Characterizing Debris-Shield Transmission Degradation and Estimating On-Target Energy

J. KWIATKOWSKI, S. J. STAGNITTO, S. F. B. MORSE, M. LABUZETA, and V. GUILIANO

University of Rochester, Laboratory for Laser Energetics

Summary

OMEGA now provides an estimate of on-target transmission losses resulting from target debris contamination of blast window assemblies

- Transmission of OMEGA debris shields is highly dependent on the type of experimental campaigns
- A laser-cleaning effect generally maintains individual beam transmission to ~90% of the "clean" blast-window-assembly (BWA) condition
- Blowthrough Omega Transport Imaging System (OTIS) measurements are used to monitor debris-shield transmission throughout the BWA cycle
- An energy report is now provided to the Principal Investigators (PI's) depicting estimated UV transmission losses
- Experiments with low debris impact are generally scheduled at the start of a BWA cycle, and high-impact shots precede refurbishment

Debris shields will be changed ~15× in FY12.

G9402a

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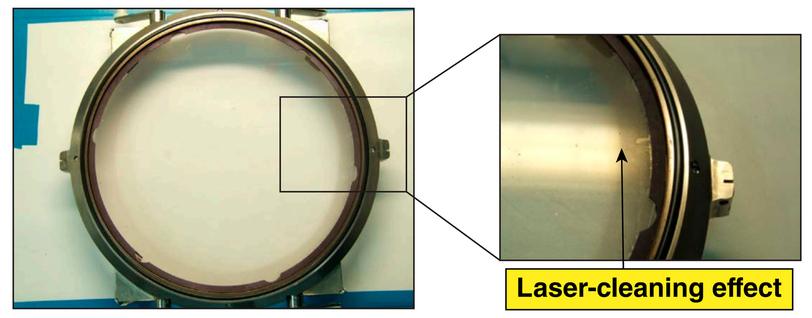

- The BWA consists of a vacuum window and a debris shield
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  - controlled surface contamination areas (CSCA)
  - qualified radiation workers
  - hardware decontamination
  - recoating or replacing debris shield

*dpm: disintegrations per minute

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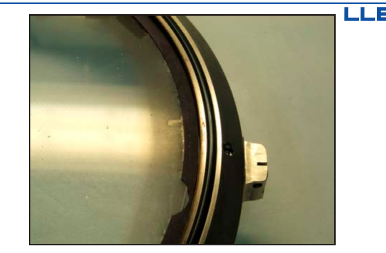

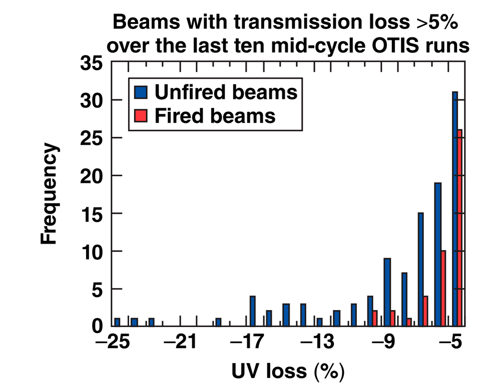

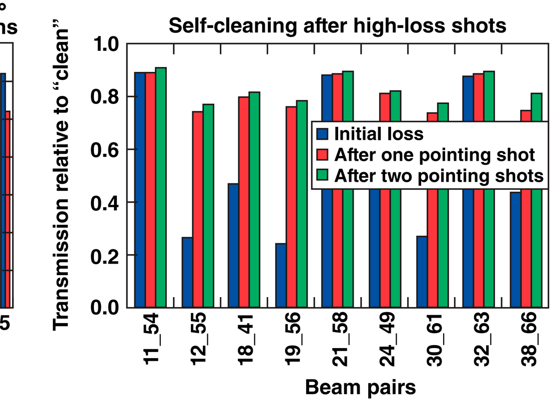

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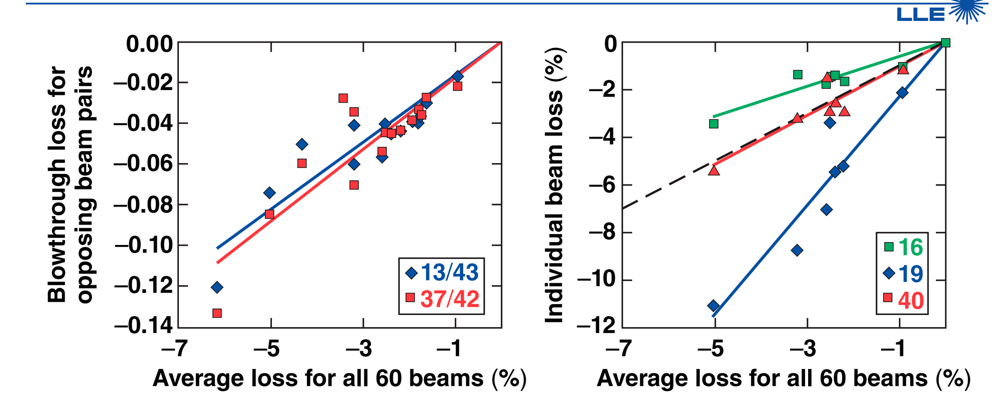
Blowthrough OTIS of two witness beam pairs is used to estimate individual transmission of all 60 beams



- Historical correlation of witness beam-pair blowthrough transmission is used to determine the overall system average
- Individual beam transmissions are calculated based on each beam's historical correlation to the system average
- Blowthrough OTIS predicts
  - 60-beam average transmission to ~1%
  - individual beam transmission for beams that are shot to <2% rms*

*rms: root mean square

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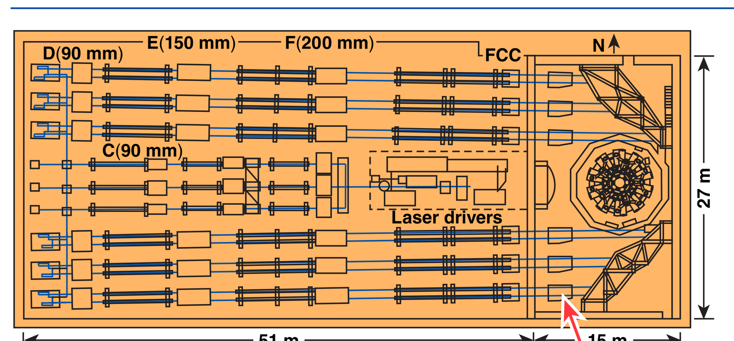
UV on-target energy is calculated based on an energy measurement made upstream of the target chamber



- A harmonic-energy detector (HED) measures on-shot UV along with residual IR and green
- HED is calibrated semi-annually (seven shots) and checked monthly (one shot) against a conventional calorimeter

