ALS-U: A major upgrade to the ALS

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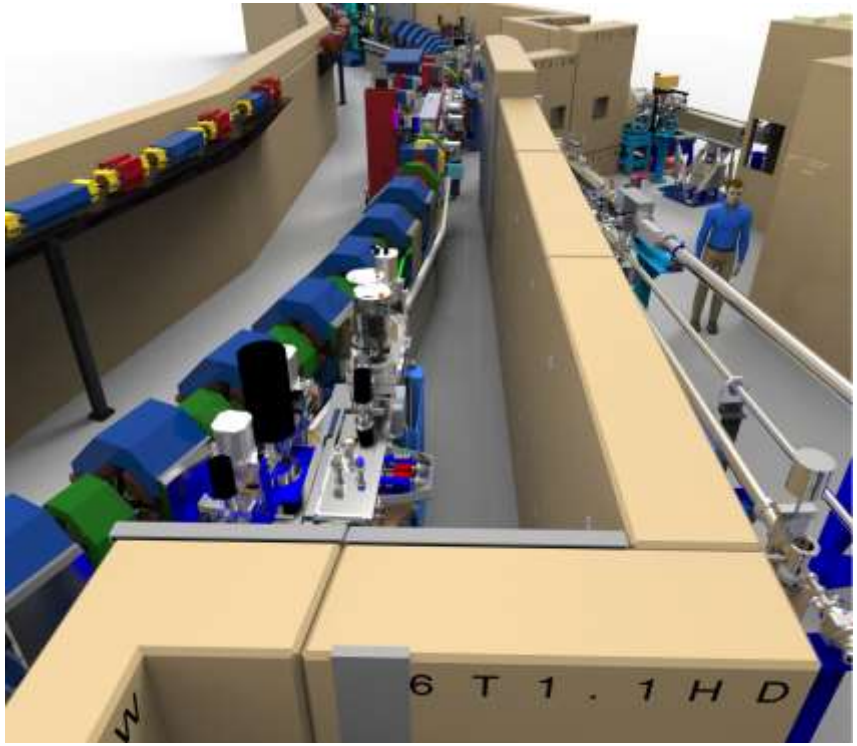
BERKELEY LAB

