



FACET-II

Facility for Advanced
Accelerator Experimental Tests

Experimental Area and Plans

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FACET and Test Facilities Division



Advanced Accelerator Research Department

- Organize and participate in science program aligned with HEP Roadmap
- Translate User needs to Test Facilities and Operations departments
- Maximize scientific output by organizing science workshops, collaboration meetings, etc.

Test Facilities Department

- Assigns User training to ensure User safety onsite
- Contributes to design of experimental equipment and manages safe and efficient installation
- Coordinates multiple groups during accelerator access periods (PAMMs)

FACET-II Operations Department

- Coordinate accelerator commissioning
- Develop new machine configurations matched to needs of experimental programs
- Create procedures for operators to ensure consistent delivery

Tight coordination between departments ensures safe and productive experience for FACET-II User community

Expect to Operate Many Experiments in Parallel



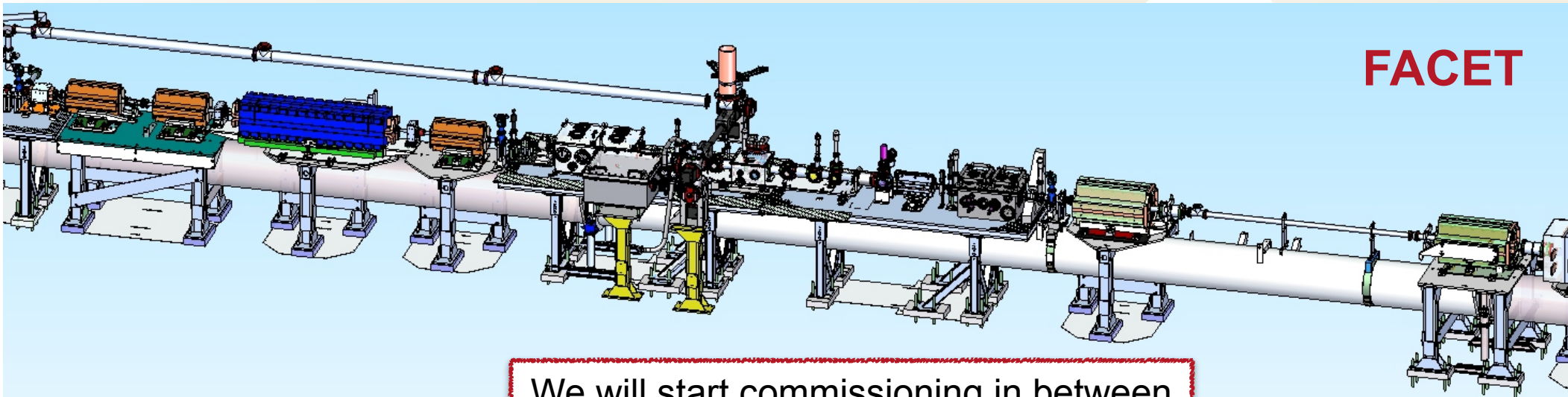
Experiment	Title
E-300	Energy Doubling of Narrow Energy Spread Witness Bunch while Preserving Emittance with a High Pump-to-Witness Energy Transfer Efficiency in a Plasma Wakefield Accelerator
E-301	Tailored Plasma Source for Emittance Preservation in Plasma Wakefield Acceleration and High-Brightness Plasma-Injected Beams
E-302	Transverse wakefields and instabilities in plasma wakefield accelerators
E-303	Generation and Acceleration of Positrons at FACET II
E-304	Downramp Trapping in PWFA for generating low emittance beams
E-305	Beam filamentation and bright gamma-ray bursts
E-307	Investigating the physics of beam loading using localized beam-induced ionization injection
E-308	Extreme Focusing in Vacuum with a Passive Plasma Lens
E-310	Trojan Horse-II
E-311	Plasma Torch Optical Density Downramp Injection
E-315	Plasma Afterglow Attosecond Metrology
E-316	Icarus: Transient tunneling ionization of crossing laser and electron beams
E-320	Probing Strong-field QED at FACET-II
E-321	Dielectric wakefield acceleration at GV/m gradients
E-324	Optical visualization of beam-driven plasma wakefield accelerators
E-326	Non-Intercepting Diagnostics for High Intensity Beams and Computer Control
E-327	Virtual diagnostic for phase space prediction and customization at FACET-II

Efficient utilization of space will be required to accommodate as many experiments as possible with minimal human intervention inside

