



FACET-II PROJECT UPDATE

Facility for Advanced Accelerator Experimental Tests


FACET-II SCIENCE WORKSHOP 2017 Kavli Auditorium, SLAC

Vitaly Yakimenko
October 17, 2017



A Roadmap for Future Colliders Based on Advanced Accelerators Contains Key Elements for Experiments and Motivates FACET-II





U.S. DEPARTMENT OF
ENERGY | Office of
Science

Advanced Accelerator Development Strategy Report

DOE Advanced Accelerator Concepts Research Roadmap Workshop
February 2-3, 2016

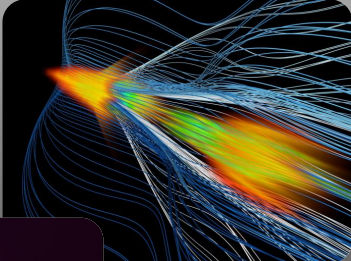
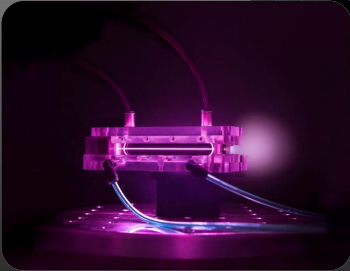
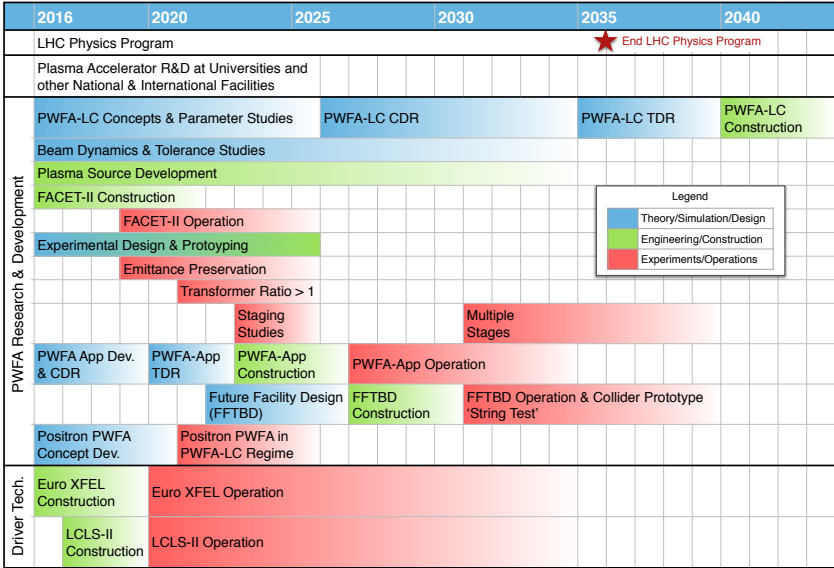



Image credits: lower left LBNL/R. Kaltschmidt, upper right SLAC/UCLA/W. An

http://science.energy.gov/~media/hep/pdf/accelerator-rd-stewardship/Advanced_Accelerator_Development_Strategy_Report.pdf

Beam Driven Plasma Accelerator Roadmap for HEP



Key Elements for PWFA over next decade:

- Beam quality – build on 9 GeV high-efficiency FACET results with focus on emittance
- Positrons – use FACET-II positron beam identify optimum regime for positron PWFA
- Injection – ultra-high brightness sources, staging studies with external injectors
- Develop PWFA demonstration facility

FACET-II Project Plan

10GeV, 2nC, 10 μ m³, e⁻ & e⁺



Timeline:

- ✓ Nov. 2013, FACET-II proposal, Comparative review
- ✓ CD-0 Sep. 2015
- ✓ CD-1 Oct. 2015 (ESAAB, Dec.2015)
- ✓ CD-2/3A Sep. 2016
- CD-3B Sep. 2017
- CD-4 2022

Experimental program (2019-2026)

Key R&D Goals:

