HINS as a Beam Diagnostics Test Facility

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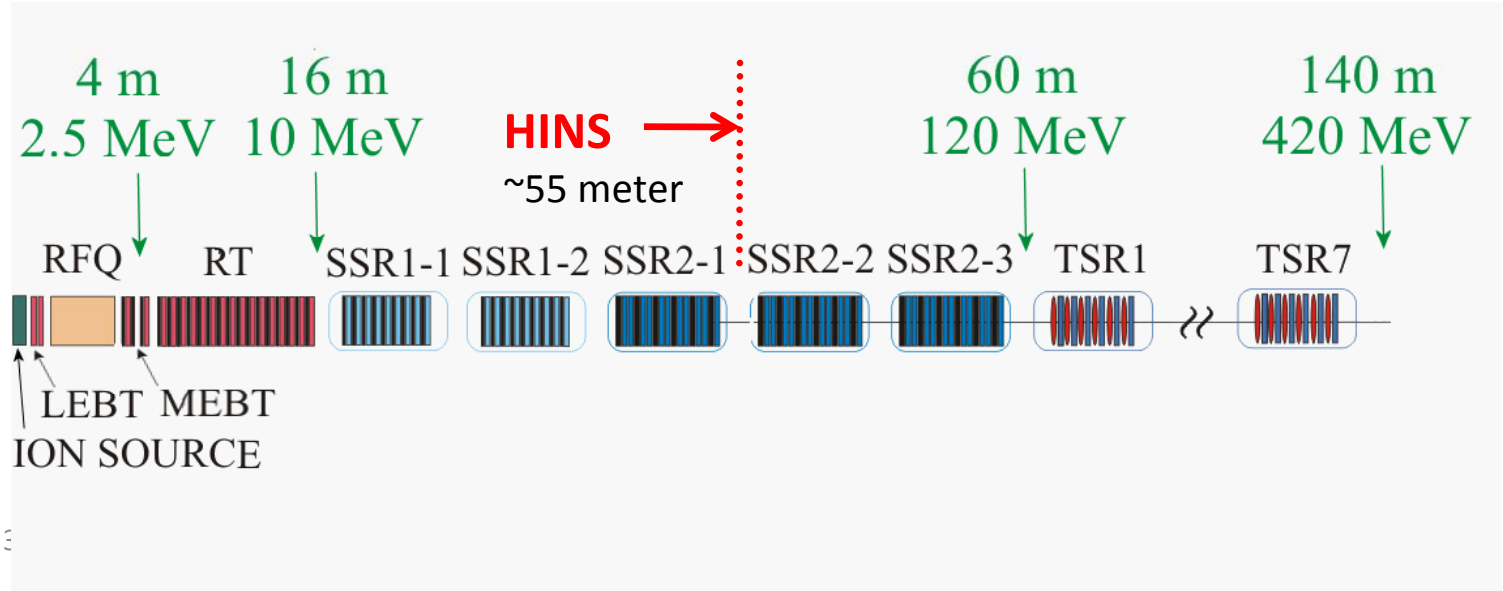
Introduction

- HINS (High Intensity Neutrino Source) is a Linac Injector R&D facility
- Potential exists to operate HINS as a low-energy, high-intensity H- test facility during Project X R&D phase
  - Development of Fermilab projects as well as facility for external collaborators
- Potential projects:
  - Beam diagnostics R&D
  - Beam chopper R&D
  - Low-energy material studies

325 MHz SCRF Injector

HINS (High Intensity Neutrino Source) Project Goals

- "to address accelerator physics and technology questions for a new concept, low-energy, high-intensity long pulse H- superconducting linac"
  - Demonstrate beam acceleration using superconducting spoke type cavity structures starting at a beam energy of 10 MeV
  - Demonstrate the use of high power RF vector modulators to control multiple RF cavities driven by a single high power klystron for acceleration of a non-relativistic beam
  - ***Demonstrate beam halo and emittance growth control by the use of solenoidal focusing optics up to 60 MeV***
  - Demonstrate a fast, 325 MHz bunch-by-bunch, beam chopper



Original HINS Linac Sections

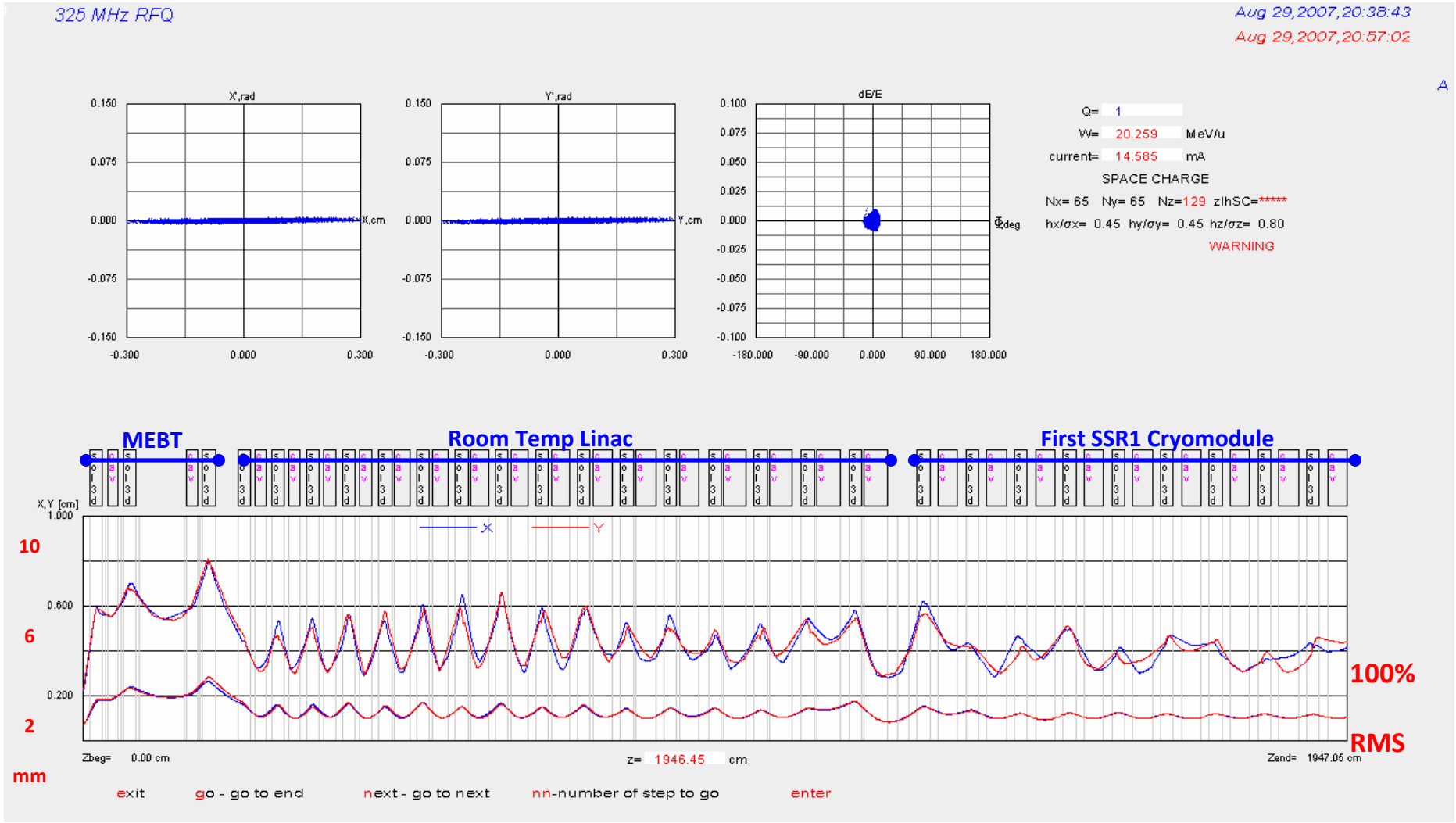
- 50 keV ion source (initially protons, ultimately H-)
- 2.5 MeV 325 MHz vane-type RFQ
- Medium Energy Beam Transport (MEBT)
  - Three superconducting solenoid magnets
  - Two 325 MHz buncher cavities
  - Fast beam chopper
- 2.5 – 10 MeV Room Temperature (RT) Cavity Section
  - Sixteen 325 MHz room-temperature crossbar-H spoke cavities
  - Sixteen superconducting solenoids
- *10 – 60 MeV SSR1 and SSR2 Cavity Section*
  - *Two cryomodules each with nine SSR1 β=0.2 325 MHz superconducting spoke cavities and nine superconducting solenoids*
  - *One cryomodule with eleven SSR2 β=0.4 325 MHz superconducting spoke cavities and six superconducting solenoids*