FACET-II Experimental Area – Many Modifications to Handle Low Emittance Beams

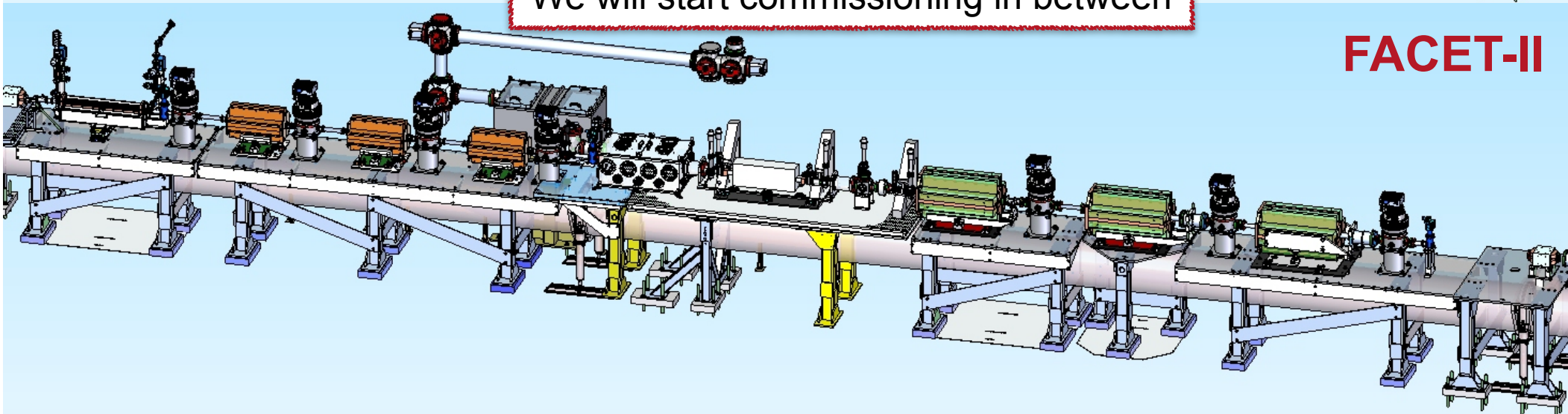
SLAC

FACET



We will start commissioning in between

FACET-II



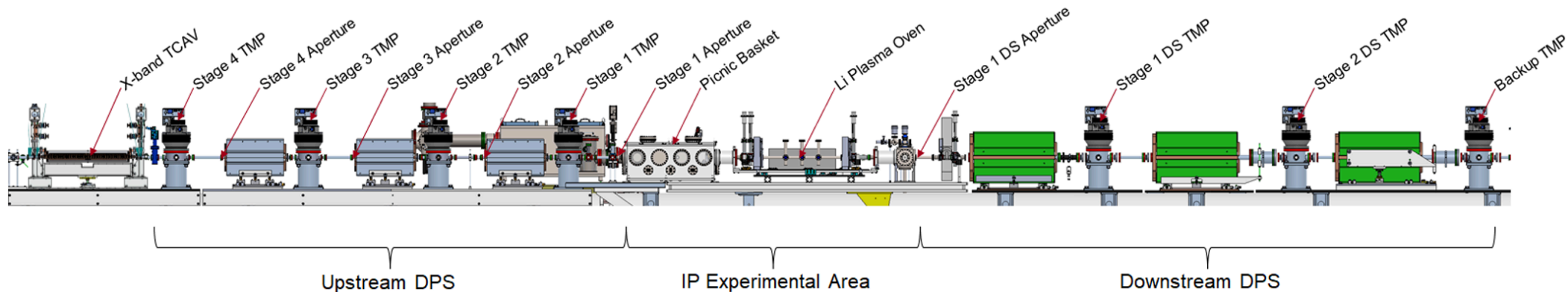
FACET-II S20 beamline upgrades planned in parallel with commissioning to address user needs around experimental area (TCAV, FF, Spectrometer)

