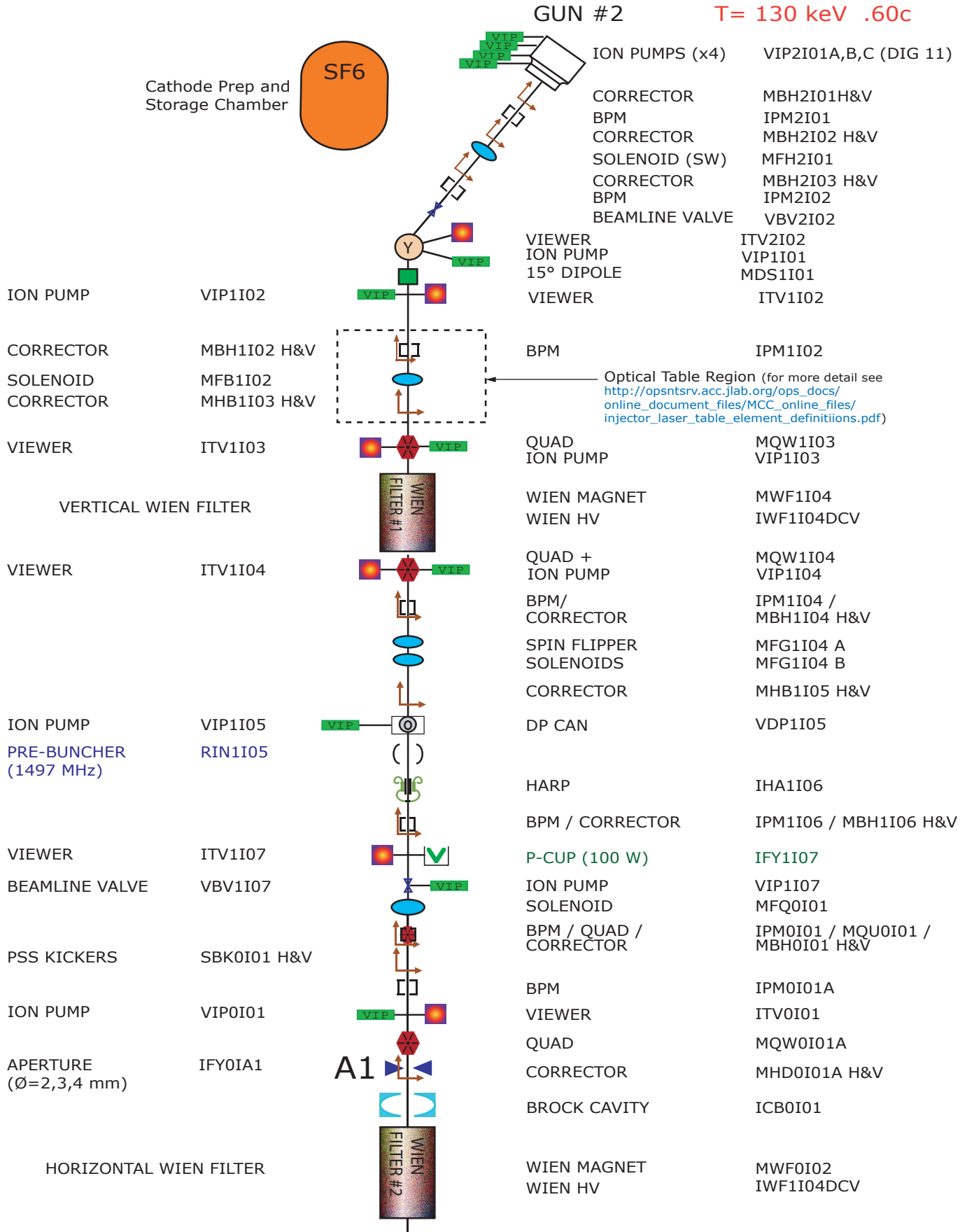
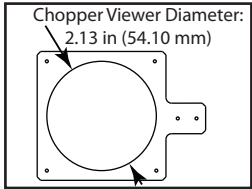