HINS Beam Parameters

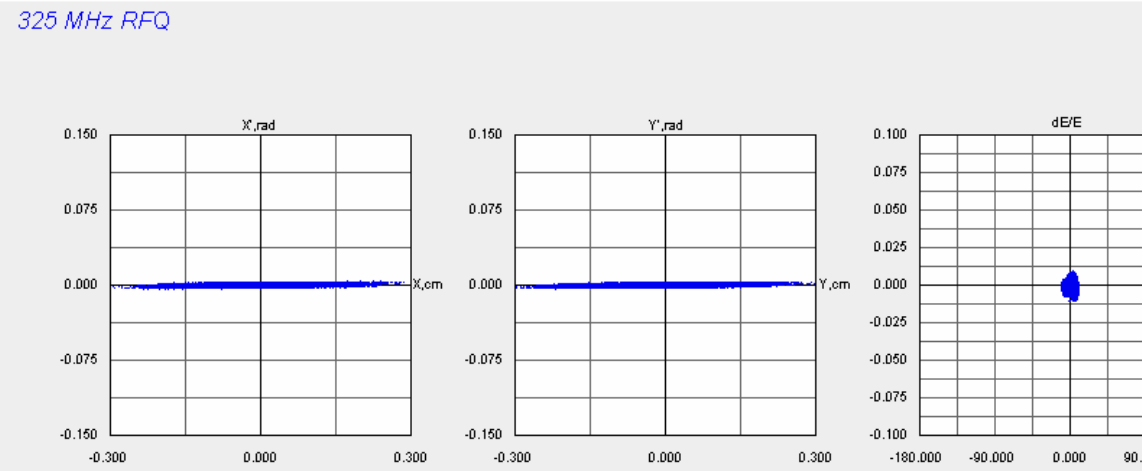
	HINS	
Particle	H+ then H-	
Nominal Bunch Frequency/Spacing	325 3.1	MHz nsec
Particles per Pulse	37.5 *	E13
Pulse Length	3/1	msec
Average Pulse Current	~20	mA
Pulse Rep. Rate	2.5/10	Hz
Chopping -6% @ 89KHz and 33% @ 53MHz	0 - 37.5%	
Bunch Current	32	mA
Bunch Intensity	6.1 98	E8 pCoul

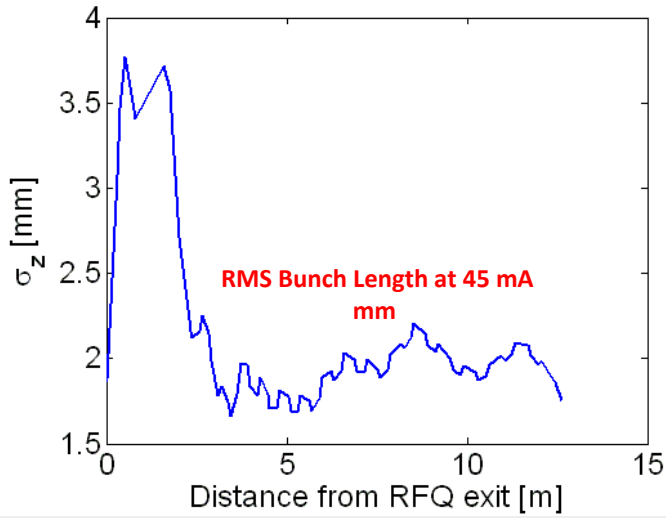
* full un-chopped 3 msec pulse at klystron-limited 20 mA