- Beam quality preservation, high brightness beam generation, characterization
- e⁺ acceleration in e⁻ driven wakes
- Staging challenges with witness injector
- Generation of high flux gamma radiation

Three stages:

- Photoinjector (e⁻ beam only) FY17-19
- e⁺ damping ring (e⁺ or e⁻ beams) FY18-20
- "Sector 20 Positrons chicane (e⁺ and e⁻ beams)

FACET-II will operate as a National User Facility with an external program advisory committee reviewing proposals and recommending priorities for the experimental program

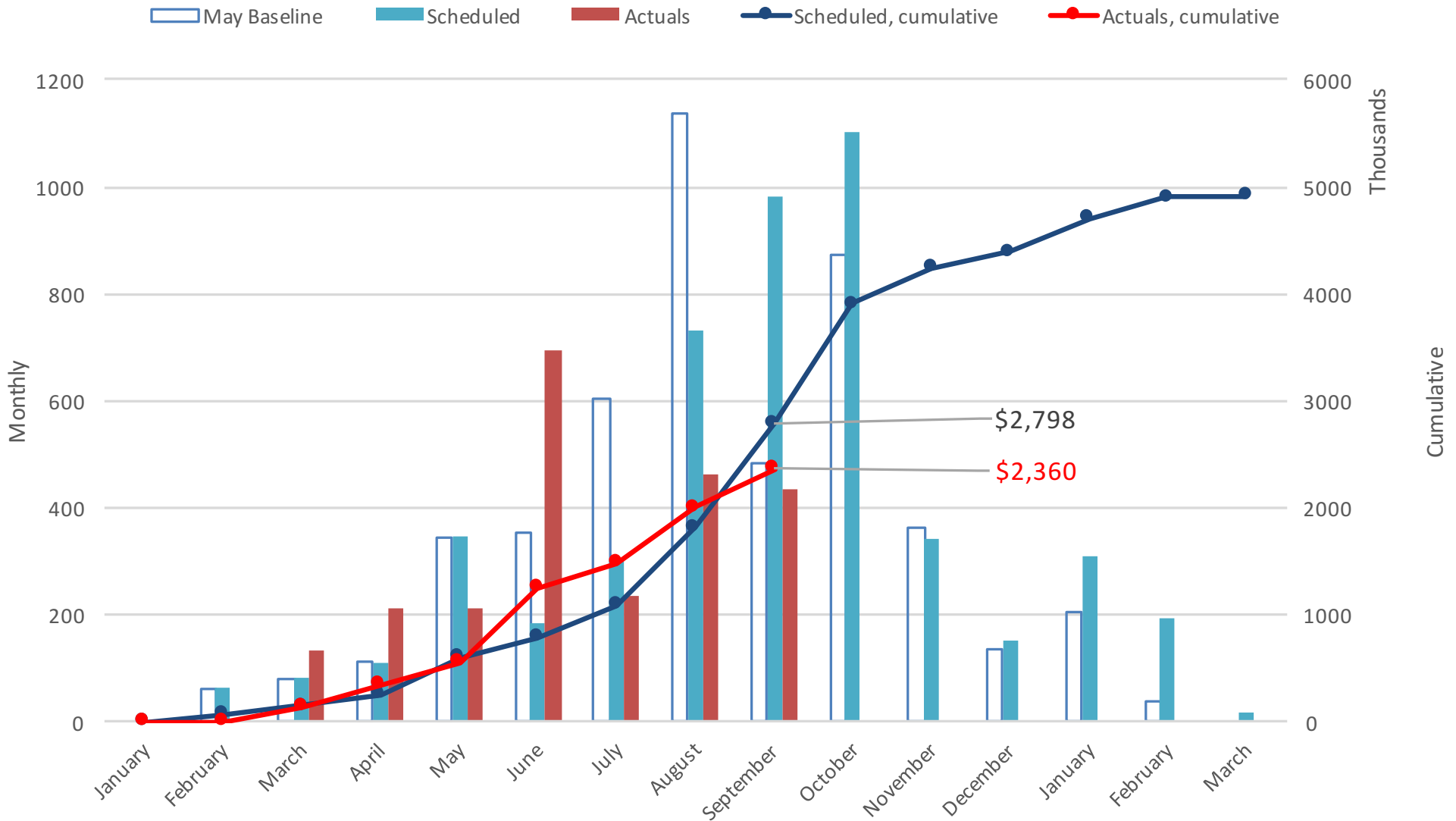
Schedule



Fiscal Year	2017				2018				2019				2020				2021				2022			
Quarter	Qtr1	Qtr2	Qtr3	Qtr4	Qtr1	Qtr2	Qtr3	Qtr4	Qtr1	Qtr2	Qtr3	Qtr4	Qtr1	Qtr2	Qtr3	Qtr4	Qtr1	Qtr2	Qtr3	Qtr4	Qtr1	Qtr2	Qtr3	Qtr4
LCLS-1	█				█				█				█				█				█			
S10 Injector AIP	█				█				█				█				█				█			
