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
- Blow-through 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 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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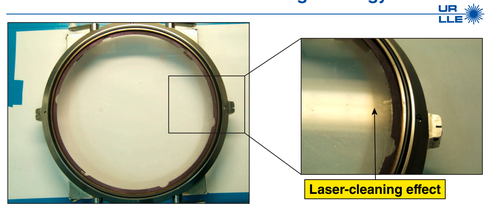

- BWA consists of a vacuum window and a debris shield
- Surface contamination often exceeds 10^6 DPM/100 cm^2
- Processing of BWA's is labor intensive and requires
  - controlled surface contamination areas (CSCA's)
  - qualified radiation workers
  - decontamination of hardware
  - recoating or replacing debris shield

G9403

A "Laser-Cleaning Effect" is Observed After Shooting the Beam Through a Low-Transmission Debris Shield

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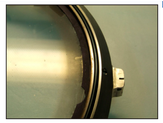
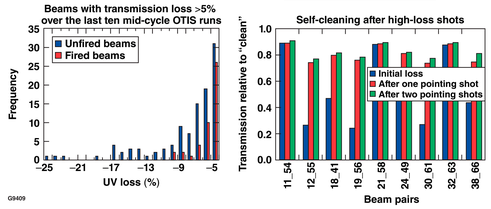
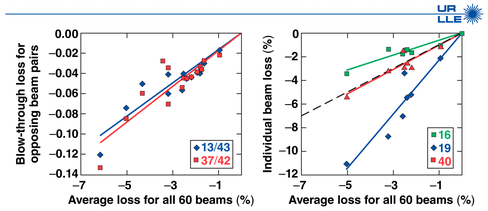




G9409

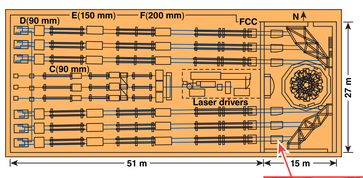
Blow-Through OTIS of Two Witness Beam Pairs is Used to Estimate Individual Transmission of all 60 Beams



- Historical correlation of witness beam-pairs blow-through 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
- Blow-through OTIS predicts
  - 60-beam average transmission to ~1%
  - individual beam transmission for beams that are shot to <2% rms

G9486

UV On-Target Energy is Reported Based on an Energy Measurement Made Upstream of the Target Chamber



- 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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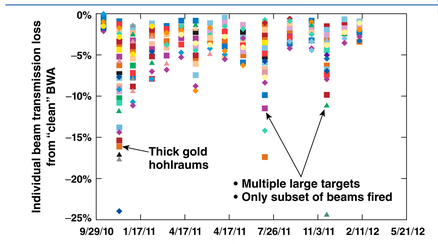

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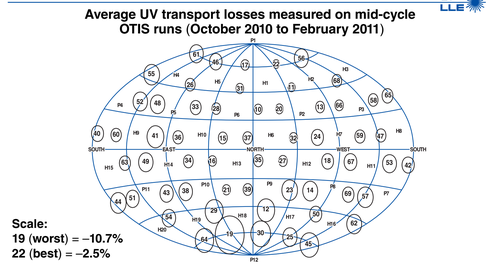
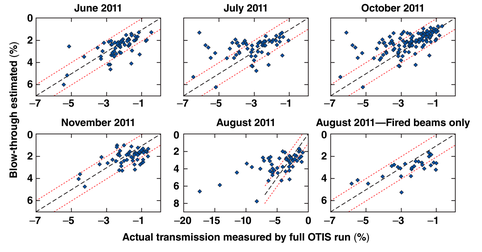


- Target type and quantity
- Which beams are fired (i.e., laser-cleaning)
- Experiment geometry
- Beam location on target chamber

G9407a

Examples of Blow-Through Estimated Individual Beam Losses Compared to Actual OTIS Measurements



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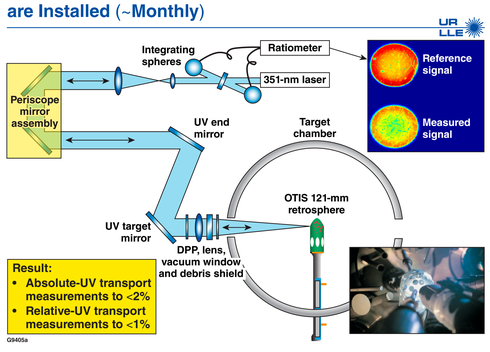
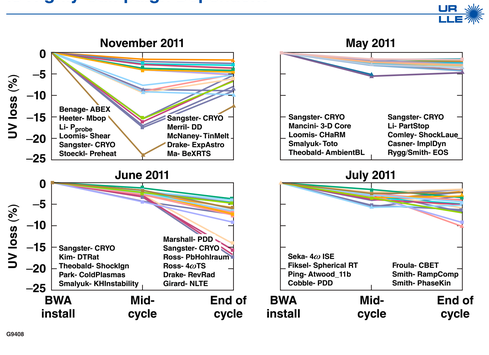
OTIS is Used to Measure Absolute UV Transmission of all 60 Individual Beams When New BWA's are Installed (~Monthly)



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

G9405a

UV Transmission Throughout each BWA Cycle is Highly Campaign Dependent



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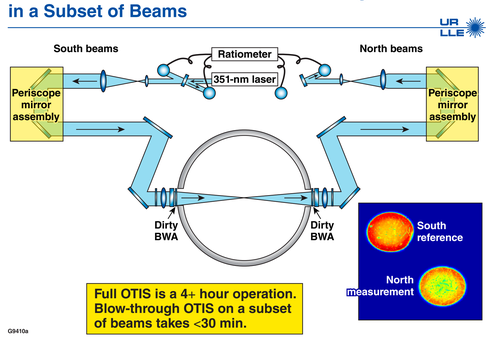

Full OTIS is a 4+ hour operation. Blow-through OTIS on a subset of beams takes <30 min.