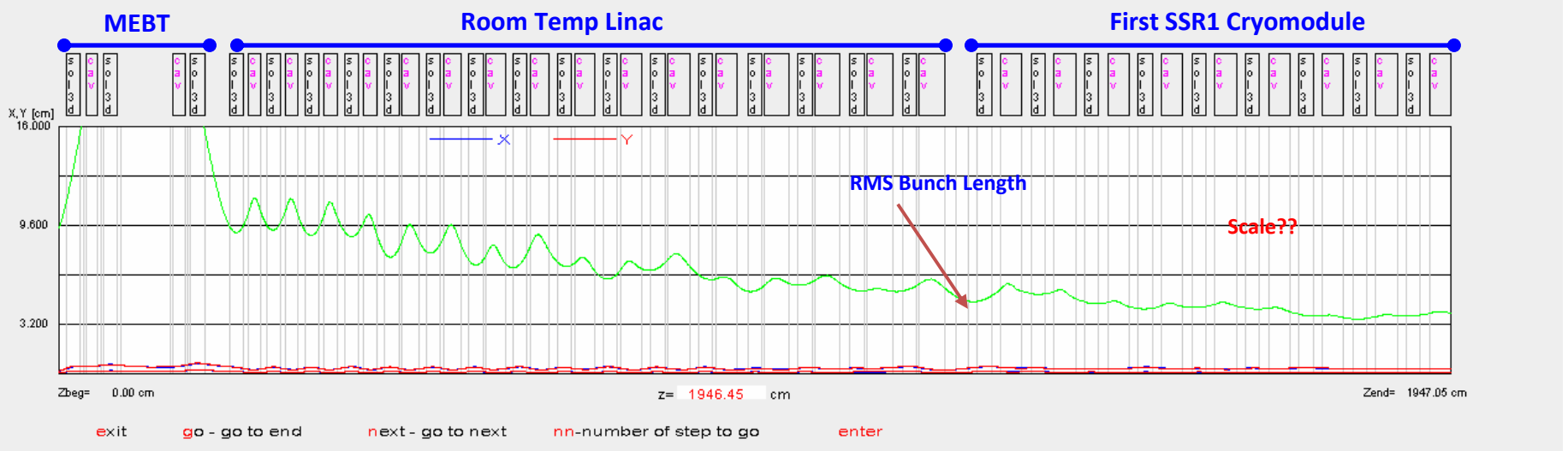
HINS Transverse Beam Parameters at 15 mA



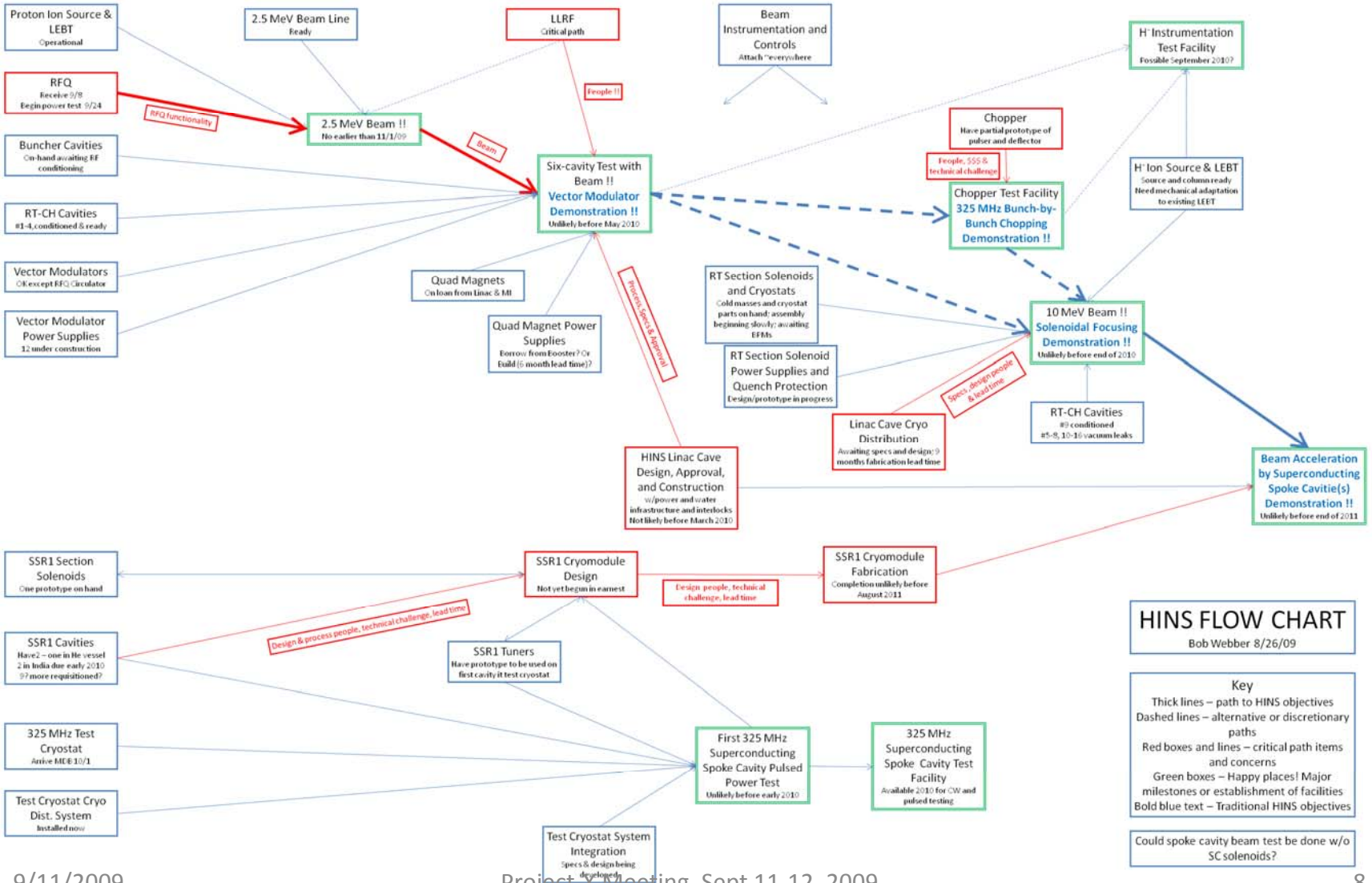
HINS Longitudinal Beam Parameters at 15 mA





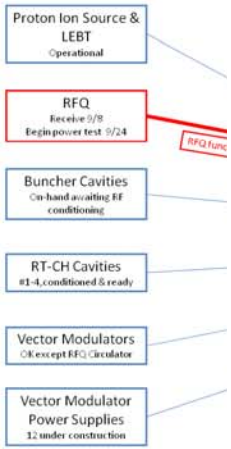


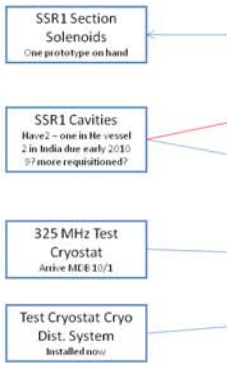
HINS Roadmap



HINS FLOW CHART

Bob Webber 8/26/09





Key

Thick lines – path to HINS objectives

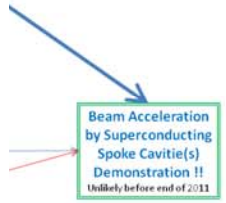
Dashed lines – alternative or discretionary paths