U.S. DEPARTMENT OF ENERGY | Office of Science

ALS-U ADVANCED LIGHT SOURCE

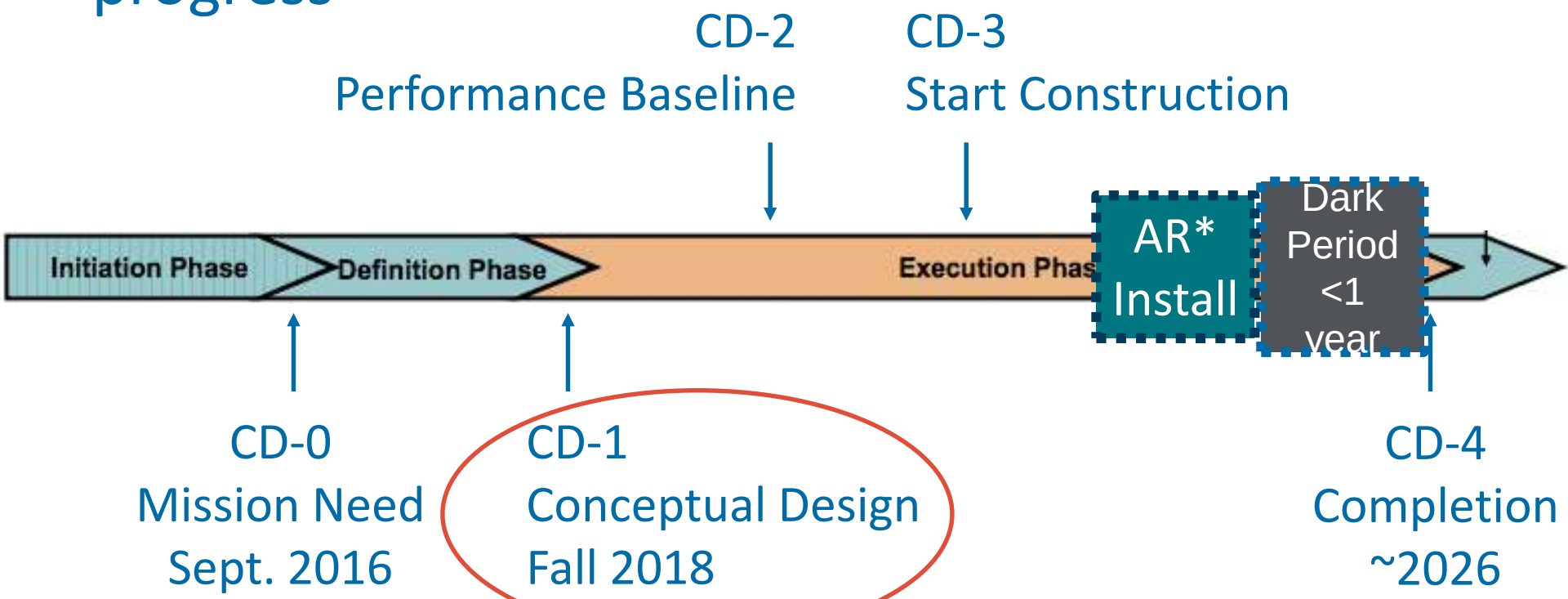
ALS-U Facility Status

- Outline
  - DOE Approval Status
  - What is ALS-U
  - Strategy



DOE Approval Status

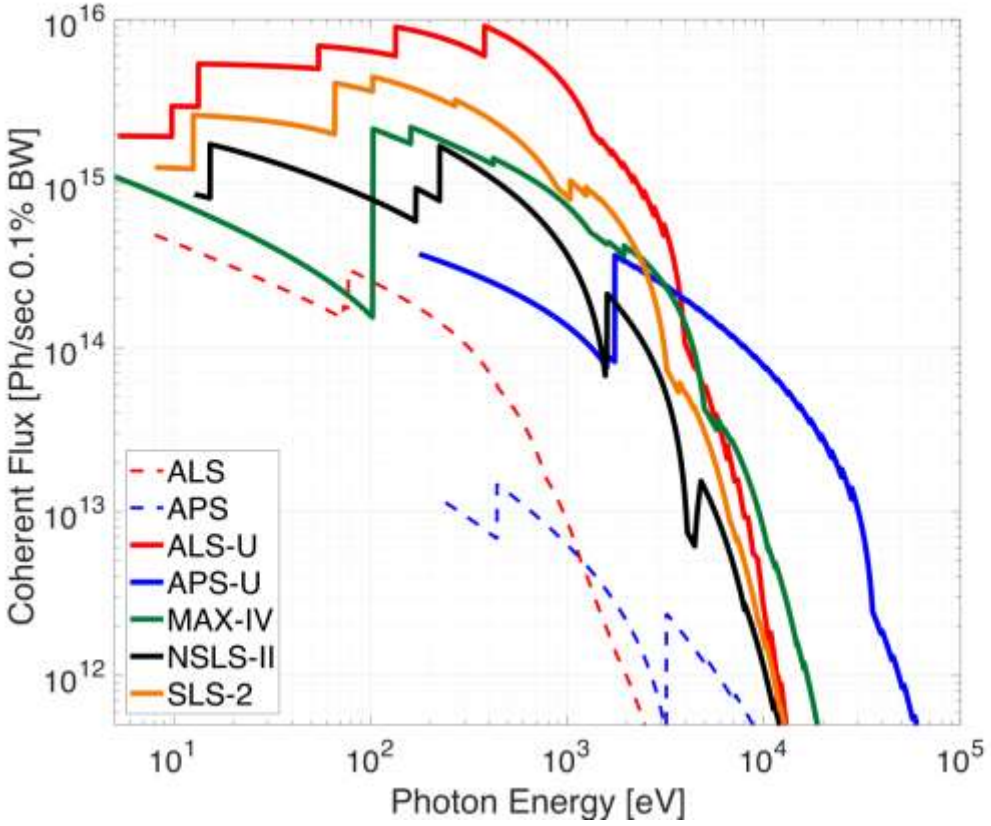
Currently at Conceptual Design stage, Reviews in progress