Differential Pumping System Required for Lowest Emittance Beams



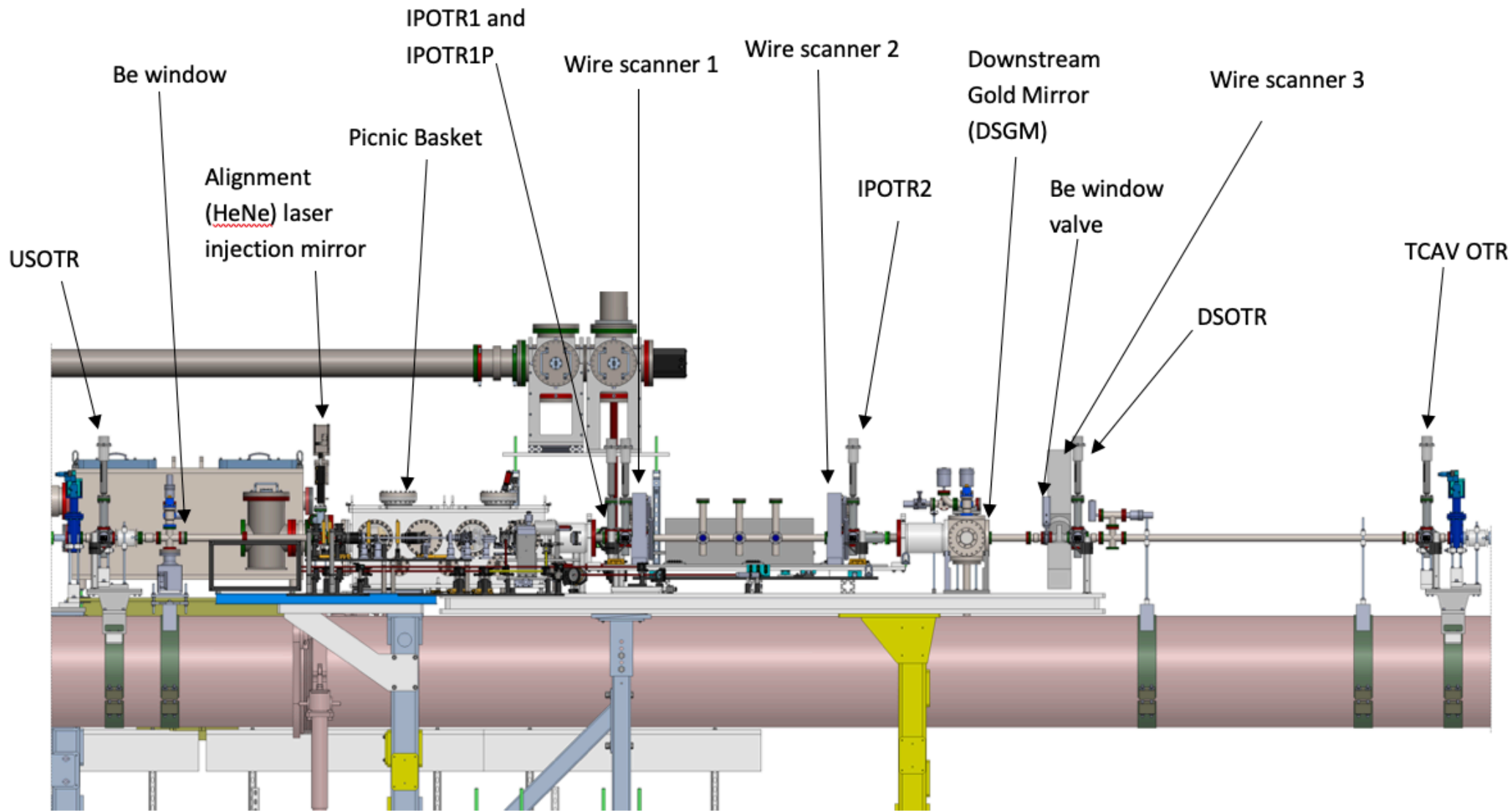
Experiment	Title	Plasma Source Type	Gas	Density [e-/cc]	Rep Rate [Hz]	Steady State Pressure [Torr]
E-300	Energy Doubling of Narrow Energy Spread Witness Bunch while Preserving Emittance with a High Pump-to-Witness Energy Transfer Efficiency in a Plasma Wakefield Accelerator	Li oven	Helium	4E+16	CW	5
E-324	Optical visualization of beam-driven plasma wakefield accelerators	Li oven				
E-305	Beam filamentation and bright gamma-ray bursts	PB Gas Jet	Hydrogen	1E+20	TBD	1E-04
E-308	Extreme Focusing in Vacuum with a Passive Plasma Lens	PB Gas Jet	Hydrogen	1E+16	TBD	1E-04
E-310/ E-315	Trojan Horse-II/Afterglow	PB Gas Jet	Hydrogen/ Helium mix	1E+18	TBD	1E-04
E-320	Probing Strong-field QED at FACET-II	N/A				

- PRD & ESD nearly complete
- Designed for flexibility
- Satisfies gas load and aperture requirements from operations and experiments



Vacuum support hardware (chambers, apertures) installation January 2021. Commission pumps/controls April 2021.

