The Advanced Photon Source Injector Test Stand

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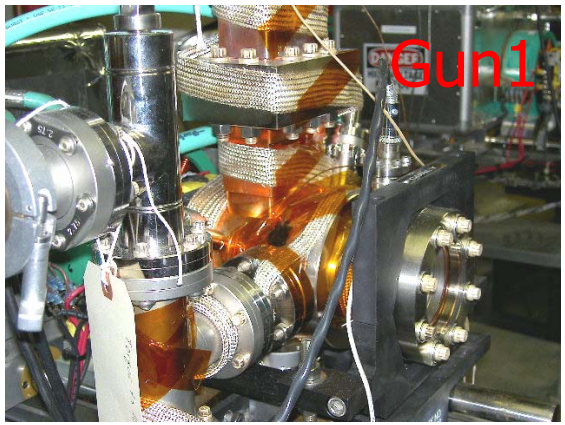
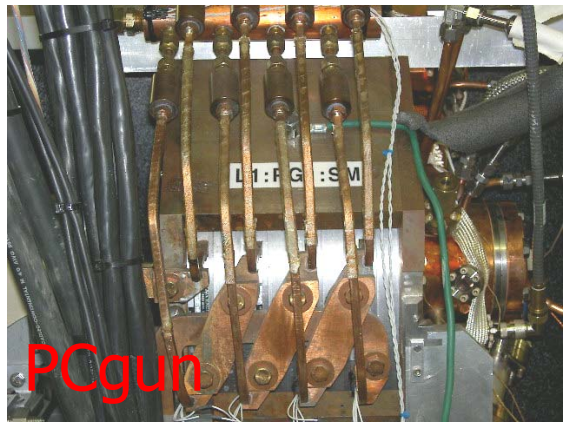
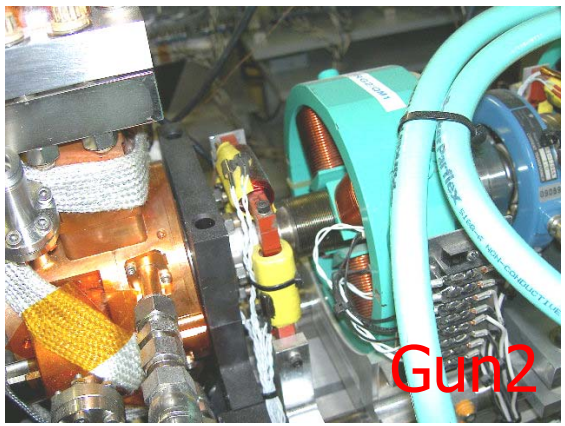
Introduction

- Why does the APS have an injector test stand?
- History
- Current Setup and Capabilities
- Limitations and Strengths
- Future Plans
- Wrap-Up

Why an Injector Test Stand at the APS?





