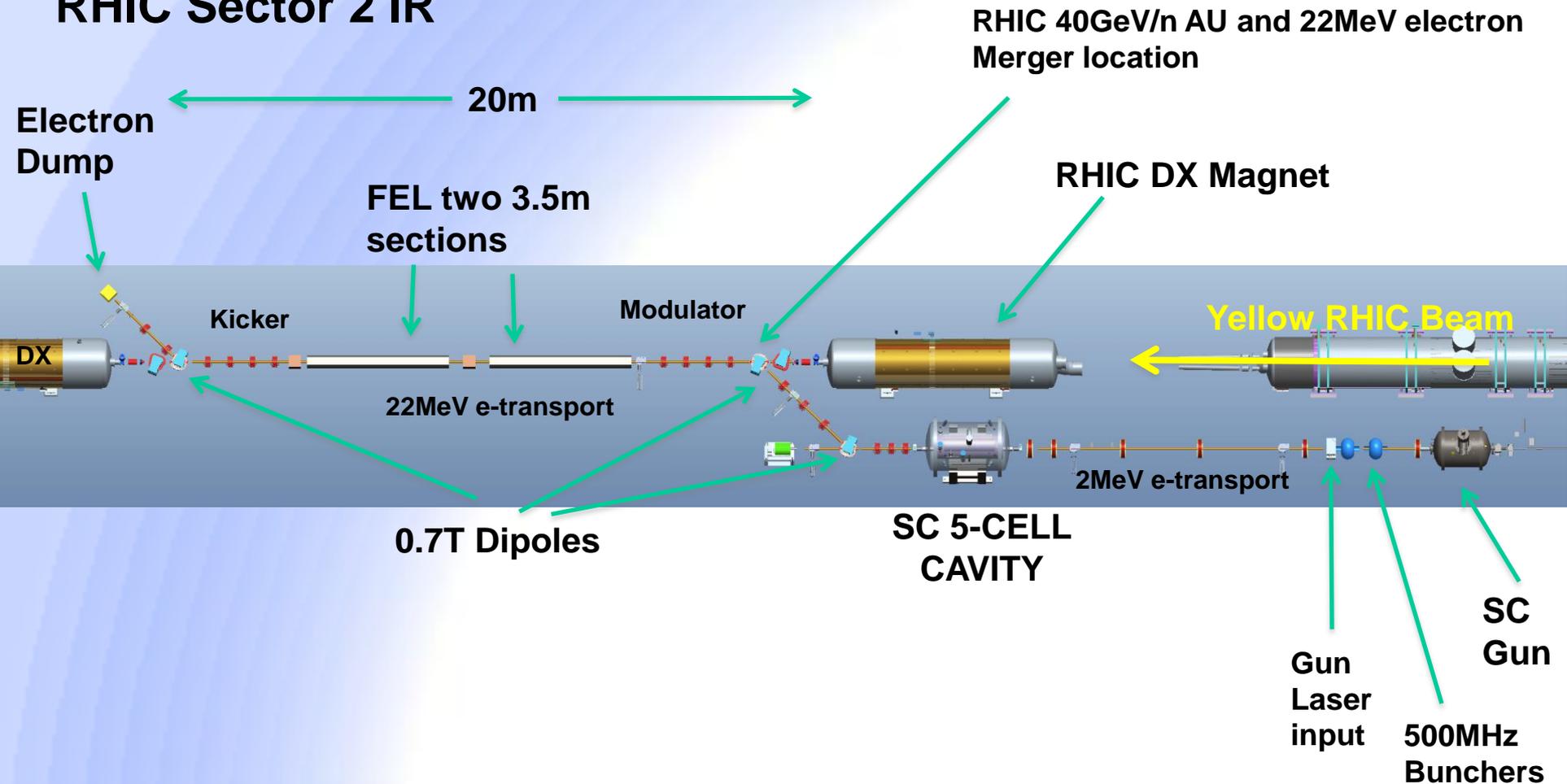

Coherent Electron Cooling PoP ASSRC Review

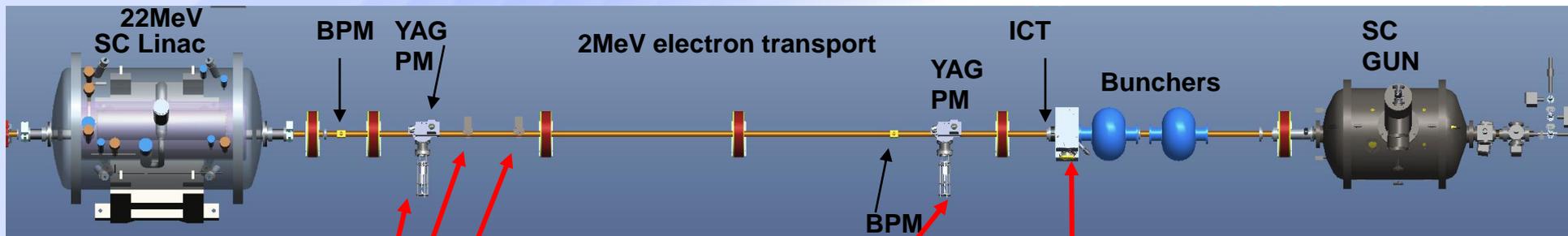
Instrumentation Systems Group
Brookhaven National Laboratory

Electron Beam Transport Overview

RHIC Sector 2 IR



2MeV Transport Overview and Diagnostics



2MeV Emittance

Pepper Pot & Profile Monitor

3 Position Profile monitor

YAG Screen + Injection Mirror for Pepper Pot Alignment Laser

Gun Laser Injection Port

Alignment Laser

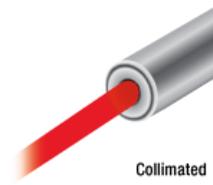
- *Laser Class 3R
- *Safe without special training
- *Comparable to laser pointer

