Argonne NATIONAL LABORATORY

Paths for Improvements in Beam Stability

John Carwardine

8/23/06

THE UNIVERSITY OF CHICAGO

Office of Science U.S. DEPARTMENT OF ENERGY

A U.S. Department of Energy laboratory managed by The University of Chicago

Continuation of an on-going program…

- APS provides excellent beam stability, and continues to commit significant resources to ongoing improvements

- Updated beam stability performance requirements were developed in 2005, culminating in a “Five year plan for APS beam stabilization” in October 2005:
  - New long-term beam stability specification.
  - 5-year roadmap that covered multiple topic areas.

Long-term beam stability goals

- New long-term stability goals were developed by Glenn Decker:
  - Take into account the significantly smaller APS beam size.
  - Anticipate future user needs.
  - Include a frequency range over which the specification is valid.

- One-week drift specification
  - Vertical: 1.0 microns / 0.50 microradians p-p
  - Horizontal: 5.0 microns / 1.0 microradians p-p

- Long-term AC goals (5% of present APS beam size, 0.017 Hz to 200Hz)
  - Vertical: 0.42 microns / 0.22 microradians rms
  - Horizontal: 3.0 microns / 0.53 microradians rms

- For reference, published historical values (5% of original APS beam size) are
  - Vertical: 4.4 microns / 0.45 microradians rms
  - Horizontal: 16 microns / 1.2 microradians rms

Multiple facets covered by the Five-year plan…

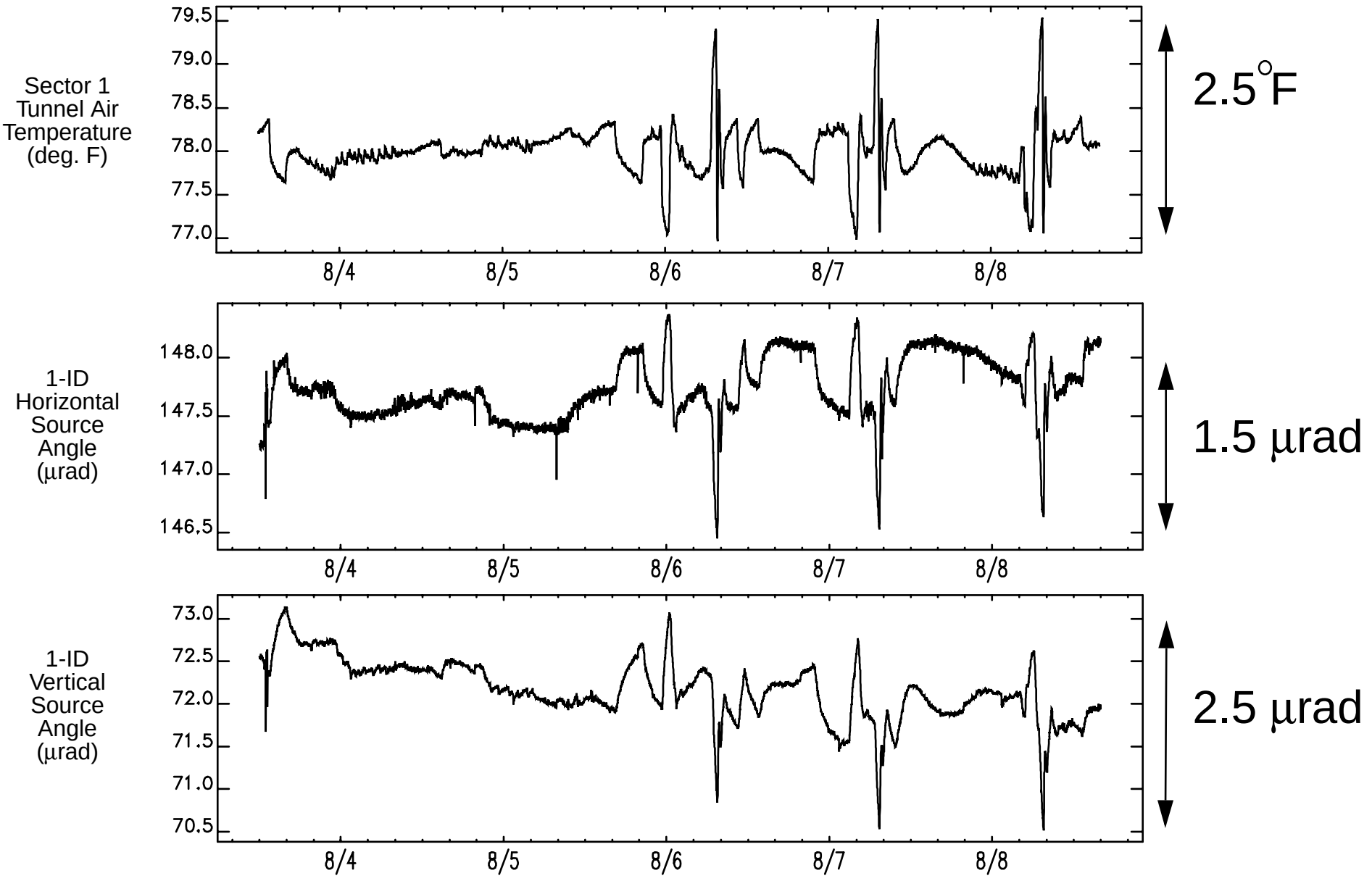
- Making precision, stable measurements of electron orbit and photon trajectory:
  - "Decker Distortion" allows xray bpms to be used in the ID lines.
  - Improvements to rf bpm and photon bpm electronics.
  - Exploring new options for accurately measuring photon trajectory.
  - Portable detector for beamline measurements.