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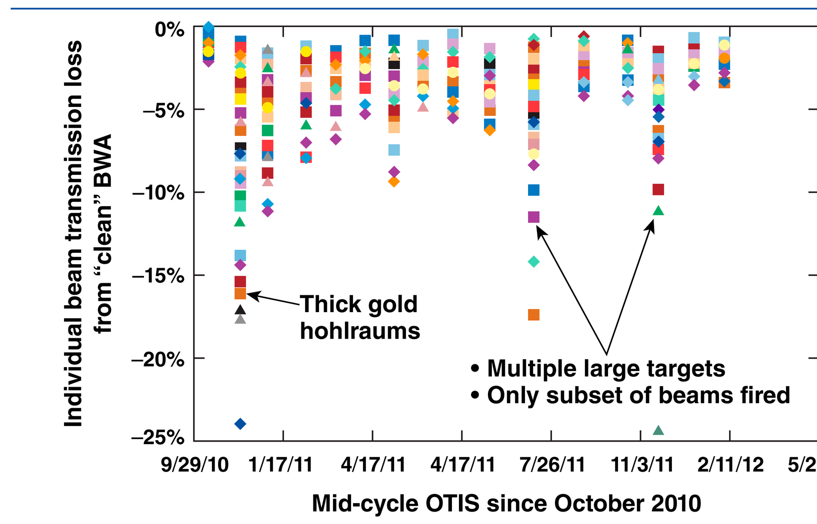
"Mid-cycle" OTIS measurements of all 60 beams are now taken to understand debris-shield transport degradation after two weeks of target shots



- Overall system, as well as beam-to-beam, transmission can vary widely
- Historical HED report specifies UV on-target energy based on clean debris-shield transmission

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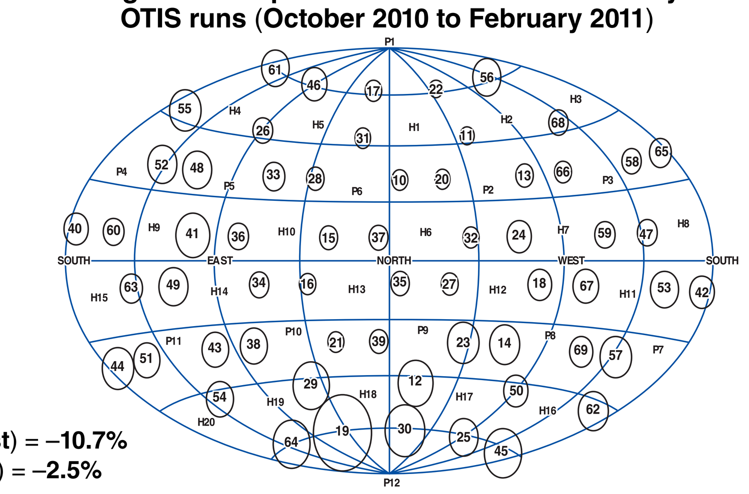
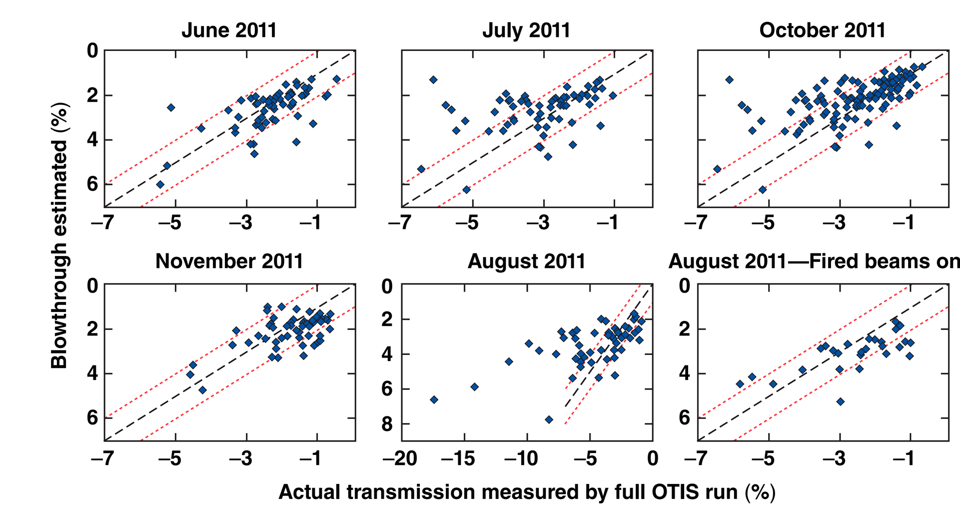
Several factors contribute to the magnitude and distribution of debris-shield transmission degradation



- Target type and quantity
- Which beams are fired (i.e., laser cleaning)
- Experiment geometry
- Beam location in target chamber

G9407a

Examples of blowthrough-estimated individual beam losses compared to actual OTIS measurements