G9410a

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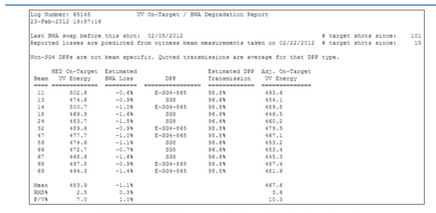

```
Log Number: 65145                UV On-Target / BWA Degradation Report
28-Feb-2012 19:57:16

Last BWA avag before this shot:  02/05/2012                  # target shots since:    101
Reported losses are predicted from witness beam measurements taken on 02/22/2012  # target shots since:     15

Non-SG4 DPPs are not beam specific. Quoted transmissions are average for that DPP type.

     HED On-Target  Estimated                    Estimated DPP  Adj. On-Target
Beam   UV Energy    BWA Loss        DPP          Transmission   UV Energy
==== ============ ========  ============  ============  ============
  11       502.6     -2.6%      E-304-565         98.8%         493.6
  13       474.6     -0.9%           SG8          96.6%         454.1
  14       500.7     -1.0%      E-304-565         98.8%         489.8
  15       669.9     -1.6%           SG8          96.6%         646.5
  24       683.7     -1.6%           SG8          96.6%         660.2
  32       689.6     -0.9%      E-304-565         98.8%         679.5
  47       677.7     -1.0%      E-304-565         98.8%         667.1
  59       674.6     -1.1%           SG8          96.6%         653.2
  66       672.7     -0.7%           SG8          96.6%         653.4
  67       660.6     -1.6%           SG8          96.6%         645.3
  68       687.6     -0.9%      E-304-565         98.8%         667.4
  69       694.3     -1.4%      E-304-565         98.8%         681.6

Mean       683.9     -1.1%                                      667.6
RMSA         2.5      0.3%                                        3.6
P/V%         7.0      1.5%                                       10.3
```

- Estimated DPP transmission is included in this report
  - SG4 DPP transmission is beam specific
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- This report is included in
  - PI Packet
  - shot Images and reports page
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G9489

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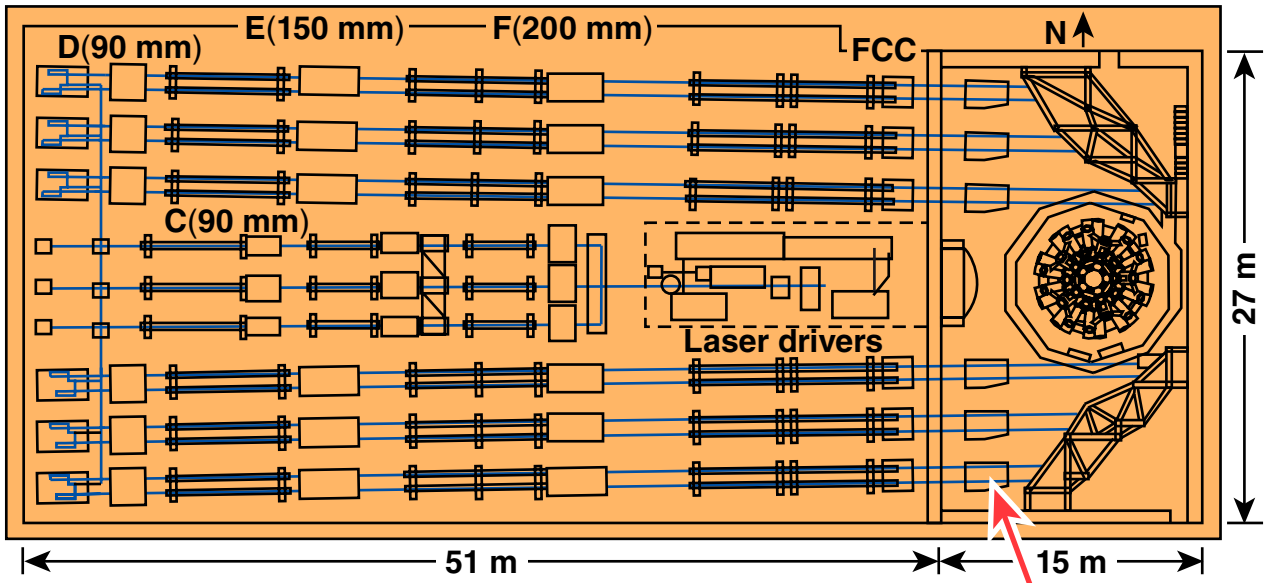

