

# **PXIE Instrumentation Update – 12 June 2012**

Vic Scarpine for Instrumentation Dept

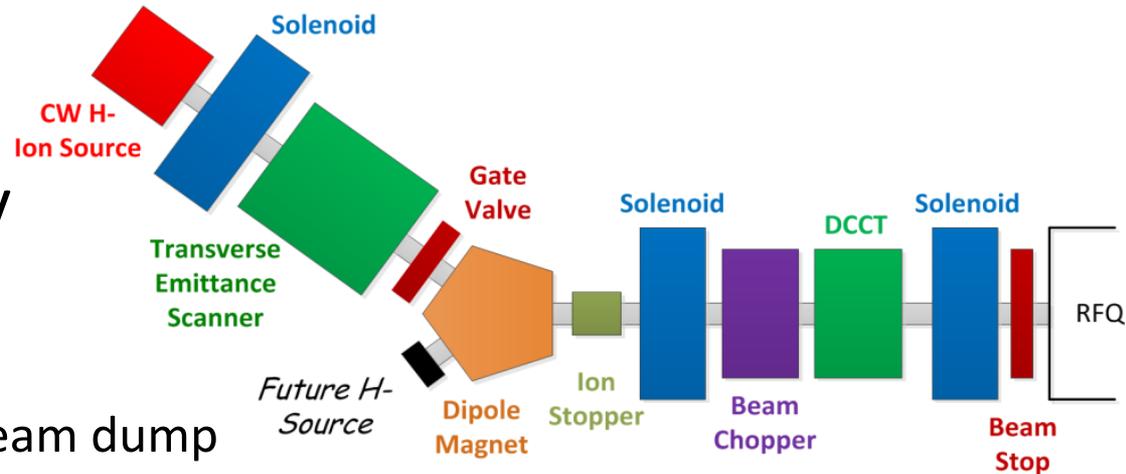
# PXIE "Operational" Instrument List

	Instrument	Instrumentation Leader	Need by Time frame
1	LEBT Transverse Emittance Station	Vic Scarpine	Early 2013
2	LEBT DCCT	Aisha Ibrahim	Early 2013
3	LEBT Isolated Apertures	???	Mid 2013
4	LEBT Beam Stop/Diaphragms	??? (New ME)	Mid 2013
5	MEBT Warm BPMs	Nathan Eddy	Early 2014
6	MEBT Wire Scanner Profile Monitor	Gianni Tassotto	Early 2014
7	Laser Wire Profile Monitor	Vic Scarpine	Early 2014
8	MEBT Transverse Emittance Monitor	Vic Scarpine (?)	Early 2014
9	Beam Current Monitor	Aisha Ibrahim	Early 2014
10	MEBT Chopper Extinction Monitor	Randy Thurman-Keup	Early 2014
11	MEBT Chopper Dump Optical Profiler	Randy Thurman-Keup	Early 2014
12	Cold BPMs	Nathan Eddy	Early 2014
13	Laser Transverse Emittance Monitor	Vic Scarpine	2015

# PXIE Instrumentation Update – 12 June 2012

- LEBT – highest priority

- Beam Current – DCCT
  - Based on Recycler design
- Beam Current – isolated beam dump
- Beam Emittance – Water-cooled Allison Scanner
  - Collaboration with SNS
- Halo/tails – electrically isolated apertures
- Completing LEBT Diagnostics FRS
- What “commissioning” diagnostics needed at end of LEBT?
  - Emittance scanner? Beam current?
  - What is commissioning plan?



# Allison Scanner for LEBT Transverse Emittance Measurements

- SNS to supply water-cooled Allison scanner and motion drive
  - First unit by end of year; 2<sup>nd</sup> unit next year
  - Fermilab needs to build vacuum chamber
  - Need water cooling, motion control, front-end software controls and DAQ
    - Signal in “standard” instrumentation DAQ
  - Risk: Medium
    - Water-cooled version untested
    - ME support for vacuum chamber
    - *Who will write front-end software?*