2MeV Transport Diagnostics

- 2 BPMs
- 2 Profile Monitors
- 2 Pepper Pot
- 1 Current transformer

* Totally enclosed optics

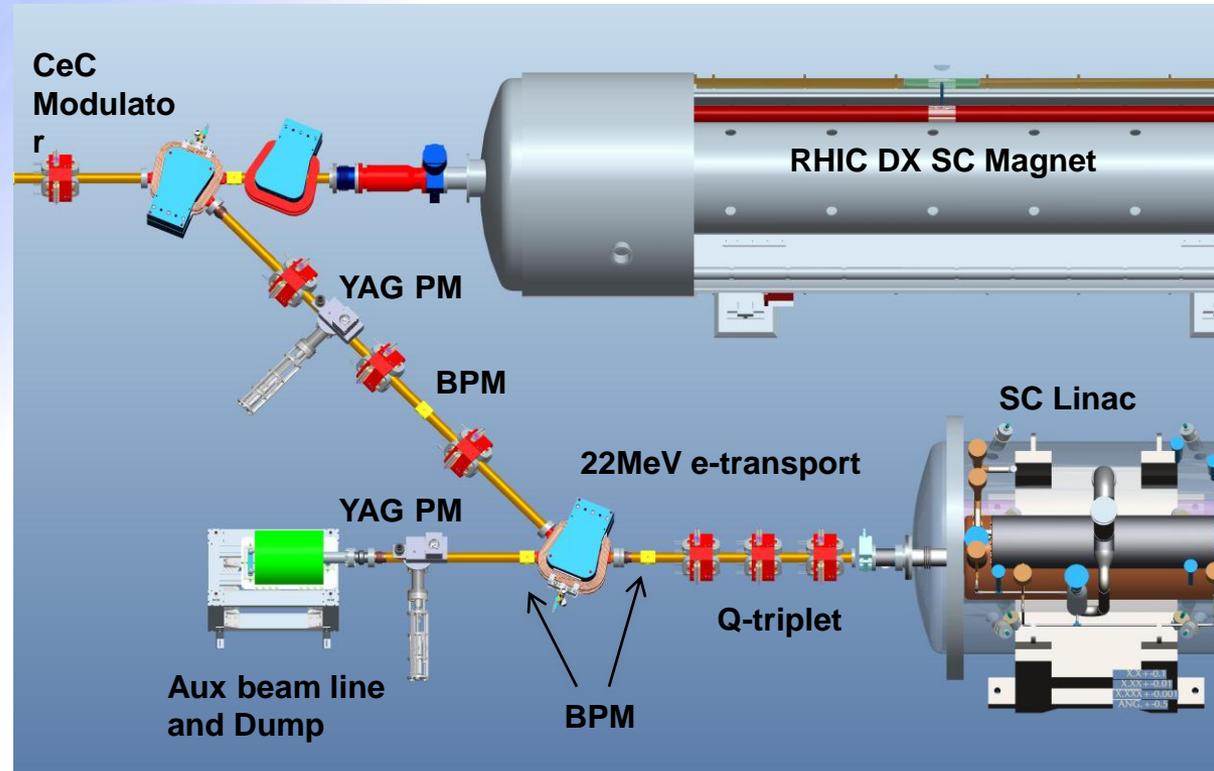


	
Collimated	CPS180
Item #	CPS180
Wavelength	635 nm
Power	1 mW
Safety Class	3R
Beam Shape	Round
Beam Profile	CPS180 Beam Profile
Housing	Ø11 mm x 55 mm
Mounting Adapter	AD11F

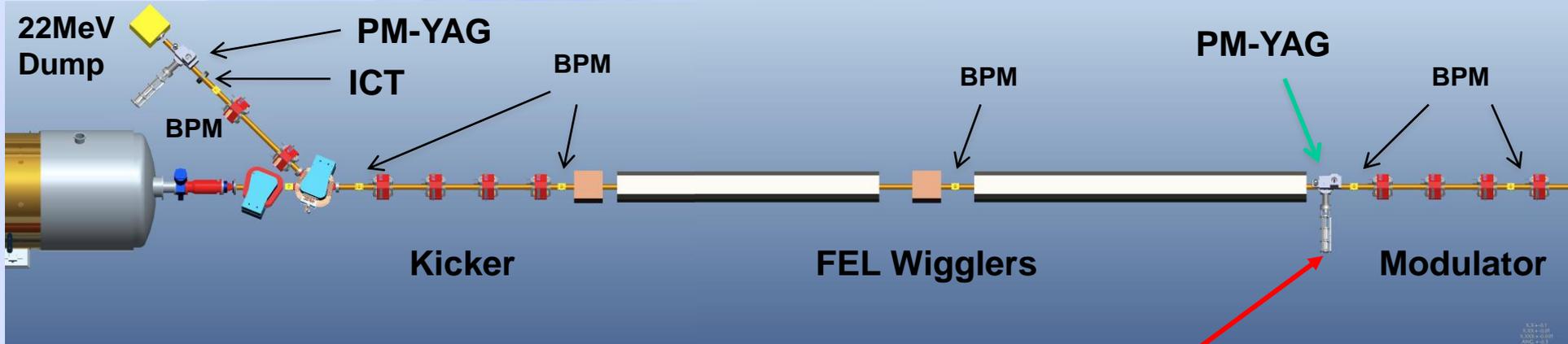
Upstream 22MeV Transport Overview and Diagnostics

Upstream 22MeV transport diagnostics

4 BPMs
2 YAG/OTR Profile Monitors



Modulator, FEL, Kicker & Dump Transport (22MeV)



Downstream 22MeV transport diagnostics

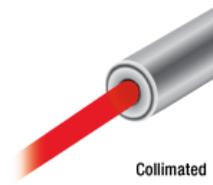
- 6 BPMs
- 2 Profile Monitors
- 1 Current transformer
- Beam loss monitors distributed throughout transport

3 Position Profile monitor

YAG Screen + Injection Mirror for Pepper Pot Alignment Laser



Alignment Laser

	
Collimated	CPS180
Item #	CPS180
Wavelength	635 nm
Power	1 mW
Safety Class	3R
Beam Shape	Round
Beam Profile	CPS180 Beam Profile
Housing	Ø11 mm x 55 mm
Mounting Adapter	AD11F