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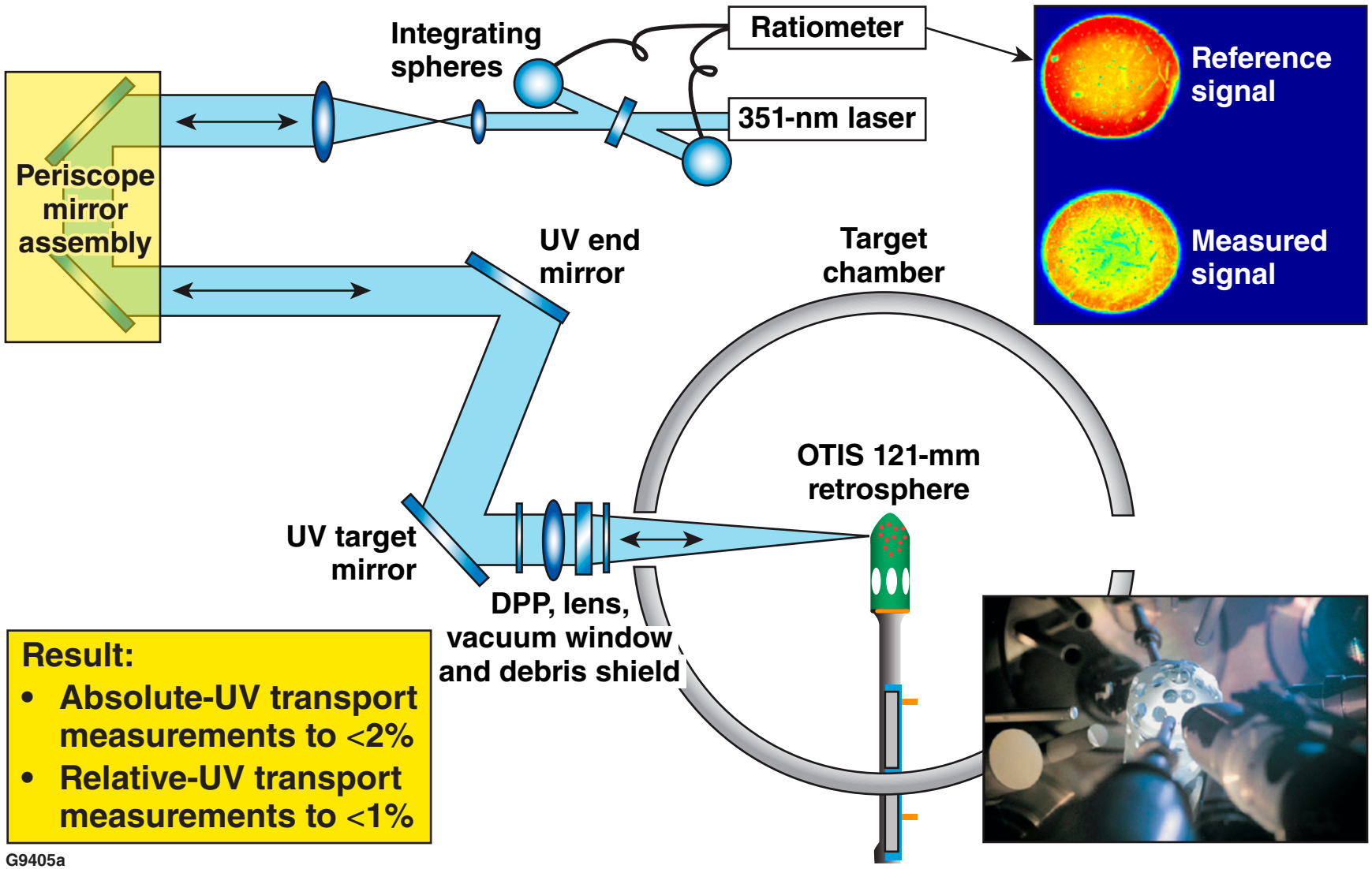

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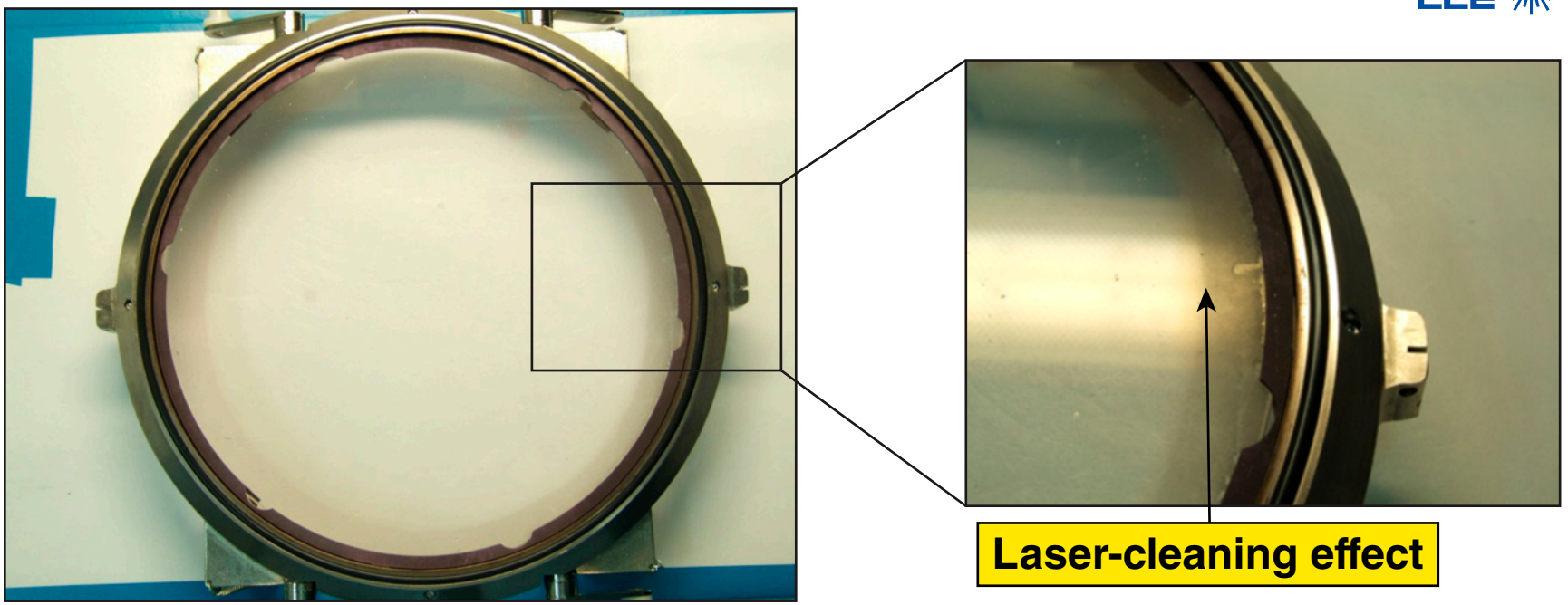