How We Expect the User Area to Look When We Are Commissioning (Nov-Dec 2020)

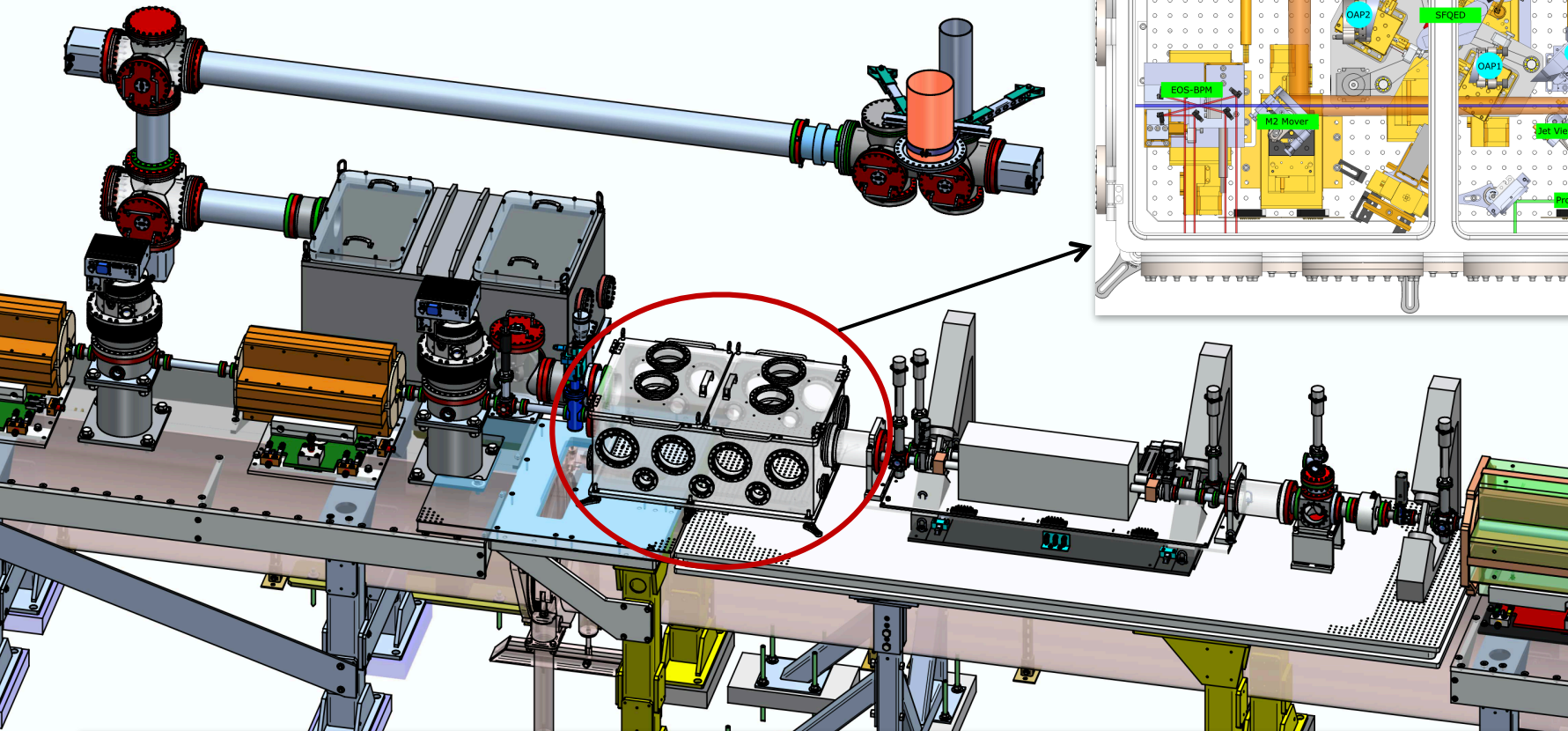


Priorities: KPP, diagnostic commissioning, ML studies, first experiments

Laser-Beam Integration Chamber (a.k.a. The Picnic Basket)