INJECTOR QUICK REFERENCE DRAWING

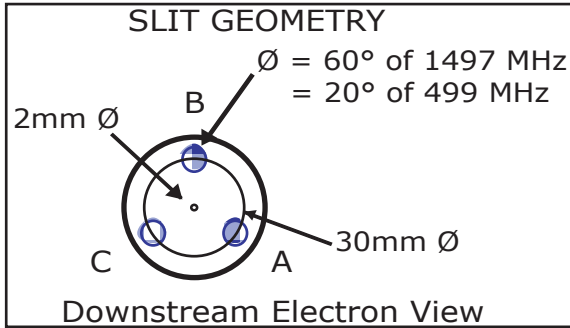


CORRECTOR MBH0I02 H&V
 VIEWER ITV0I02
 APERTURE IFY0IA2
 (Ø=4,6,8 mm)

CHOPPER #1 (499 MHz)



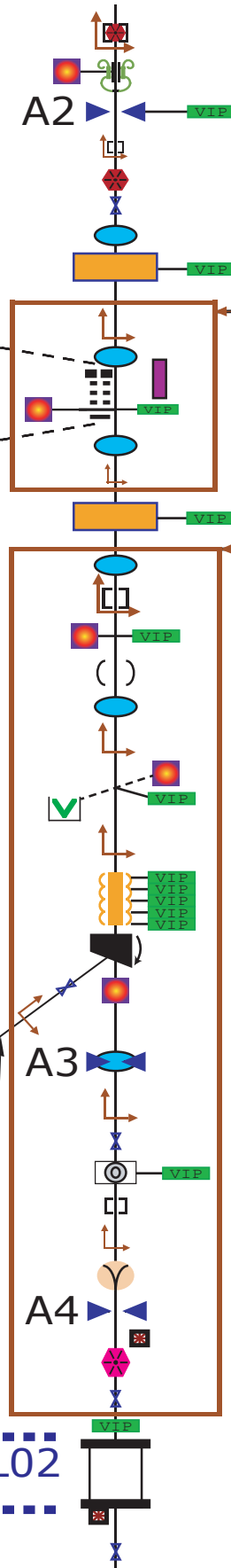
CHOPPER #2 (499 MHz)



