

# Radiography & Infrared Imaging Capabilities at the APS

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# *Radiography & Infrared Imaging Capabilities at the APS*

## Update:

- The MED Group recently purchased a new radiometer/infrared imaging system (FLIR SC6000) and the system has been in operation since January 2008.
- Many advancements have been made in recent years with infrared technology. Modern systems allow real-time high-speed imaging with excellent resolution.
- Unlike older IR imaging systems, the primary output from the SC6000 is spectral emitted infrared radiation intensity allowing true radiometry to be performed.
- The SC6000 system can also be used in the traditional manner as a thermal infrared imaging system.

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## SC6000 (MWIR 3 $\mu$ m-5 $\mu$ m) System Features:

- 640 x 512 focal plane array (FPA) fabricated by hybridizing an Indium Antimonide (InSb) detector array to an readout integrated circuit (ROIC) array
- Measurement range from -20°C to 1500°C
- Temperature sensitivity better than 25 milliKelvin
- 50 Megapixels per second data rate with 14-bit digital image data
- 126 frames per second using the full 640 x 512 FPA
- The FPA can be windowed down to yield frames rates up to 50,000 frames per second
- Image sequences can be recorded in a movie format for high-speed transient analysis
- Synchronized triggering using TTL and CMOS
- Numerous outputs including Gigabit Ethernet, Camera Link, NTSC or PAL

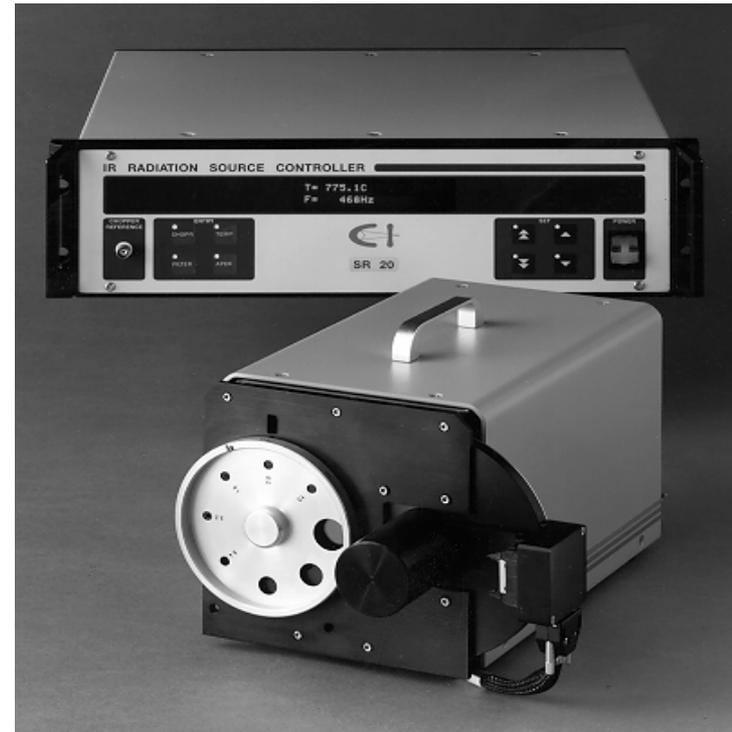
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## Blackbody Sources for In-House Calibration



