

# ACCELERATOR SYSTEMS DIVISION UPDATE



**JOHN BYRD**

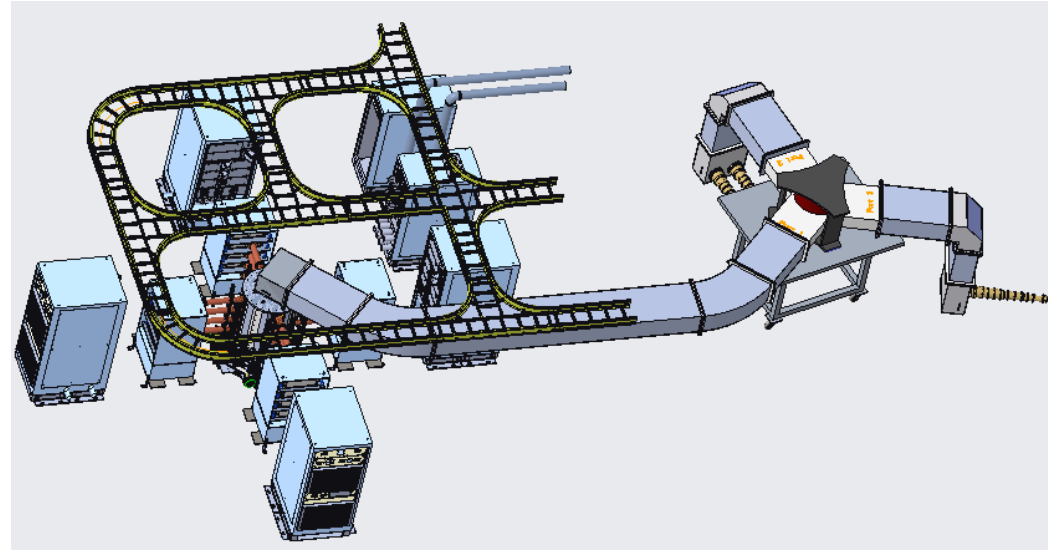
Division Director, Accelerator Systems Division  
Photon Sciences Directorate

PSC All Hands Meeting  
January 26, 2022

# SOLID-STATE RF PROGRAM IS PROGRESSING

## First 200-kW unit from vendor due in June 2022 for testing in B400A

- We are planning to replace the klystron-based storage-ring RF system over the next decade due to obsolescence; the configuration will be one amplifier/cavity with 12 cavities (storage ring) and 4 cavities (booster)
- We have selected a vendor (R&K Electronics) to provide this system and are expecting the first 200-kW unit in June 2022 for testing in B400A
- We are planning to order 4 additional units in FY23 with plans for installation in Sector 40 sometime after APS-U commissioning
- DOE-BES has encouraged us to submit a MIE proposal to fund the remainder of the system in FY25; total cost of the system is \$40-\$50M



Planned configuration of the first SSA unit in 400A; 4 SSAs feed a central combiner cavity that couples to a waveguide

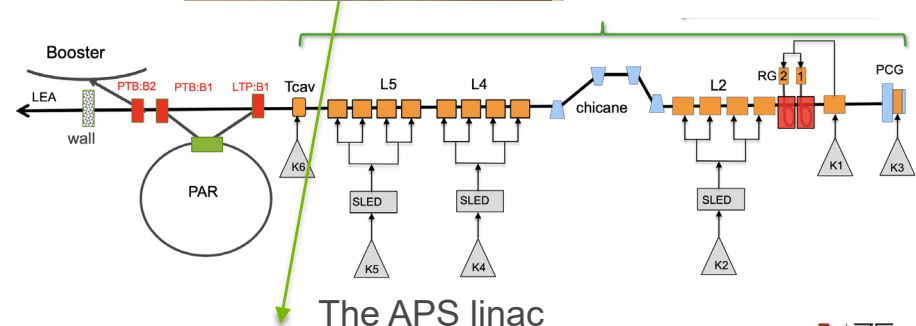
# APS LINAC REFURBISHMENT IS HAPPENING

## Address obsolescence issues in the APS linac to support APS-U operation

- A refurb plan has been developed by Yine Sun focused on a phased upgrade of the RF systems; a new modulator has arrived along with a new Canon klystron
- Following high-power tests, installation in the APS linac in early 2022 timeframe; first digital RF controller has been tested on the linac and will be implemented with the new RF station
- A second modulator/klystron has passed the factory acceptance test and will arrive in Feb 2022
- Several other improvements are also moving forward (timing, magnet power supply, etc.)