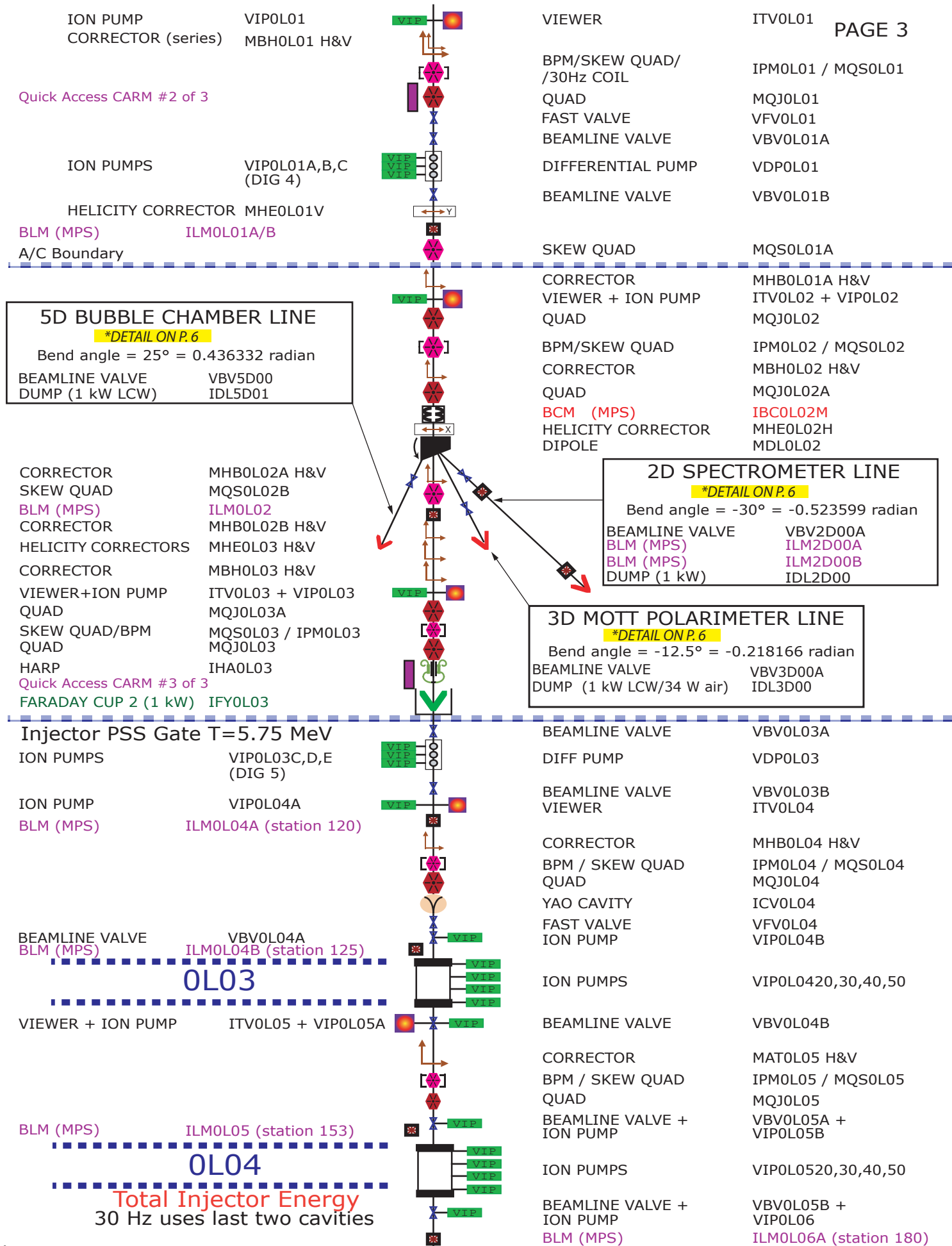
CAPTURE
 T = 500keV .86c

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



Quick Access CARM #2 of 3

BLM (MPS) A/C Boundary

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

2D SPECTROMETER LINE
 *DETAIL 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
 *DETAIL 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 VIP03C,D,E (DIG 5)
 ION PUMP VIP04A
 BLM (MPS) ILM04A (station 120)

BEAMLINE VALVE VBV04A
 BLM (MPS) ILM04B (station 125)

OL03

VIEWER + ION PUMP ITV05 + VIP05A

BLM (MPS) ILM05 (station 153)

OL04

Total Injector Energy
 30 Hz uses last two cavities

ION PUMP CORRECTOR (series) VIP0L01 MBH0L01 H&V

ION PUMPS VIP0L01A,B,C (DIG 4)

HELICITY CORRECTOR MHE0L01V

VIEWER ITV0L01
 BPM/SKEW QUAD/30Hz COIL IPM0L01 / MQS0L01

QUAD MQJ0L01
 FAST VALVE VFV0L01
 BEAMLINE VALVE VBV0L01A

DIFFERENTIAL PUMP VDP0L01
 BEAMLINE VALVE VBV0L01B

SKEW QUAD MQS0L01A

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

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 VFV0L04
 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

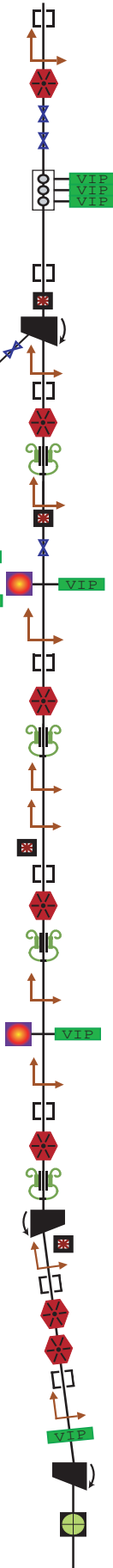
BEAMLINE VALVE	VBV4D00
ARC 10 CROSS	
BEAMLINE VALVE	VBV4D00A
VIEWER	ITV4D00
BPM	IPM4D00
HARP	IHA4D00
BLM	ILM4D001 (station 215)
VIEWER	IOR4D00
DUMP (17 kW)	IDL4D00