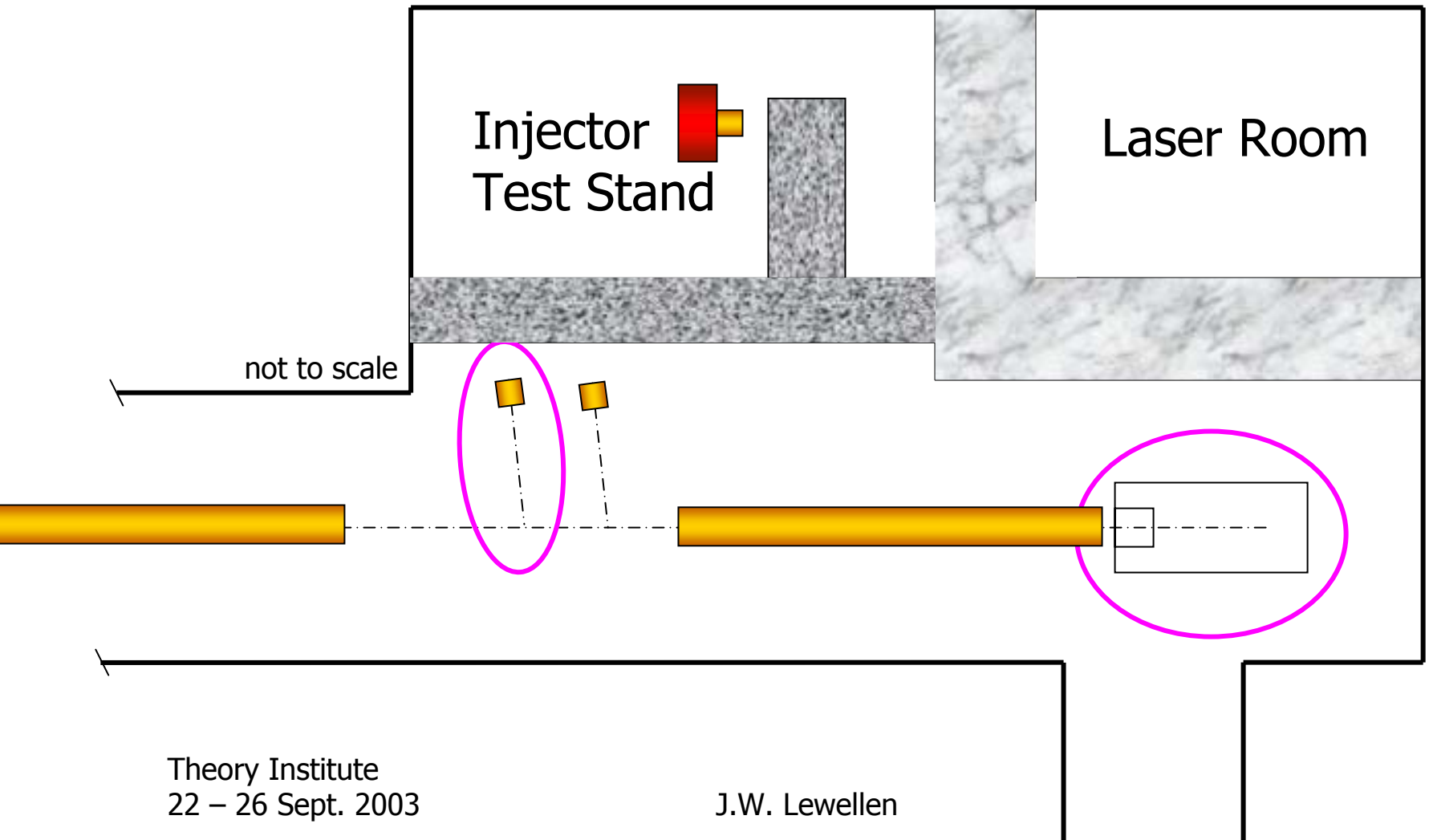


APS costs about $10k / hour to run