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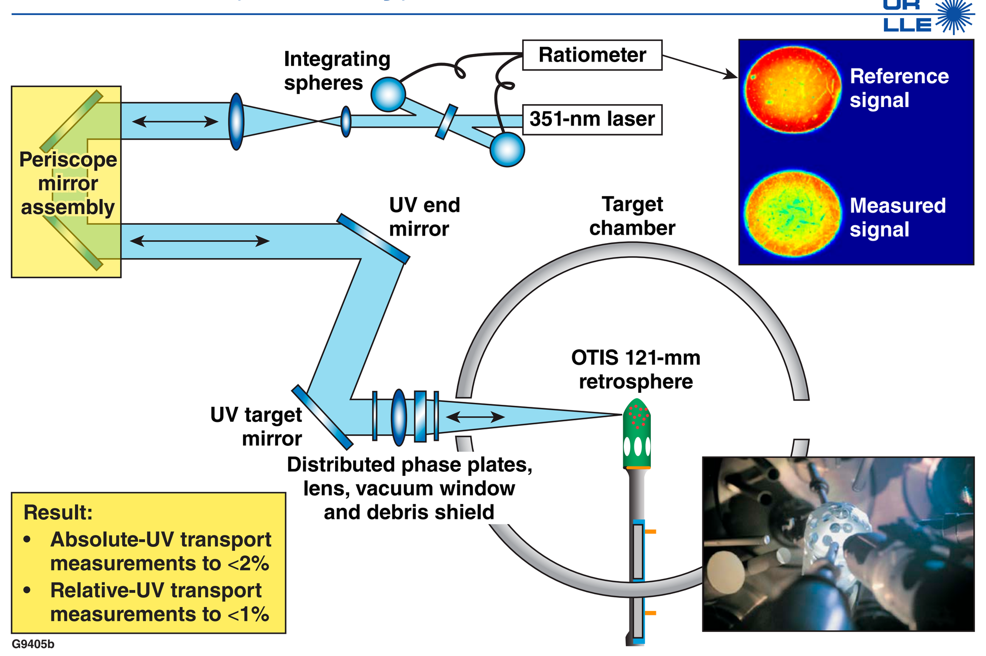
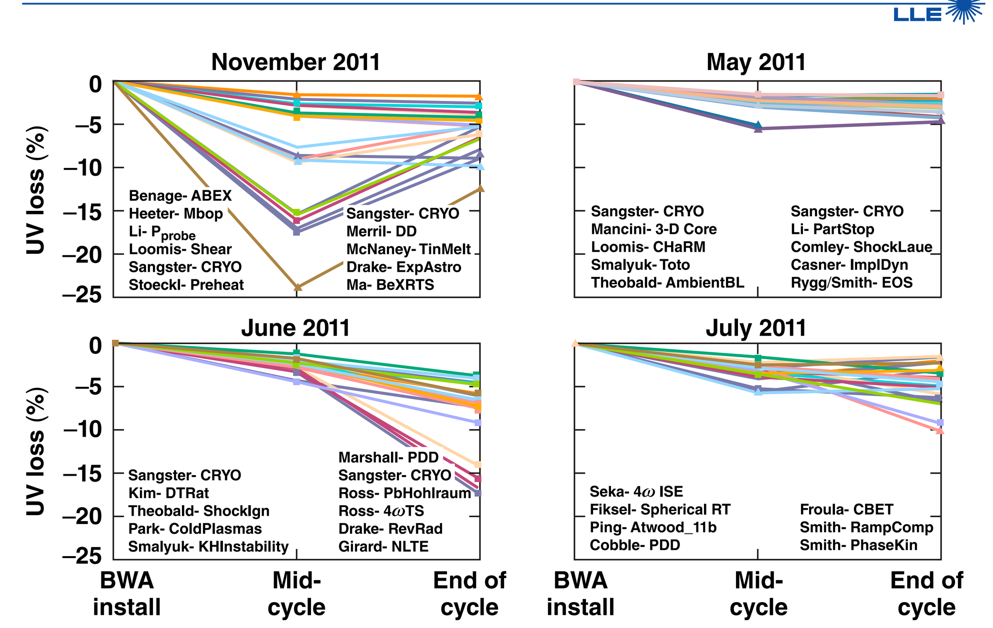
OTIS is used to measure absolute UV transmission of all 60 Individual beams when new BWA's are installed (~monthly)



Result:
- Absolute-UV transport measurements to <2%
- Relative-UV transport measurements to <1%

G9405b

UV transmission throughout each BWA cycle is highly campaign dependent



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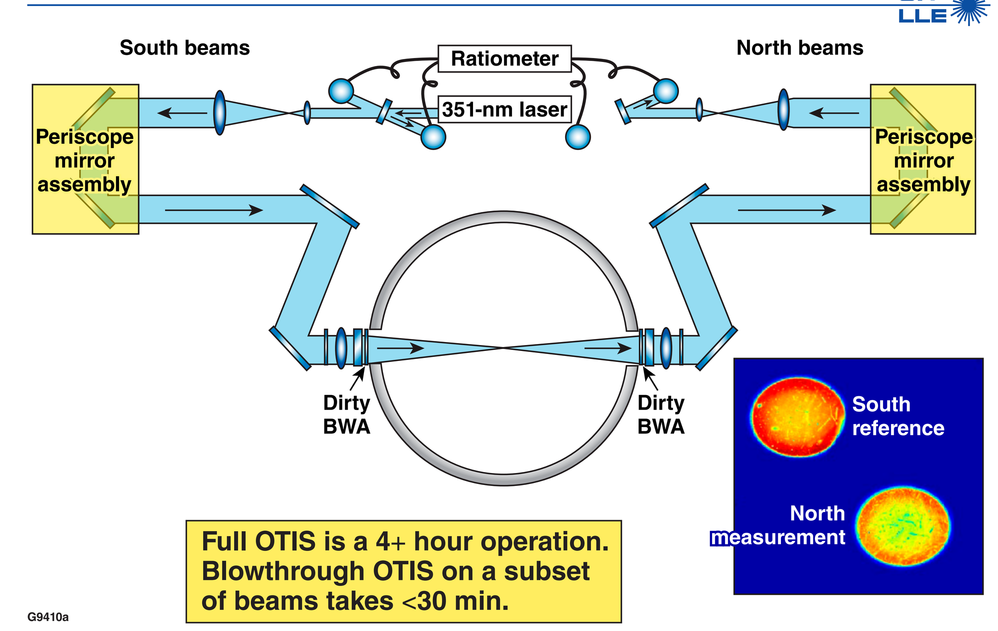

Full OTIS is a 4+ hour operation. Blowthrough OTIS on a subset of beams takes <30 min.

G9410a

Operations now provides an HED report that *estimates* UV on-target energy as a function of beamline

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23-Feb-2012 19:57:16

Last BWA swap before this shot: 02/05/2012 # target shots since: 101
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Non-SG4 DPPs are not beam specific. Quoted transmissions are average for that DPP type.

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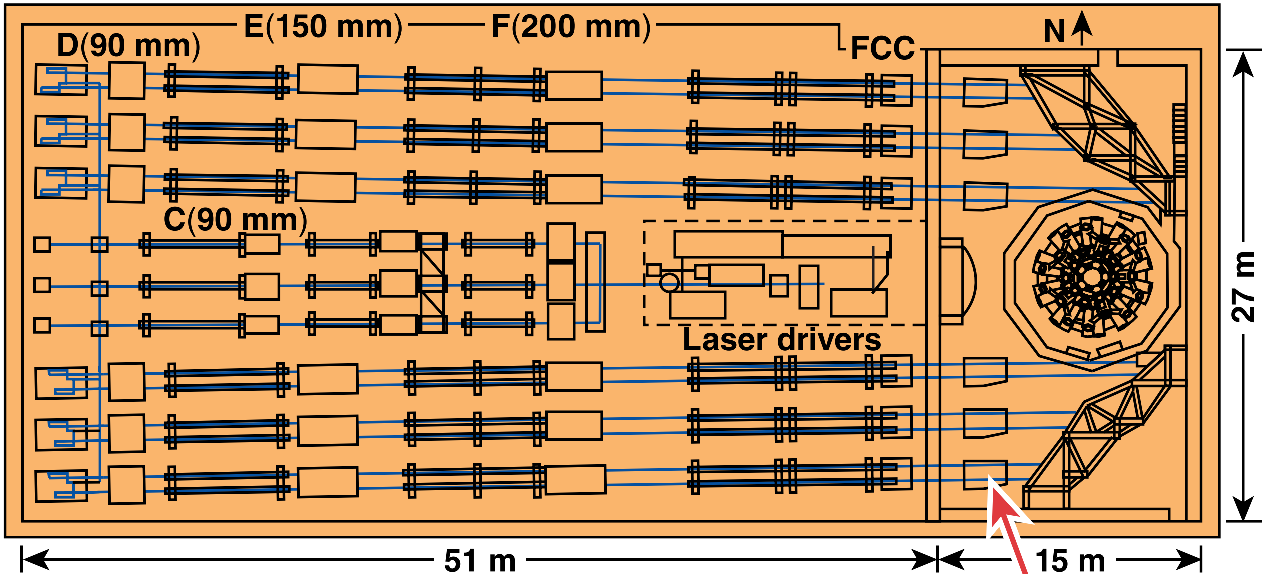