### Extended Area Blackbody

- 50°C to 600°C Range
- 0.10°C Resolution



### High-Temperature Cavity Blackbody

- 100°C to 1200°C Range
- 1.0°C Resolution

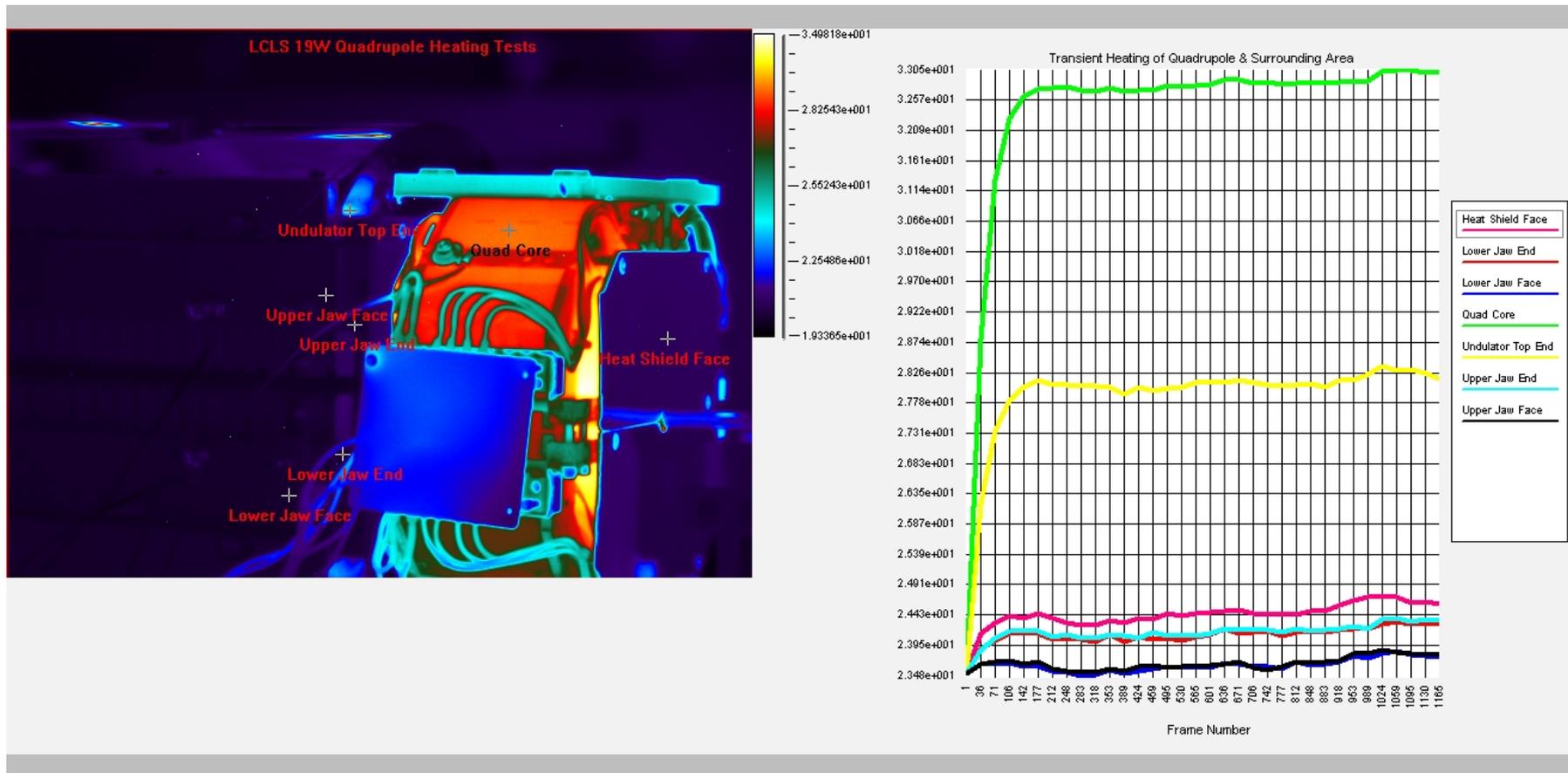
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## The System was Recently Used in Support of the LCLS Project

- Heat dissipation from the relay rack located under an LCLS Undulator system was monitored over a long-term period in order to assess heating effects on the undulator magnetic jaws.
- Similar tests were performed on the LCLS quadrupole.

[Quadrupole 19 Watts.avi](#)

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## Upcoming Experiment in Sector 30-ID:

### Motivation:

- Sector 30 personnel are concerned that they may not be receiving adequate beam transmission through their 3-mm x 1-mm exit mask aperture.
- They are particularly concerned with beam transmission at energy levels at 7 keV or less.
- They are interested in determining if either the exit mask or the undulator are in the wrong positions.
- Though they are interested in flux, a feedback signal that allows them to monitor the total power throughput would allow the control room to adjust beam steering to maximize beam transmission.

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## Upcoming Experiment in Sector 30-ID:

- Using an existing ion pump stand in the sector 30-ID beam line, remove a tee cross and ion pump and in its place install a spare V2.0 BM photon shutter.
- Place cross-hair scribe lines on the BM shutter beam intercepting surface (out from the beam strike area) to indicate the theoretical beam center. These scribe lines will be visible with an infrared camera. Survey and alignment will align the shutter to this center.
- Place a tee spool piece under the shutter that contains an infrared gold mirror oriented at  $45^\circ$  so that the beam strike surface can be viewed through a sapphire viewport using an infrared camera.
- Monitor the shutter inlet/outlet water temperatures and flow rate using a precision turbine flow meter so that the absorbed power can be measured via the enthalpy rise of the cooling water. This can be compared with the theoretical available beam transmission power.
- Provide the control room a signal from the enthalpy measurement.

