD	Offset: measured from face nearest to interaction point Weight: based on parametric estimate from SBS Gem
	LD EMCal		6.10.05	60	9	63	-175	-175	-235	0.73	4,738	PbWO4	Offset: measured from face nearest to interaction point Weight: estimated as 85% lead glass and 15% steel
	Service Gap			10			-320	-320	-330	0.00			Offset: measured from location nearest to interaction point
LEPTON DIRECTION ENDCAP	Backward Field Return		6.10.06	20.32			-330	-330	-350.32	5.18	40,649	Iron	Offset: measured from face nearest to interaction point Weight: calculated as 100% iron.
		Return Cylinder		*20.32*	*20*	*270*	*-330*	*-330*	*-350.32*	*4.63*			
		Support Panel		*7.62*	*454*	*664*	*-336.35*	*-336.35*	*-343.97*	*0.55*			*Height: specified in outer radius* *Width: specified in inner radius*

Comments, References and Contact Information

The information provided on this page is generated directly from the originating spreadsheet. The data in this section should provide insights into the design choices that have been made over time, along with references to documentation regarding the changes. To request clarification or changes to this information (or to information in the geometry matrix), please reach out to the individuals listed in the Contacts section.

Comments

Author	Date	Comment
Tanja Horn	April 13, 2022	Initial Detector-1 DB posted
Tanja Horn	May 19, 2022	Fixed inconsistencies in DIRC frame, hpDIRC and MPGD: Iterated hpDIRC position as balance between phi-coverage and frame engineering strength need; added 2-cm space for MPGD tracker (muRWell or MM) on top of DIRC bar boxes --> now 5cm slot for both together; added slots for service needs in frame
Walt Akers	June 20, 2022	Finalizing the design of the detector portion of the EIC Geometry Management System.

References

Title	Date	Description
Detector Menagerie		A complete collection of Sketchup models that can be used to construct detector systems from parts. Each of the sub-components is independently configurable.
Experimental Equipment Sharepoint Repository		This is the BNL Sharepoint root directory for Experimental Equipment documents. Key sub-directories are listed in the expanded list below. These links require authenticated access.

Contacts

Name	E-Mail	Details
Tanja Horn	hornt@cua.edu	Primary contact for information that is stored in the Geometry Matrix.
Walt Akers	akers@jlab.org	Technical contact for online data, features and accessibility.