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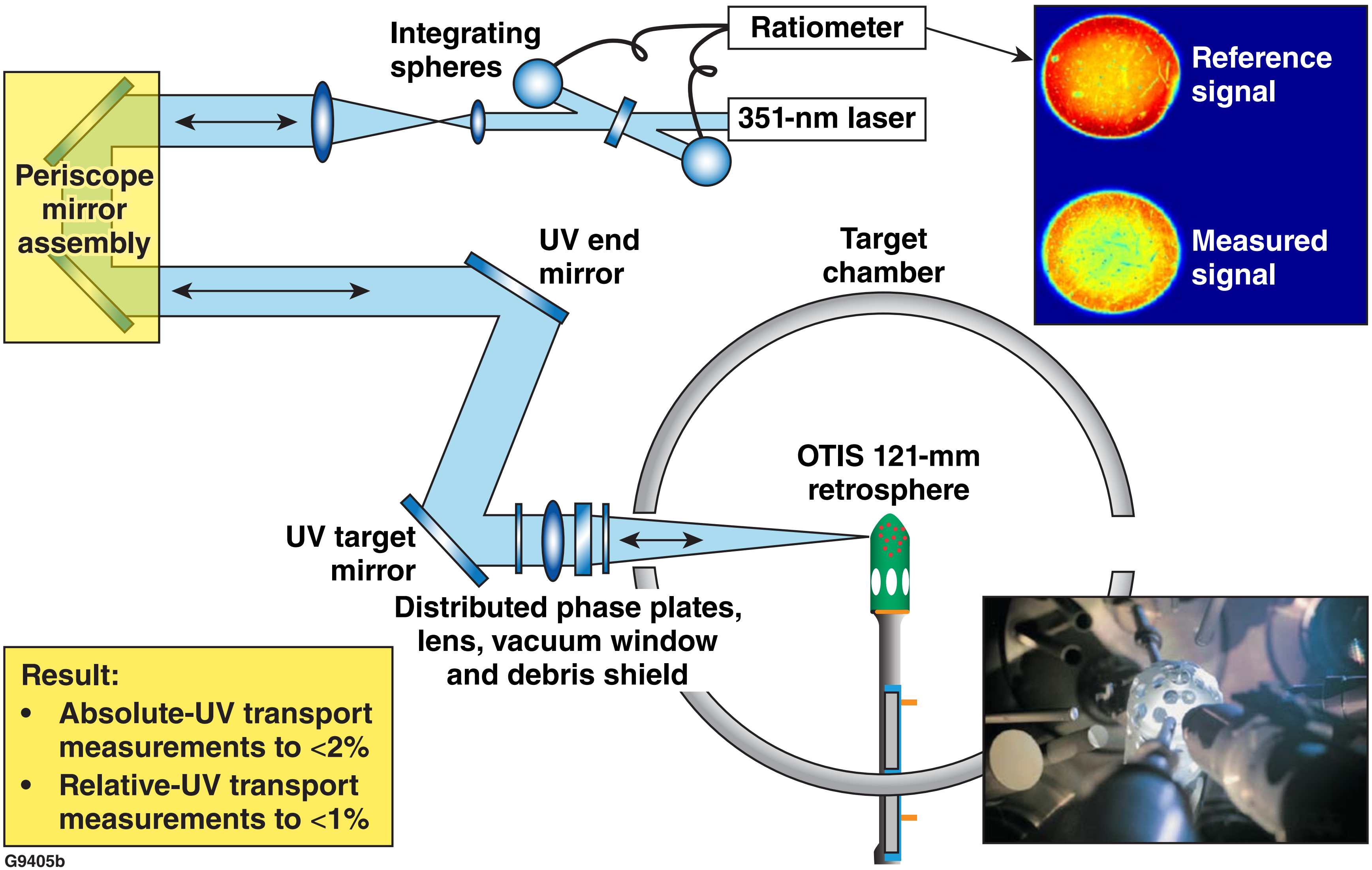

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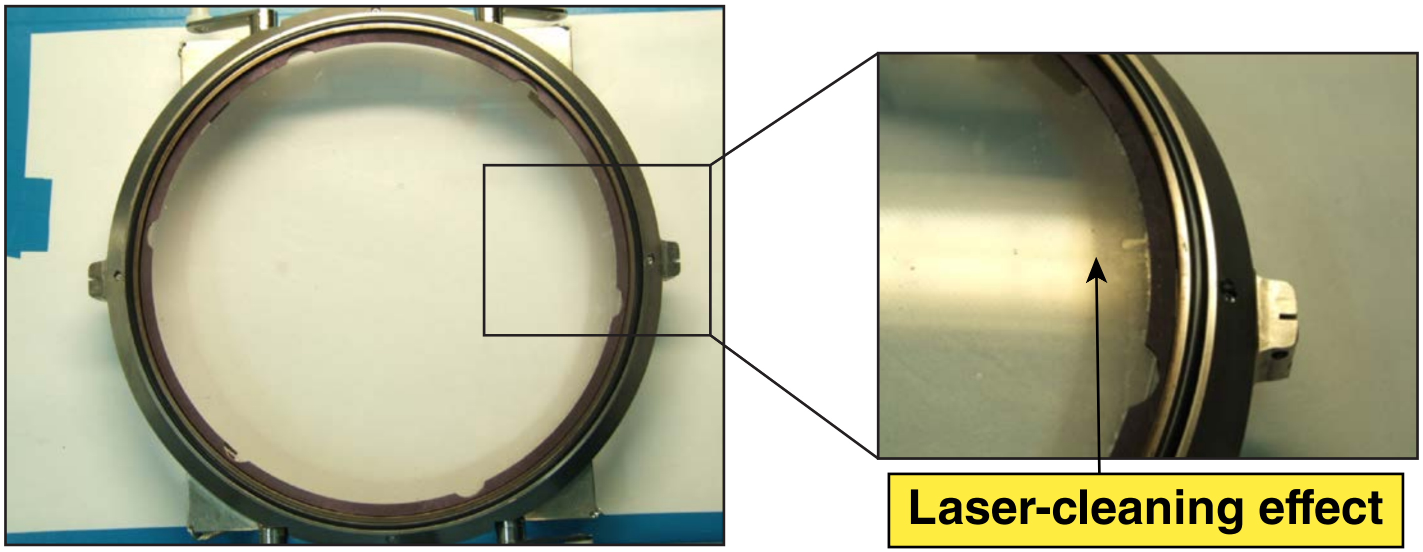