Red boxes and lines – critical path items and concerns

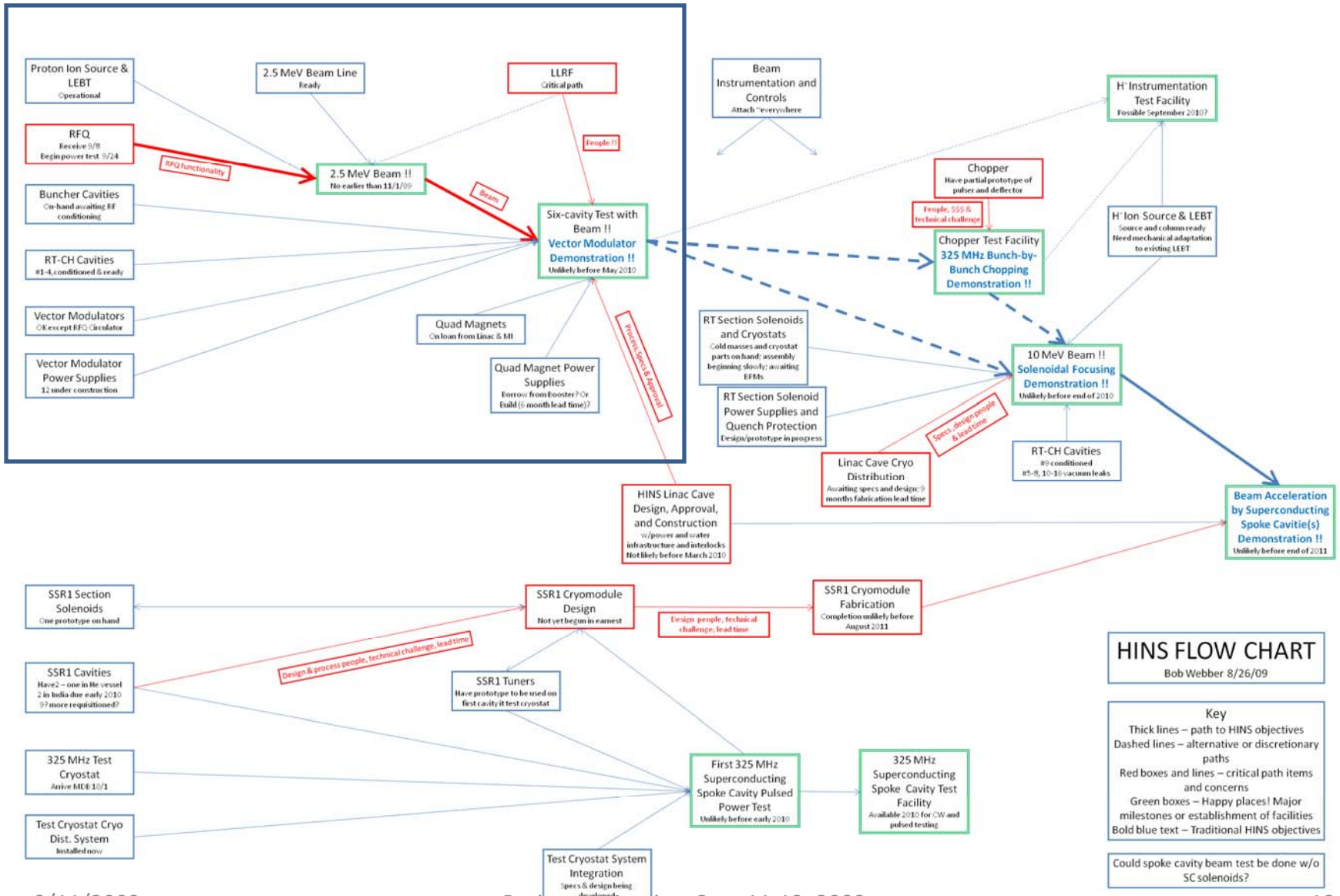
Green boxes – Happy places! Major milestones or establishment of facilities

Bold blue text – Traditional HINS objectives

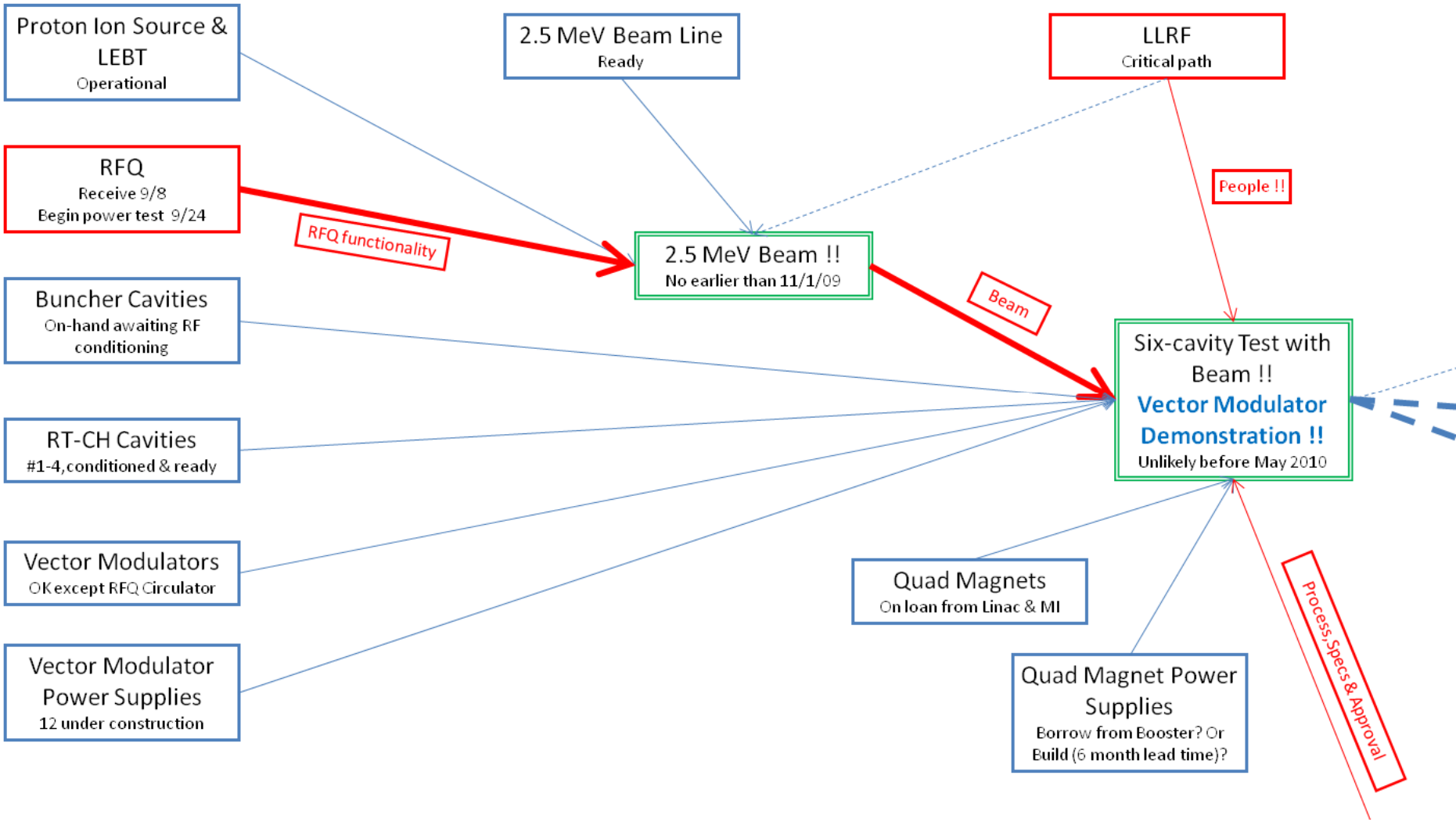
Could spoke cavity beam test be done w/o SC solenoids?