* 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
CORRECTORS
QUAD
FAST VALVE
BEAMLINE VALVE
DIFF PUMP + ION PUMPS

BPM
BLM (MPS)
DIPOLE
CORRECTORS
BPM
QUAD
HARP
CORRECTOR
BLM (MPS)
BEAMLINE VALVE
VIEWER + ION PUMP
CORRECTORS

BPM
QUAD
HARP
CORRECTOR
CORRECTORS
BLM (MPS)
BPM
QUAD
HARP
CORRECTOR

ION PUMP
CORRECTORS
BPM
QUAD
HARP
CHICANE DIPOLE
CORRECTOR
BPM
QUAD
CORRECTOR
ION PUMP

CHICANE DIPOLE
SLM

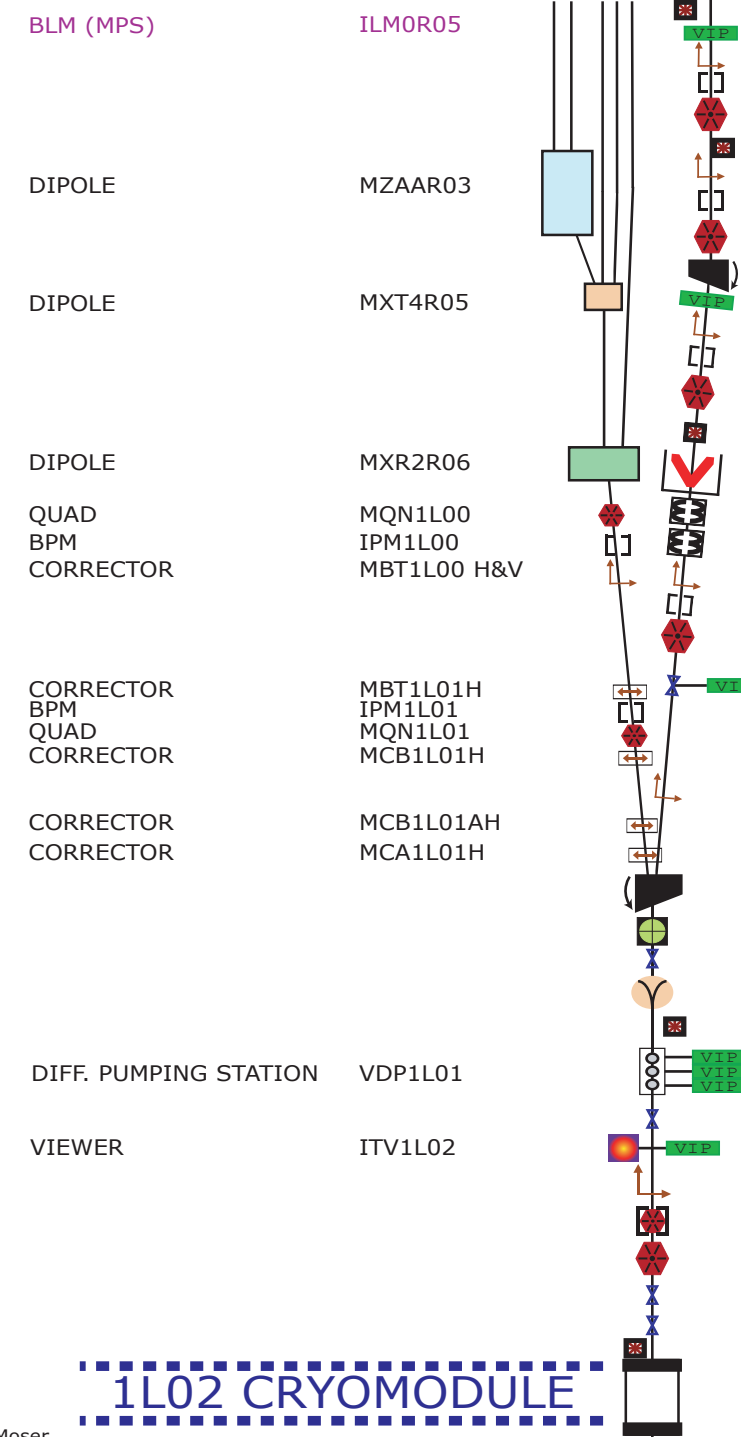
IPM0L06
MDB0L06H & MDJ0L06V
MQD0L06
VFV0L06
VBV0L06A
VDP0L06 + VIP0L06A,B,C

IPM0L06A
ILM0L06B (station 190)
MBF0L06 "SPECTROMETER"
MDB0L07H & MDJ0L07V
IPM0L07
MQB0L07
IHA0L07
MAT0L07V
ILM0L07 (station 210)
VBV0L08
ITV0L08 + VIP0L08
MDB0L08H & MDJ0L08V

IPM0L08
MQB0L08
IHA0L08
MAT0L08 H&V
MDB0L09H & MDJ0L09V
ILM0L09 (station 240)
IPM0L09
MQB0L09
IHA0L09B
MAT0L09H

VIP0L10
MDB0L10H & MDJ0L10V
IPM0L10
MQB0L10
IHA0L10
MBL0R01
MAT0R01 H&V
IPM0R01
MQD0R01
MQD0R02
IPM0R02
MAT0R02 H&V
VIP0R02
MBL0R02
ISR0R02

