

ACCELERATOR SYSTEMS DIVISION 2020 VISION



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APS All-Hands Meeting

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ACCELERATOR SYSTEMS DIVISION: 20/20 VISION

Modernizing the APS Accelerator Complex for a new brightness era

- In 2020, APS will reach 25 years of user operation as the “crown jewel” among DOE light sources due to highly skilled and dedicated staff.
- By 2025, we will be operating a new ring that will lead the world in hard x-ray sources.
- **ASD will be preparing for this over the next three years!**
 - Revamping of injector systems to provide 20 nC/shot
 - Modernization of Main Control Room instrumentation and diagnostics.
 - Development of efficient and high reliability RF sources beyond klystrons
 - Succession planning to maintain highly skilled staff
 - Accelerator R&D that looks beyond APS Upgrade

MODERNIZATION OF APS ACCELERATOR COMPLEX

Many of the APS subsystems use analog systems designed in the early 1990s

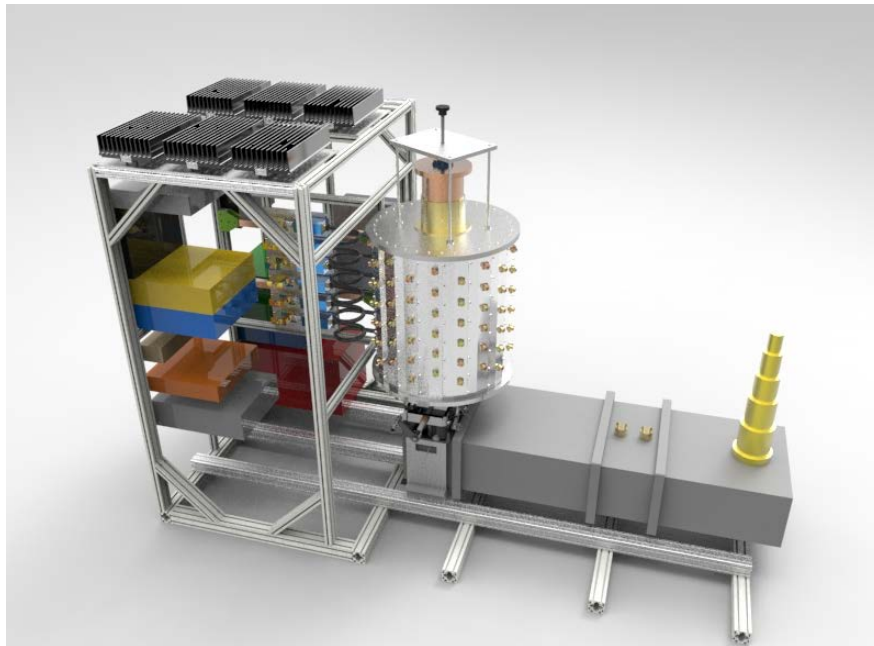
- Much of the APS accelerator systems, especially the injector, still use the analog control electronics developed for commissioning in the 1990s.
- New demands for APS upgrade require the injectors to perform 10 times better than at present.
- Many of the diagnostics around the complex and MCR are also 25 years.
- **Time for renovation!**



State of the art cell phones in 1990

ENSURING RF SYSTEM PERFORMANCE FOR THE APS FUTURE WITH A PLAN B

- With the decreasing number of vendors and rising costs of tube-based rf sources, we are pursuing R&D towards alternate rf sources. The main candidates are modular solid-state rf sources.
- LDRD support has led to a possible design that has 100-2 kW SSAs combined to give a single 200 kW amplifier driving a single cavity.