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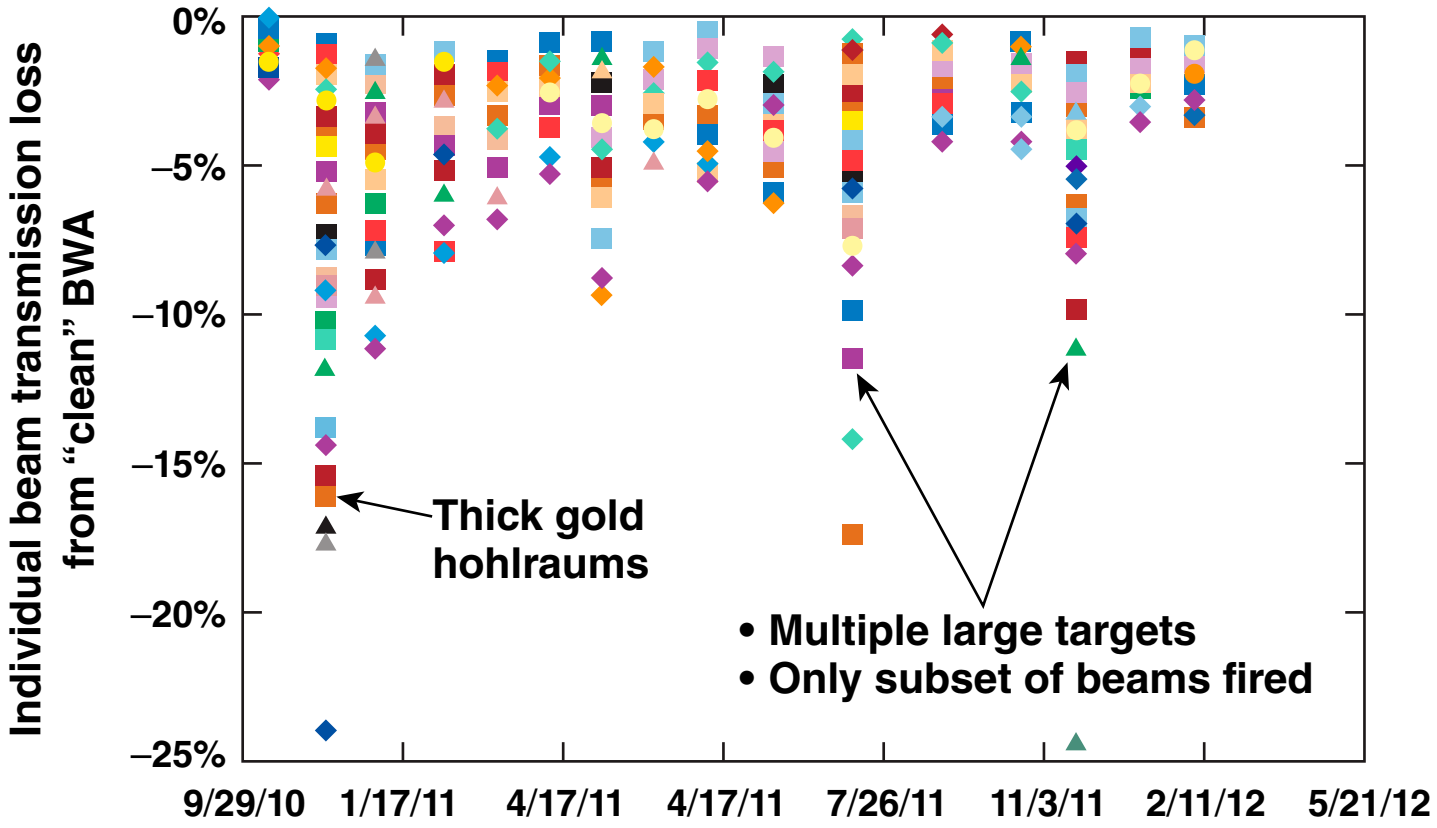