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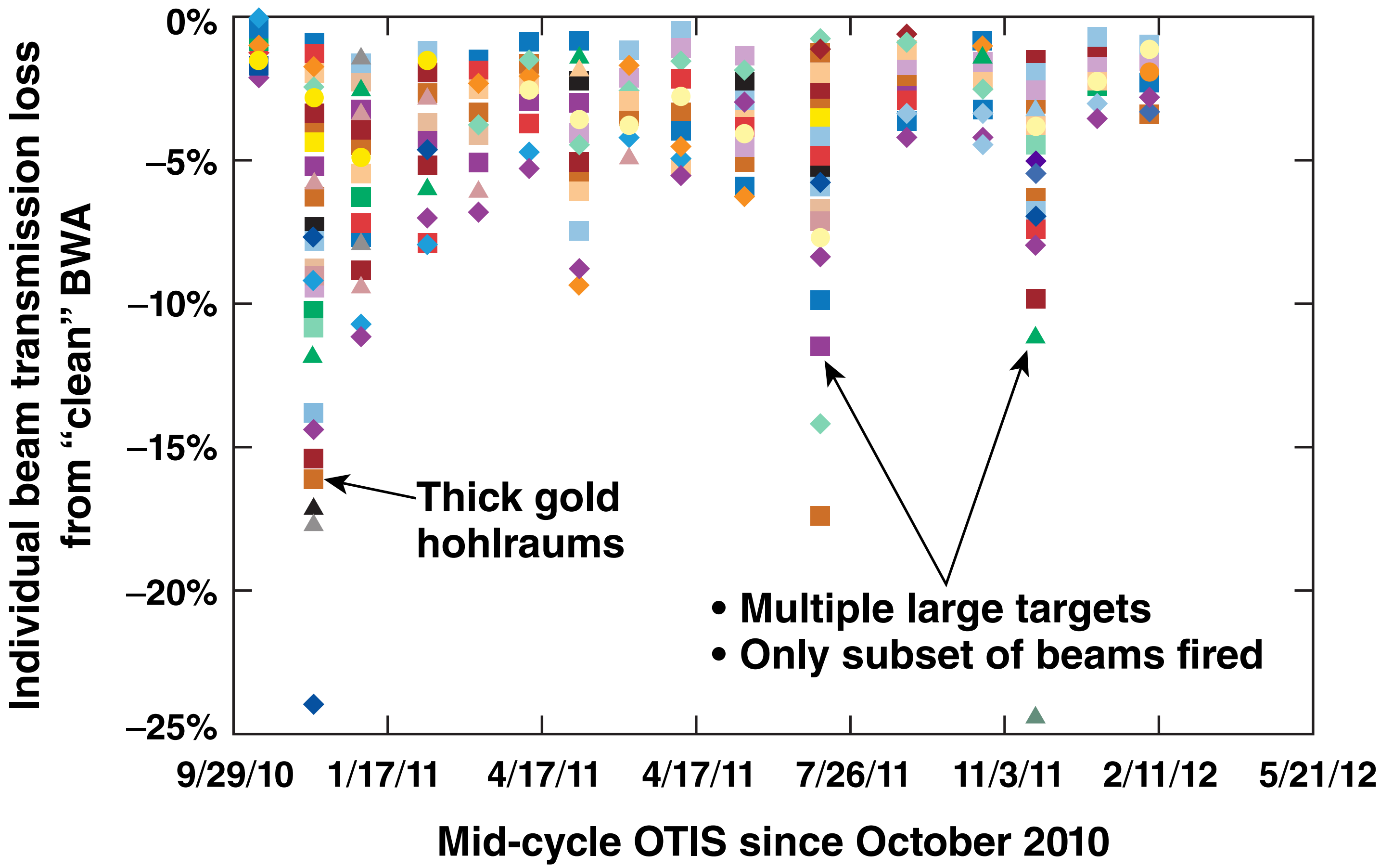

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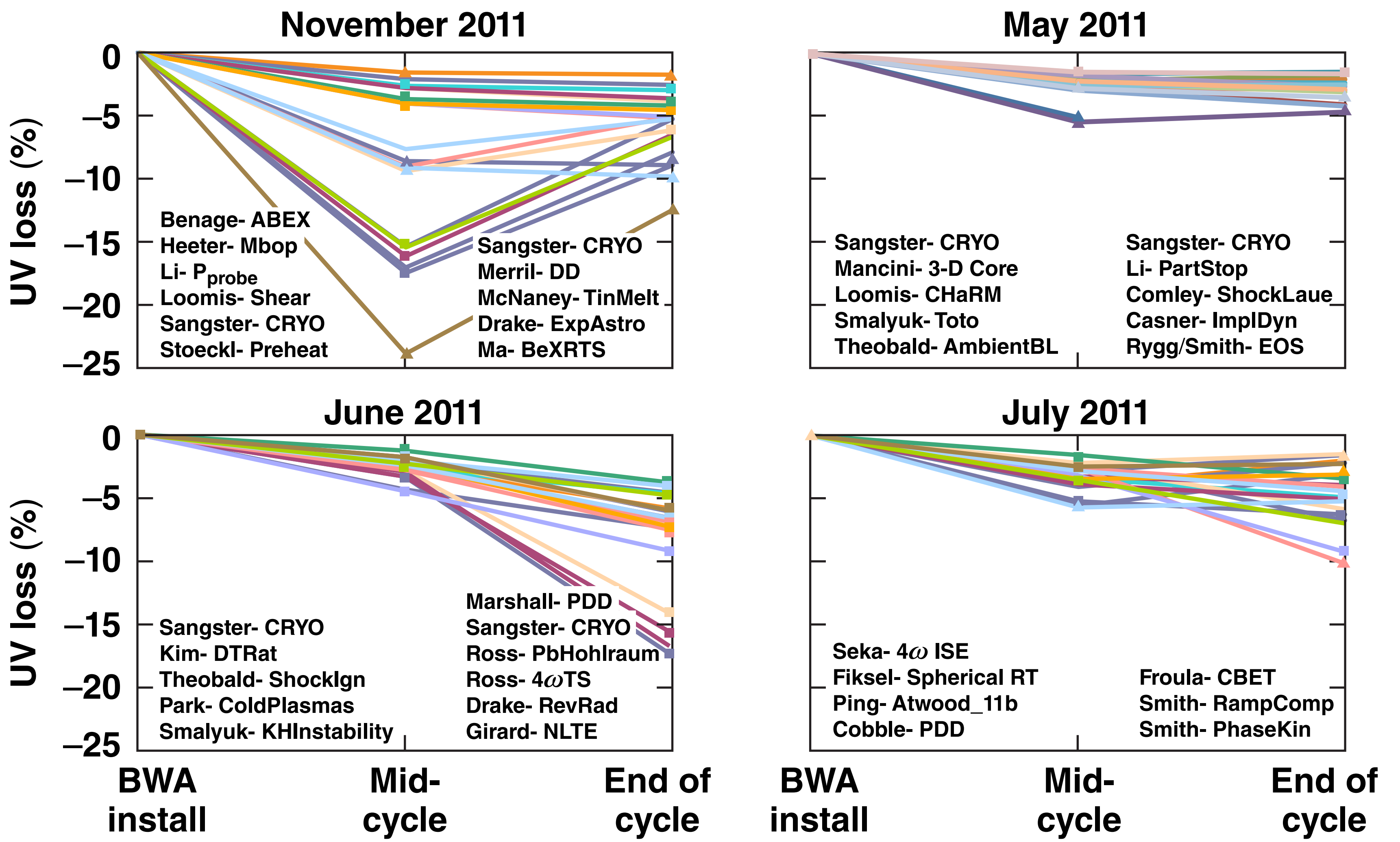