FACET-II Stage 1: 135 MeV e ⁻ beam 10 GeV e ⁻ beam S20 e ⁻ chicane	█				█				█				█				█				█			
FACET-II Stage 2: 10 GeV e ⁺ beam S20 e ⁺ chicane	█				█				█				█				█				█			

FY18: Gun/cathode R&D will start
 FY20: 10 GeV compressed e⁻ beam
 FY19: 135MeV e⁻ beam
 FY22: e⁻ and e⁺ compressed beams

Progress on Sector 10 Injector AIP



Project progressing well

Progress on AIP

Laser Room: rack anchoring and laser controls installation

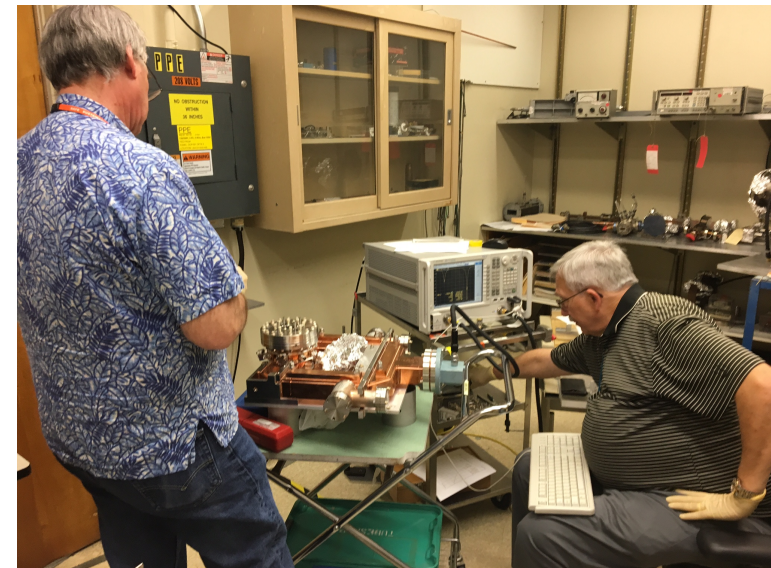


Gallery: Electrical circuits for new racks - done
Magnet power supplies ready for cables



S10 Injector vault:

- Waveguide hung, awaiting gun & accelerator structures
- Water manifolds and fittings installed
- PPS installing conduit and terminal cabinets
- LCLS style gun had a successful cold test
- Gun table in shop (drilling new holes)



Planning for FACET-II as a Community Resource

FACET-II

SLAC Linac Tunnel (Sectors 10 – 19)