*AR = Accumulator Ring

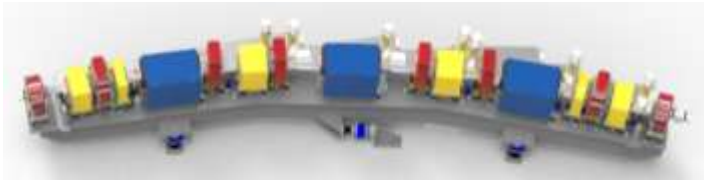
What is ALS-U

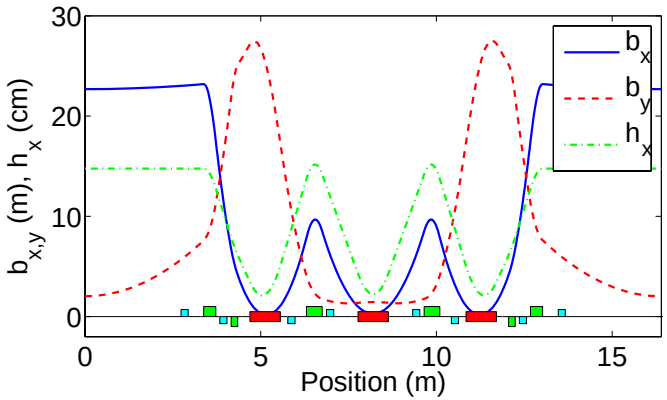
- 2-3 orders of magnitude brighter than ALS
- Higher coherence due to lower emittance