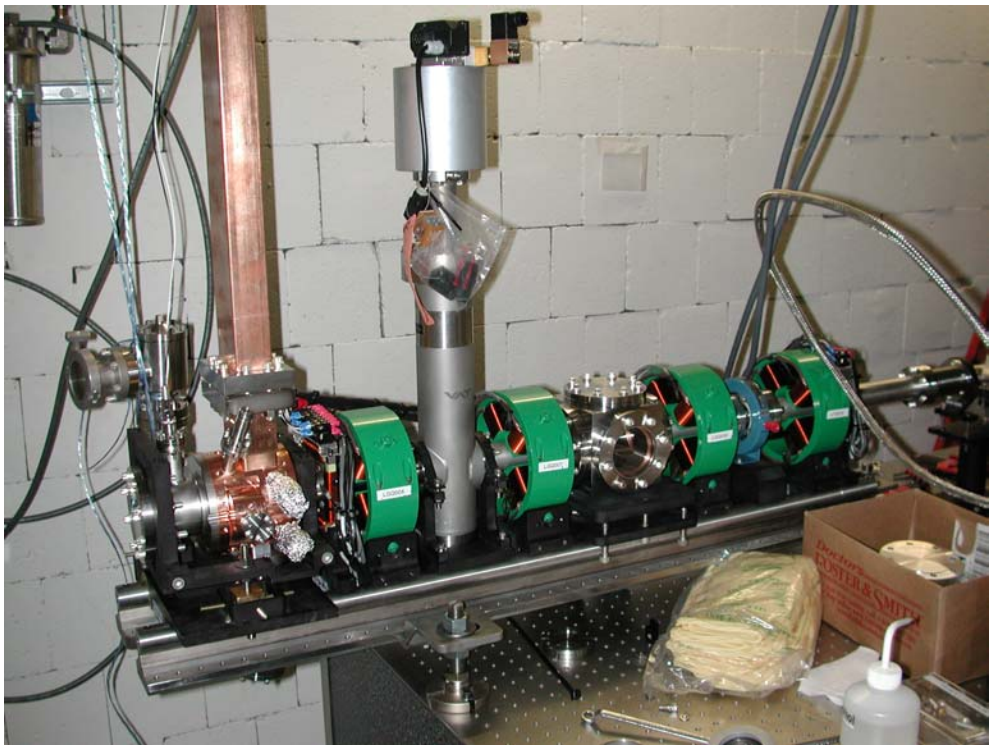
Any Other Reasons?