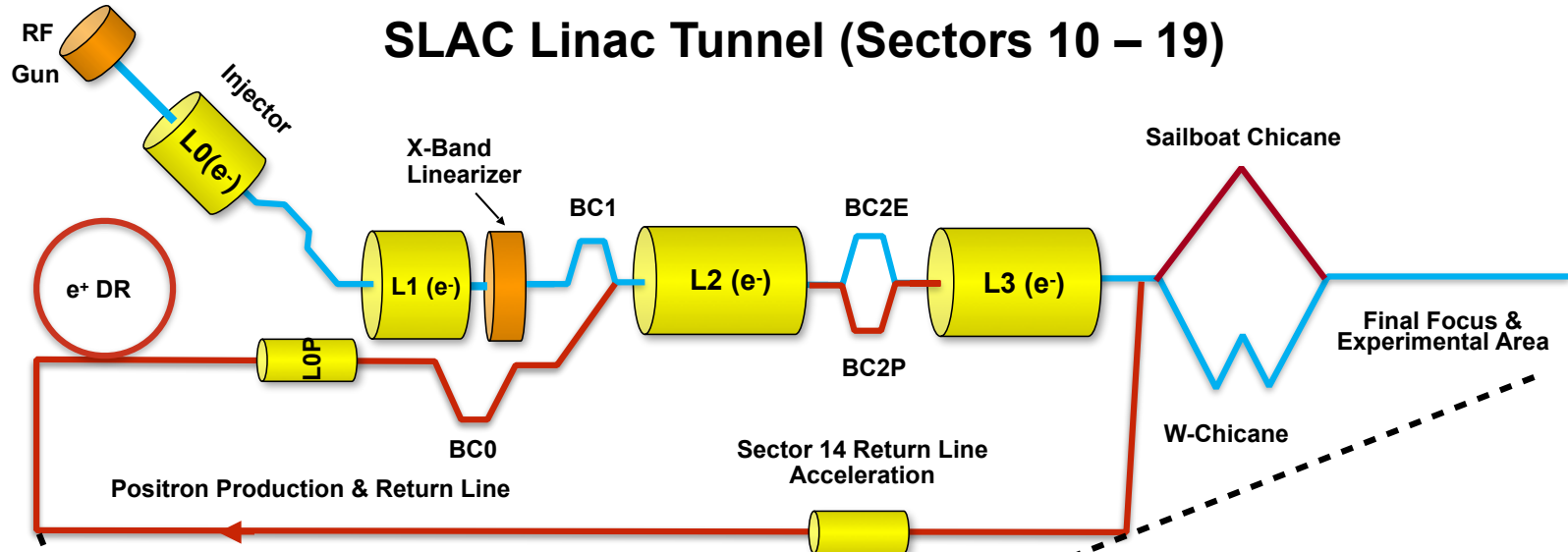
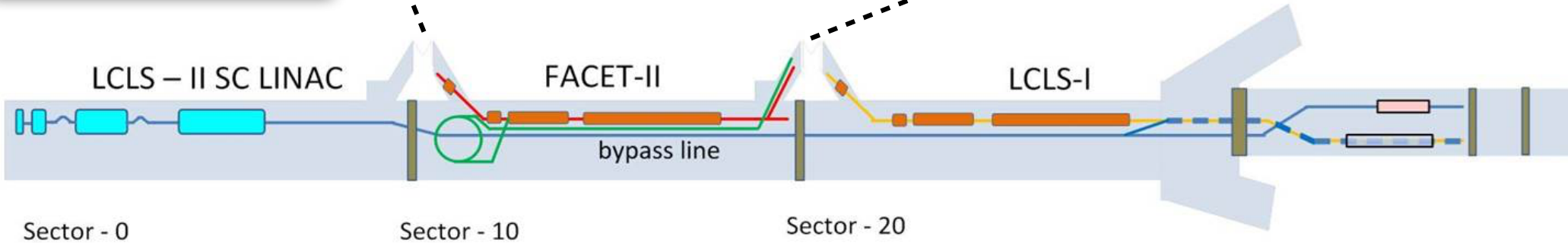