Scandinova modulator and Canon klystron installed in test area; will move to K2

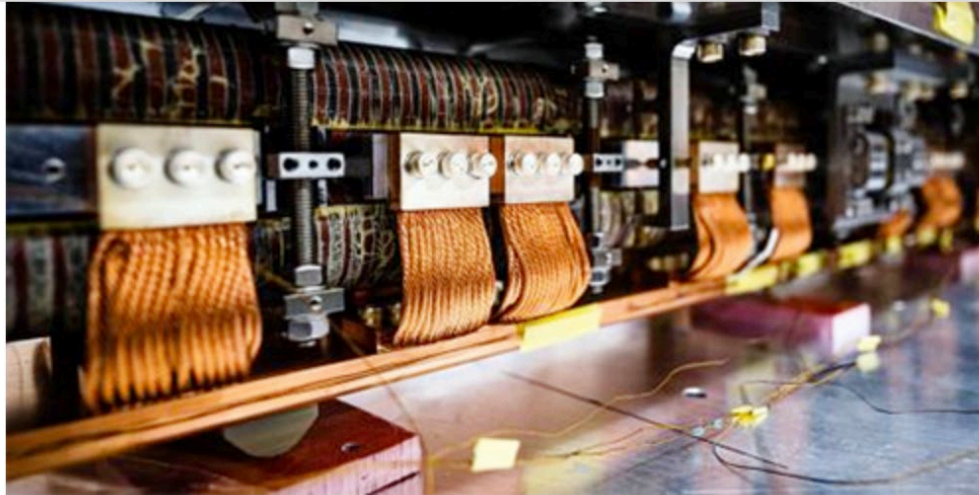


The APS linac

# FIRST APS-U SCU PASSES COLD-TEST

## First production model SCU cryostat was cooled to 4 deg-K with core magnets powered

- APS-U Project is building three new SCUs for APS-U with a new design of a full-straight cryostat with two SCUs/cryostat



<https://www.aps.anl.gov/APS-News/2022-01-14/everythings-cool-aps-upgrade-components-pass-their-first-cold-tests/2022-01-14>

The first production model superconducting undulator magnet for the Advanced Photon Source Upgrade. The upgraded facility will use eight of these magnets to help generate some of the world's brightest X-rays. (Image by Jason Creps/Argonne National Laboratory)

# ASD IS PURSUING SEVERAL DOE-BES R&D PROGRAMS IN ACCELERATOR TECHNOLOGY

## ▪ **Nb<sub>3</sub>Sn SCU (Efim Gluskin, Ibrahim Kesgin)**

- Nb<sub>3</sub>Sn superconducting wire has the potential for a ~30% field increase compared with NbTi; in the final year of this program and have tested 0.5 prototypes up to full field; awaiting vendor delivery of 1.1-m cores for final bench testing; if successful, will install in the APS prior to APS-U dark time for beam tests

## ▪ **SCU-FEL (Yury Ivanyushenkov, Efim Gluskin)**

- SCUs have huge promise for FELs but several challenges, including high-precision photon-electron beam alignment at 4 deg-K; in a collaboration with LCLS, working to demonstrate that this can be achieved; will build two SCUs that will be added to the end of the HXR free-electron laser (FEL) at LCLS; SCUs are currently in design stage with demonstration expected in ~CY2025

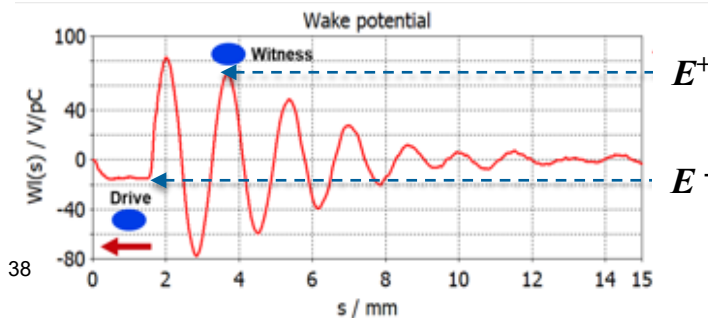
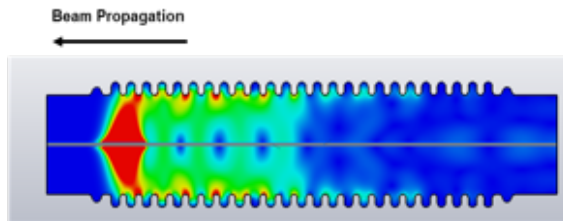
## ▪ **Cavity-based XFEL (Kwang Je Kim, Yury Shvyd'ko, Marion White, Deming Shu)**

- In a collaboration with LCLS, are working to build an x-ray optical cavity for resonating LCLS x-rays with the goal of increasing longitudinal coherence of x-ray pulses, increasing the peak brightness by several orders of magnitude and creating a true x-ray laser

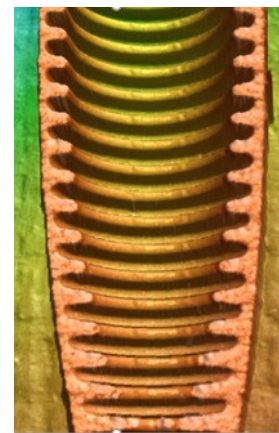
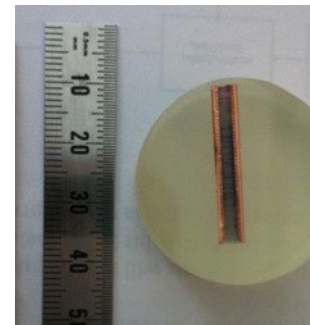
# SUB-THZ WAKEFIELD ACCELERATION: A PROMISING PATH TOWARD COMPACT FEL DRIVER LINAC

ASD is looking to the future for options beyond the APS-U; focus is on compactness, energy-transfer efficiency, simplicity, and cost

- Focusing on collinear wakefield accelerators (CWA) at sub-THz frequencies of 180 GHz
- Excellent machining results in using modern electroforming techniques on a mandrel
- Basic concept is verified; moving toward a beam test of a single CWA module



Wakefield acceleration uses the wake of a drive electron bunch to accelerate a “witness” bunch; the drive beam is discarded at the end of the linac



angular cut