- Prototyping of systems required for top-up support
- Operator training facility during top-up operation
- Check operation of new hardware, with beam, without operations risk
- Keep resident physicists quiet and out of trouble

Injector Test Stand History



Phase I - New Linac Injector Guns



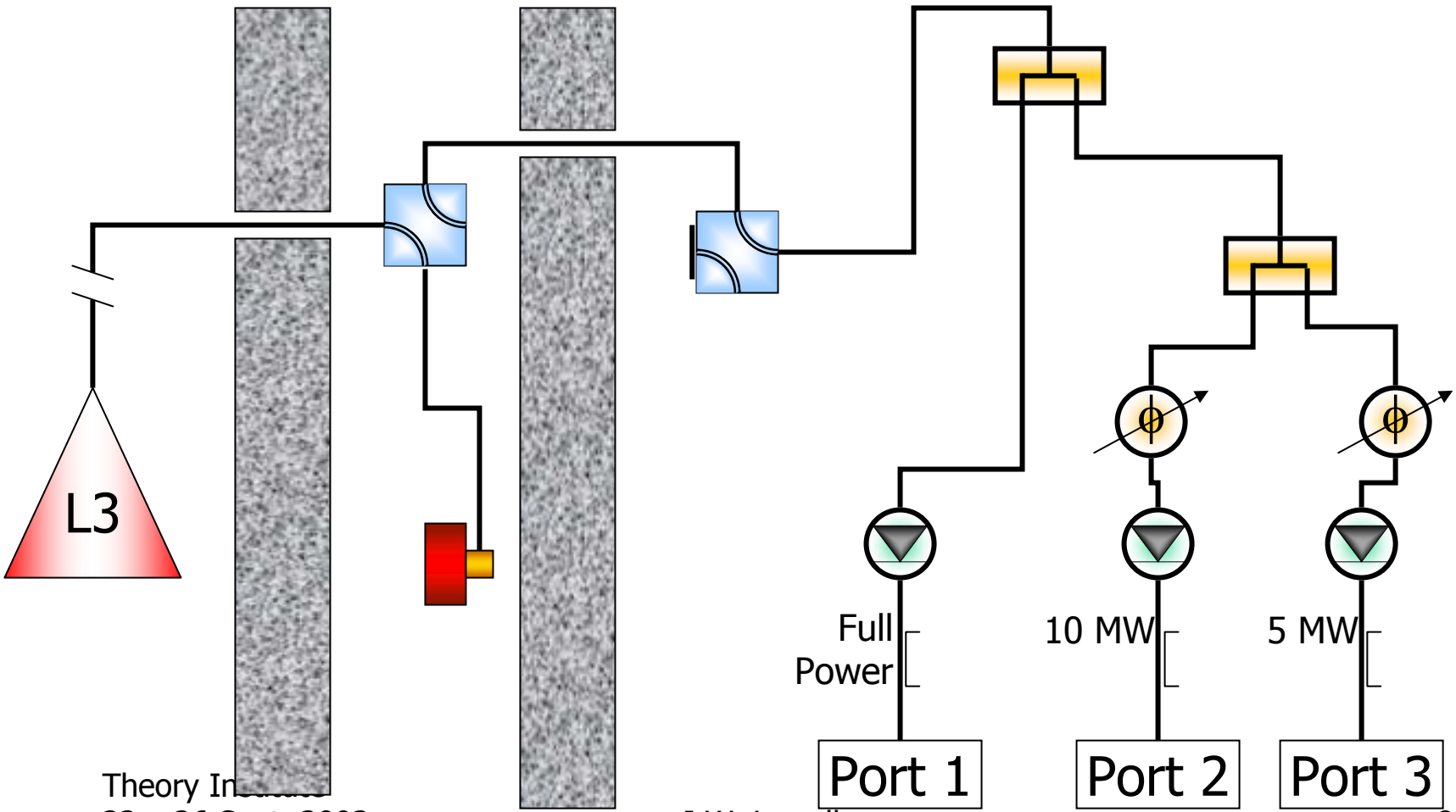
- Single waveguide feed
- Validation of linac injector guns
- Built as much as possible with research in mind
  - quick-disconnects on magnets
  - modular rail system

