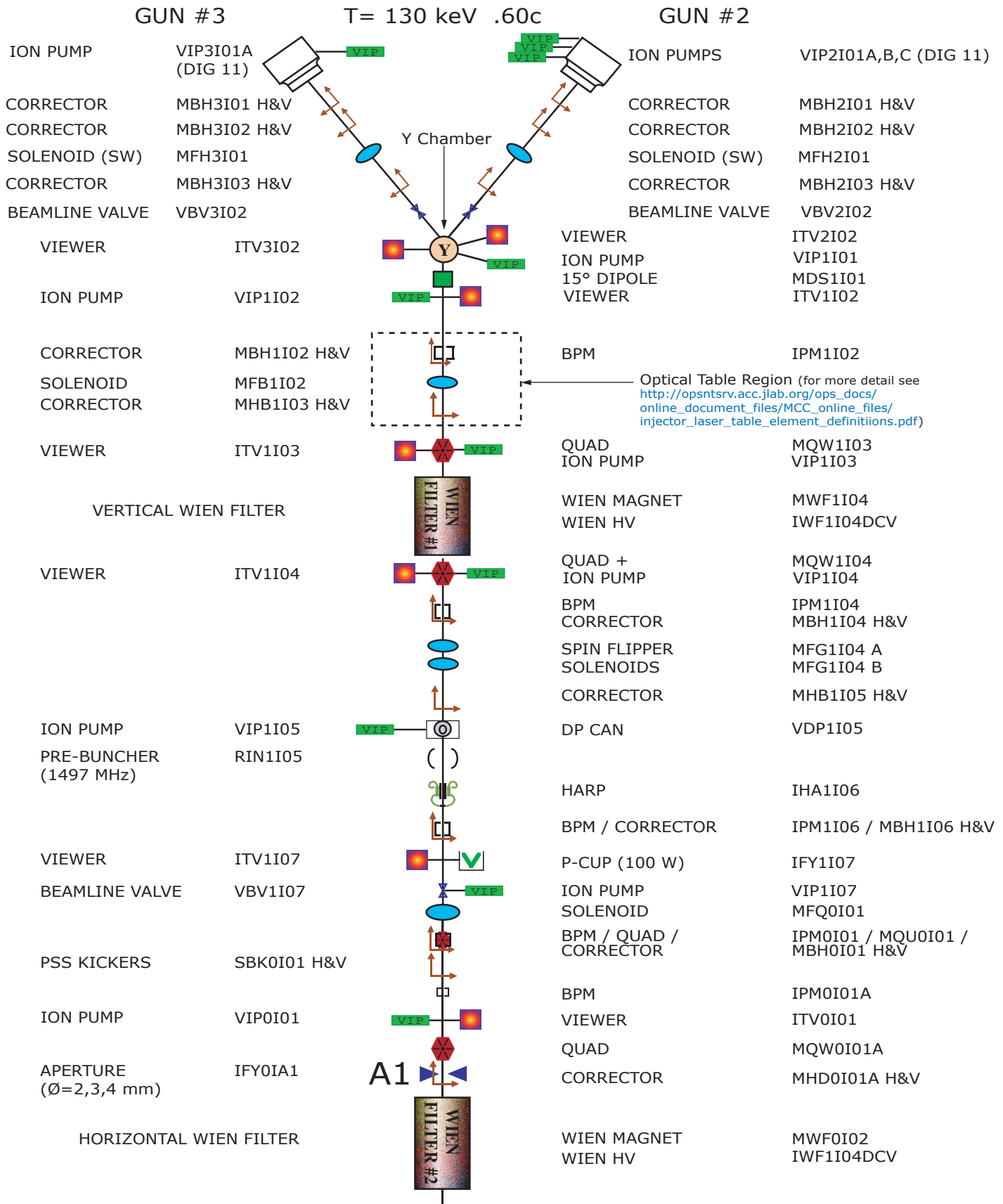


INJECTOR QUICK REFERENCE DRAWING



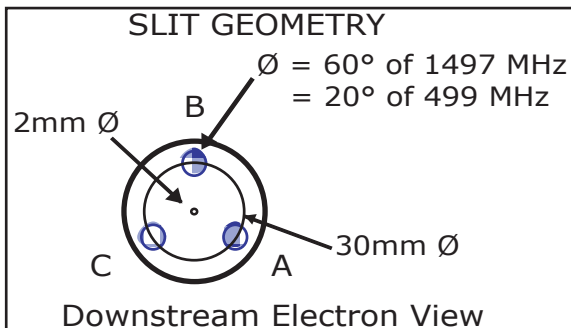
Optical Table Region (for more detail see http://opsntrv.acc.jlab.org/ops_docs/online_document_files/MCC_online_files/injector_laser_table_element_definitions.pdf)