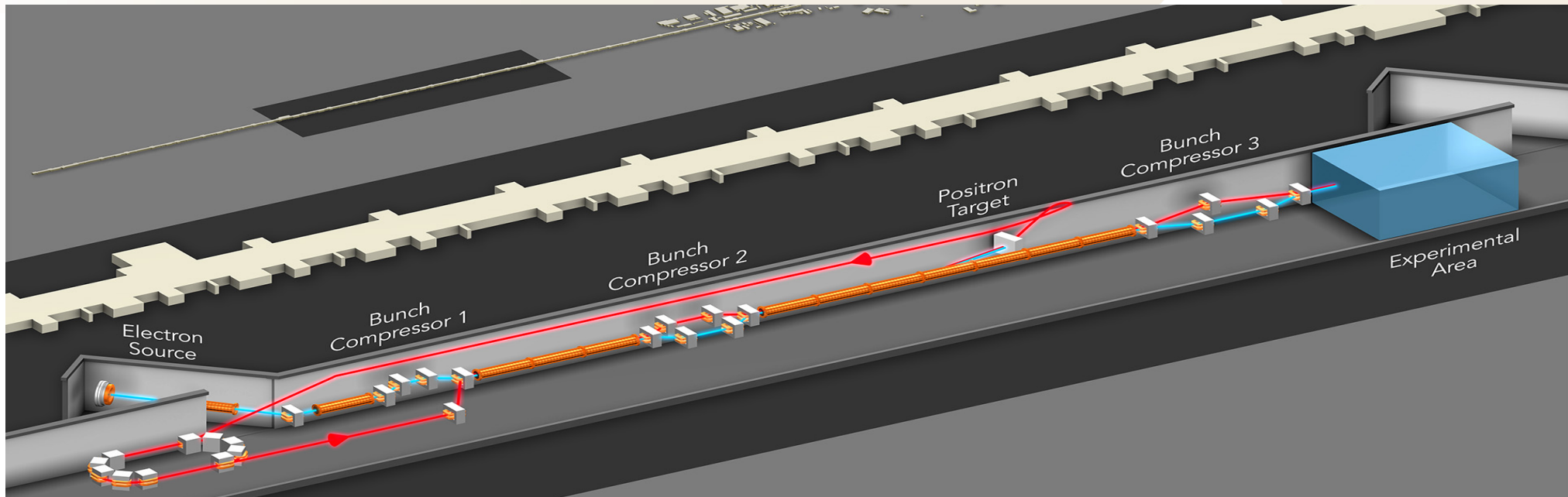
Photo injector
(e- beam only)
FY17-20

e+ damping ring
(e+ or e- beams)
FY21-22

SLAC Linac in 2025



FACET-II Layout and Beams



<i>Electron Beam Parameter</i>	<i>Baseline Design</i>	<i>Operational Ranges</i>	<i>Positron Beam Parameter</i>	<i>Baseline Design</i>	<i>Operational Ranges</i>
<i>Final Energy [GeV]</i>	10	4.0-13.5	<i>Final Energy [GeV]</i>	10	4.0-13.5
<i>Charge per pulse [nC]</i>	2	0.7-5	<i>Charge per pulse [nC]</i>	1	0.7-2
<i>Repetition Rate [Hz]</i>	30	1-30	<i>Repetition Rate [Hz]</i>	5	1-5
<i>Norm. Emittance $\gamma\epsilon_{x,y}$ at S19 [μm]</i>	4.4, 3.2	3-6	<i>Norm. Emittance $\gamma\epsilon_{x,y}$ at S19</i>	10, 10	6-20
<i>Spot Size at IP $\sigma_{x,y}$ [μm]</i>	18, 12	5-20	<i>Spot Size at IP $\sigma_{x,y}$ [μm]</i>	16, 16	5-20
<i>Min. Bunch Length σ_z (rms) [μm]</i>	1.8	0.7-20	<i>Min. Bunch Length σ_z (rms)</i>	16	8
<i>Max. Peak current I_{pk} [kA]</i>	72	10-200	<i>Max. Peak current I_{pk} [kA]</i>	6	12

Call for proposals

- The FACET-II science research program has been under development through a series of events that span several years (from 2012). Events include community workshops and collaboration meetings