Phase II – Research Lab

- Multiple RF feeds
- Expanded control system capability
- More conventional facilities available

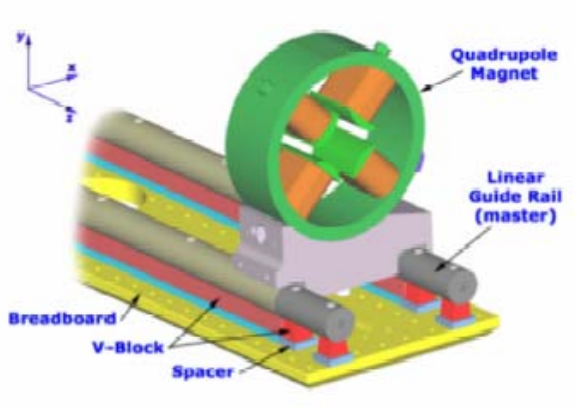
- Support from APS management
  - various groups' time and effort
  - obtaining ARIM funding for construction

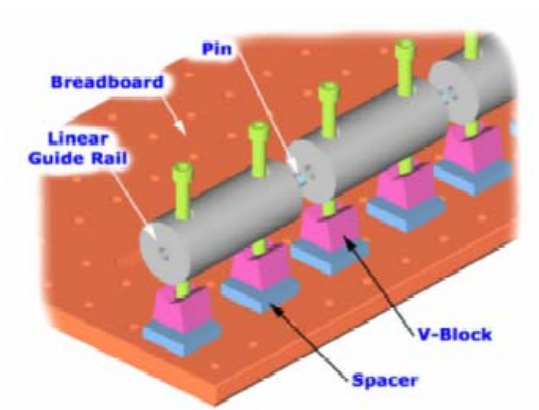
Layout and Capabilities – RF Systems



Layout and Capabilities - Construction

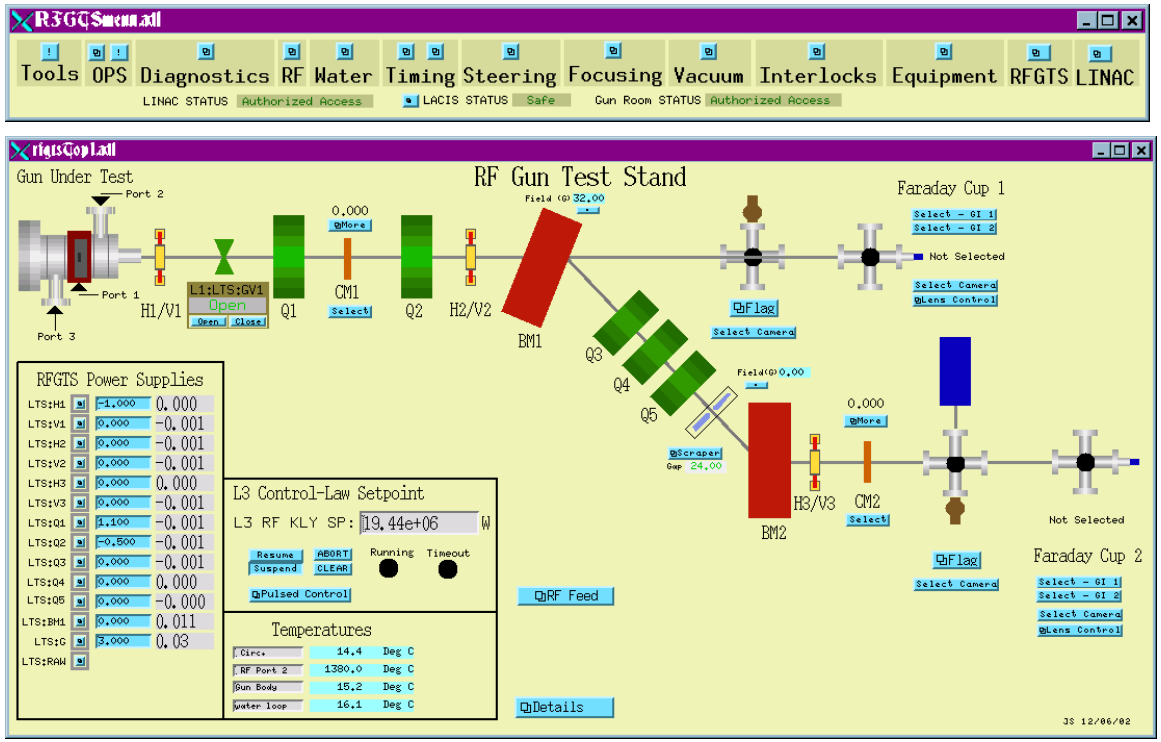
- Optical table "substrate"
- 3-point-mount breadboards
- Modular Thompson-like rail system