- Simplified laser transport, larger laser compressor chamber, space for differential pumping



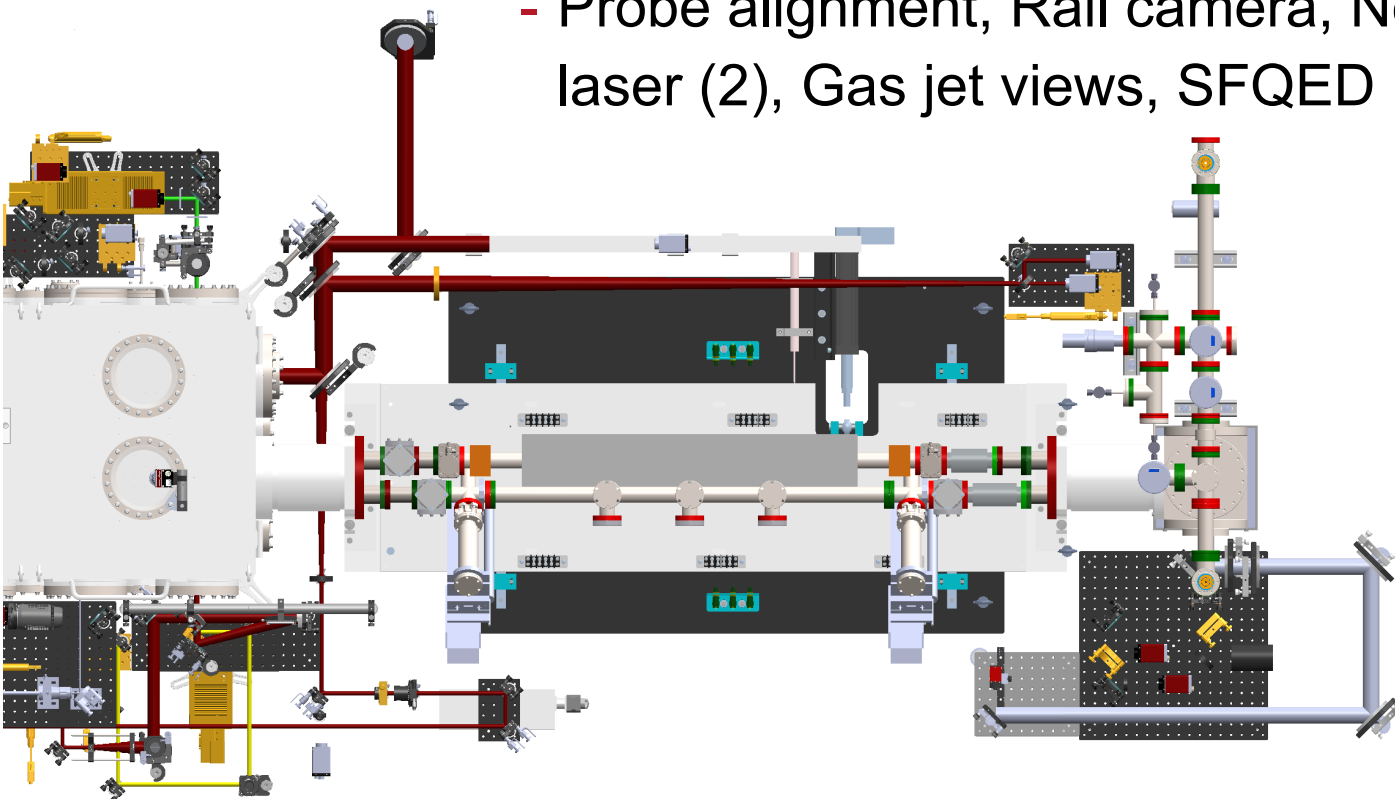
The User Area is designed for ~17 experiments without major reconfigurations of the hardware

Laser Probes & Diagnostics



- 4 probe lines & corresponding diagnostics:
 - EOSBPM, E324, Afterglow/TPL, Gas Jet Shadography
- 8 external diagnostics:
 - Probe alignment, Rail camera, Near- and far-field for main laser (2), Gas jet views, SFQED Focus/Near/Far-field

- CAD model complete
- Parts inventory and procurement ongoing
- Plan for phased build-out being developed
- Expect installation throughout 2021