FACET-II WebEx Meeting Agenda 21-DEC-2012

Start Time	Duration	Speaker	Title	Confirmed
9:00 AM	0:20	Vitaly Yakimenko	Introduction to FACET-II and purpose of this meet	Yes
9:20 AM	0:30	Mark Hogan	FACET-II facility and beam parameters	Yes
9:50 AM	0:20	Daniel Schulte	CLIC studies	Yes
10:10 AM	0:20	Bernhard Hidding	Plasma sources and Trojan Horse	Yes
10:30 AM	0:20	Patric Muggli	SMPWFA	Yes
10:50 AM	0:20	Claudio Pellegrini & Zhirong Huang	FEL related R&D	Yes
11:10 AM	0:20	Hermann Durr	THz and Ultrafast	Yes
11:30 AM	0:20		Break	
11:50 AM	0:20	Gerard Andonian	Dielectric Wakefield Accelerators	Yes
12:10 PM	0:30	Jamie Langenbrunner	National security experiments with MeV gammas	Yes
12:40 PM	0:20	Vitaly Yakimenko	High Brightness Muon Beams	Yes
1:00 PM	0:20	Jamie Rosenzweig	PWFA with High Brightness Beams	Yes
1:20 PM	0:20	Chan Joshi	Next Generation PWFA	Yes
1:40 PM	0:20	Vladimir Litvenenko	Nuclear Physics with High Energy Gammas	Yes

FACET-II
Facility for Accelerator Science and
Experimental Test Beams-II
Located in the SLAC Linac at Sector 10

April 2, 2013

SLAC-R-1063

FACET-II Science Opportunities Workshop
Summary Report
October 12-16, 2015
Editor: Nan Phinney
Publication Date: March, 2016

SLAC National Accelerator Laboratory
2575 Sand Hill Road
Menlo Park, CA, 94022

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SLAC-R-1078

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- Community engagement will continue with annual FACET-II science workshops. Development of individual high profile FACET-II experiments is expected to be coordinated through numerous collaborations meetings

The call for proposals is expected after the project is baselined and will be followed by the first FACET-II external advisory committee meeting (expected in FY18)

FACET-II operation modes

- 6 months/year operations with target operational efficiency of 85%
- Simplified injector system and LCLS operations experience allows to consider different patterns (Cost analyses shows very similar cost of operations):

1 week on - 1 week off

2 weeks on - 2 weeks off

...

6 months on - 6 months off

- Access:
 - 12 hours every 2 weeks
 - ~2 months summer
 - 3 weeks winter shutdowns



Improvements and discussion on agenda:

- FACET-II new Beam Capabilities: Glen White
- Accelerator Diagnostics: Nate Lipkowitz
- Experimental area diagnostics: Brendan O'Shea and Mike Litos (tomorrow)
- Differential pumping: Christine Clark
- Experimental laser upgrade: Alan Fry (Friday)