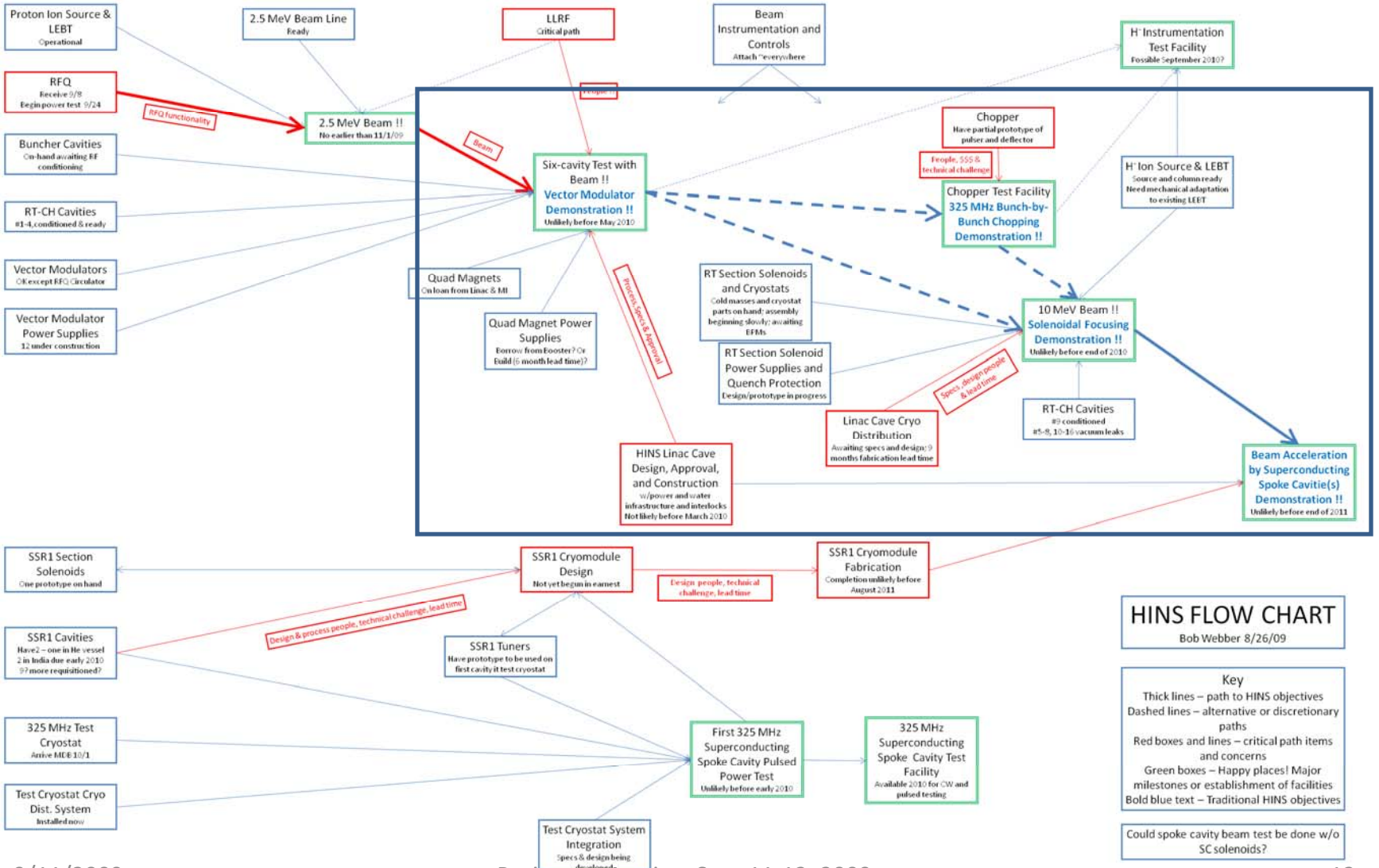
HINS Roadmap - Early



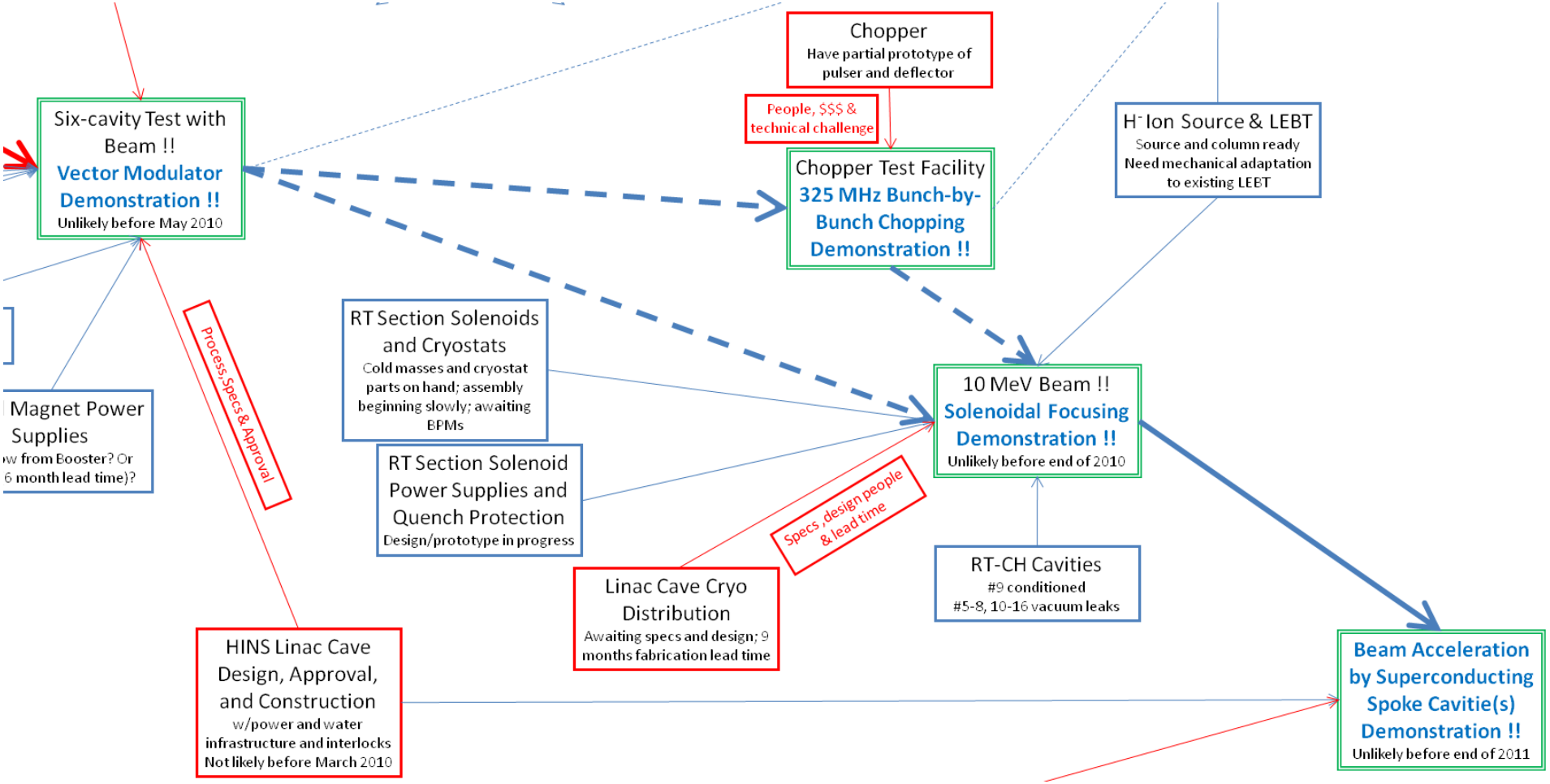
HINS Roadmap - Early



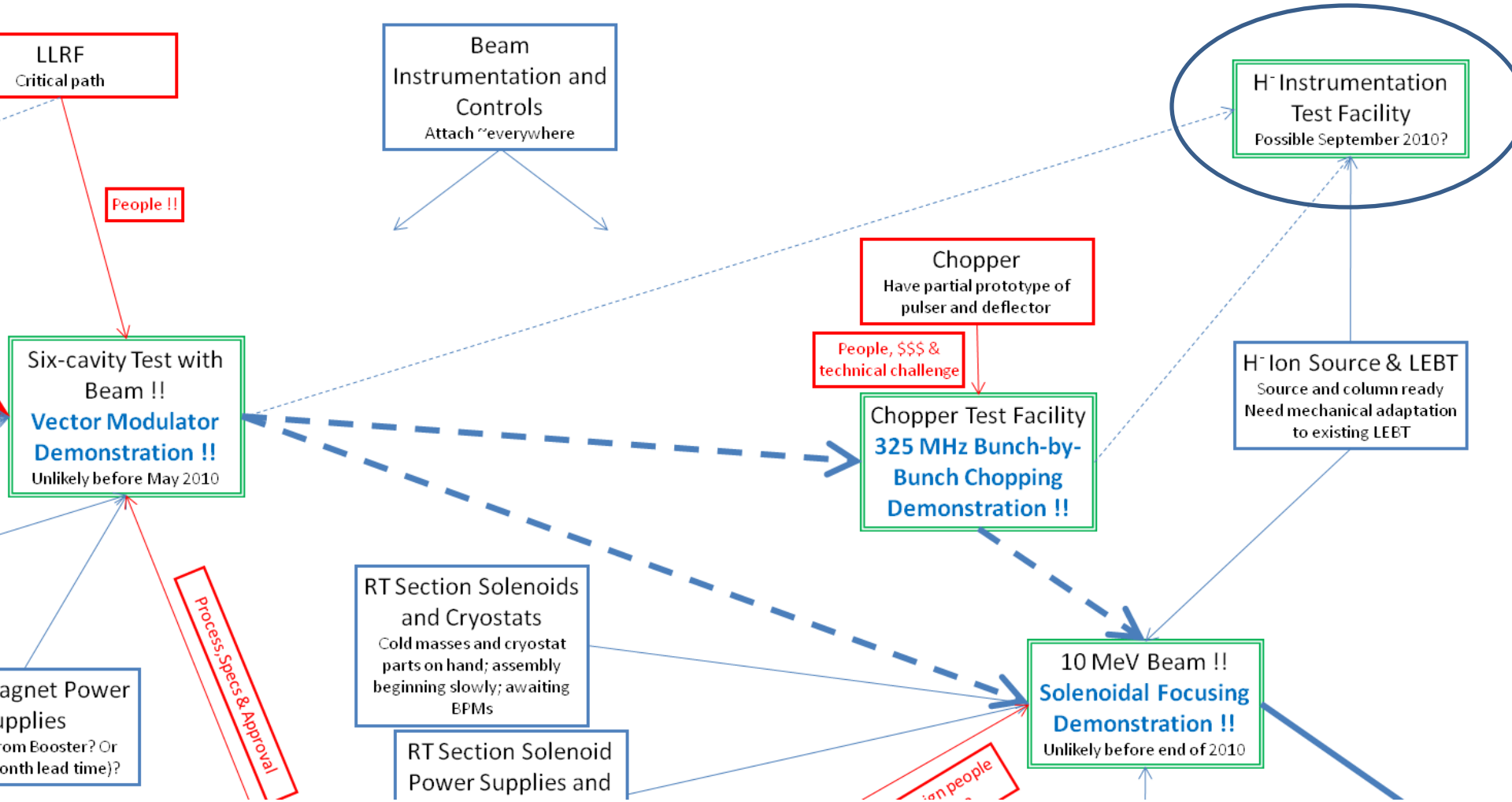
HINS Roadmap - Late



HINS Roadmap - Late

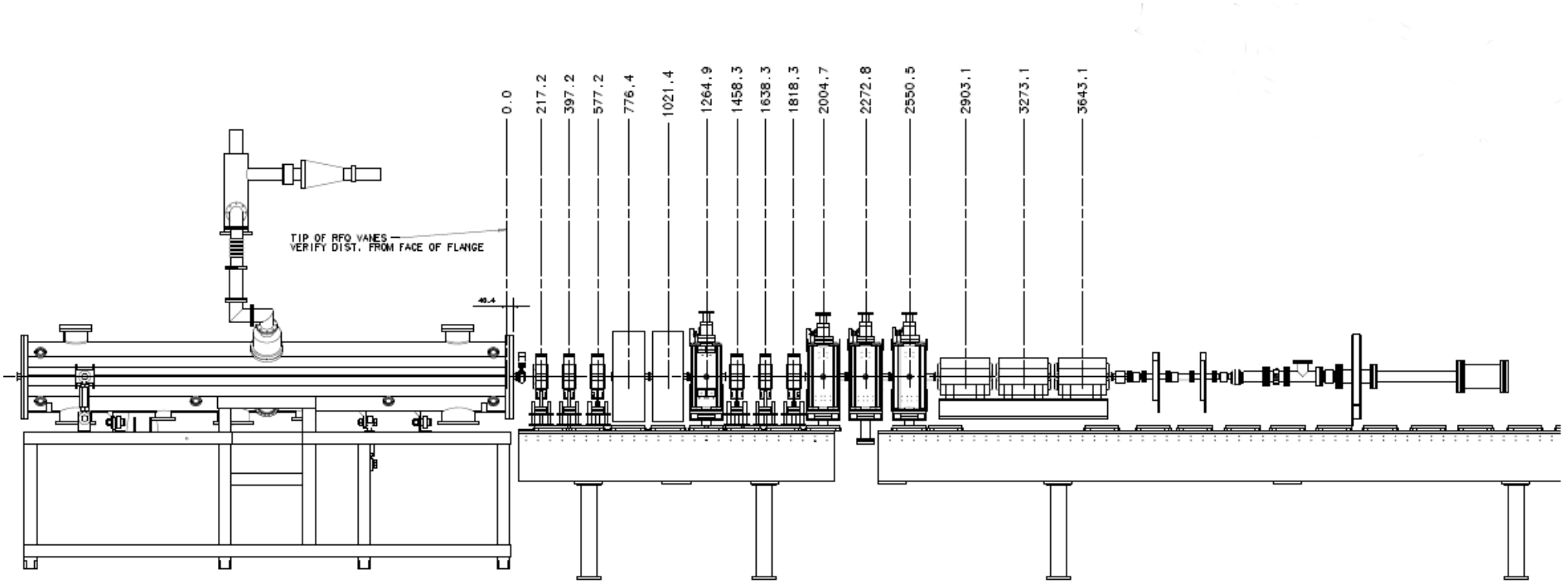


Paths to H- Test Facility



Six Cavity Test

- To test vector modulator concept