CORRECTOR MBH0I02 H&V
 VIEWER ITV0I02
 APERTURE IFY0IA2
 (Ø=4,6,8 mm)

CHOPPER #1 (499 MHz)

MASTER SLIT
 SLIT A
 SLIT B
 SLIT C
 VIEWER
 CENTER PLUG

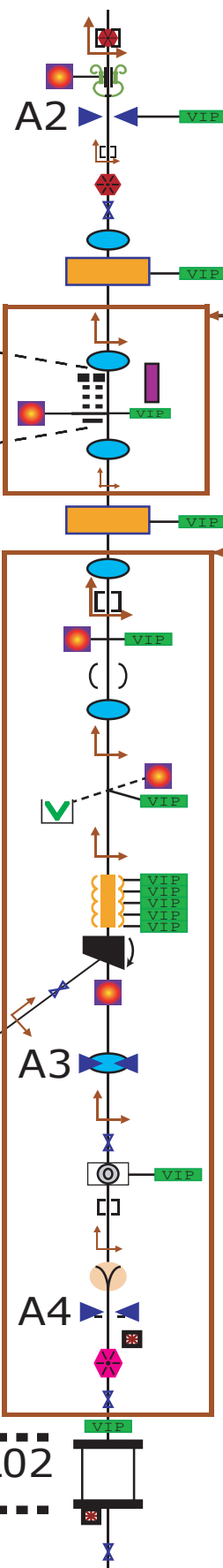
CHOPPER #2 (499 MHz)