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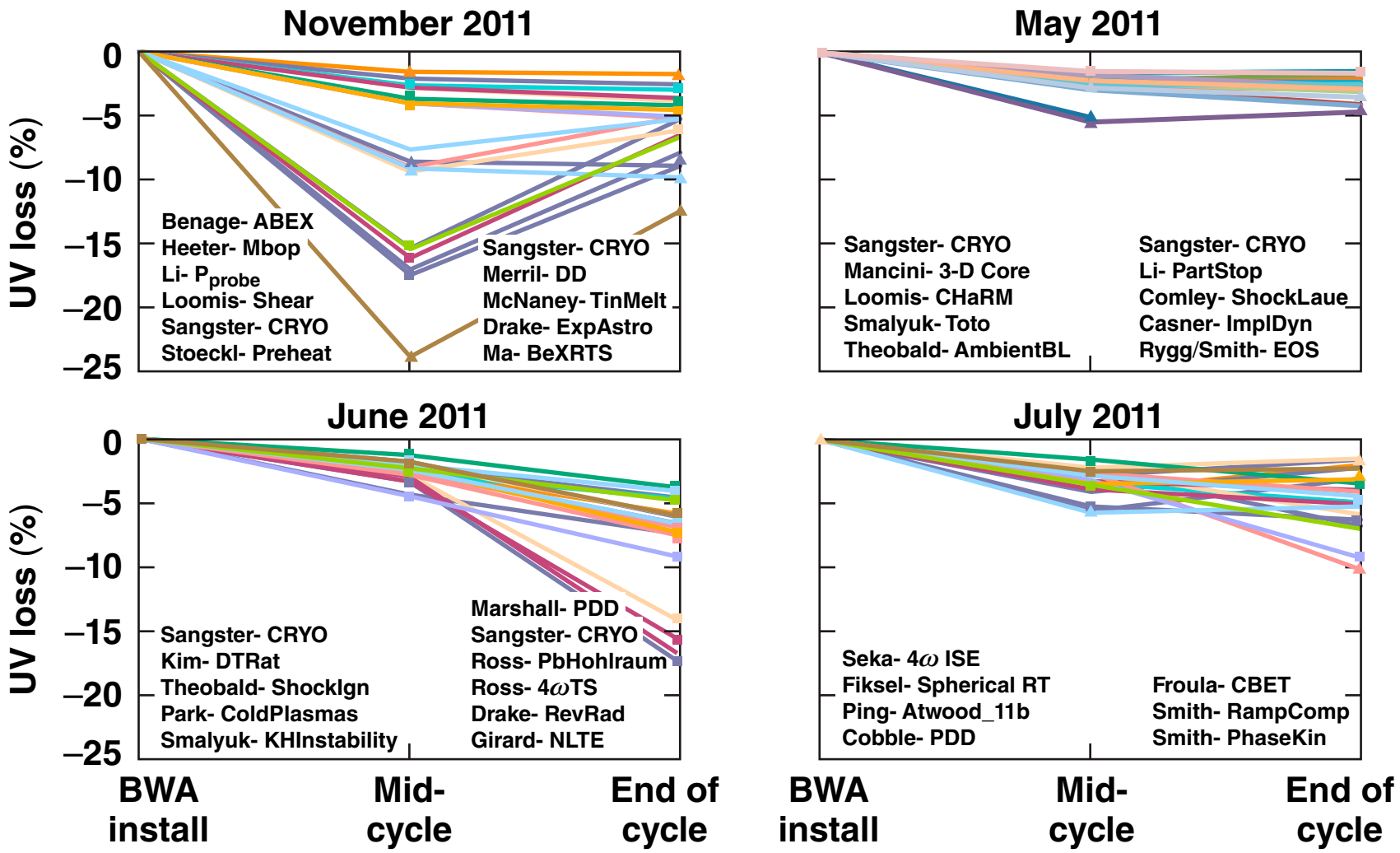

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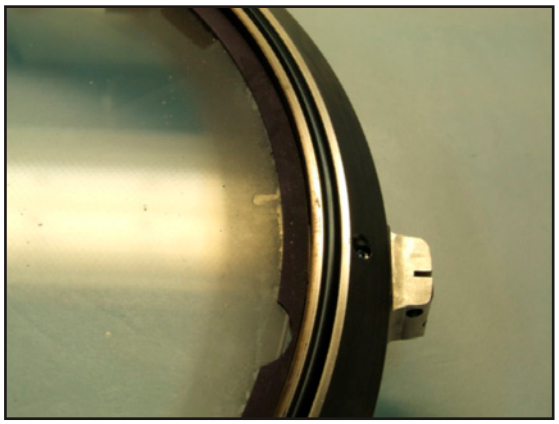

