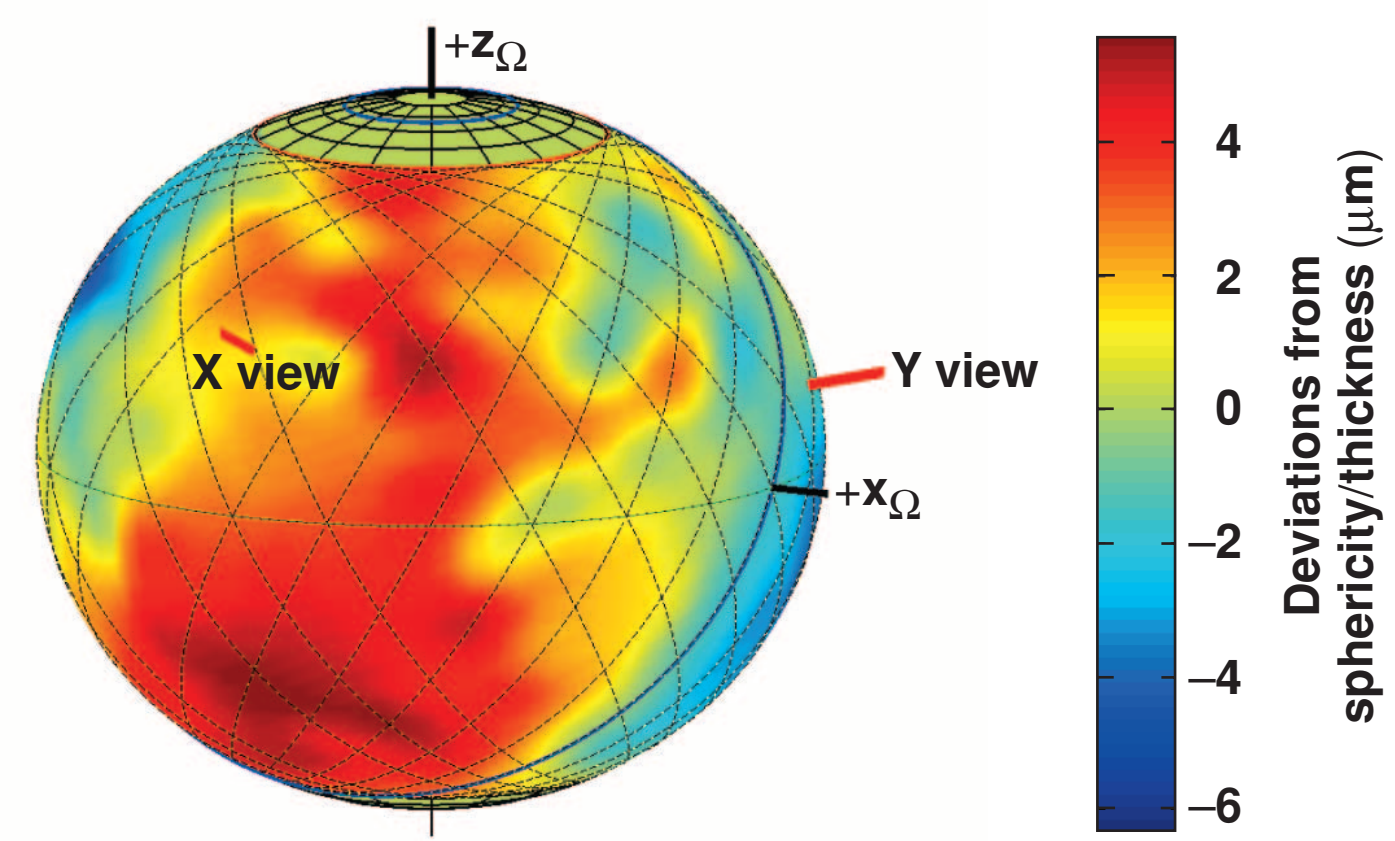
Cryogenic Target Characterization at LLE



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45th Annual Meeting of the
American Physical Society
Division of Plasma Physics
Albuquerque, NM
27–31 October 2003