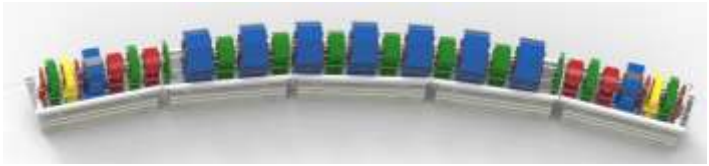
What is ALS-U

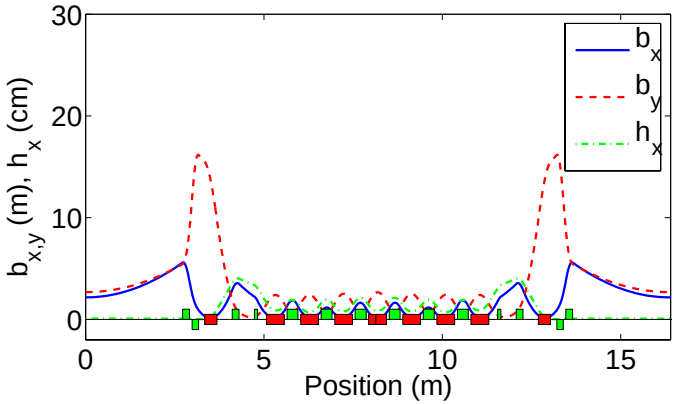
ALS today : triple-bend achromat



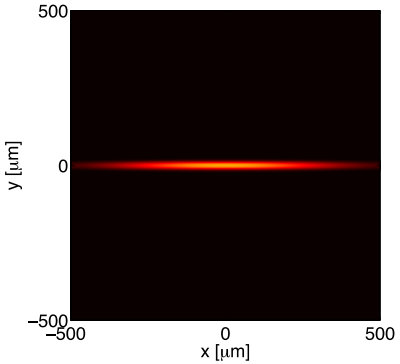


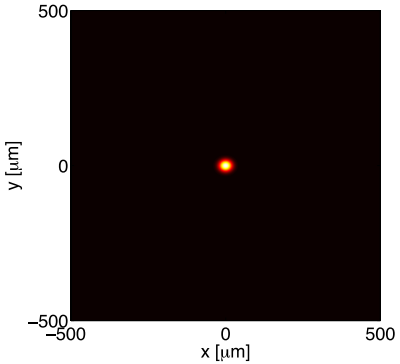
ALS-U: multi-bend achromat





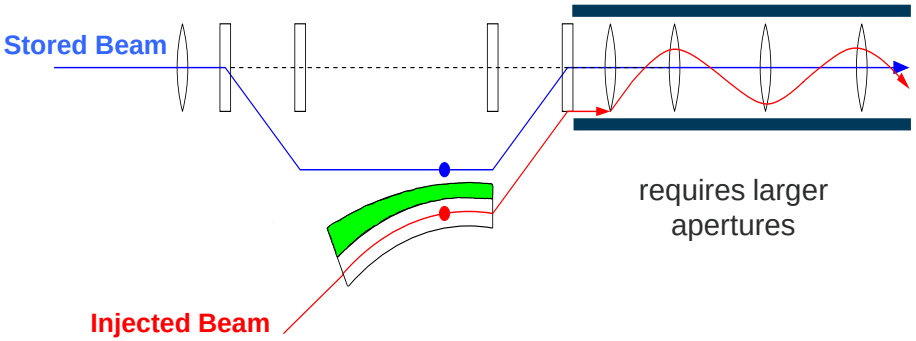
Beam Size Comparison



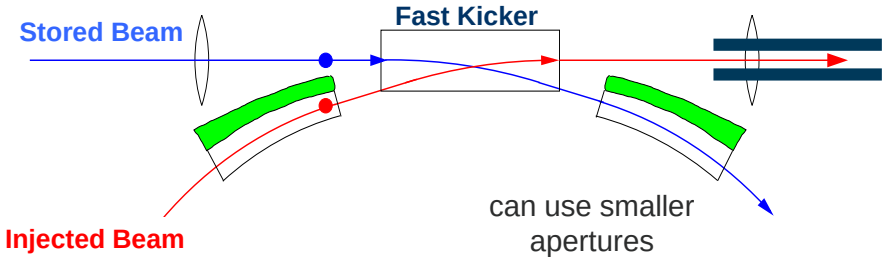


Bunch Train Swap-Out

Traditional off-axis injection



On-axis swap-out injection
(initially proposed by M. Borland)



Only ALS-U and APS-U plan to include swap-out

– Swap-out enables:

- Stronger-focusing MBA lattices with smaller dynamic apertures
- Round beams - more useful shape and reduced emittance growth
- Vacuum chambers with small round apertures → Improved undulator performance

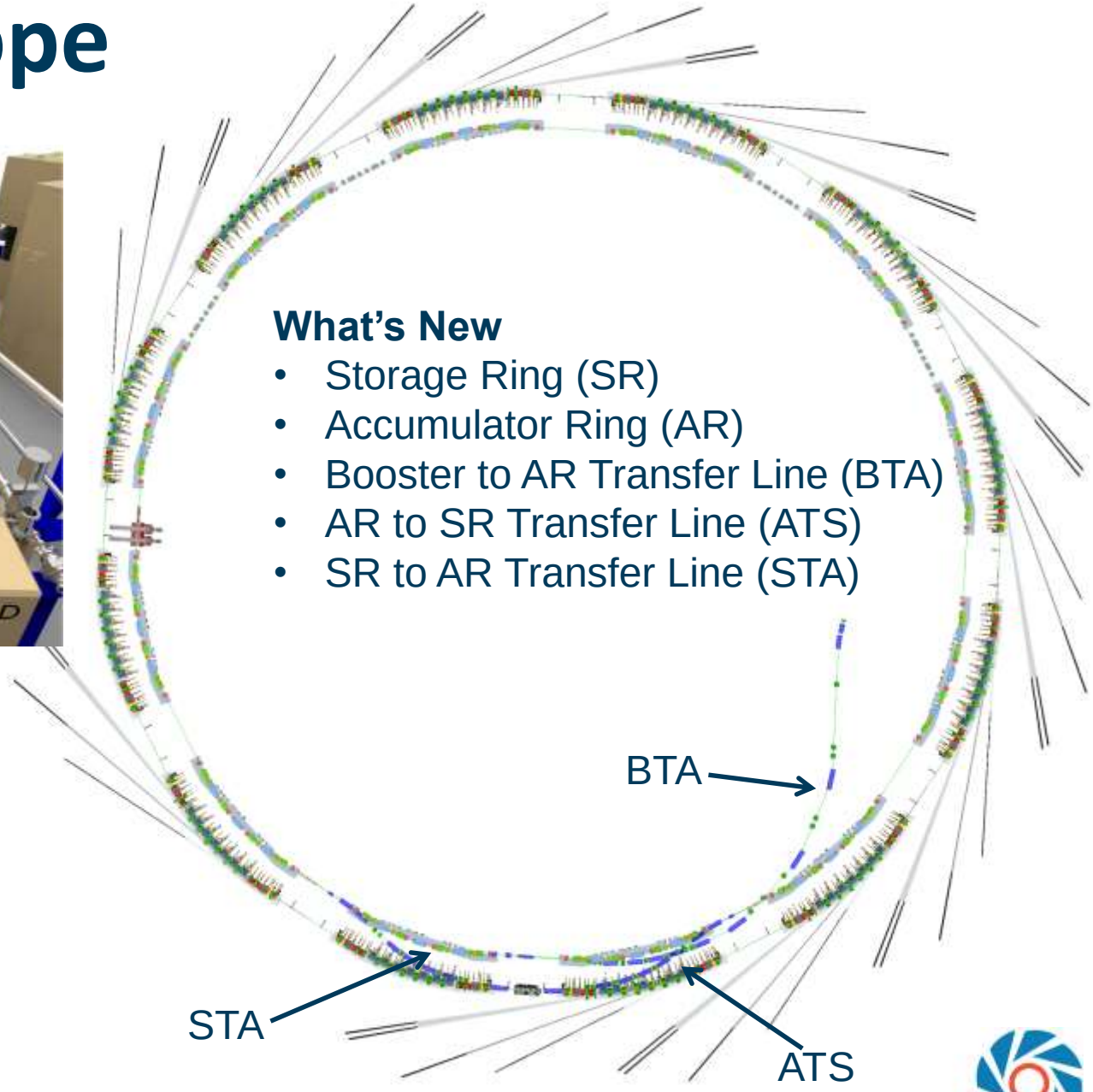
– Swap-out with full energy accumulator enables:

- Bunch train swap-out and recovery of the stored beam current
  - Lower demand on the injector
  - Very small (~nm) injected emittance
  - More flexibility in fill patterns

Project Scope

What's New

- Storage Ring (SR)
- Accumulator Ring (AR)
- Booster to AR Transfer Line (BTA)
- AR to SR Transfer Line (ATS)
- SR to AR Transfer Line (STA)



What Doesn't Change

- Gun
- Linac
- Booster

ALS-U Strategy

- Re-use ALS systems
  - Including recent & upcoming upgrades
- Use Community Contributions
  - EPICS7
  - eTraveller & other tools
  - Archiver Appliance
- Follow other sites' progress (APS-U)
- Build new stuff when necessary
- Plan for higher device count
  - Possibly >1 million PVs vs. 200k for ALS
  - Networking redesign

Conclusions

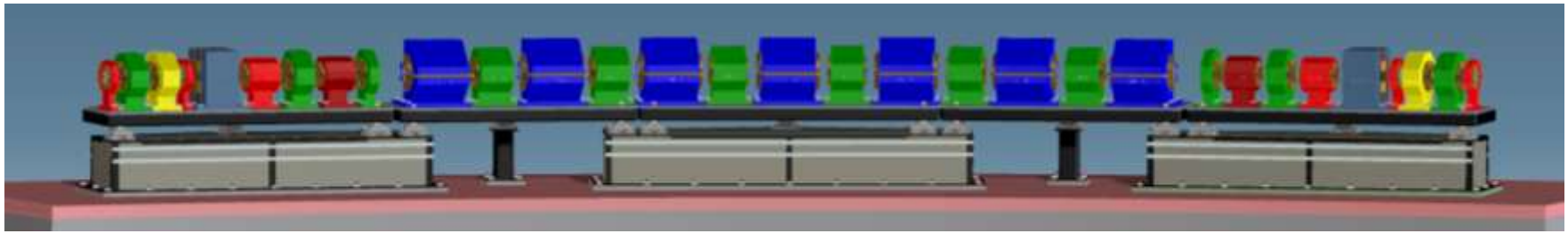
- ALS-U is a large and interesting project
- The use of existing tools and expertise will be important for project success
- New development will also be required
  - We need people!
  - http://jobs.lbl.gov, search by keyword

Questions?