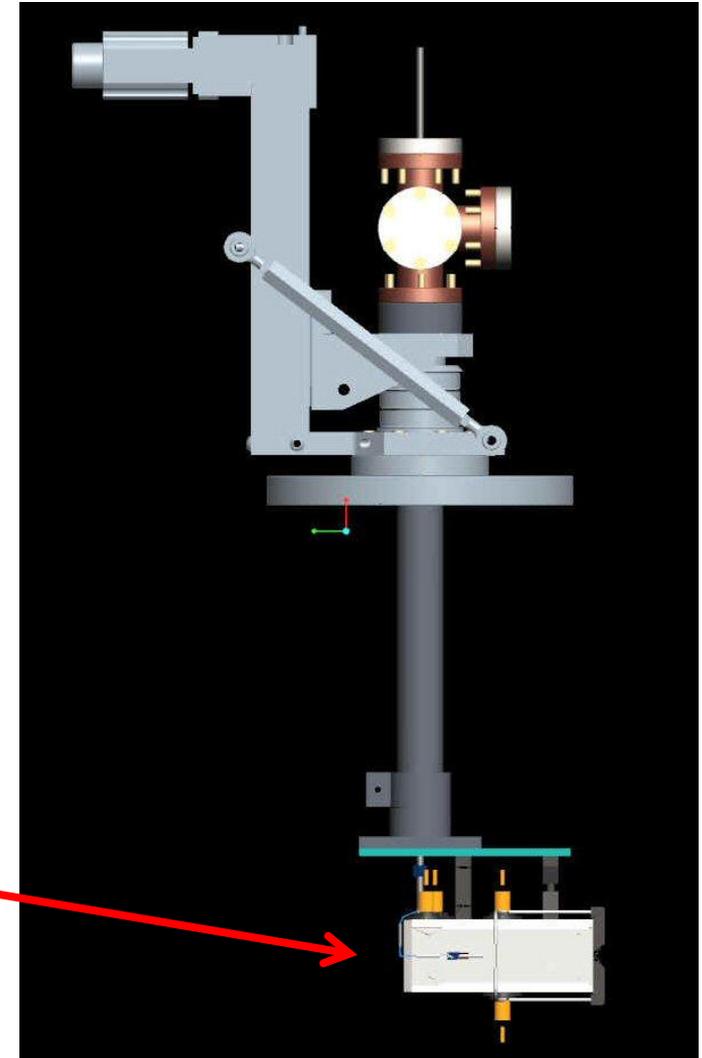
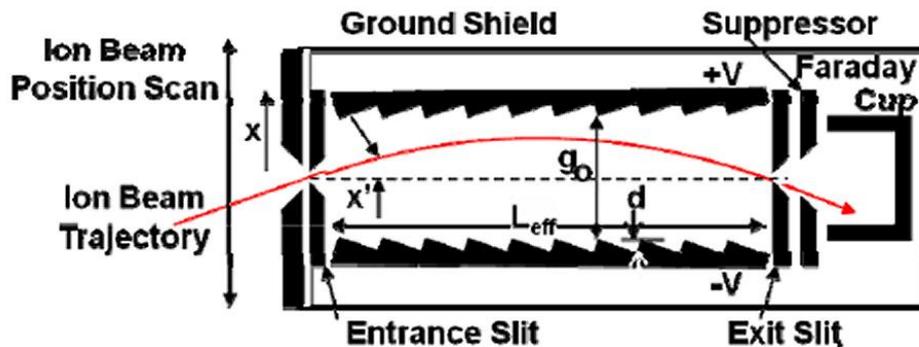