- Two buncher cavities
- Quadrupole focusing instead of superconducting solenoids



Movable Diagnostics

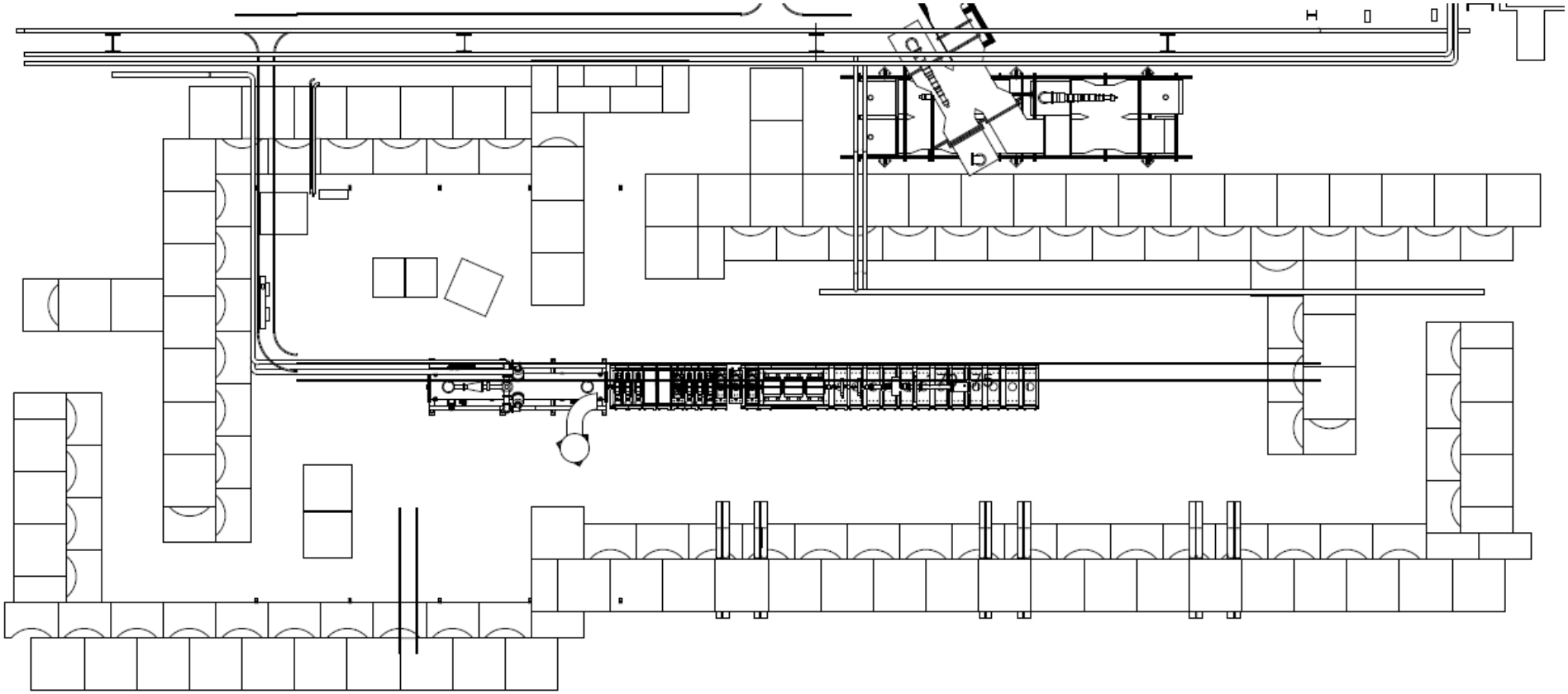
- The movable diagnostics station is to use at the end of the following linac sections as HINS evolves
  - RFQ+MEBT, RT section, SSR1, SSR2
- Minimum instrumentation includes:
  - 2 BPMs, includes phase pick-up – time-of-flight
  - 3 profile monitors
  - 1 current transformers
  - Beam dump –water cooled
  - Faraday cup
- Maximum set – R&D
  - *Emittance station – slit-collector/laser slit*
  - *Bunch length – wire and/or laserwire*
  - *Bunch profile – laserwire*
  - *Beam Diagnostics R&D section*