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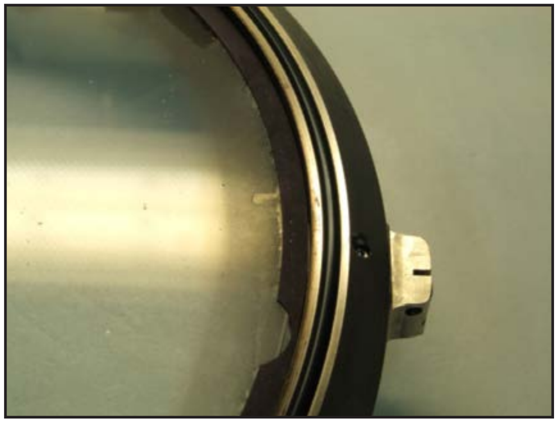

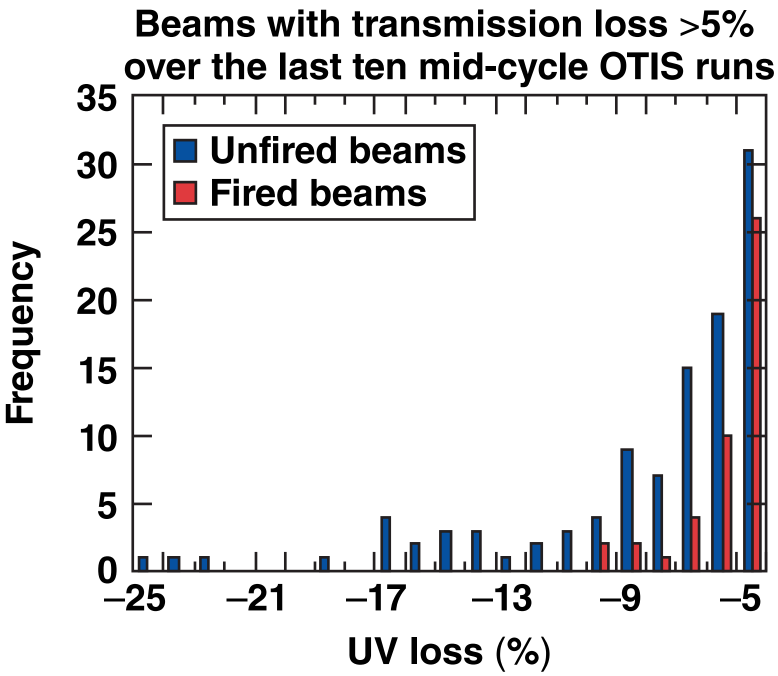

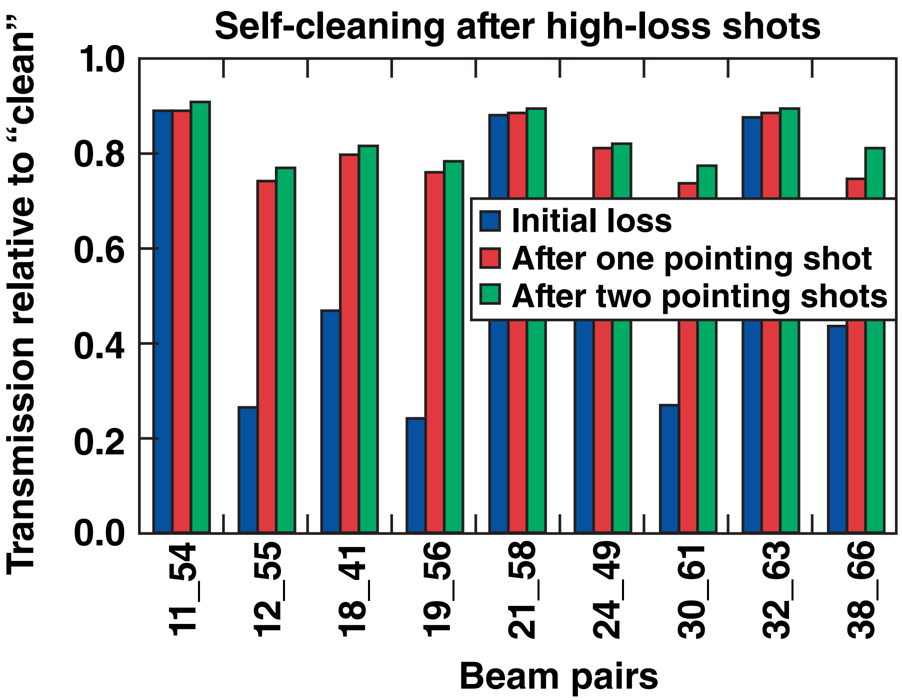

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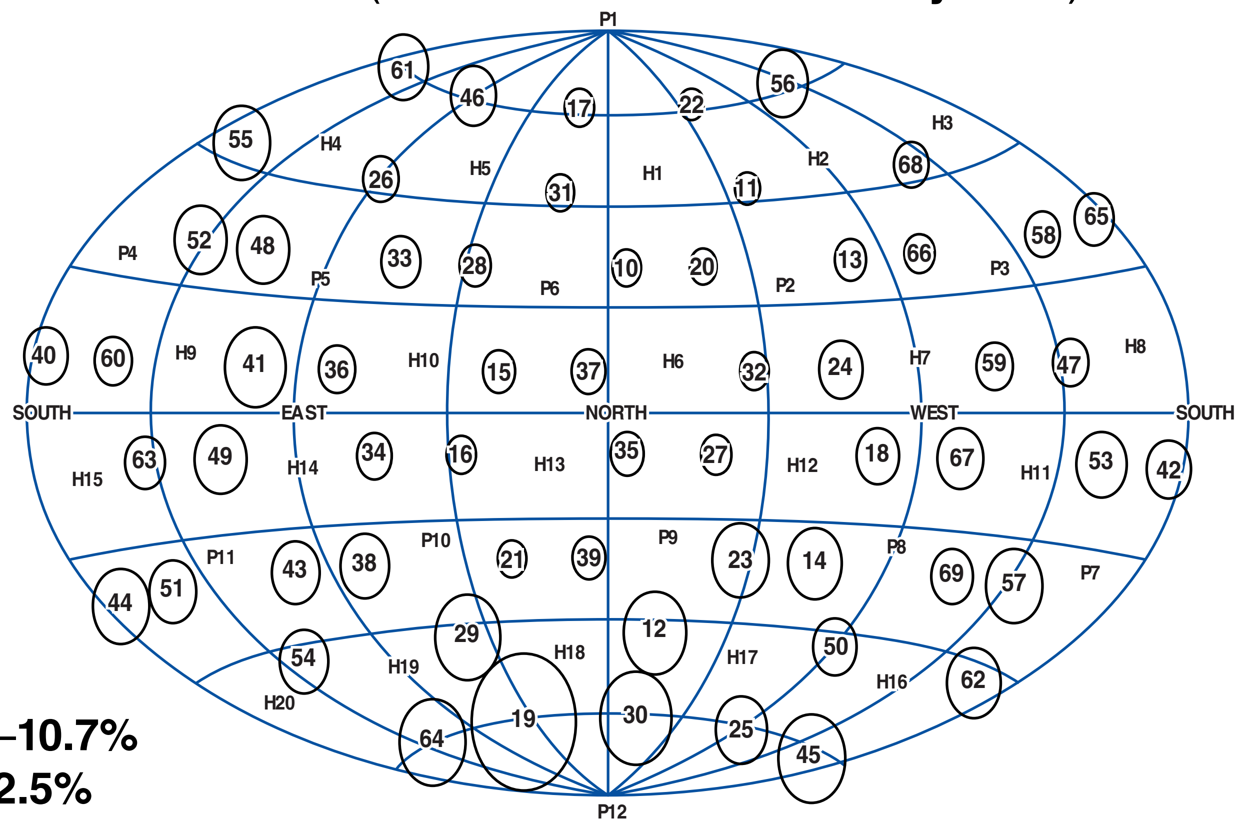