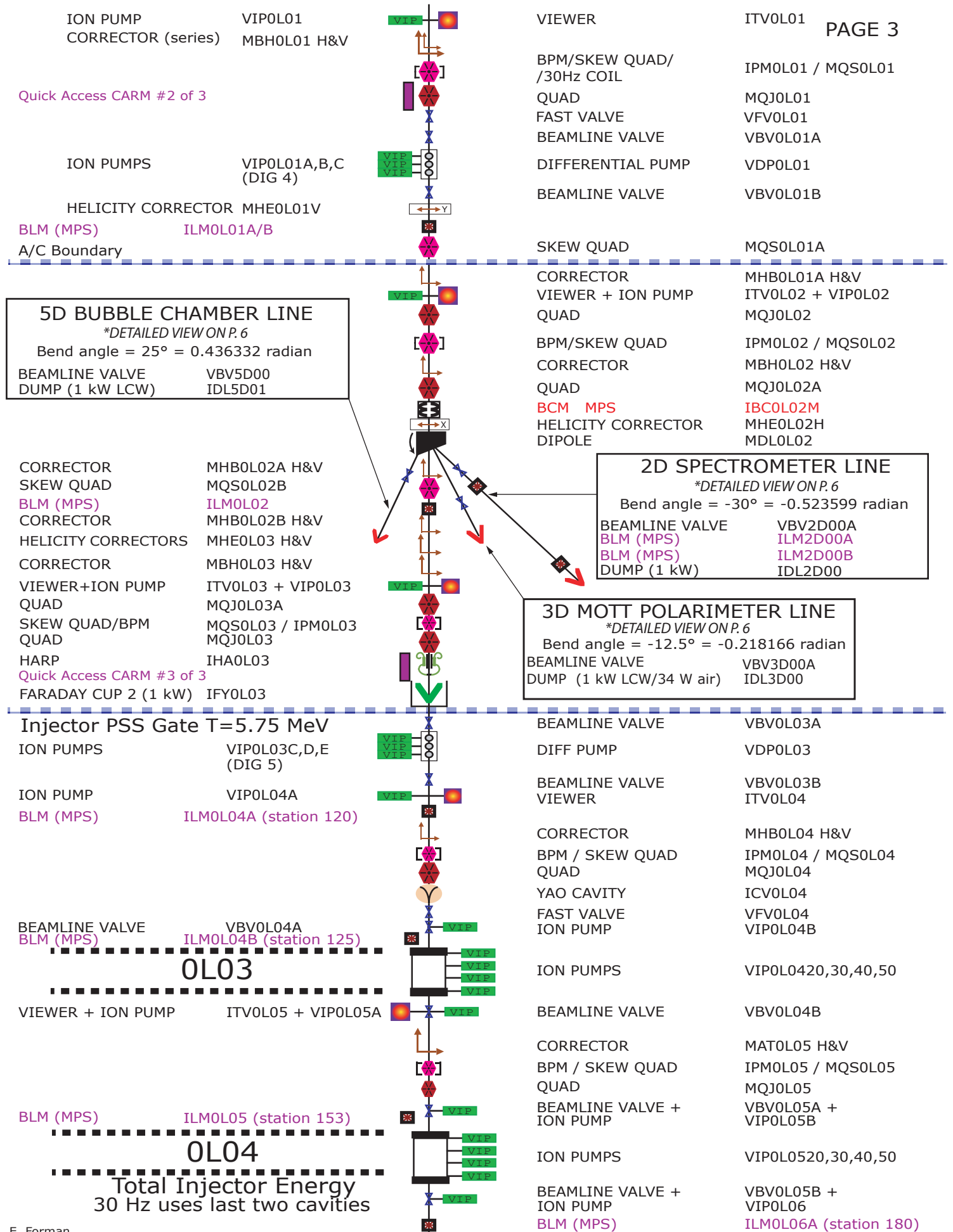
CAPTURE
 T= 500keV .86c

1D SPECTROMETER
 Bend angle = 30° = 0.523599 radian
 BEAMLINE VALVE VBV1D00
 CORRECTOR MAD1D00 H&V
 HARP (DISCONNECTED) IHA1D00
 VIEWER + ITV1D00
 ION PUMP VIP1D00 (DIG 3)
 500 keV Dump (1 kW) IDL1D00

¼ CRYOMODULE 0L02
 T= 5.75 MeV



BPM / QUAD IPM0I02 / MQU0I02
 HARP (disconnected) IHA0I02
 ION PUMP VIP0I02
 CORRECTOR / BPM MBH0I02A H&V / IPM0I02A
 QUAD MQU0I02A
 BEAMLINE VALVE VBV0I02
 SOLENOID MFA0I03
 ION PUMP VIP0I03 (DIG 7)
EARTH CORRECTING COIL MED0I03
 CORRECTOR MBH0I03 H&V
 SOLENOID MFD0I04
Quick Access CARM #1 of 3
 VIEWER + ION PUMP ITV0I04 + VIP0I04 (DIG 2)
 SOLENOID(same power supply as MFD0I04) MFD0I04A
 CORRECTOR MBH0I04 H&V
 ION PUMP VIP0I04A (DIG 7)
EARTH CORRECTING COIL MEE0I05
 SOLENOID MFA0I05
 CORRECTOR/BPM MBH0I05 H&V / IPM0I05
 VIEWER + ION PUMP ITV0I05 + VIP0I05 (DIG 3)
 RF BUNCHER CAVITY (1497 MHz)
 SOLENOID MFA0I06
 CORRECTOR MBH0I06 H&V
 VIEWER ITV0I06
 ION PUMP VIP0I06 (DIG 3)
 FARADAY CUP #1 (100W) IFY0I06
 CORRECTOR MAD0I06A H&V
 CAPTURE ION PUMPS VIP0I06A,B,C,D,E (DIG 3)
 DIPOLE MBO0I06
 VIEW SCREEN ITV0I06A
 APERTURE (Ø=6mm) / SOLENOID IFY0IA3 / MFL0I07
 CORRECTOR MAD0I07 H&V
 BEAMLINE VALVE VBV0I07
 DP CAN + ION PUMP VDP0I07 + VIP0I07 (DIG 4)
 BPM IPM0I07
 CORRECTOR MBH0I07A H&V
 YAO CAVITY ICV0I07
 APERTURE (Ø=6.5mm) IFY0IA4
BLM (MPS) ILM0I07
 SKEW QUAD MQS0I07
 BEAMLINE VALVE VBV0L00A
 ION PUMP VIP0L00
BLM (MPS) ILM0L01A
 BEAMLINE VALVE VBV0L00B