Backup Slides

Device Count

Power Supplies and Vacuum



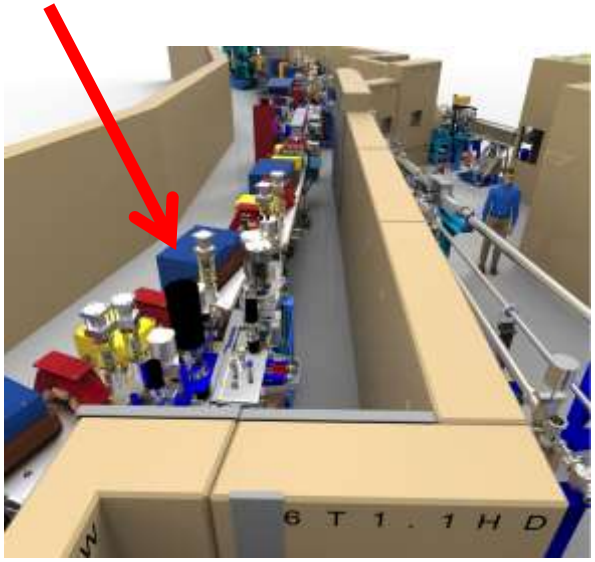
	Power supplies				
	SR	AR	TL	Totals	Method of Control
Individual PS / per sector	84	16	52	1252	Ethernet
Large Series PS / ring		4		4	TBD
Klixon circuits / sector	84	25	52	1360	PLC
Rack water flow	6	4	?	120	PLC

	Vacuum Channels per Sector				
	SR	AR	TL	Totals	Method of Control
Gauges	8	2	4	124	PLC: Analog (0-10 V, .01 V resolution, 2 Hz)
Pumps	10	6	6	198	PLC: Analog (0-10 V, .01 V resolution, 2 Hz)
Gauges	4	1	2	62	Ethernet
Pumps	5	3	3	99	Ethernet
Valves	5	1	2	74	PLC: 4 Booleans/Valve
Thermocouples	42	20	0	744	Slow monitoring
Thermocouples	50	20	16	856	PLC: Slow monitor & interlock
RGA	2	0	0	24	Ethernet

Scope of ALS-U

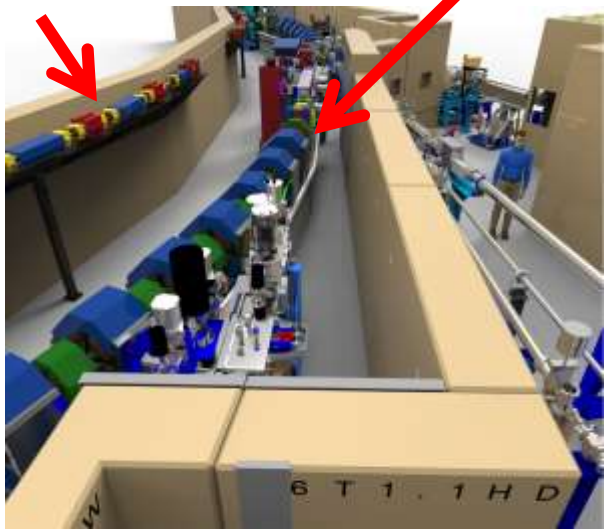
1. **Retain** the existing gun, linac, booster
2. **Replace** the existing triple-bend achromat storage ring with a new, high-performance storage ring based on a multi-bend achromat.
3. **Add** a low-emittance, full-energy accumulator ring in the existing storage-ring tunnel to enable on-axis, swap-out injection using fast magnets.
4. **Replace** the existing transfer line with new lines: BTA, ATS, STA

Existing ALS ring



New accumulator ring

New ALS-U ring



ALS BPM Development

160 built: 114 SR, 37 injector, and a few spares.

The ALS-U needs are,

- **192 in the storage ring (16 /sector)**
- **72 in the accumulator ring (6 /sector)**
- **~20 in the transfer lines**

(We can reuse the present ALS SR BPMs (114) with a VCXO change)