Some Project-X Beam Diagnostics Projects

- *Laser Transverse Profile Monitor**
- *Laser Longitudinal Profile Monitor**
- Wire Longitudinal Profile Monitor*
- Ionization Profile Monitors
- Electron Wire Transverse Profile Monitor
- Halo Monitor – vibrating wire/*Laser**
- Emittance station – slit-collector*/Allison Scanner/Pepper Pot/*Laser Slit**
- Optical Transition Radiation Profile Monitor

** Projects for HINS - various stages*

HINS Cave Layout



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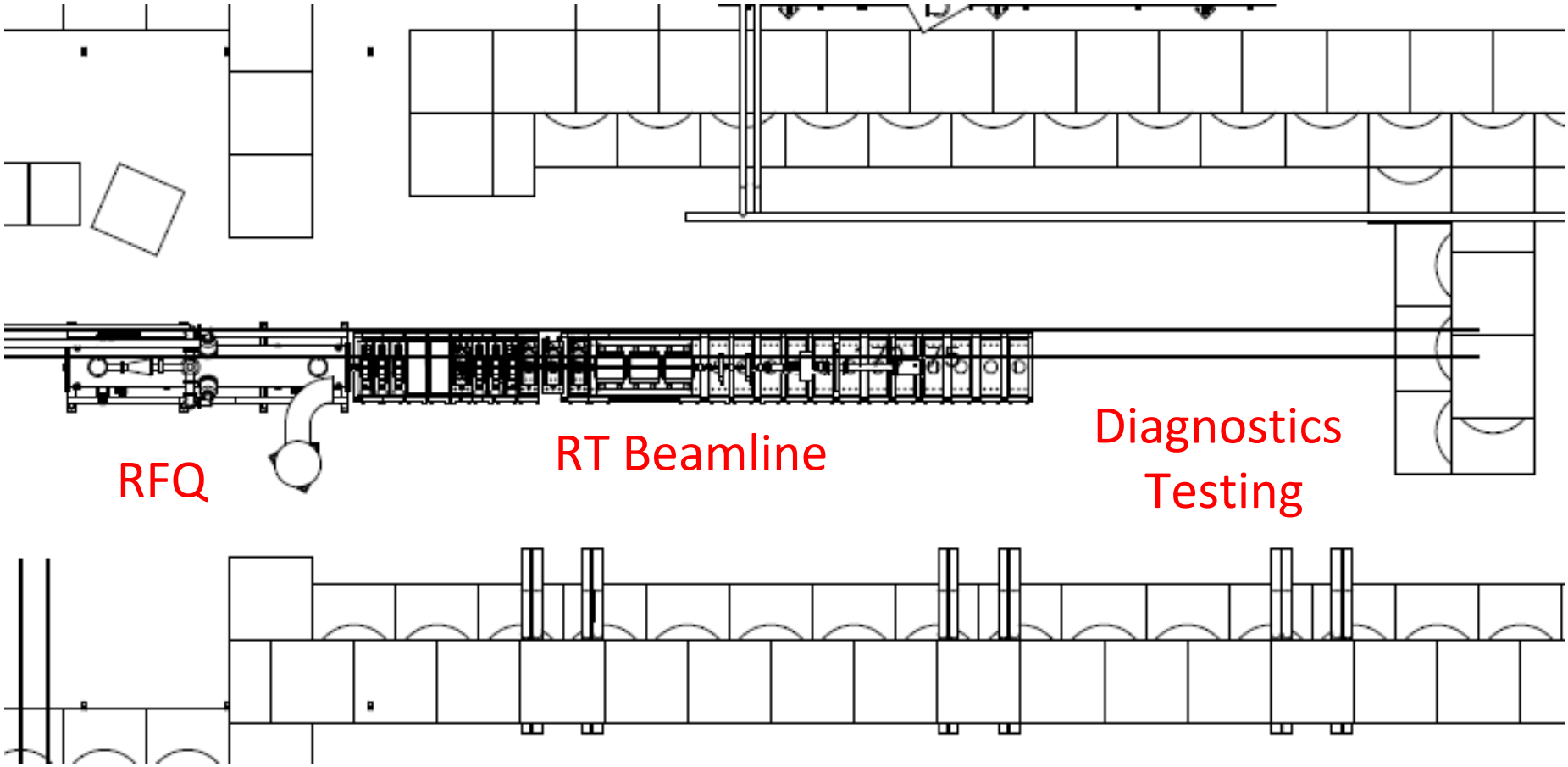

Conclusion

- HINS beamline construction and testing over next two years
  - 2.5 MeV H- sometime in mid-2010?
  - 10 MeV beam in 2011?
- HINS can provide a unique test facility for low-energy high-intensity beam diagnostics R&D
- Intension is to operate HINS as a test facility during Project-X R&D phase even after initial goals