ION PUMP CORRECTOR (series) VIP0L01 MBH0L01 H&V

Quick Access CARM #2 of 3

ION PUMPS VIP0L01A,B,C (DIG 4)

HELICITY CORRECTOR MHE0L01V

BLM (MPS) A/C Boundary ILM0L01A/B

VIEWER ITV0L01

BPM/SKEW QUAD/ /30Hz COIL IPM0L01 / MQS0L01

QUAD MQJ0L01

FAST VALVE VVF0L01

BEAMLINE VALVE VBV0L01A

DIFFERENTIAL PUMP VDP0L01

BEAMLINE VALVE VBV0L01B

SKEW QUAD MQS0L01A

5D BUBBLE CHAMBER LINE
 *DETAILED VIEW ON P. 6
 Bend angle = 25° = 0.436332 radian
 BEAMLINE VALVE VBV5D00
 DUMP (1 kW LCW) IDL5D01

CORRECTOR MHB0L01A H&V

VIEWER + ION PUMP ITV0L02 + VIP0L02

QUAD MQJ0L02

BPM/SKEW QUAD IPM0L02 / MQS0L02

CORRECTOR MBH0L02 H&V

QUAD MQJ0L02A

BCM MPS IBC0L02M

HELICITY CORRECTOR MHE0L02H

DIPOLE MDL0L02

CORRECTOR MHB0L02A H&V

SKEW QUAD MQS0L02B

BLM (MPS) ILM0L02

CORRECTOR MHB0L02B H&V

HELICITY CORRECTORS MHE0L03 H&V

CORRECTOR MBH0L03 H&V

VIEWER+ION PUMP ITV0L03 + VIP0L03

QUAD MQJ0L03A

SKEW QUAD/BPM MQS0L03 / IPM0L03

QUAD MQJ0L03

HARP IHA0L03

Quick Access CARM #3 of 3

FARADAY CUP 2 (1 kW) IFY0L03

2D SPECTROMETER LINE
 *DETAILED VIEW ON P. 6
 Bend angle = -30° = -0.523599 radian
 BEAMLINE VALVE VBV2D00A
 BLM (MPS) ILM2D00A
 BLM (MPS) ILM2D00B
 DUMP (1 kW) IDL2D00

3D MOTT POLARIMETER LINE
 *DETAILED VIEW ON P. 6
 Bend angle = -12.5° = -0.218166 radian
 BEAMLINE VALVE VBV3D00A
 DUMP (1 kW LCW/34 W air) IDL3D00

Injector PSS Gate T=5.75 MeV

ION PUMPS VIP0L03C,D,E (DIG 5)

ION PUMP VIP0L04A

BLM (MPS) ILM0L04A (station 120)

BEAMLINE VALVE VBV0L04A

BLM (MPS) ILM0L04B (station 125)

OL03

VIEWER + ION PUMP ITV0L05 + VIP0L05A

BLM (MPS) ILM0L05 (station 153)

OL04

Total Injector Energy
 30 Hz uses last two cavities

BEAMLINE VALVE VBV0L03A

DIFF PUMP VDP0L03

BEAMLINE VALVE VBV0L03B

VIEWER ITV0L04

CORRECTOR MHB0L04 H&V

BPM / SKEW QUAD IPM0L04 / MQS0L04

QUAD MQJ0L04

YAO CAVITY ICV0L04

FAST VALVE VVF0L04

ION PUMP VIP0L04B

ION PUMPS VIP0L0420,30,40,50

BEAMLINE VALVE VBV0L04B

CORRECTOR MAT0L05 H&V

BPM / SKEW QUAD IPM0L05 / MQS0L05

QUAD MQJ0L05

BEAMLINE VALVE + ION PUMP VBV0L05A + VIP0L05B

ION PUMPS VIP0L0520,30,40,50

BEAMLINE VALVE + ION PUMP VBV0L05B + VIP0L06

BLM (MPS) ILM0L06A (station 180)