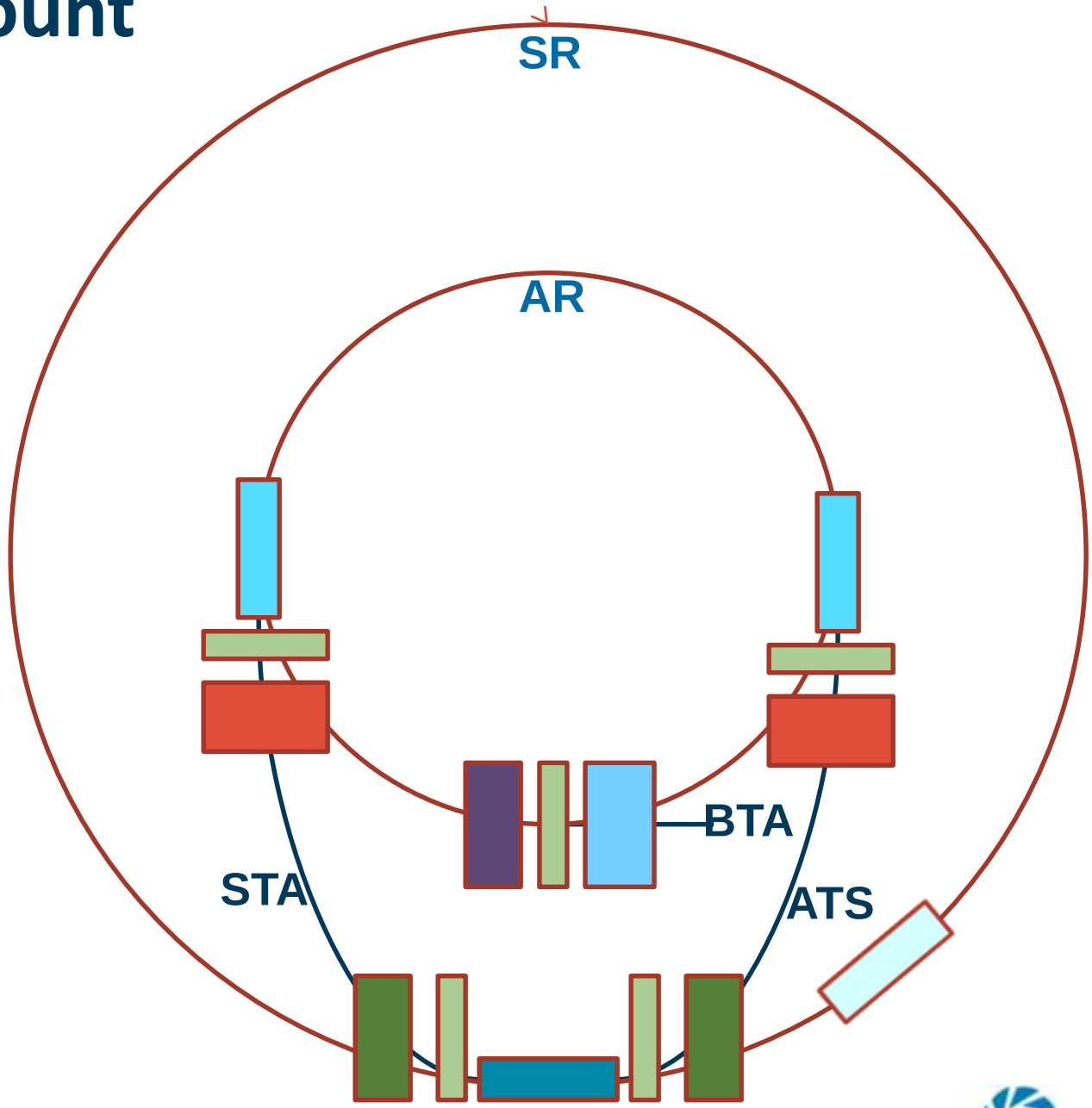
Mike Chin, Eric Norum, Greg Portmann, Jonah Weber at ALS and Kurt Vetter and others at NSLS-II

Fast orbit feedback architecture

Candidate Fast Power Supply for FOFB (Caen Fast-PS Series)

Fast Magnet Count

- Decoherence kicker
- AR kicker
- SR kicker
- NLK
- Thin Septum
- Thick Septum
- BTA Lambertson Septa
- ATS/STA Lambertson Septa



Monitoring and Control Required

- Timing
- Controls
  - HV Power Supplies (Enet)
  - Interlocking (PLC)
- Scopes
  - 6 channels @ 100 MHz
  - 18 channels @ 500 MHz

Standard HW Architecture