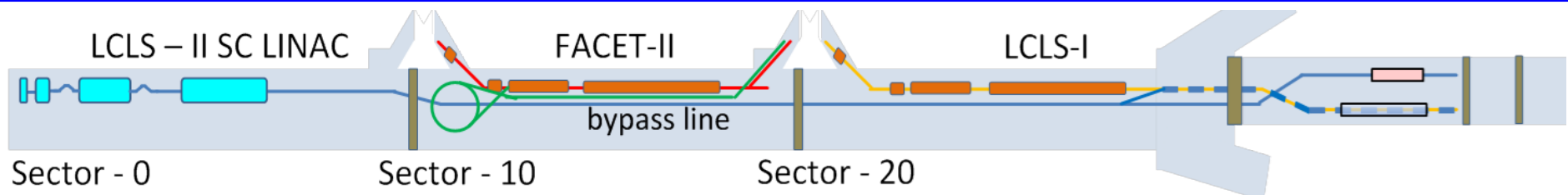
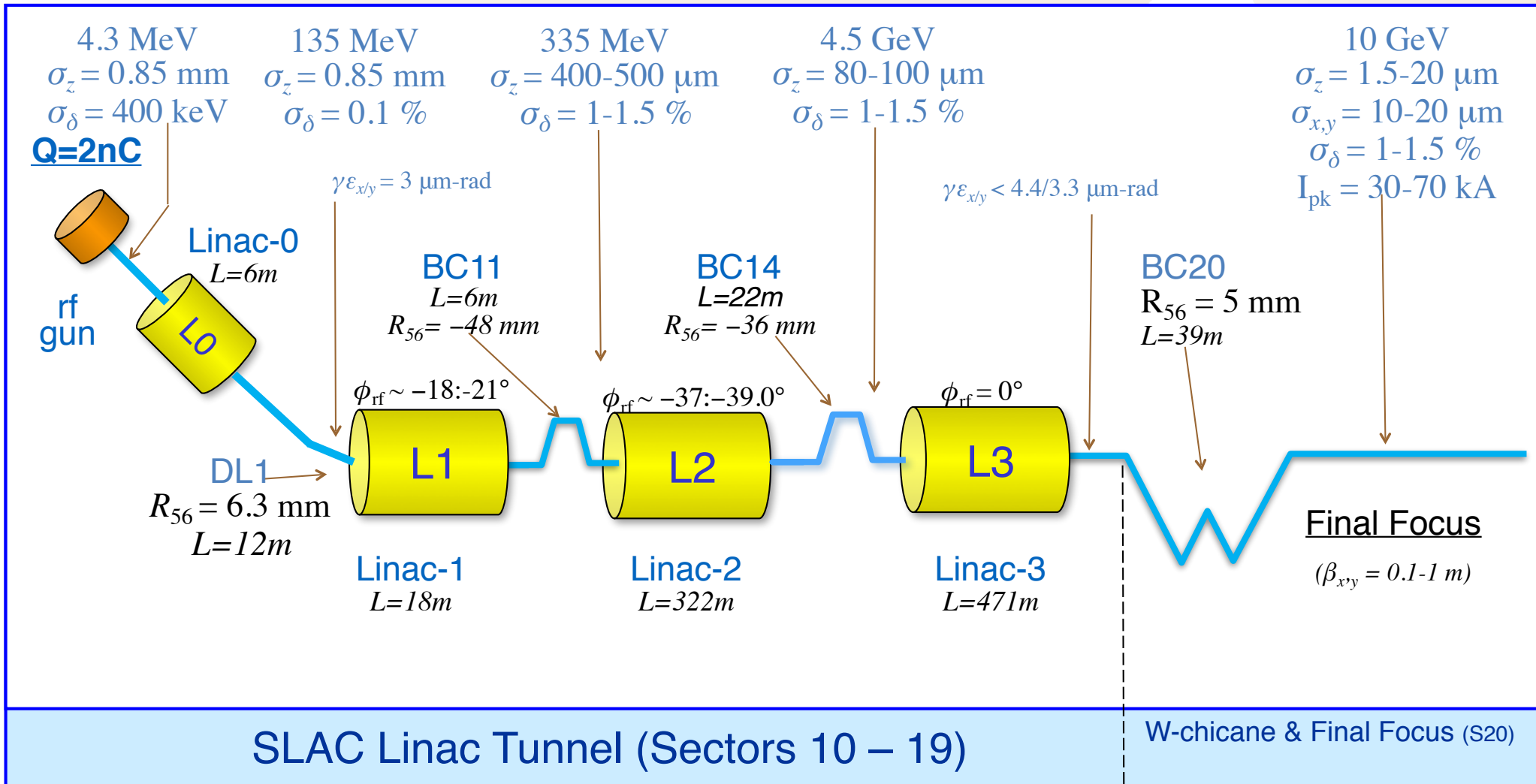


Tonight at 6pm

Backup Slides:



Baseline FACET-II Electron Single-Bunch Design Parameters



Baseline FACET-II Positron Parameters