Integrating Current Transformer

Located downstream of the gun, and at dump

Bergoz ICT-CF6-60.4-070-05:1-H-UHV-THERMOE

Integrating type, In-flange CT

For bunches & bunch trains

Bergoz IHR electronics

Noise <1pC beam charge

Calibrated



Mechanical details:

60.4mm ID

40mm axial length

Rad-Hard option

Bakeable to 180C, plan 48h at 150C

Separate bake-out zone

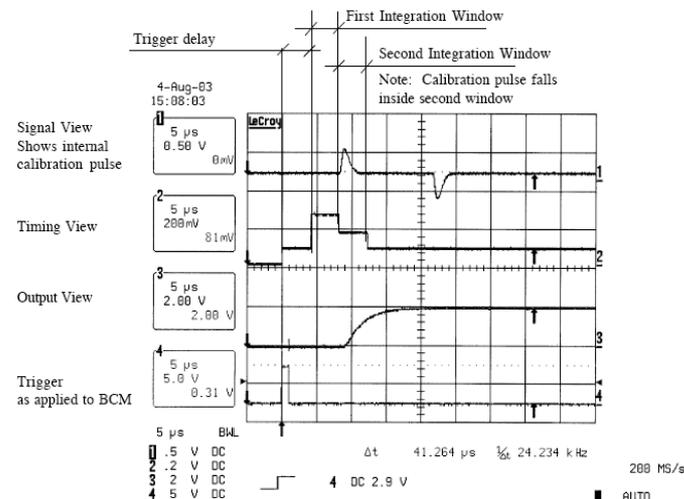
Internal TC, type-E

Requirements for bunch charge at 0.5-1nC:

5% accuracy

1% resolution

Signal processing timing diagram: Gate width <0.1us up to >7us

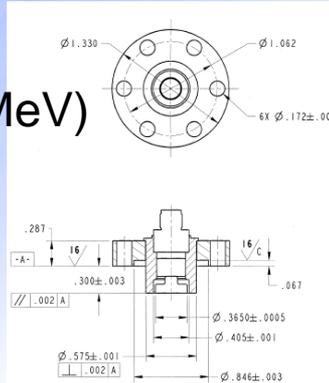


Beam Position Monitors – Pick-ups

Dual plane button pick-ups
11 locations (2 at 2MeV, 9 at 22MeV)

Times Microwave SK-59044

9.3 mm diameter molybdenum button's
SMA Connector
1- 4pF, 5% matching



BPM Button Stainless Steel cube
2.5" X 3.25"

Libera Brilliance Single Pass Electronics

Worked Closely with I-Tech to modify the standard LBSP for our ERL facility.

Advertised features:

- High accuracy
- Low drift
- Built-in custom configurable FPGA processor
- GB Ethernet
- Beam inhibit capability
- Beam positions measured: average orbit 0.1-100mA, and single bunch, 0.1-5nC.



Beam Profile Monitor

6 Profile Monitor Stations (Low power only)

Radiabeam product as per BNL specification.

2 units with TWO positions (YAG / Open)

2 units with THREE positions (YAG/Laser/Open)

Plunging head detail:

YAG:Ce Screens:

35mm dia., 100u thick crystal, Crytur

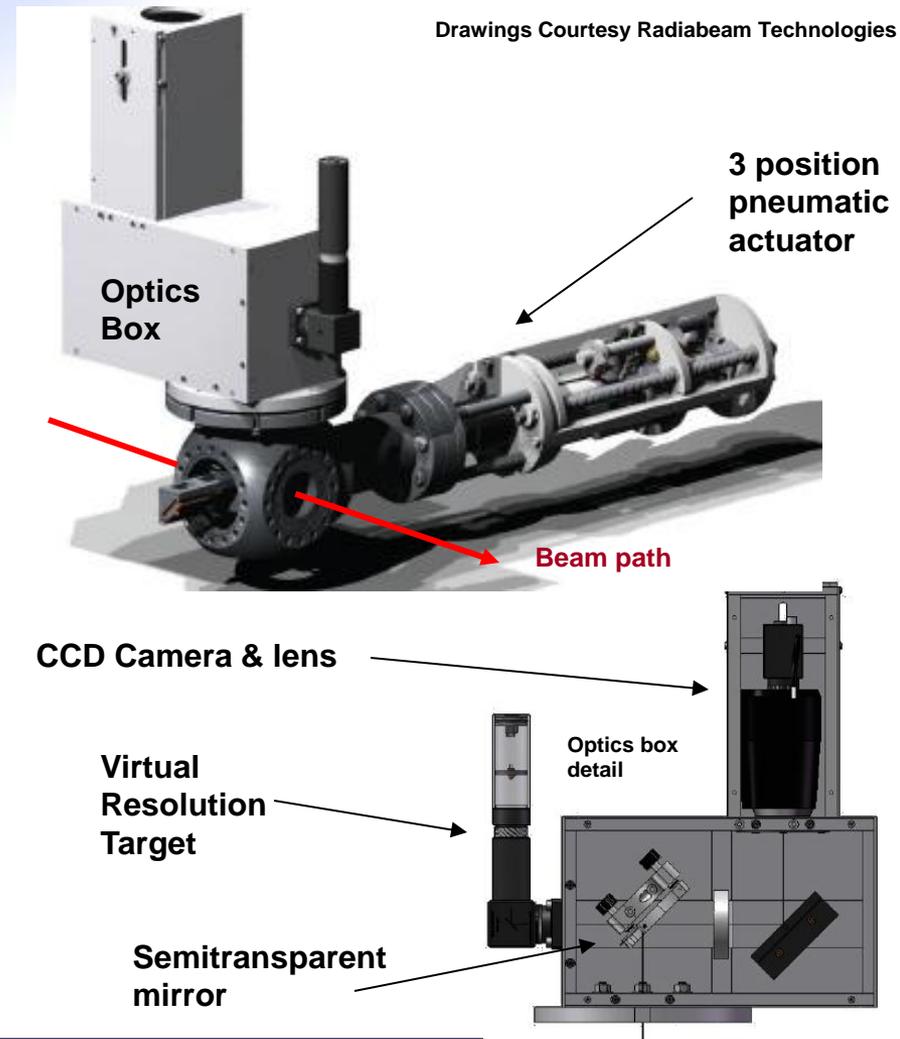
For low intensity beams:

10' s of pC at 2MeV, and ~1 pC at 22MeV

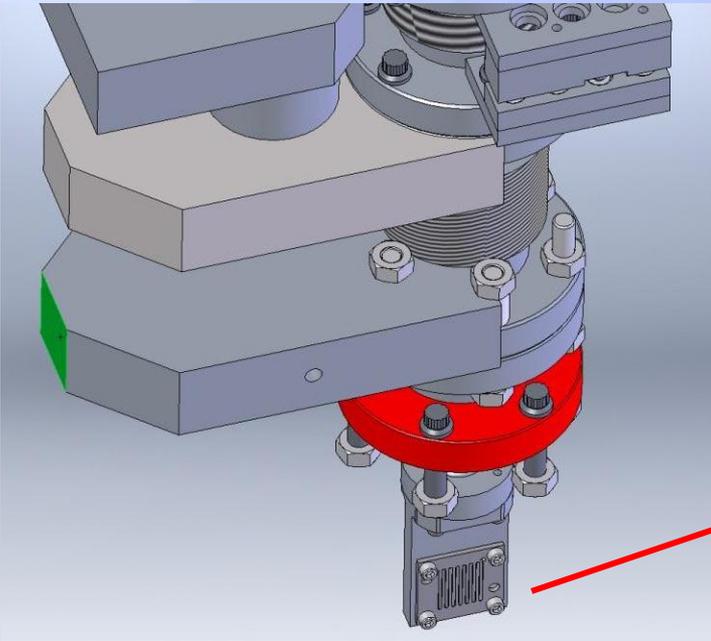
Laser:

Reverse facing mirror

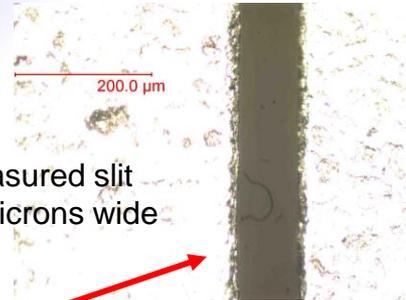
Class 3R laser injected for downstream alignment



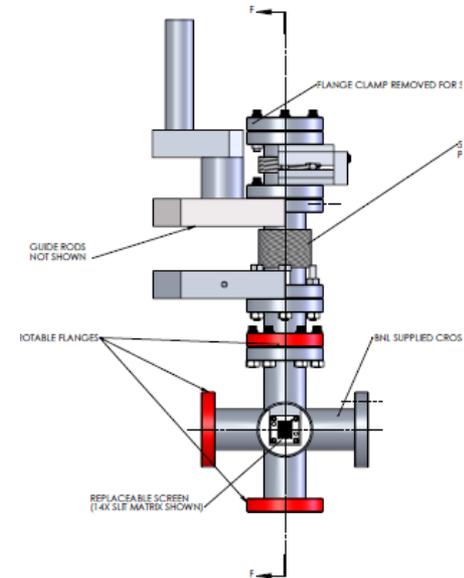
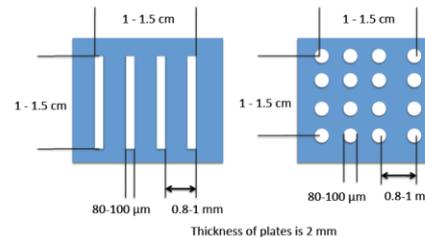
Pepper Pot Mask – Emittance measurement



Status – all parts in house



Measured slit
~90microns wide



Pneumatic plunger
50mm stroke

Low Power Operations Only

Slit matrix screens, Tungsten.
14 slits, 1mm separation, 90µm width in 1.5mm thick.

Optional Hole pattern matrix:
14 X 14 pattern of 140µm diameter holes in 0.5 mm thick tungsten.

Loss Monitors

Beam Loss Monitors

PMT Detector (similar to JLAB-CEBAF, FEL)

(Hamamatsu R11558 PMT)

Fast ($<10\mu\text{s}$), HV tunable for sensitivity adjustments

50dB DR (5nA – 100uA from tube)

Limited coverage, small cross section



BLM Electronics

The new version of BLM electronics developed at JLAB for the 12GeV upgr will be used for the PMT detectors.

HVPS

4kV, 3mA/ch, 6ch VME based bias power supplies, **SHV** connectors, built by CAEN S.p.A.



Features:

- Provide both machine protection and diagnostic functions.
- Instantaneous readback of beam loss.
- 16 bit digital output for integrating and logarithmic signals.
- Fast response, $\ll 1 \mu\text{s}$ response time for integrating, 10 nA^2 for log.
- Wide dynamic range ($>50 \text{ dB}$) for logarithmic signals.
- Built-in self test and onboard signal injection.
- FPGA controlled.
- Local data buffer for integrating and logarithmic signals.
- VME interface and fully integrated into EPICS.
- Pulse beam measurement and continuous monitoring.
- Low cost ($\leq \$100$ per channel).

New Beam Loss Monitor for 12GeV Upgrade
J. Yan, K. Mahoney, ICALEPCS 2009

Infrared Camera (FLIR A310)

Check for beam pipe heating, or losses other detectors can't



Remote image display & storage, Ethernet communication.

Summary

Hazard Concerns?

Beam power limited to a $< ?$ W

MACHINE RISK:

Non-destructive:

Current Monitor (ICT)

Position Monitor (BPM)

Loss Monitors (PMT, PD, IC, FLIR)

Semi-destructive:

Pepper Pot (<1 W)

Fully Destructive:

Profile Monitor (<1 W)

Dump (<50 W)

PERSONNEL RISK:

Calibration Laser

Red diode laser, < 5 mW

High Voltage

6kV, 3mA Bias Voltage

**Do not interact with
primary beam**

**Run only with
reduced power**

Safety Class 3R

->laser pointer equivalent

SHV Connectors

->finger safe connector