ARC 10
*Incomplete on this diagram

BEAMLINE VALVE VBVAA19

QUAD CORRECTOR ION PUMP MQPAA32 MDBAA32V VIPAA32

DIPOLE MXPAA31

DIPOLE MXPAA32

ION PUMP VIPAR01

ION PUMP BEAMLINE VALVE VIPAR07 VBVAR08

4D (123 MeV) SPECTROMETER
Bend angle = $25^\circ = 0.436332$ radian

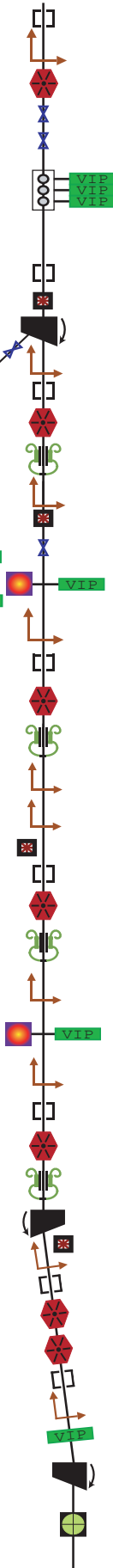
| | |
|----------------|------------------------|
| BEAMLINE VALVE | VBV4D00 |
| ARC 10 CROSS | |
| BEAMLINE VALVE | VBV4D00A |
| VIEWER | ITV4D00 |
| BPM | IPM4D00 |
| HARP | IHA4D00 |
| BLM | ILM4D001 (station 215) |
| VIEWER | IOR4D00 |
| DUMP (17 kW) | IDL4D00 |

* Note that the 4D Spectrometer and Arc 10 share vacuum. Closest isolation valves in the arc are VBVAA19 and VBVAR08.

VIEWER ITV0L10

BLM (MPS) ILM0R01 (station 275)

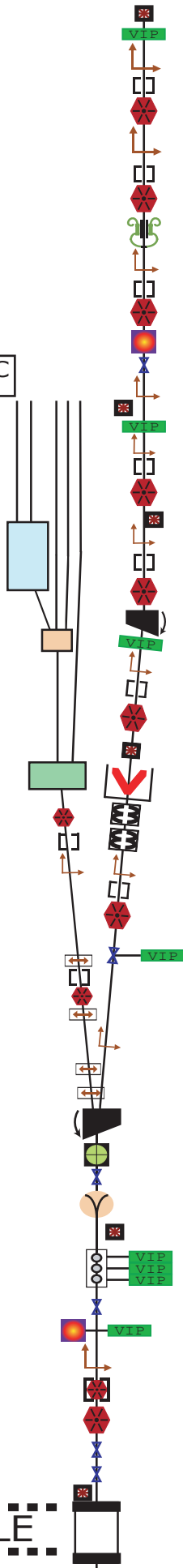
Injector Chicane Bend Angle
 $-5.5^\circ = -0.0959931$ radian



- | | |
|-----------------------|------------------------|
| BPM | IPM0L06 |
| CORRECTORS | MDB0L06H & MDJ0L06V |
| QUAD | MQD0L06 |
| FAST VALVE | VFV0L06 |
| BEAMLINE VALVE | VBV0L06A |
| DIFF PUMP + ION PUMPS | VDP0L06 + VIP0L06A,B,C |
| BPM | IPM0L06A |
| BLM (MPS) | ILM0L06B (station 190) |
| DIPOLE | MBF0L06 "SPECTROMETER" |
| CORRECTORS | MDB0L07H & MDJ0L07V |
| BPM | IPM0L07 |
| QUAD | MQB0L07 |
| HARP | IHA0L07 |
| CORRECTOR | MAT0L07V |
| BLM (MPS) | ILM0L07 (station 210) |
| BEAMLINE VALVE | VBV0L08 |
| VIEWER + ION PUMP | ITV0L08 + VIP0L08 |
| CORRECTORS | MDB0L08H & MDJ0L08V |
| BPM | IPM0L08 |
| QUAD | MQB0L08 |
| HARP | IHA0L08 |
| CORRECTOR | MAT0L08 H&V |
| CORRECTORS | MDB0L09H & MDJ0L09V |
| BLM (MPS) | ILM0L09 (station 240) |
| BPM | IPM0L09 |
| QUAD | MQB0L09 |
| HARP | IHA0L09B |
| CORRECTOR | MAT0L09H |
| ION PUMP | VIP0L10 |
| CORRECTORS | MDB0L10H & MDJ0L10V |
| BPM | IPM0L10 |
| QUAD | MQB0L10 |
| HARP | IHA0L10 |
| CHICANE DIPOLE | MBL0R01 |
| CORRECTOR | MAT0R01 H&V |
| BPM | IPM0R01 |
| QUAD | MQD0R01 |
| QUAD | MQD0R02 |
| BPM | IPM0R02 |
| CORRECTOR | MAT0R02 H&V |
| ION PUMP | VIP0R02 |
| CHICANE DIPOLE | MBL0R02 |
| SLM | ISR0R02 |