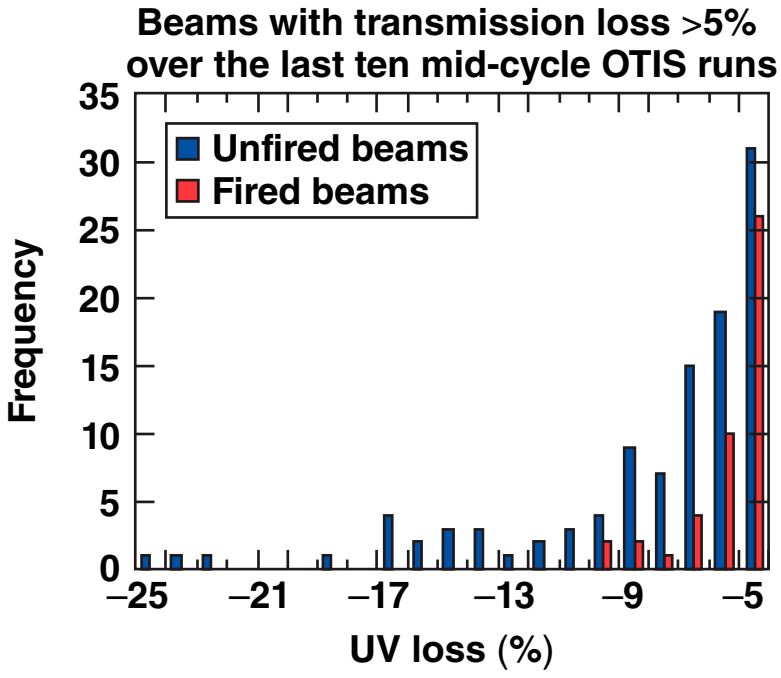

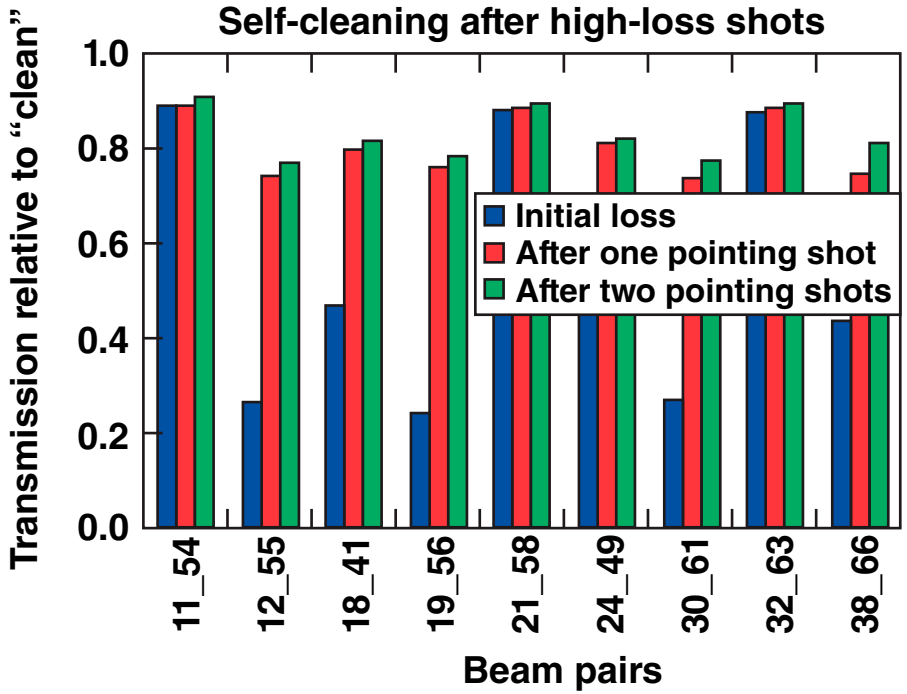

G9409

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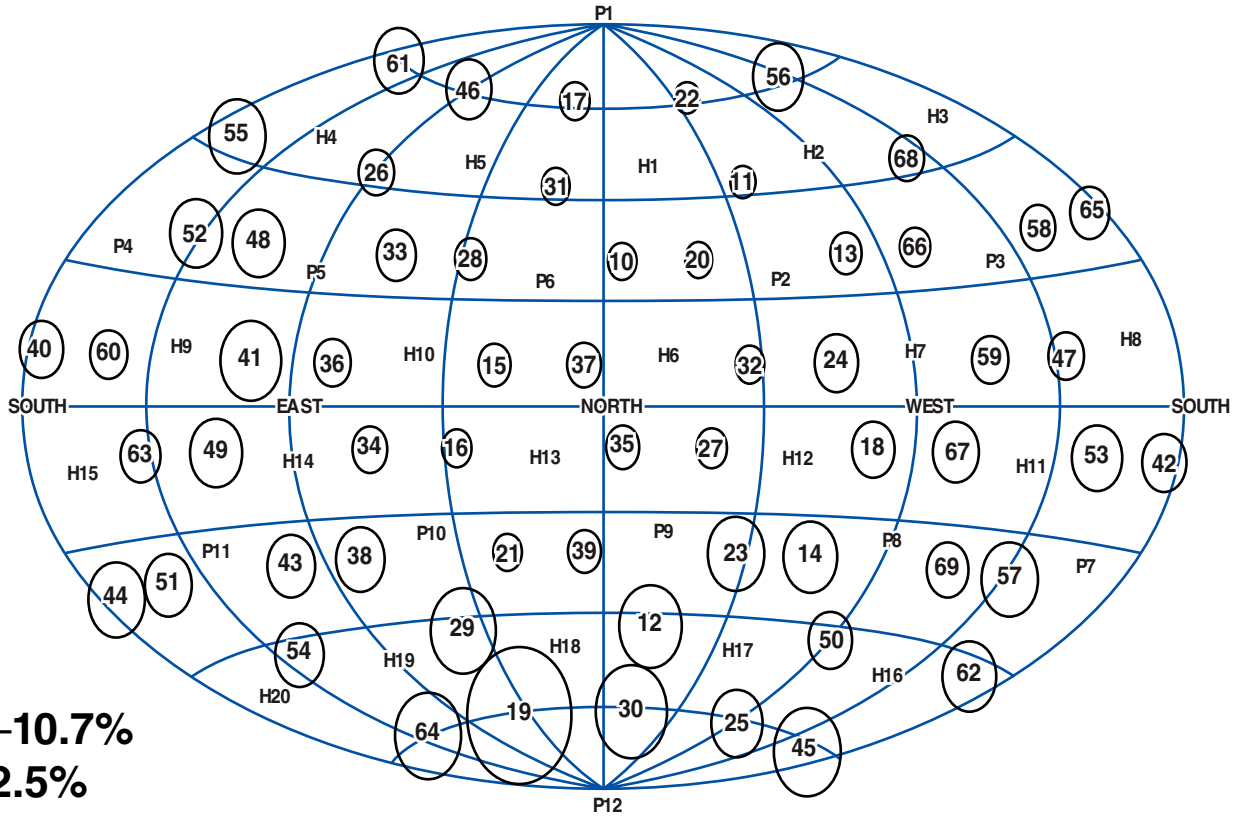
UR LLE