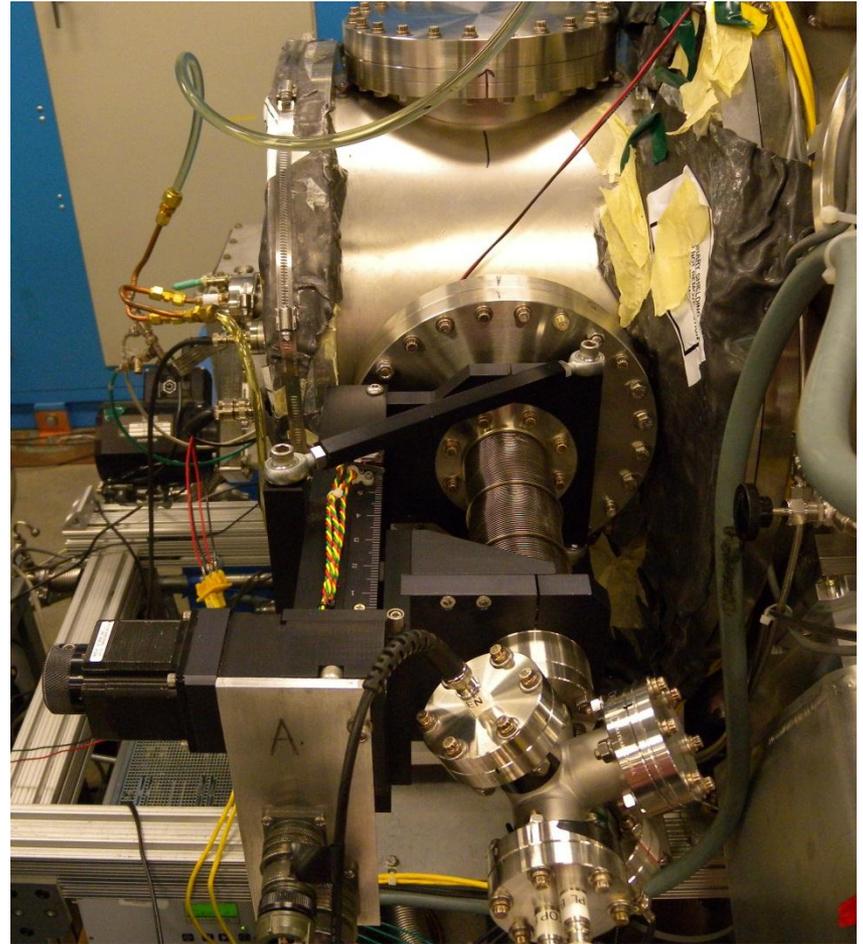
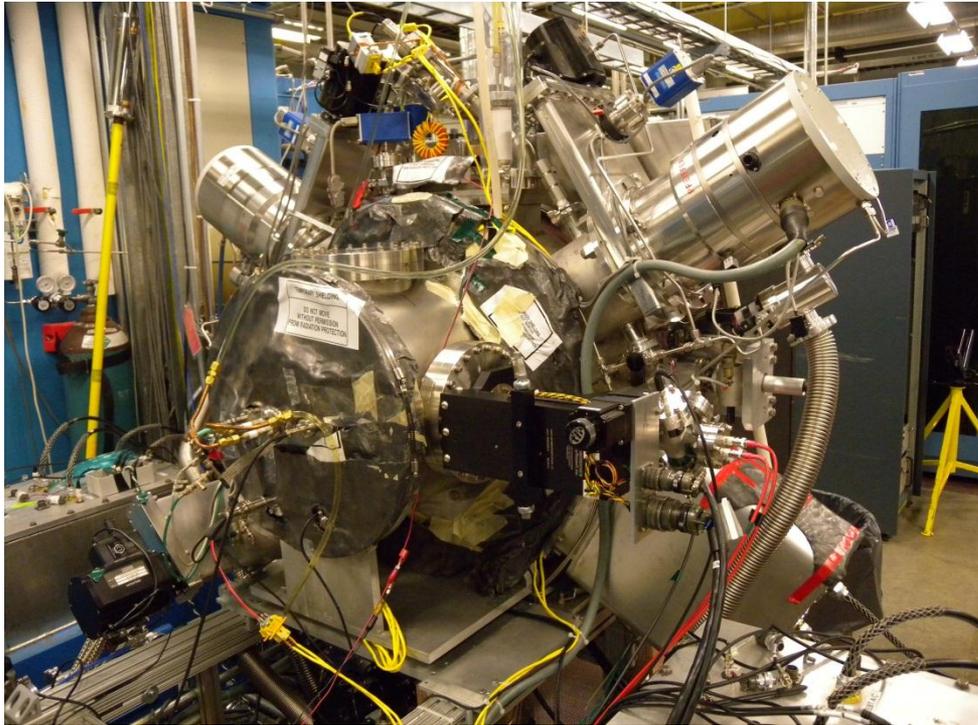