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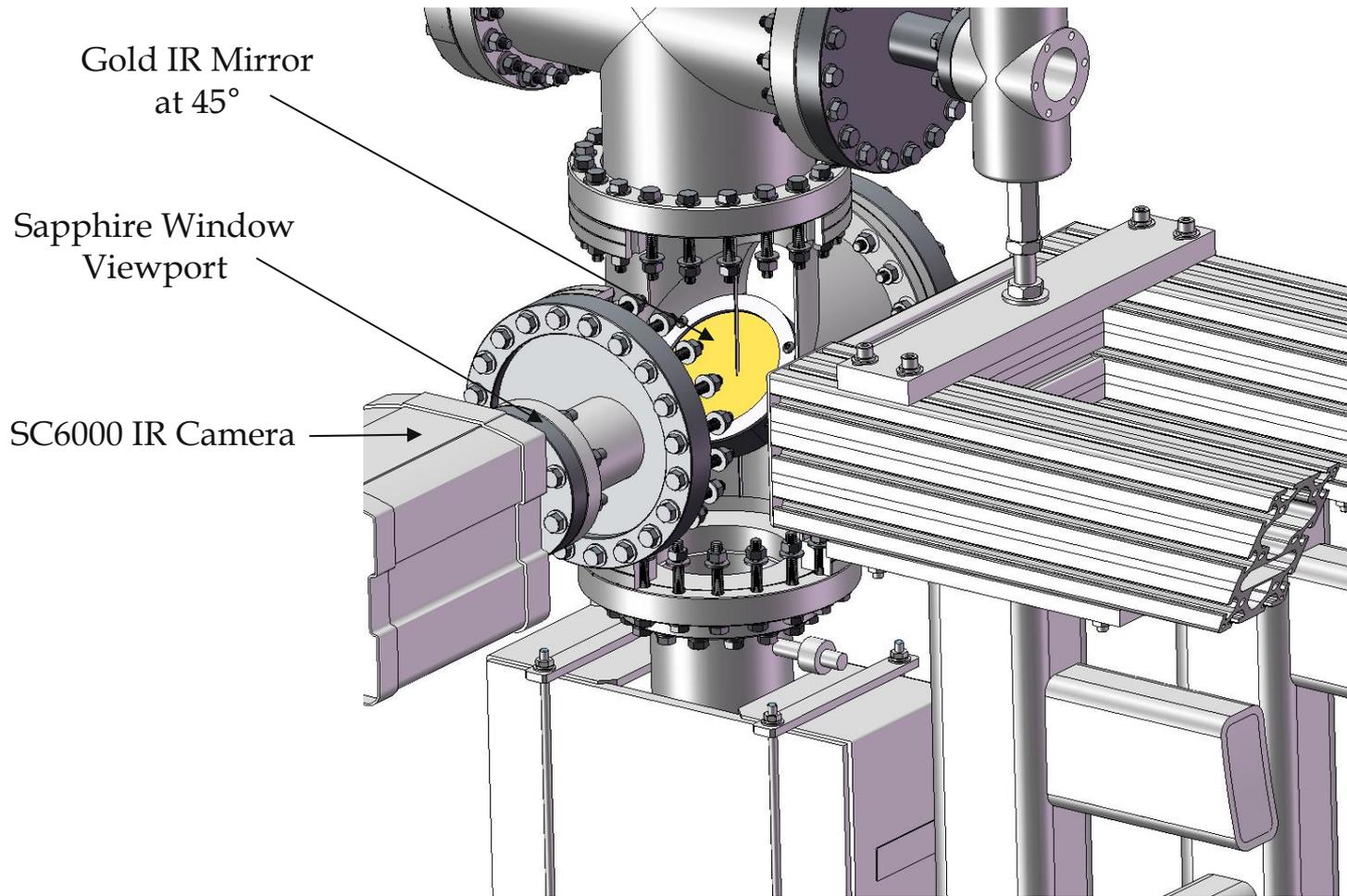
## Upcoming Experiment in Sector 30-ID:

### Measurements:

- The infrared camera will be used to image the beam strike surface with frame rates up to 1000 frames/second so that the beam position can be determined just as it first intercepts the surface. The peak temperature should correspond to the beam center and this can be compared with the theoretical center as indicated by the cross-hair lines.
- The total absorbed power will be very accurately measured with anticipated error less than 0.5% overall. A software routine will be created to do the power calculation. The measured values will be compared with the theoretical absorbed power.
- Measurements will be made at 20 mA to yield energy in the range of 7 keV. Operating parameters will be adjusted so that the thermo-mechanical limits of the OFE shutter body will not be exceeded.