Layout and Capabilities – Controls

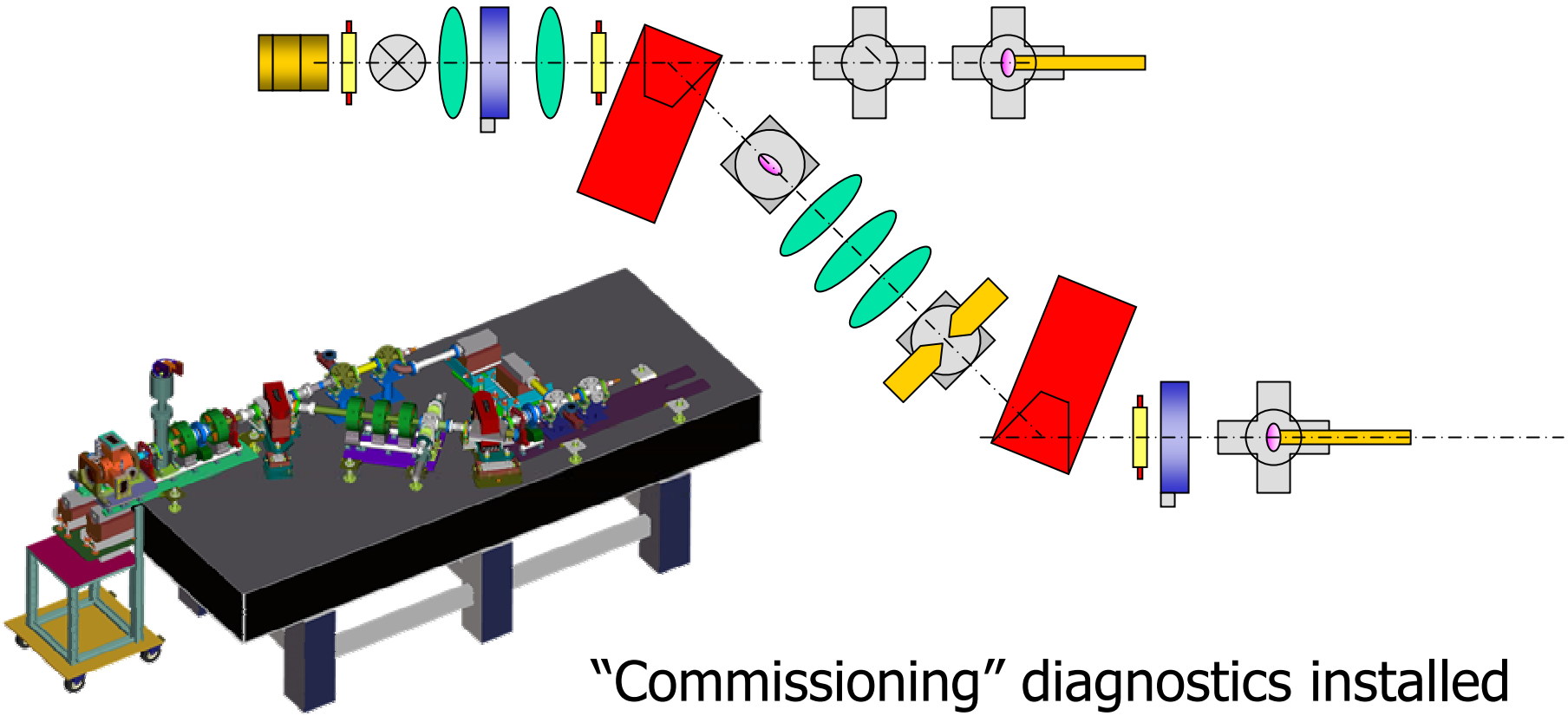
- Built using the APS-standard EPICS architecture
  - availability of "canned" component support and tools
  - good for cross-training purposes
  - easy to modify control screens
- Independent IOC provides fault isolation



Layout and Capabilities – Other

- Power supplies prototyped another APS system
- MIL-type magnet PS cables for no-hassle, no-error connections
- EPICS-controlled water station
- Linac process water w/flow meters
- Compressed air

Beamline Layout – Current



"Commissioning" diagnostics installed at the present time

Beamline Layout – Next Up

- Emittance diagnostics
  - Pepperpot on in-line beamline
  - Quads following dogleg
- Bunch length diagnostics
  - Golay cells in-hand
  - Have design for interferometer
- Secondary beamline
  - Interfaces with existing beamline
  - Draws rf power from new switch in Port 2 line