Figure 1: Schematic of SNS Allison Emittance Scanner.

# SNS Allison Scanner

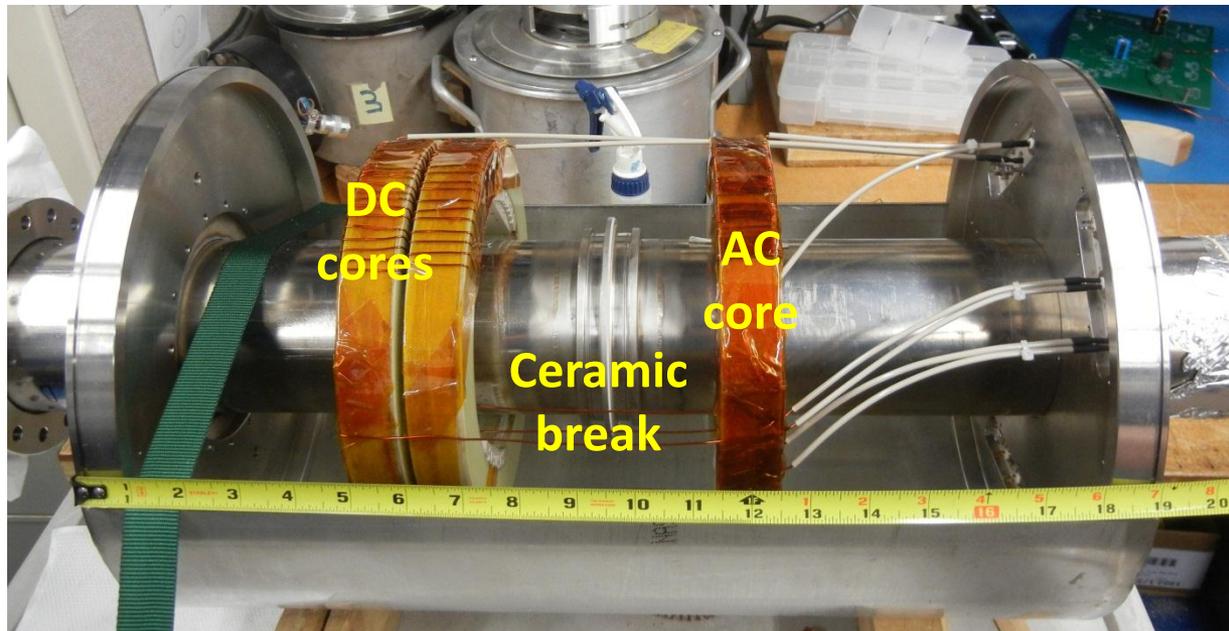
*Not water cooled*



# LEBT DCCT

- Initial requirement to measure beam current from DC to  $\sim 1$  MHz
- Base PXIE LEBT DCCT on Recycler design
  - Uses digital electronics to control DCCT
  - Make design smaller for PXIE
- Need 3 cores to get to  $\sim 1$  MHz
  - Two cores for DC and one for AC
    - Need space between cores
  - ***Need  $\sim 5''$  for three cores***