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



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

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

G9407a

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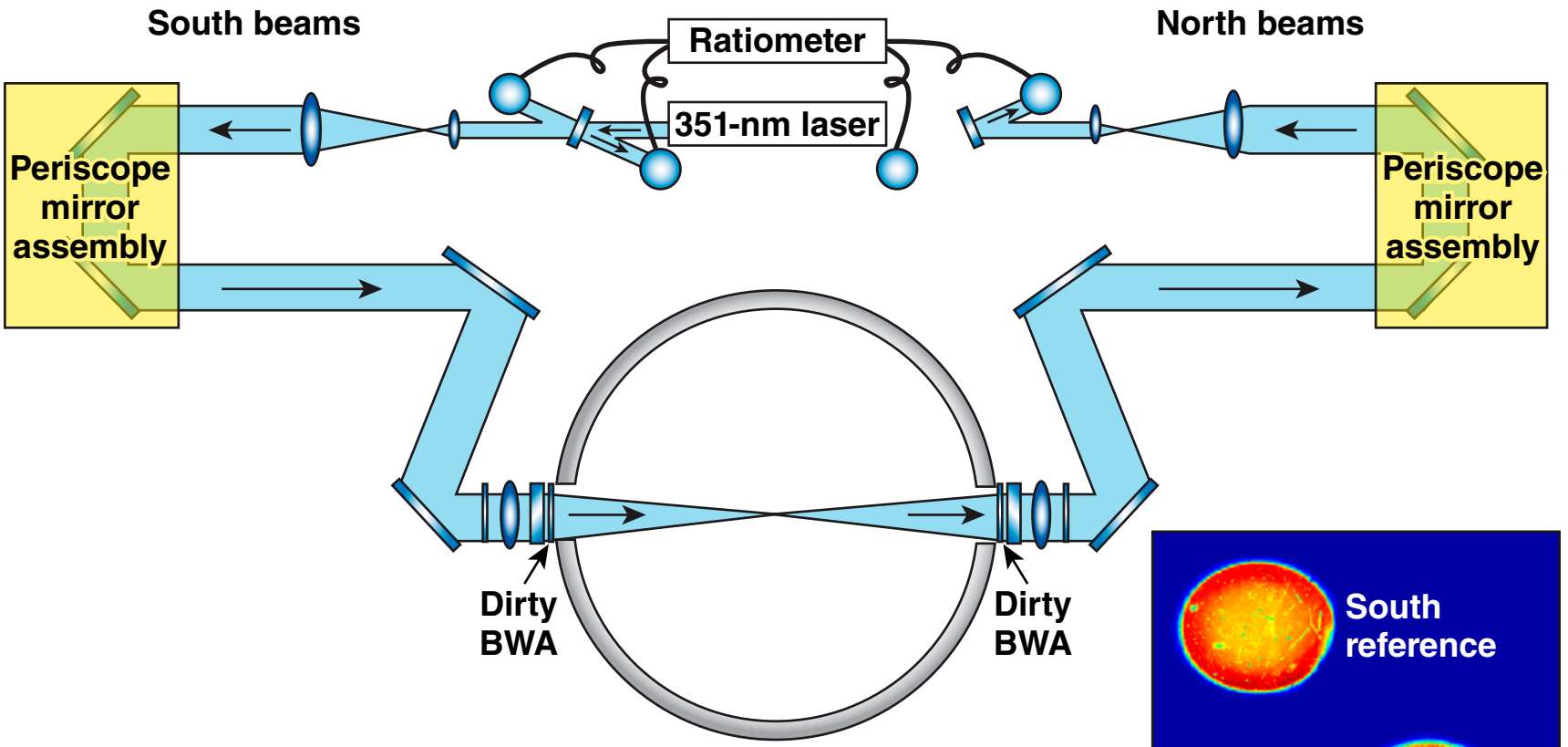

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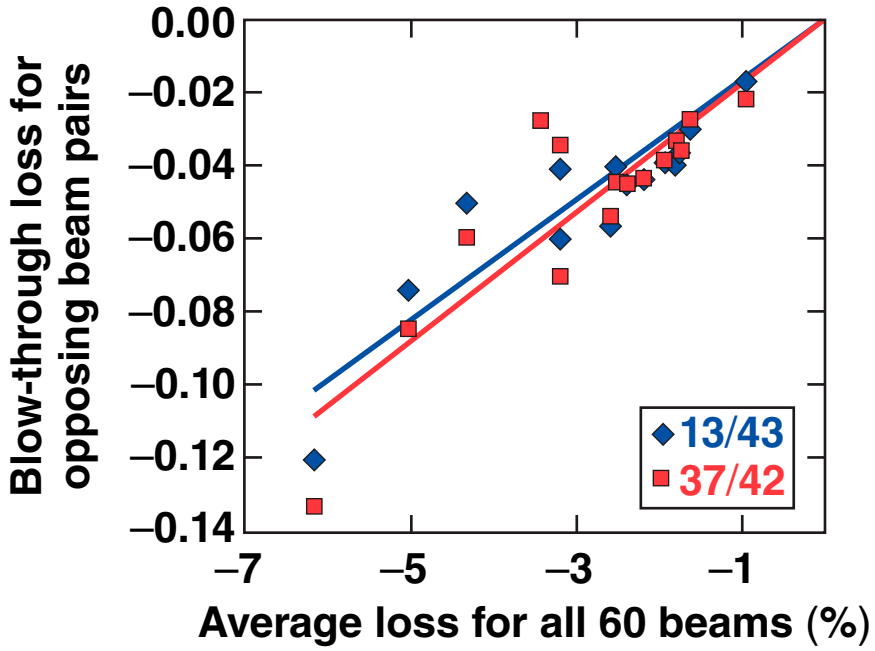