Collaborators

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Summary

LLE has made significant progress in characterizing cryogenic targets

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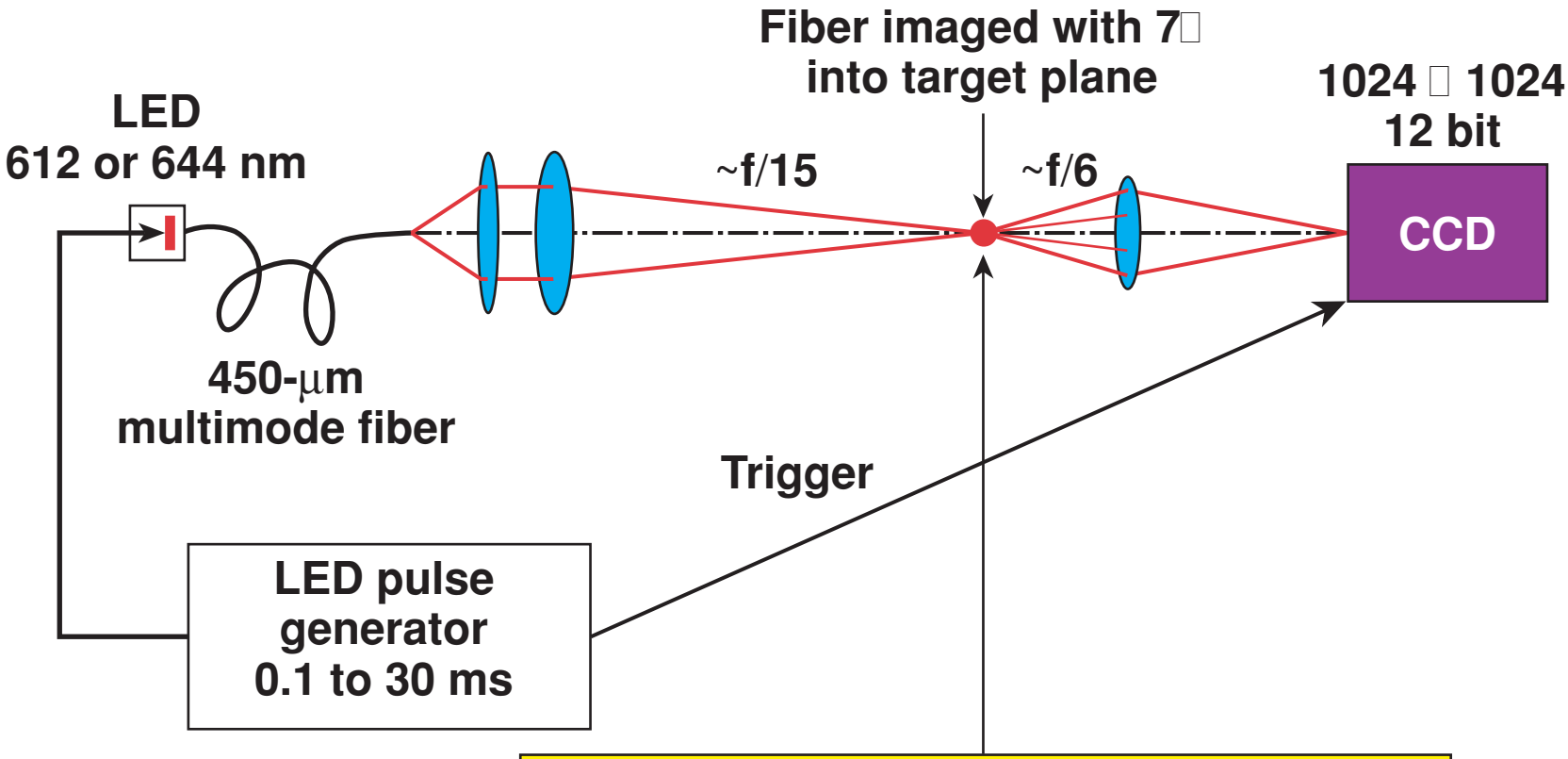
- 1-D ray tracing and 3-D optics codes are used to understand the imaging.
- Interpretation routines can handle spider web suspension and other surface perturbations.
- Multiple views during layering provide
  - average power spectra
  - 3-D surface images
  - spherical-harmonic decomposition ($Y_{\ell m}$)
- Targets are also characterized immediately prior to the shot.