WEST RECOMBINER / NORTH LINAC
**Incomplete on this diagram*

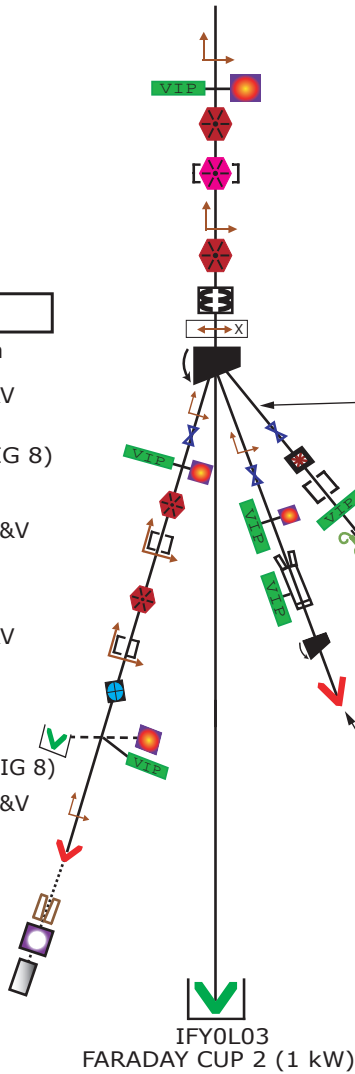


- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------|----------|-----------|---------|---------|-----------|-------------|----------|---------|-----------|----------|-----------|----------|----------------|-----------|-----------------------|-------------|---------|---------|--------------------------|-----------|-------------|---------|----------------|----------|-----------|---------|---------|-------------|-------------------------|-----------|-------------------|-------------|---------|---------|---------------------------|-----------|-----------------------|--------------|----------------|------------|-------------|-------------------|----------------|----------|-----------|-----------------------|------|------------|----------------|-----|
| BLM (MPS) | ION PUMP | CORRECTOR | BPM | QUAD | CORRECTOR | BPM | QUAD | HARP | CORRECTOR | BPM | QUAD | VIEWER | BEAMLINE VALVE | CORRECTOR | ION PUMP | CORRECTOR | BPM | QUAD | BLM (MPS, lead shielded) | CORRECTOR | BPM | QUAD | CHICANE DIPOLE | ION PUMP | CORRECTOR | BPM | QUAD | BLM | INSERTABLE DUMP (17 kW) | BCM (PSS) | BCM (MPS) | CORRECTOR | BPM | QUAD | BEAMLINE VALVE + ION PUMP | CORRECTOR | CHICANE DIPOLE | SLM | BEAMLINE VALVE | YAO CAVITY | BLM | ION PUMPS | BEAMLINE VALVE | ION PUMP | CORRECTOR | BPM / SKEW QUAD | QUAD | FAST VALVE | BEAMLINE VALVE | BLM |
| ILM0R05 | MZAAR03 | MXT4R05 | MXR2R06 | MQN1L00 | IPM1L00 | MBT1L00 H&V | MBT1L01H | IPM1L01 | MQN1L01 | MCB1L01H | MCB1L01AH | MCA1L01H | VDP1L01 | ITV1L02 | ILM0R06 (station 363) | MATOR07 H&V | IPM0R07 | MQD0R07 | MBL0R03 | VIP0R08 | MBT0R08 H&V | IPM0R08 | MQD0R08 | ILM0R08 | IDL0R08 | SBC0R08 | IBC0R08 | MATOR09 H&V | IPM0R09 | MQD0R09 | VBV0R09 + VIP0R09 | MIM0R09 H&V | MBL0R04 | ISR0R09 | VBV1L00A | ICV1L01 | ILM1L01 (station 385) | VIP1L01A,B,C | VBV1L01 | VIP1L02 | MAT1L02 H&V | IPM1L02 / MQS1L02 | MQD1L02 | VFV1L02 | VBV1L02A | 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:

- 15: Removed Gun #3 line and replaced with Cathode prep and storage chamber. Updated correctors in 2I-region.
- 14: Added drawing of viewer to P.2 by request (based on CEBAF DWG. No. 58432-C-0254 rev. A).
- 13: Corrected locations of the PSS and MPS BCM's
Used [blue labels](#) for RF components
- 12: Added Brock Cavity (ICB0I01) between A1 and Wien #2 (per email from Marcy 7/1/15)
- 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