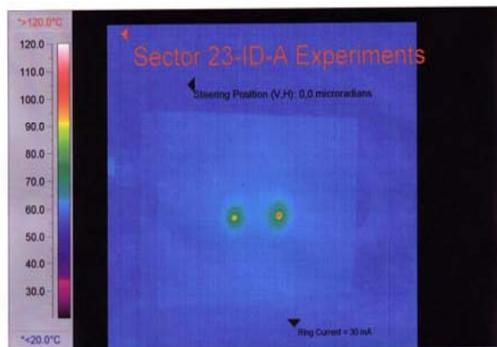
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## Upcoming Experiment in Sector 30-ID:

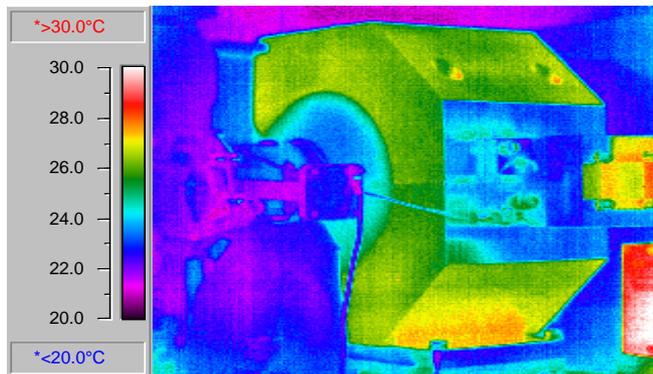


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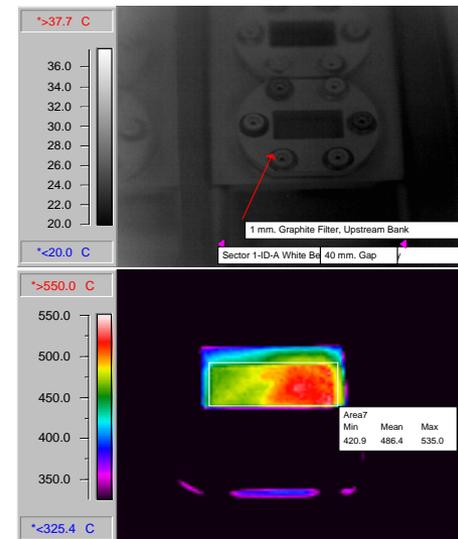
## Past IR Imaging at the APS (Using Old SC1000 System):



Sector 23-ID: Canted Undulator Beams Impinging on a Water-Cooled Copper Block



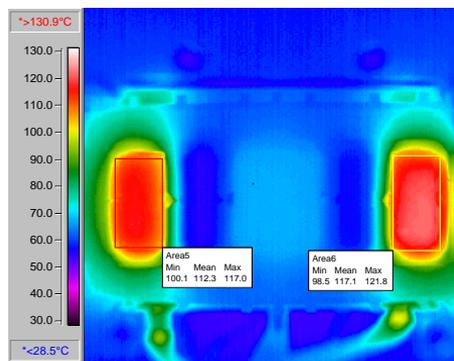
LCLS Undulator Support/Mover System Testing



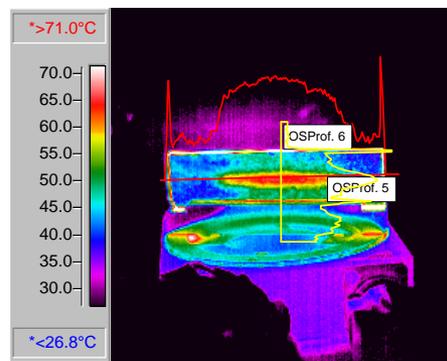
Sector 1-ID: Measurements of Various Filter Material under Beam Conditions



Sector 8-ID: Silicon Wafer on a Heated Copper Base



Nanospheres, Inc.: Temperature Uniformity on a Biological Sample Holder



Sector 13-BM: Grazing Incidence Beam on Silicon Mirror

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