LLE cryogenic target characterization is based on a diffuse f/15 source and f/6 (f/15) imaging optics

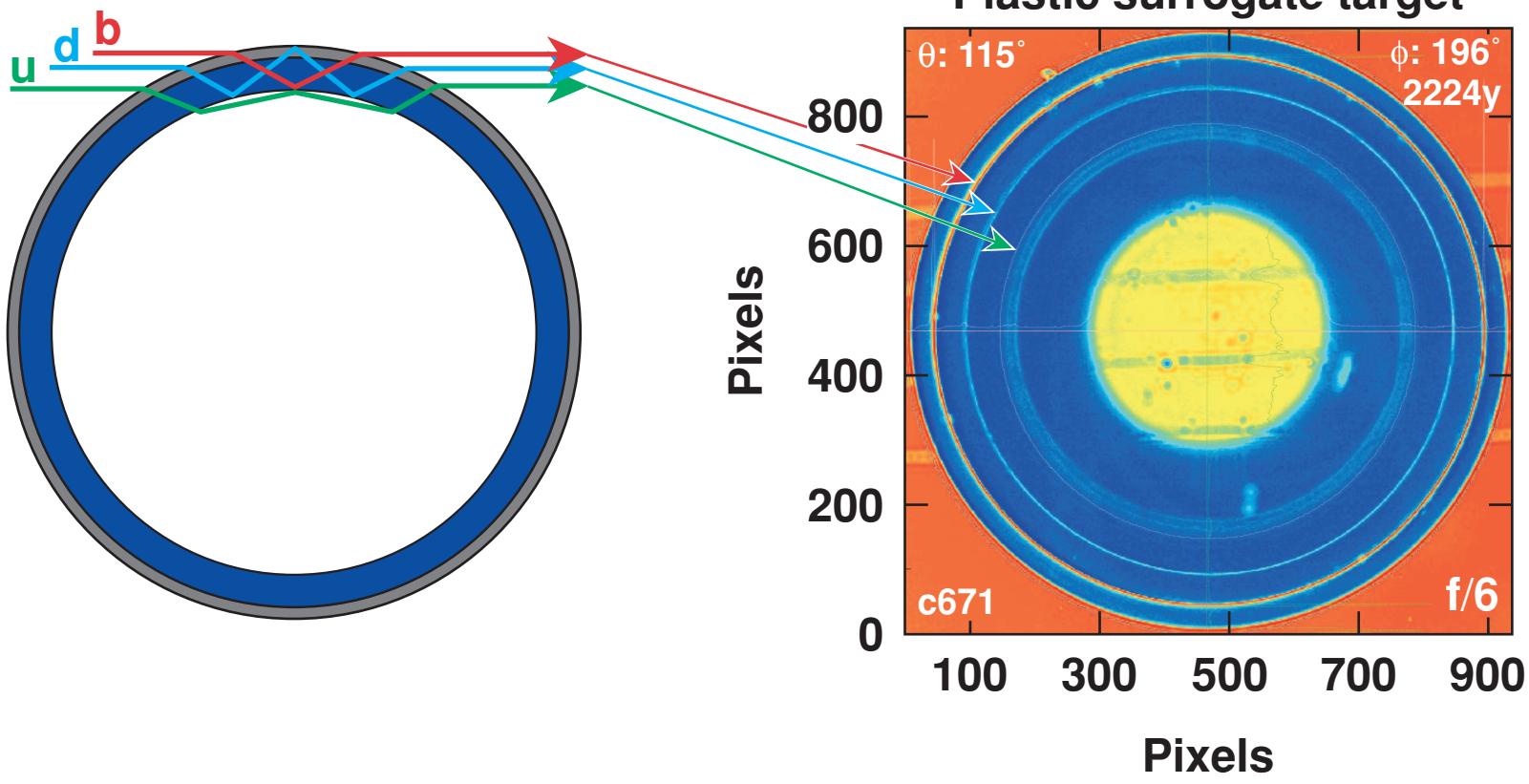


A pulsed LED light source and a high-quality CCD camera are used for target characterization

UR LLE

- High-brightness LED at 644 nm 0.2 ms exposures
- DALSA CCD triggers on LED pulse for timing and integration
- Darkfield and flatfield corrections improve image quality
- Rapid image transfer CCD permits images to be taken during last 50 ms before shot with minimum interference at shot time
- Sapphire targets serve to determine lowest order optical image distortions appropriate corrections are then applied to all images
- Sapphire targets also serve for calibration of target sized and measured target distortions via AFM-characterization