Average UV transport losses measured on mid-cycle OTIS runs (October 2010 to February 2011)



Scale:
19 (worst) = –10.7%
22 (best) = –2.5%

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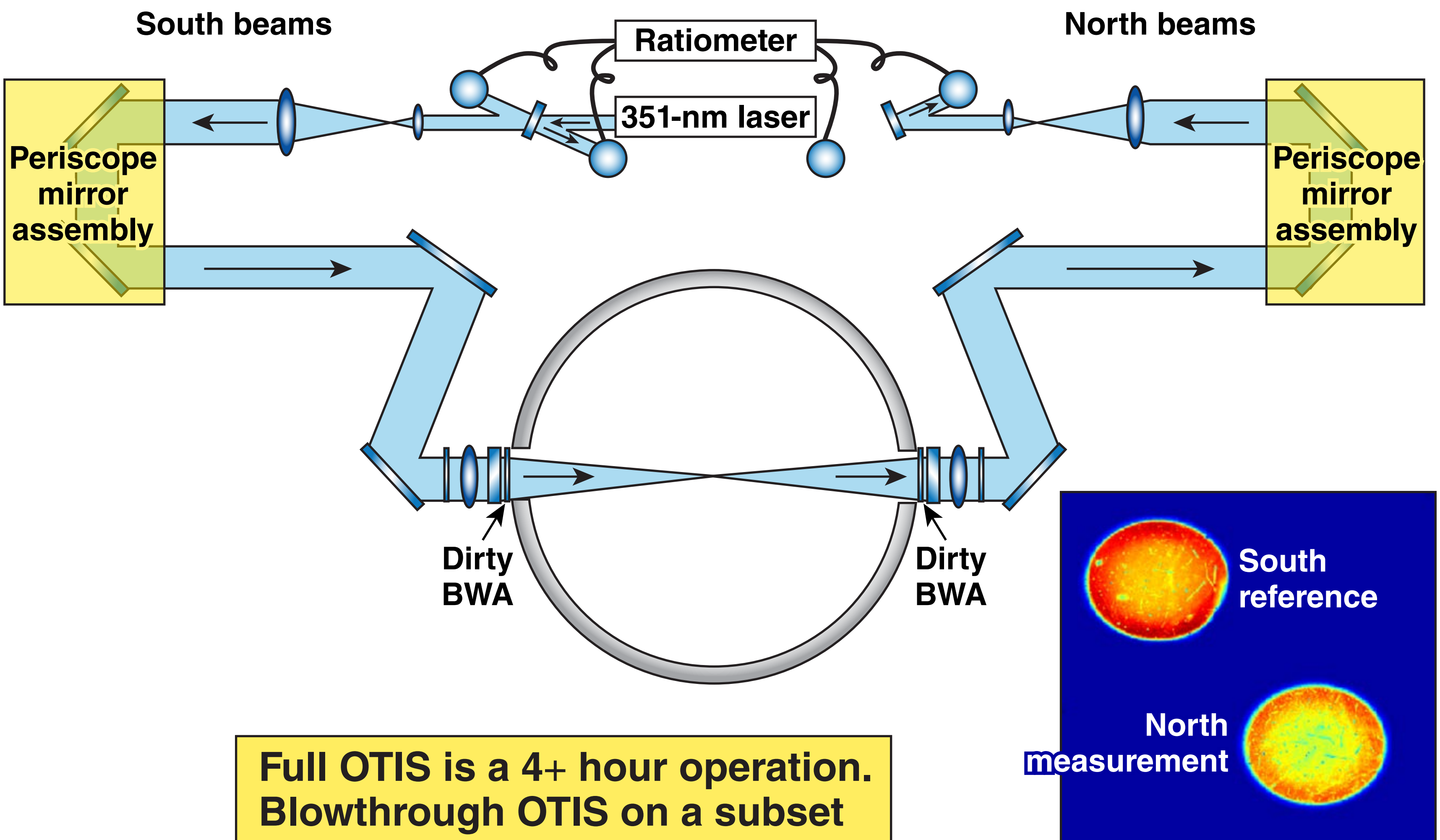