WEST RECOMBINER / NORTH LINAC
 *Incomplete on this diagram

- BLM (MPS) ILM0R05
- DIPOLE MZAAR03
- DIPOLE MXT4R05
- DIPOLE MXR2R06
- QUAD MQN1L00
- BPM IPM1L00
- CORRECTOR MBT1L00 H&V
- CORRECTOR MBT1L01H
- BPM IPM1L01
- QUAD MQN1L01
- CORRECTOR MCB1L01H
- CORRECTOR MCB1L01AH
- CORRECTOR MCA1L01H
- DIFF. PUMPING STATION VDP1L01
- VIEWER ITV1L02

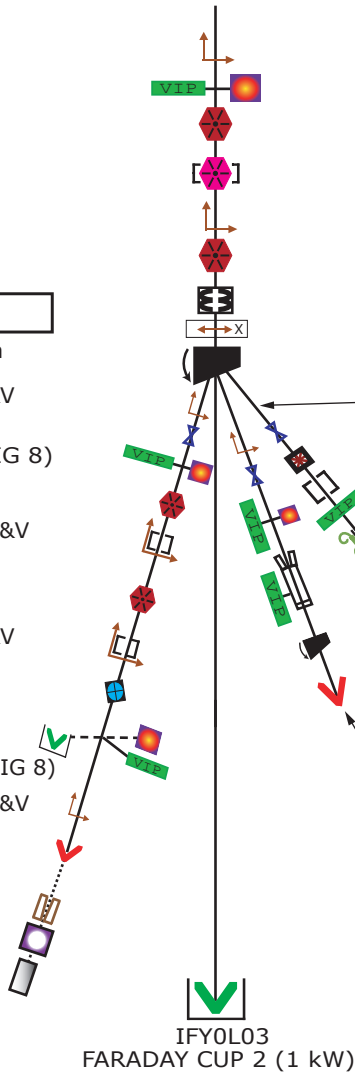


- BLM (MPS) ILM0R03 (station 312)
- ION PUMP VIP0R02A
- CORRECTOR MAT0R03 H&V
- BPM IPM0R03
- QUAD MQD0R03
- CORRECTOR MAT0R04 H&V
- BPM IPM0R04
- QUAD MQD0R04
- HARP IHA0R05
- CORRECTOR MAT0R05 H&V
- BPM IPM0R05
- QUAD MQD0R05
- VIEWER ITV0R05
- BEAMLINE VALVE VRV0R05
- CORRECTOR MIM0R05 H&V
- ION PUMP VIP0R06
- CORRECTOR MAT0R06 H&V
- BPM IPM0R06
- QUAD MQD0R06
- BLM (MPS, lead shielded) ILM0R06 (station 363)
- CORRECTOR MAT0R07 H&V
- BPM IPM0R07
- QUAD MQD0R07
- CHICANE DIPOLE MBL0R03
- ION PUMP VIP0R08
- CORRECTOR MBT0R08 H&V
- BPM IPM0R08
- QUAD MQD0R08
- BLM ILM0R08
- INSERTABLE DUMP (17 kW) IDL0R08
- BCM (MPS) IBC0R08
- BCM (PSS) SBC0R08
- CORRECTOR MAT0R09 H&V
- BPM IPM0R09
- QUAD MQD0R09
- BEAMLINE VALVE + ION PUMP VBV0R09 + VIP0R09
- CORRECTOR MIM0R09 H&V
- CHICANE DIPOLE MBL0R04
- SLM ISR0R09
- BEAMLINE VALVE VBV1L00A
- YAO CAVITY ICV1L01
- BLM ILM1L01 (station 385)
- ION PUMPS VIP1L01A,B,C
- BEAMLINE VALVE VBV1L01
- ION PUMP VIP1L02
- CORRECTOR MAT1L02 H&V
- BPM / SKEW QUAD IPM1L02 / MQS1L02
- QUAD MQD1L02
- FAST VALVE VFV1L02
- BEAMLINE VALVE VBV1L02A
- BLM ILM1L02 (station 413)