Various rings focus at different locations and encode different information that has been identified with the 1-D ray trace code

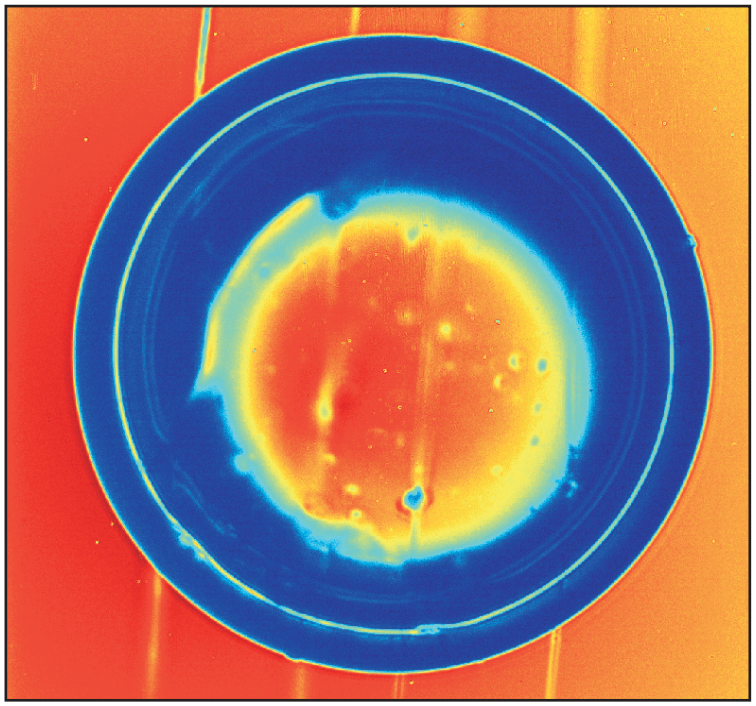


- In real cryogenic targets, the bright ring is located further inside, and the other rings are more closely spaced but still visible.

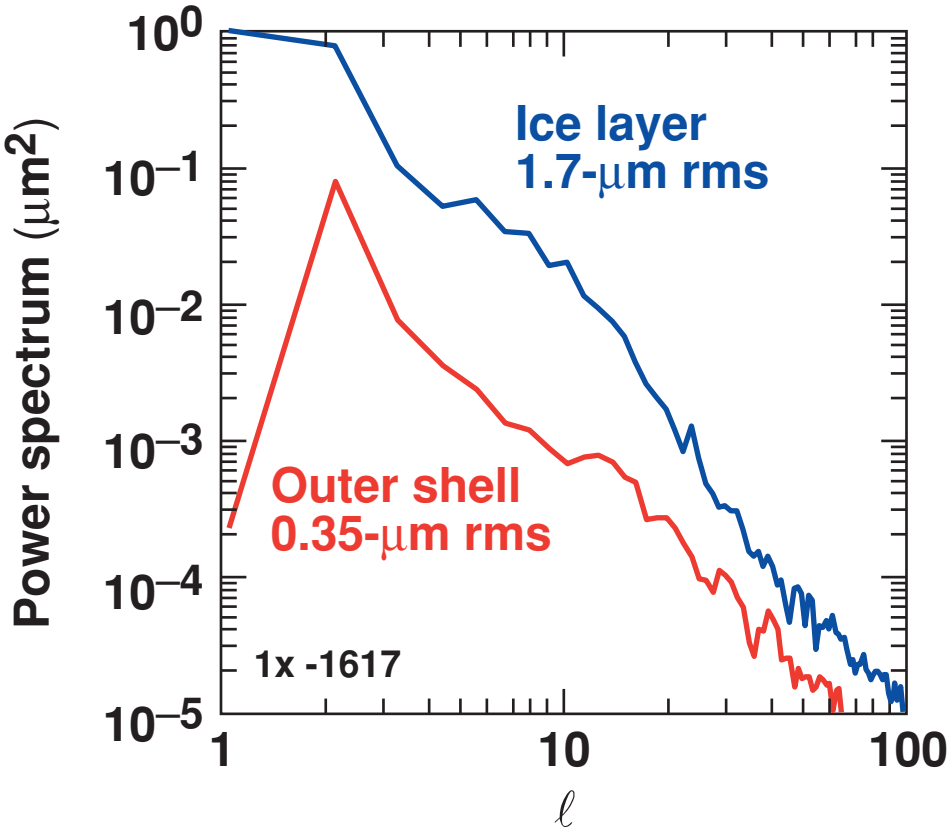
E12198

Recent D_2-ice layers with IR heating approach direct-drive ICF requirements at 1 to 2 times the equivalent tritium decay heating (Q_{DT})