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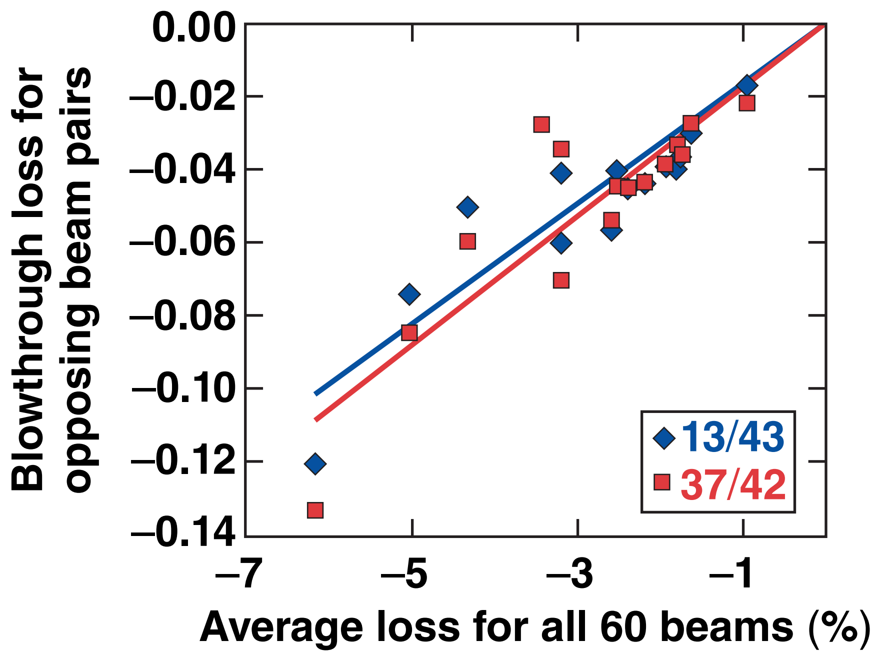

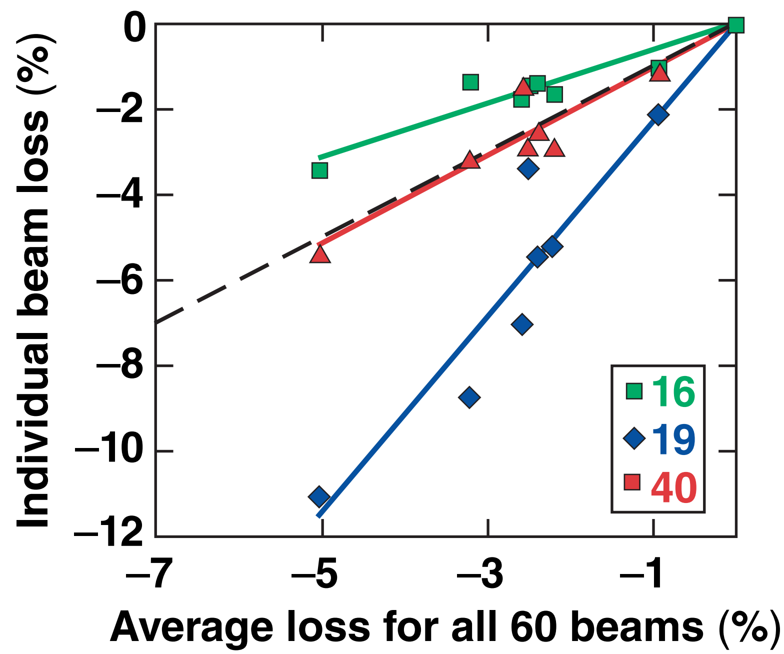

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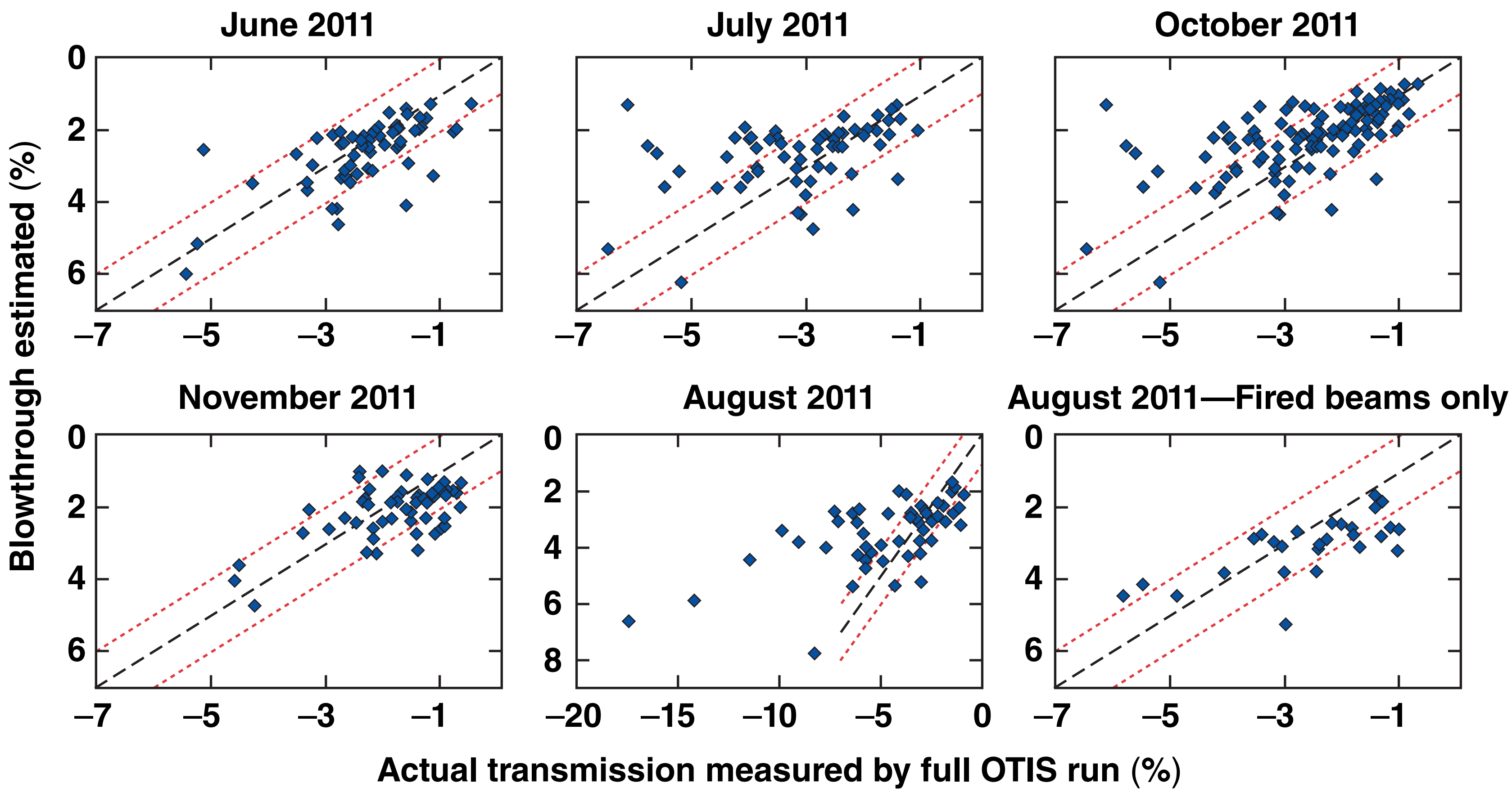

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