## Recycler DCCT

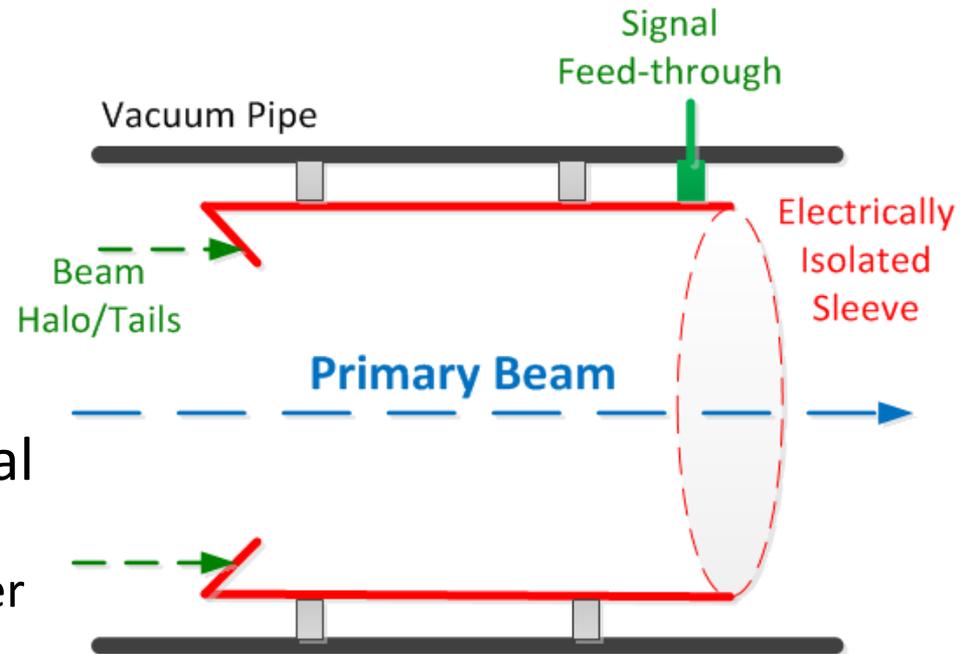


### Risks:

- Low if space available
- Go with only two cores if space unavailable?
  - DC to  $\sim 1$  KHz

# LEBT Transverse Halo/Tails

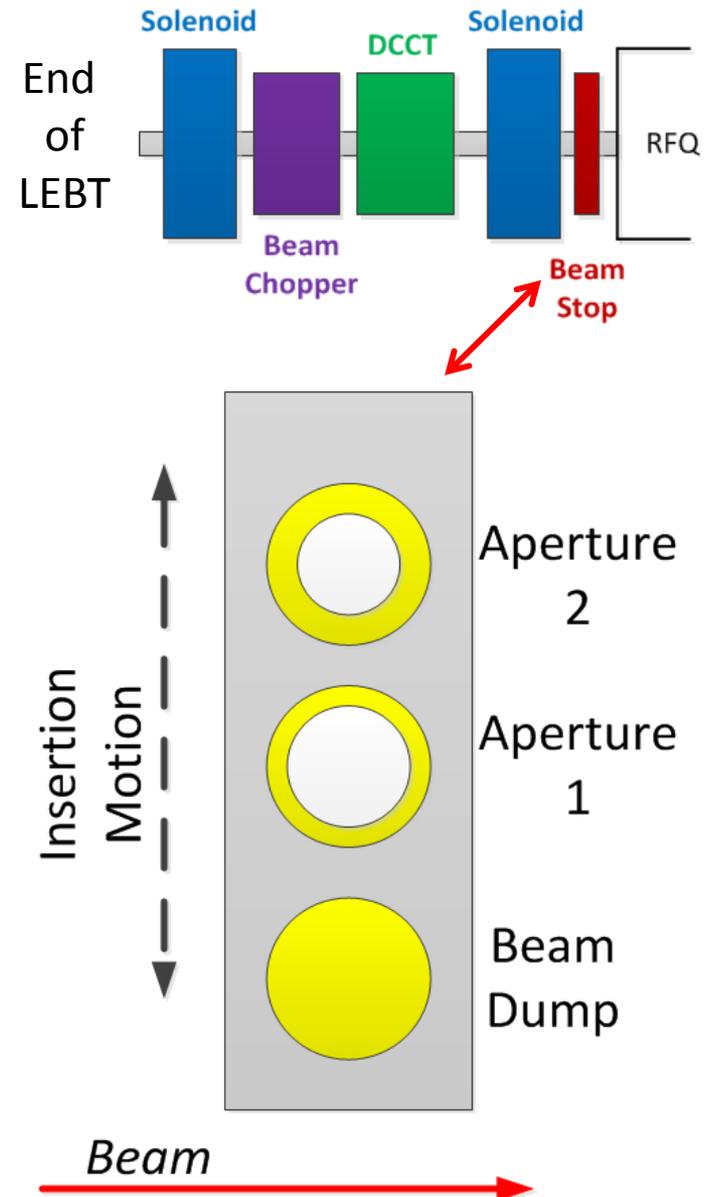
- Use electrically isolated sleeves inside vacuum pipe to measure beam
  - Sleeves like Faraday cup
    - Do sleeves need bias?
  - Who designs/builds sleeves?
    - Not presently on instrumentation list
  - Do these need to be water-cooled?
- Instrumentation will treat signal as toroid-type signal
  - Plug into “standard” VME digitizer card
- Risks: Low
  - *Except for front-end application software*