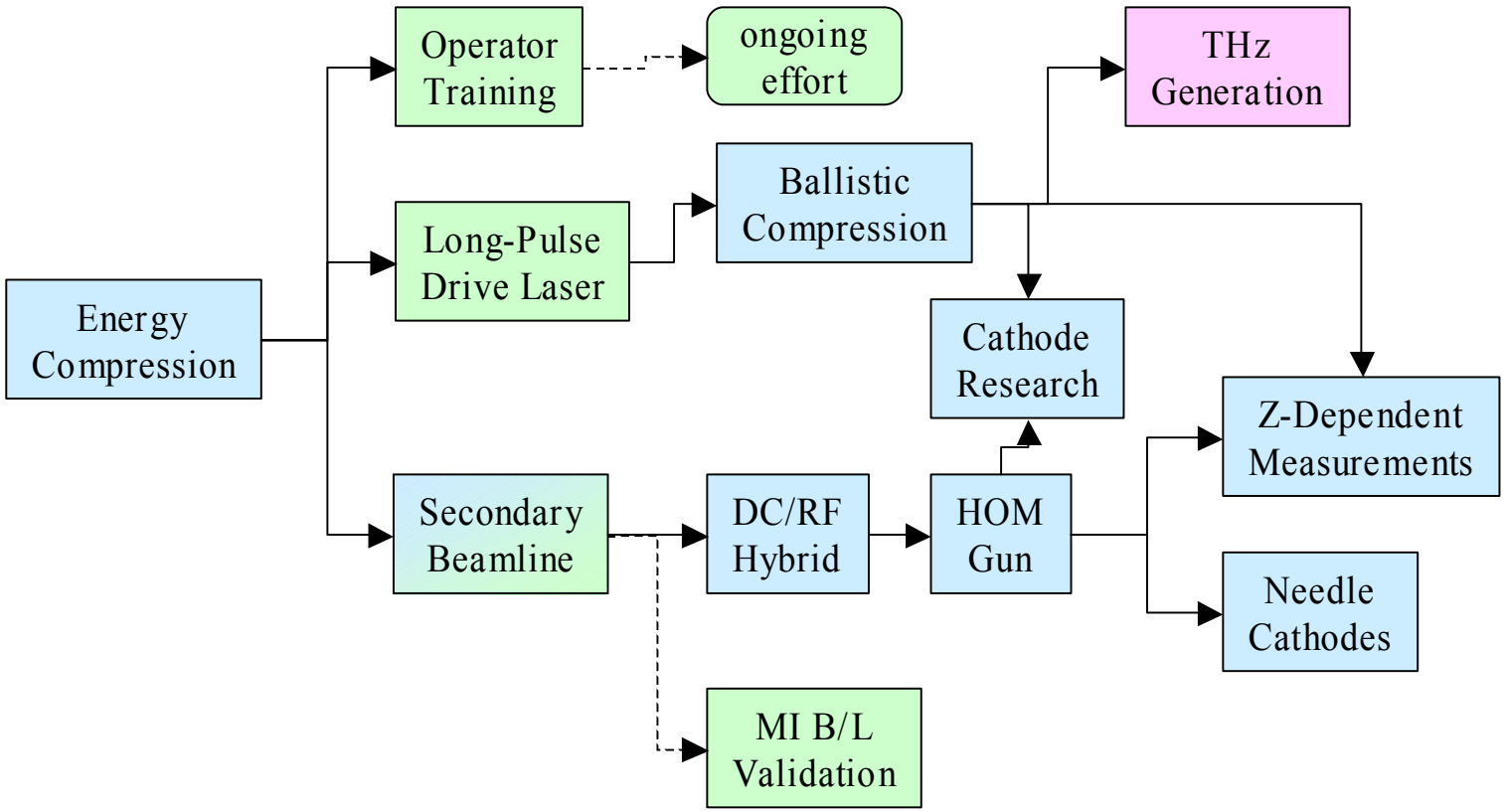
Limitations and Strengths – Limitations

- Existing diagnostics setup good for energy-related measurements
- Limited space on table for new diagnostics, more beamlines, etc.
- Limited RF power sources
- Reconfiguration required for injector validation task

Limitations and Strengths – Strengths

- Flexible design allows for easy modification
- "Zero-jitter" RF power distribution
  - extremely stable relative phase jitter
  - extremely stable relative power ratios
- Designed for gradual increase of capabilities
- Control system is very over-designed
- Secondary beamline for injector validation appears very possible
- Limited size forces focus on near-gun studies

Current Experimental Plan (rough)



Operator Training Facility

- Top-Up operation requires 24/7 APS injector operation
  - no time for training – can't touch anything
  - only hands-on time during top-up is when something fails
- Test stand, esp. with BBC gun, can provide a linac surrogate
  - similarity of control systems
  - similarity of tasks, e.g. energy spread tuneup
  - ability to introduce faults for training & testing

Small Experiment Platform

- High-brightness, low-energy beams available
- Flexible, expandable control system

- Support for experiments needing unique beam properties at low eneries
  - THz radiation generation
  - x-ray backscatter
  - compact FELs
  - etc…

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Wrap-Up

- APS Injector Test Stand is currently operational
- Initial experimental results on BBC gun are very encouraging
- Design philosophy has proven itself in practice
- Ambitious series of experiments planned