Update on Short Pulse Studies for the APS

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Update on Short Pulse Production

- The RF, Accelerator Physics, and Accelerator Operations Groups have been continuing their investigations into the production of short (~1 ps) pulses at the APS.

- One of the main points being looked into has been the comparison between a room temperature (warm) pulsed rf deflection system and a superconducting (cold) continuously operating rf deflecting system.

- The latest findings from these groups were reported to APS management last week and will be summarized here.

Performance Differences

- A cold system would chirp all the pulses between the two installed cavities (all pulses all the time).

- A warm system would necessarily have to be a pulsed system.
  - Rise/fall time <1 microsecond
  - Maximum pulse length 5 microseconds
  - 1 kHz repetition rate

Hardware Availability

- We are looking at an 8th harmonic system (2.82 GHz)

- Cold
  - Closest:

    2.856 GHz (2.82 GHz)

    P_{ave}= 40 kW for 100 mA op (50 kW)

- Warm
  - Between 5 to 10 MW pulsed at 2815 MHz (8×351.93 MHz)
  - No “off the shelf” klystron to buy
  - Closest:

    2.856 GHz (2.82 GHz)

    5 MW Peak (5 MW) **P_{ave}=32 kW** (25 kW)

    16.3 μsec pulse (ok) **400 Hz rep rate** (1000 Hz)

Pluses and Minuses

- A cold system:
  - Eats up more straight section (extended straights?)
  - Cost would be higher
  - Timeline estimated to be the same as warm (within 1/2 year)
  - Overall better compatibility with normal operations
  - Less susceptible to phase noise

- A warm system:
  - Some development work on klystron required
  - Transients always more difficult to “handle” than cw systems
  - Would be limited to a (few?) kilohertz rep rate

Summarizing All the Issues

	Warm System		Cold System (Multi)	
	Technical Difficulty	Project Risk/Impact	Technical Difficulty	Project Risk/Impact
HOM/LOM/etc. Damping				
100 kW (300 mA)				
40 kW (100 ma)				
5 MW 1 kHz klystron				
rf cavity structure				
input/output design				
6 MV deflecting voltage				
4 MV deflecting voltage				
real estate in straight				
Beam Operations				
BBU/Wakefields				

LOW

MEDIUM

HIGH

Moving On - What's Next?

- Continued refinement of the x-ray compression optics to improve throughput, focal spot-size, etc.
- Ray-tracings of beam through front end and beamline components need to be done.
- We see the *cold option as the preferred choice*, but will continue interactions/discussions with APS user community to determine which system simultaneously meets the needs of the time-resolved experimenters and the overall goals of the APS.