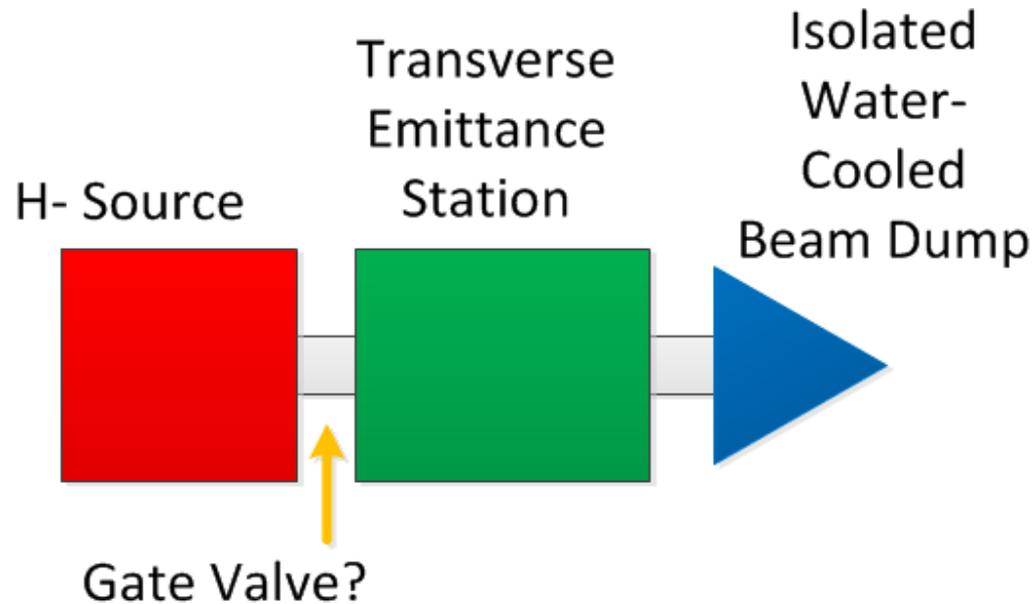
*Preliminary Sketch*

# LEBT Beam Dump and RFQ Entrance Apertures

- Use water-cooled electrically isolated beam dump and apertures
  - Handle up to 450 watts
  - Isolated dump and apertures acts like Faraday cup
    - Bias voltage?
  - *How many apertures are needed?*
- First project for new instrumentation Mech. Eng.
  - Starts in July
- Instrumentation will treat signals as toroid-type signals
- Need stepper motor motion drive and control
  - Can small steps to get some estimate of beam size
- Risk:
  - Medium-low technically
  - Medium schedule