1L02 CRYOMODULE

0L02 Injector Diagnostic and Experimental Spurs Detail

T=5.75 MeV



- CORRECTOR MHB0L01A H&V
- VIEWER + ION PUMP ITV0L02 + VIP0L02
- QUAD MQJ0L02
- BPM/SKEW QUAD IPM0L02 / MQS0L02
- CORRECTOR MBH0L02 H&V
- QUAD MQJ0L02A
- BCM MPS IBC0L02M
- HELICITY CORRECTOR MHE0L02H
- DIPOLE MDL0L02

5D BUBBLE CHAMBER LINE

Bend angle = $25^\circ = 0.436332$ radian

- CORRECTOR MBH5D00 H&V
- BEAMLINE VALVE VBV5D00
- ION PUMP + VIEWER VIP5D00 (DIG 8) + ITV5D00
- QUAD MQD5D00
- CORRECTOR / BPM MBH5D00A H&V / IPM5D00
- QUAD MQD5D01
- CORRECTOR / BPM MBH5D01 H&V / IPM5D01
- VACUUM COLD GAUGE VCG5D01
- FARADAY CUP + VIEWER + ION PUMP IFY5D01 + ITV5D01 + VIP5D01 (DIG 8)
- CORRECTOR MBH5D01A H&V
- ELECTRON DUMP (1 kW LCW) IDL5D01
- PHOTON COLLIMATOR IPC5D01
- BUBBLE CHAMBER ITG5D01
- PHOTON DUMP IDL5D01A

2D 5 MeV SPECTROMETER LINE

Bend angle = $-30^\circ = -0.523599$ radian

- BEAMLINE VALVE VBV2D00A
- BLM (MPS) ILM2D00A
- BPM IPM2D001
- ION PUMP VIP2D00A
- HARP IHA2D00
- VIEWER ITV2D00
- BLM (MPS) ILM2D00B
- DUMP (1 kW) IDL2D00

3D MOTT POLARIMETER LINE

Bend angle = $-12.5^\circ = -0.218166$ radian

- CORRECTOR MAD3D00 H&V
- BEAMLINE VALVE VBV3D00A
- VIEWER+ION PUMP ITV3D00 + VIP3D00A (DIG 12)
- MOTT VIEWER IFL3D00
- TARGET LADDER ITG3D00
- ION PUMP VIP3D00B (DIG 12)
- DIPOLE MDT3D00, MDT3D01
- DUMP (1 kW LCW/34 W air) IDL3D00

Source Material Used:

| | | |
|---------------------|------------------|---------|
| 12 GeV Song Sheets: | ACC-000-2845-001 | rev. - |
| | ACC-000-2845-002 | rev. 4 |
| | ACC-000-2845-003 | rev. 11 |
| | ACC-000-2845-004 | rev. 9 |
| | ACC-000-2845-029 | rev. 7 |

CEBAF Element Database queried at various times

Mike Spata's notes on CED corrections dated 9/27/2013

Joe Grames' notes on the beam line up to the PSS Gate from 10/1/2013

Revisions to the this document from Yan Wang received 10/8/2013

Revisions to this document from Joe Grames received 10/16/2013

Notes on injector ion pumps from Marcy Stutzman and Phil Adderley received 10/16/2013

Revisions to song sheet from Yan Wang received 10/18/2013

Mott dump operational limits (elog 3271441 2/27/2014)

Bubble Chamber Installation Kick-Off Meeting Notes (Grames, 5/28/2014)

Numerous personal inspections of the beam line and conversations with others

Revision Notes:

- 11: Corrected position of MBH0L03 H/V (moved upstream of ITV0L03)
MQS0L02 and IPM0L02 are colinear, rather than in series
corrected per elog 3316769 1/8/2015
- 10: Removed ICB1D00 (Brock Cavity) from 1D line
Added VFV0L01 fast valve
Added detail page for 2D, 3D, and 5D lines (main drawing was too cluttered)
Added bubble chamber components to 5D line
Renamed 500 keV Spectrometer -> 1D Spectrometer
Added bend angles for all spurs and the chicane
Corrected various mistakes throughout