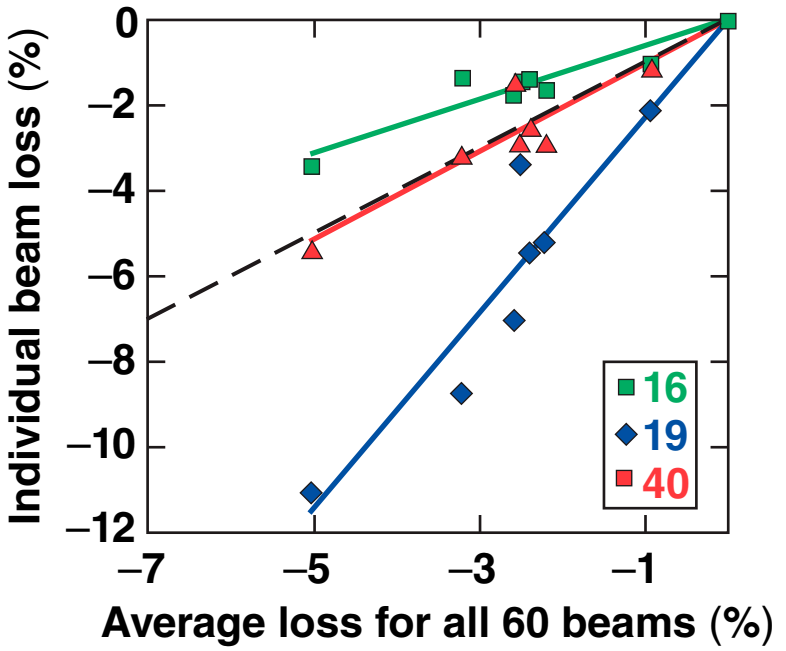

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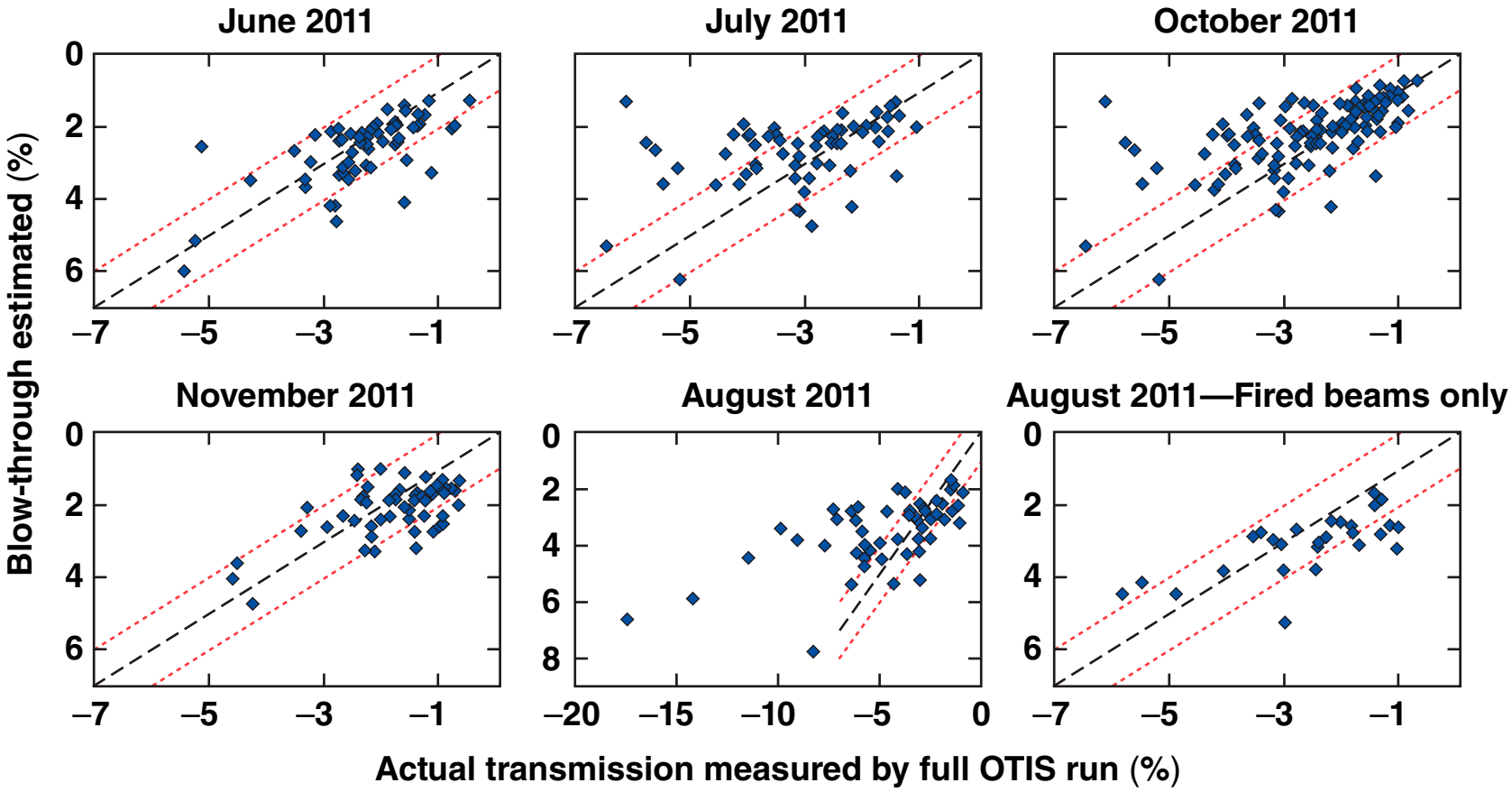
G9486

Examples of Blow-Through Estimated Individual Beam Losses Compared to Actual OTIS Measurements



G9487

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Log Number: 65145 UV On-Target / BWA Degradation Report
23-Feb-2012 19:57:16

Last BWA swap before this shot: 02/05/2012 # target shots since: 101
Reported losses are predicted from witness beam measurements taken on 02/22/2012 # target shots since: 15

Non-SG4 DPPs are not beam specific. Quoted transmissions are average for that DPP type.

Beam	HED On-Target UV Energy	Estimated BWA Loss	DPP	Estimated DPP Transmission	Adj. On-Target UV Energy
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68	497.8	-0.9%	E-SG4-865	98.8%	487.4
69	494.3	-1.4%	E-SG4-865	98.8%	481.6
Mean	483.9	-1.1%			467.6
RMS%	2.5	0.3%			3.6
P/V%	7.0	1.0%			10.3

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