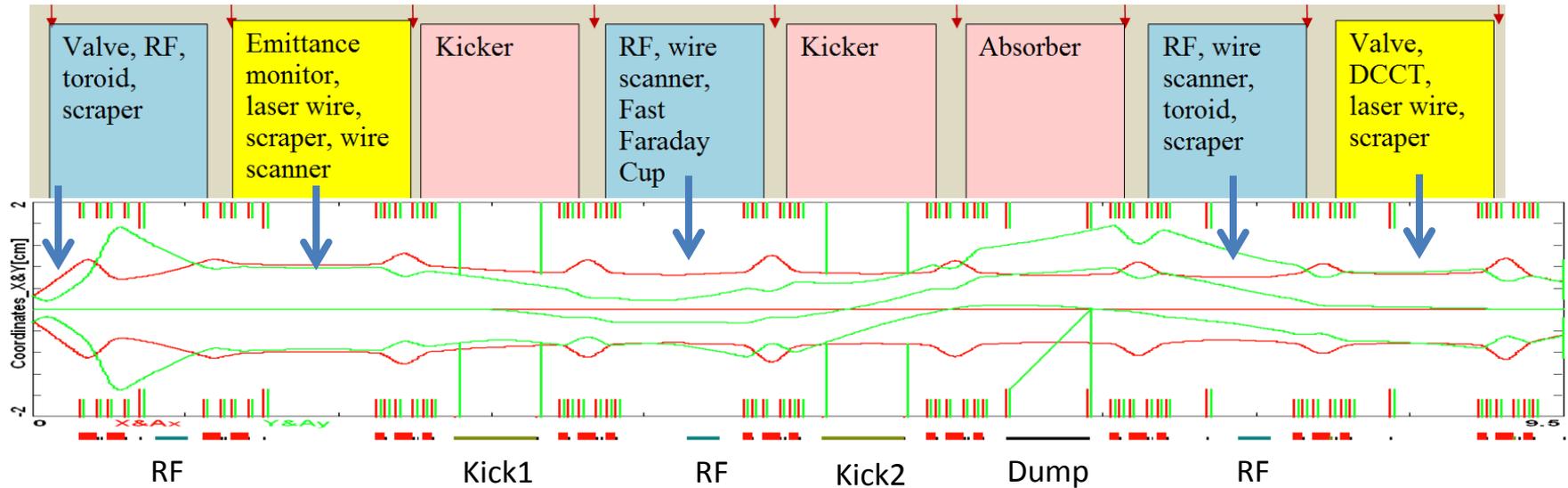


# Possible H- Source Commissioning Setup



- Initially, start with single Allison Scanner
- Isolated beam dump for beam current
- Will beam dump be used in MEBT?
- Any vacuum gate values?