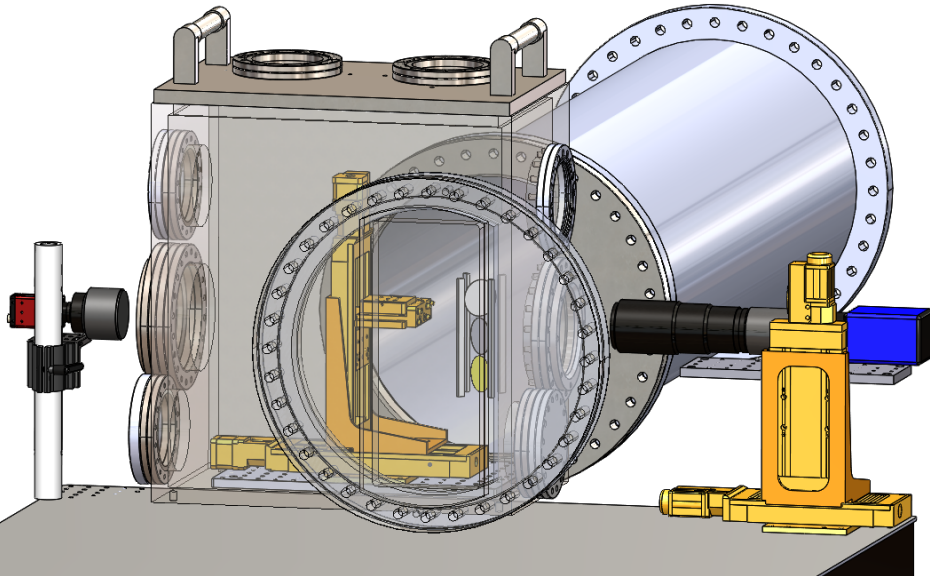
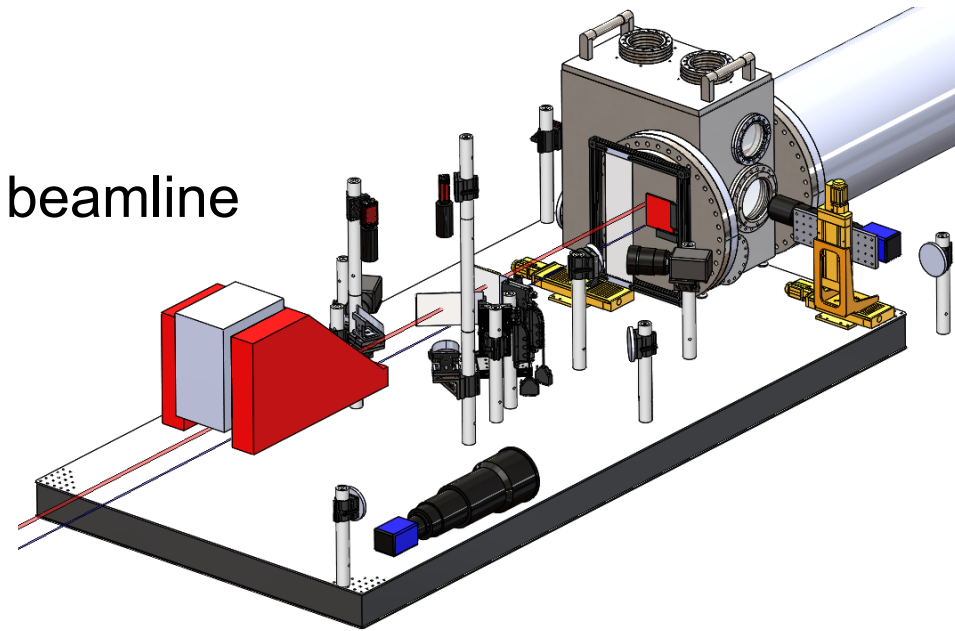
Low energy probe pulses provide valuable diagnostic information
e.g. timing, alignment, quality

Spectrometer Diagnostic Table Hardware Upgrades from FACET to FACET-II



Major changes for electrons:

- Quadrupole doublet changes to a triplet
- Differential pumping removes windows in beamline
- In vacuum YAG:Ce and OTR screen for high-res profile measurements



Major changes for gammas:

- Ross & Camembert filters optimized for low emittance 10GeV beams
- DRZ screens and CsI array
- Gamma distribution in space, angle and frequency

Spectrometer diagnostic upgrades are needed to measure low emittance beams

Summary

- Thank you to everybody for the spirit of cooperation as we all worked together through zoom environment to collaboratively develop plans for the experimental area