- Attenuation of residual beam motion using feedback/control
  - Orbit feedback and orbit correction applications.
  - Faster processing for orbit correction.
  - More correctors available to the AC orbit correction system.

- Improve SR air temperature stability.

- Actively seeking out and mitigating sources of beam motion.

Variation of Source Pointing Angle with Tunnel Temperature



SR tunnel temperature stability is one aspect…

- Original tunnel temperature stability spec. was +- 1 deg. C (+- 1.8 deg.F)
- This has generally been met, however enhanced accelerator performance (e.g. reduced emittance) and a higher level of beamline sophistication make this level of stability insufficient.

Some issues…

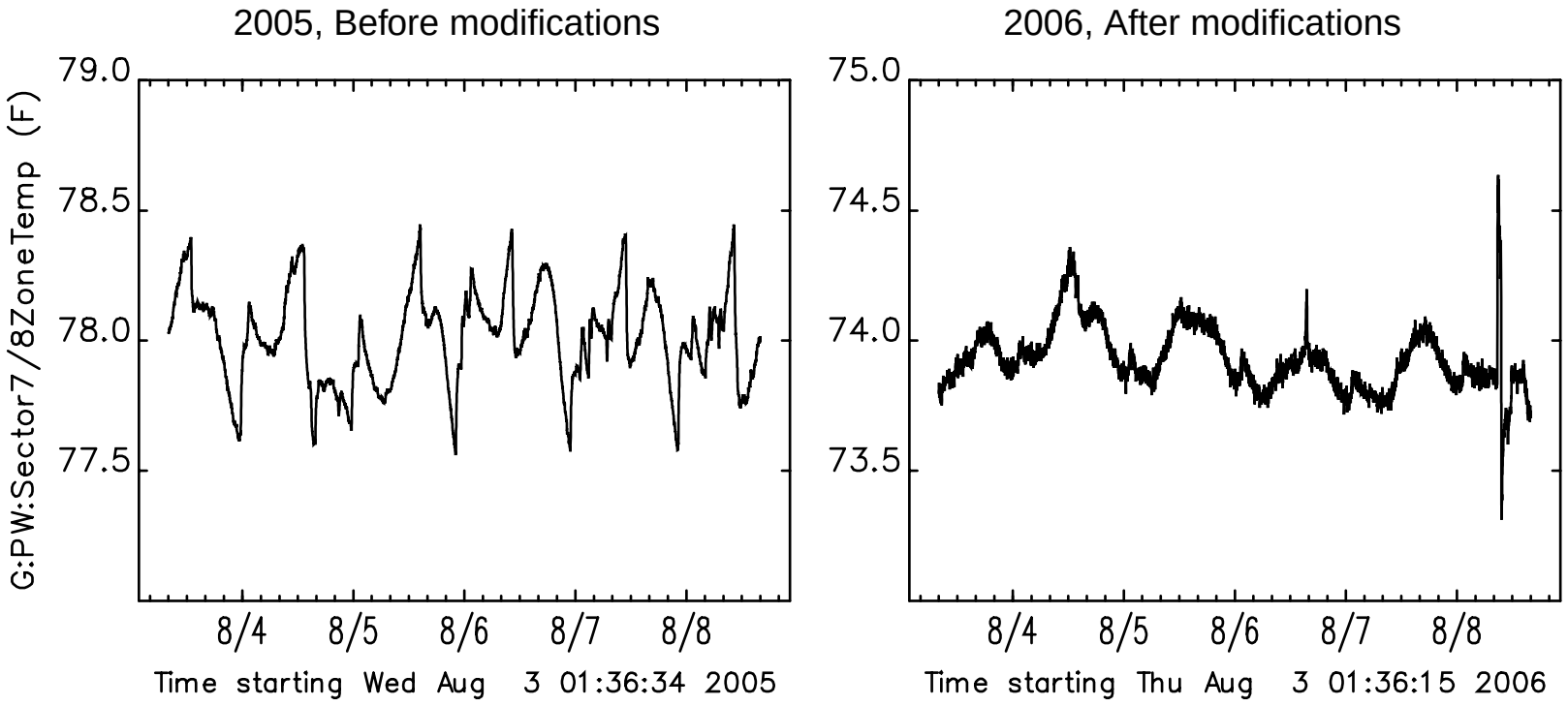
- SR air handling units were designed for a much higher heat load than exists, and are unable to provide the fine control now needed.
- Air from the experiment hall is designed to infiltrate the SR tunnel, so temperature variations in the experiment hall impact the storage ring.
- SR temperature stability is affected by chilled water temperature and outdoor air temperature.

Improvement studies…

- Air handling units in Sectors 2-6 (3 units) have been modified as a test, with significant improvements observed:
  - Smaller control valves provide finer resolution of control.
  - Dampers were closed to prevent influx of outside air.
  - *If implemented throughout the SR, there are also energy savings.*

- A proposal to upgrade all air handling units has been submitted to the DOE energy savings program (Marvin Kirshenbaum):
  - If approved, the work would be done at no cost to the APS.
  - Approval could come as soon as October, with work beginning as early as the Jan 07 shutdown.

Results of Air-Handling System Modification: Control Valve Replacement



Improvement plan…

- Short term
  - Implement changes already in place at Sectors 2-6.
  - Continue to make incremental improvements to get the best from the existing system:
    - *Better stability of chilled water.*
    - *Better control of water temperature.*
    - *Better preventative maintenance program.*
    - *Better control of the experiment hall air temperature.*

- Longer term
  - Consider more significant changes to the air handler design if the incremental improvements do not get to the level we need.