ASD RF Group SSPA concept



Single 2-kW module

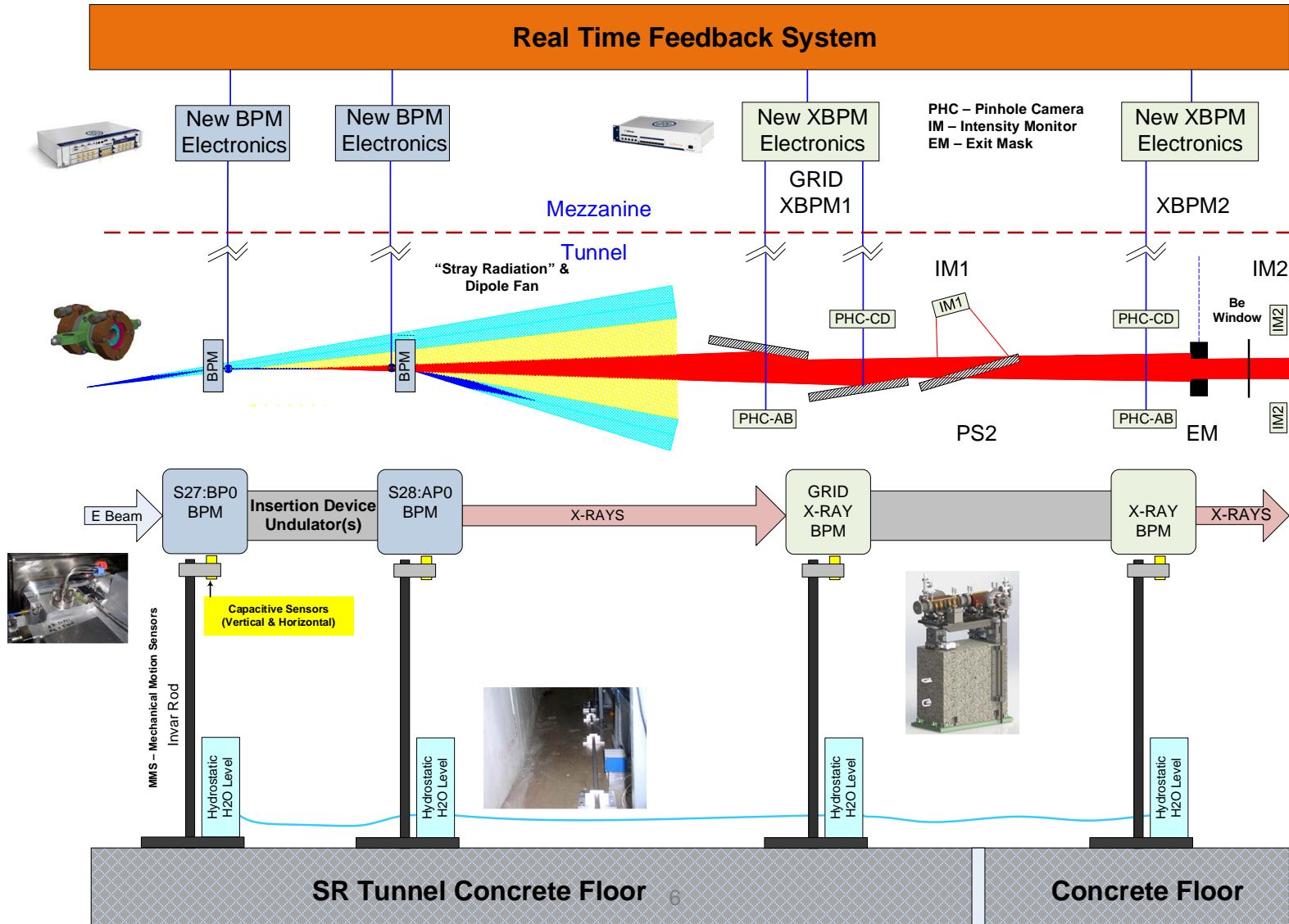
ASD HAS A COMPLETE WORLD-CLASS ACCELERATOR DESIGN TEAM FOR NEXT GENERATION RINGS

APS Develops, Distributes, and Maintains ELEGANT: One of the Primary Tools For Accelerator Design and Development.

- Next generation light storage ring light sources push the beam emittance so low that all known beam physics must be considered to reach the performance:
 - Nonlinear dynamics from strong sextupole fields
 - Intrabeam scattering from the high electron bunch density
 - Bunch lengthening using harmonic cavities
 - On-axis swap-out injection requiring 20 nC/pulse from our injectors.
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- ASD is the world leader in developing tools to understand the interaction and optimization of all of these effects **BEFORE** we build the accelerator.
- APS has a magnetic design and engineering team that can create real magnets, girders, vacuum chambers, and power supplies that meet the extreme demands of the accelerator design.

APS IS DEVELOPING THE NEXT GENERATION BEAM AND X-RAY STABILIZATION SYSTEM

Essential for effective use of the ultrabright beams of APS-U



APS IS THE WORLD LEADER IN SUPERCONDUCTING INSERTION DEVICES

ASD-Magnetic Devices has an unfair competitive advantage over the entire community

- Due to early investment by the APS and leadership in superconducting undulators, we now have the skills and infrastructure to dominate this light source technology for years to come.
- SCU-18-1 and SCU-18-2 (18 mm periods) are installed and operating in the APS. Helical SCU installation on schedule for Dec 2017.
- R&D for LCLS SCU has been very successful with funding opportunities for building full-scale prototypes.
- What's next? **Super**Conducting **A**rbitrary **P**olarizing **E**mitter (SCAPE). Funded by LDRD. This enables variable polarization of x-rays.