# PXIE MEBT

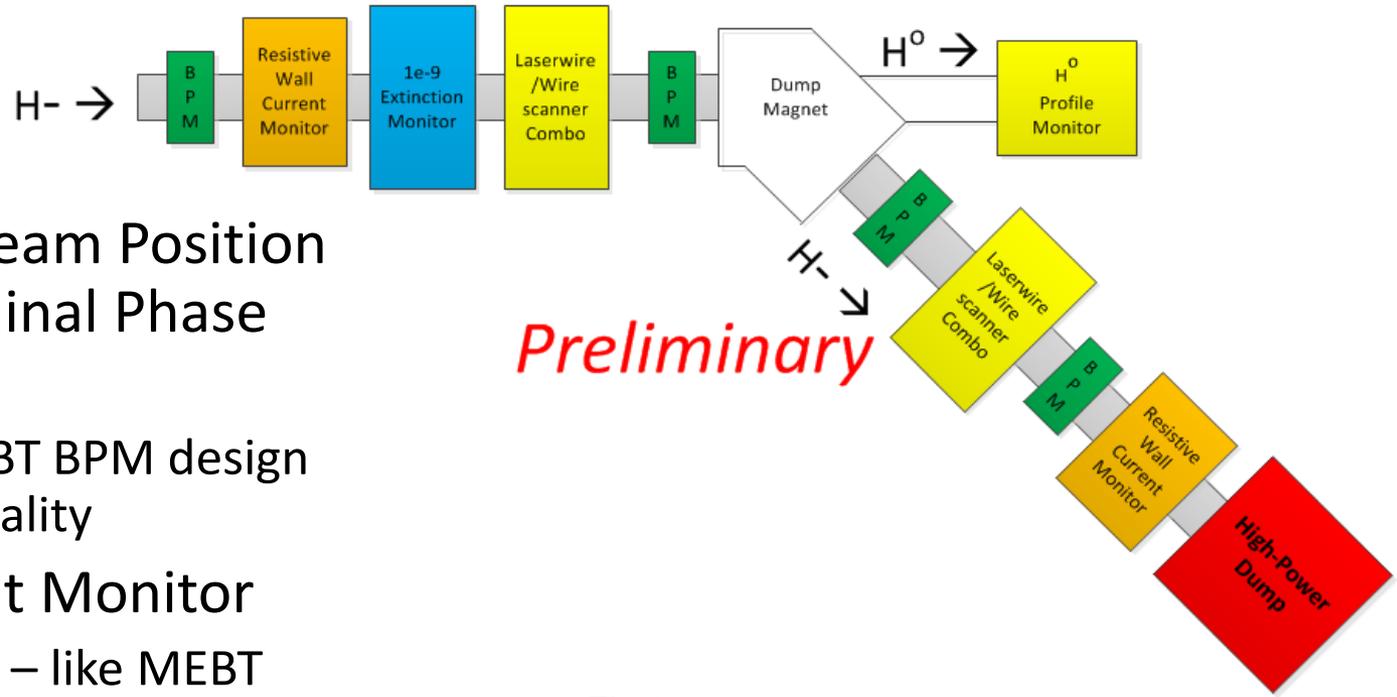


- Ion type: H-
- Output energy: 2.1 MeV, same as input
- Max bunch freq: 162.5 MHz
- Operational beam current: 1 – 10 mA
- Nominal input beam current: 5 mA
- Particles per bunch: 1.8e8 nominal
- Bunch extinction: < 1e-4

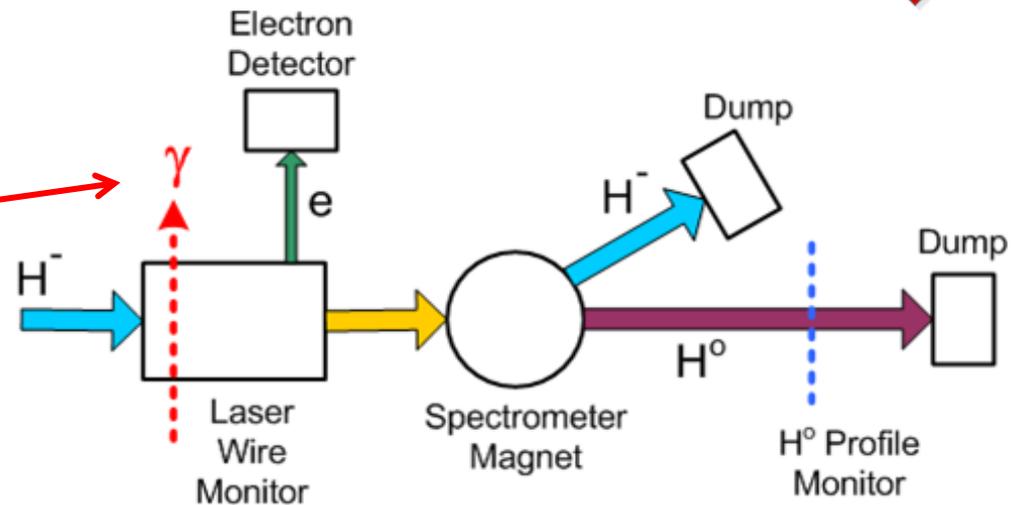
## MEBT Operational Beam Measurements: (red = CW)

- Transverse position - **BPMs**
- Bunch Phase – **BPMs**
- Beam Current – **RWCM (resistive wall current monitor)**
- Extinction - **RWCM**
- Transverse shape – wire scanners, **laser wires**
- Transverse emittance – slit/multiwire
- Longitudinal shape – Fast Faraday Cup?, **laser wires**
- Absorber Profiler – **OTR Imager**

# End of Beamline Instruments



1. Transverse Beam Position and Longitudinal Phase
  - Warm BPMs
  - Same as MEBT BPM design and functionality
2. Beam Current Monitor
  - Two RWCM – like MEBT
3. Profiles in dump line to measure energy spread
4. Laser Wire Emittance Monitor
5.  $1e-9$  Extinction Monitor



# PXIE MEBT and Beyond

- Lower priority
  - Assigning instrument leaders and finding people
    - Many involved with shut-down
- Risk items:
  - Laser diagnostics
    - Laser development occurring
      - Built Ytterbium mode-locked fiber laser – first pulsed light seen
    - Vacuum chamber not defined
      - Use SNS design? Modify?
    - Technical risk: Will low-power lasers work?
      - If not then high-power laser (SNS-like) is fallback option
      - Require transport of laser from outside cave → **Need laser room at PXIE!**
    - H- at HINS would allow us to test system
  - Extinction measurement
    - Using high BW RWCM
    - No single-bunch chopped beam to test system
      - H- at HINS would allow us to test system
  - **Losing key people**
    - Need front-end software support
    - Losing BPM designer/expert
    - New ME will take time to get up to speed – many projects for him

*Possible HINS test setup*