UR LLE



Average spectra for 23 different angular views of the same cryo target



930-μm-diam OMEGA cryo target with 100-μm-D_2-ice layer and 3.5-μm-CH shell

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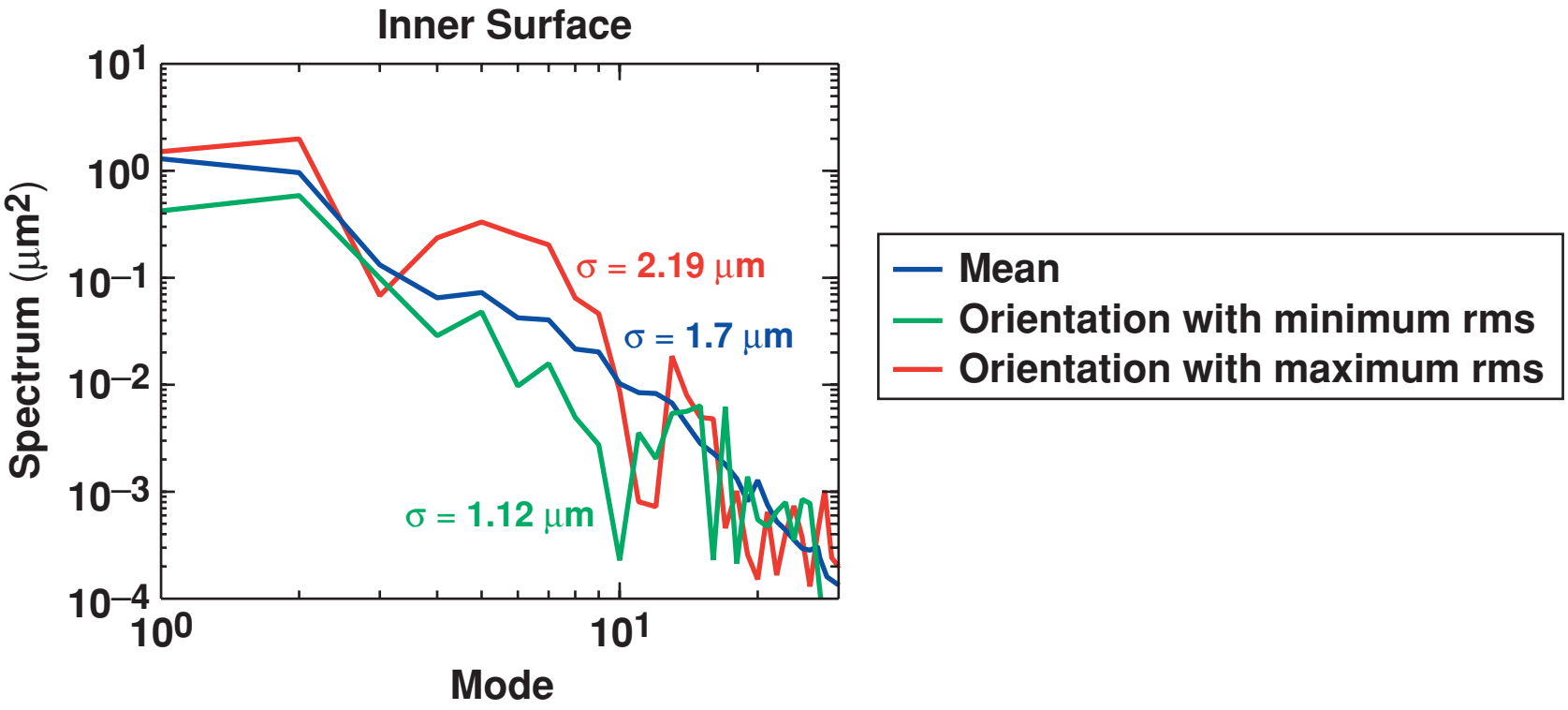
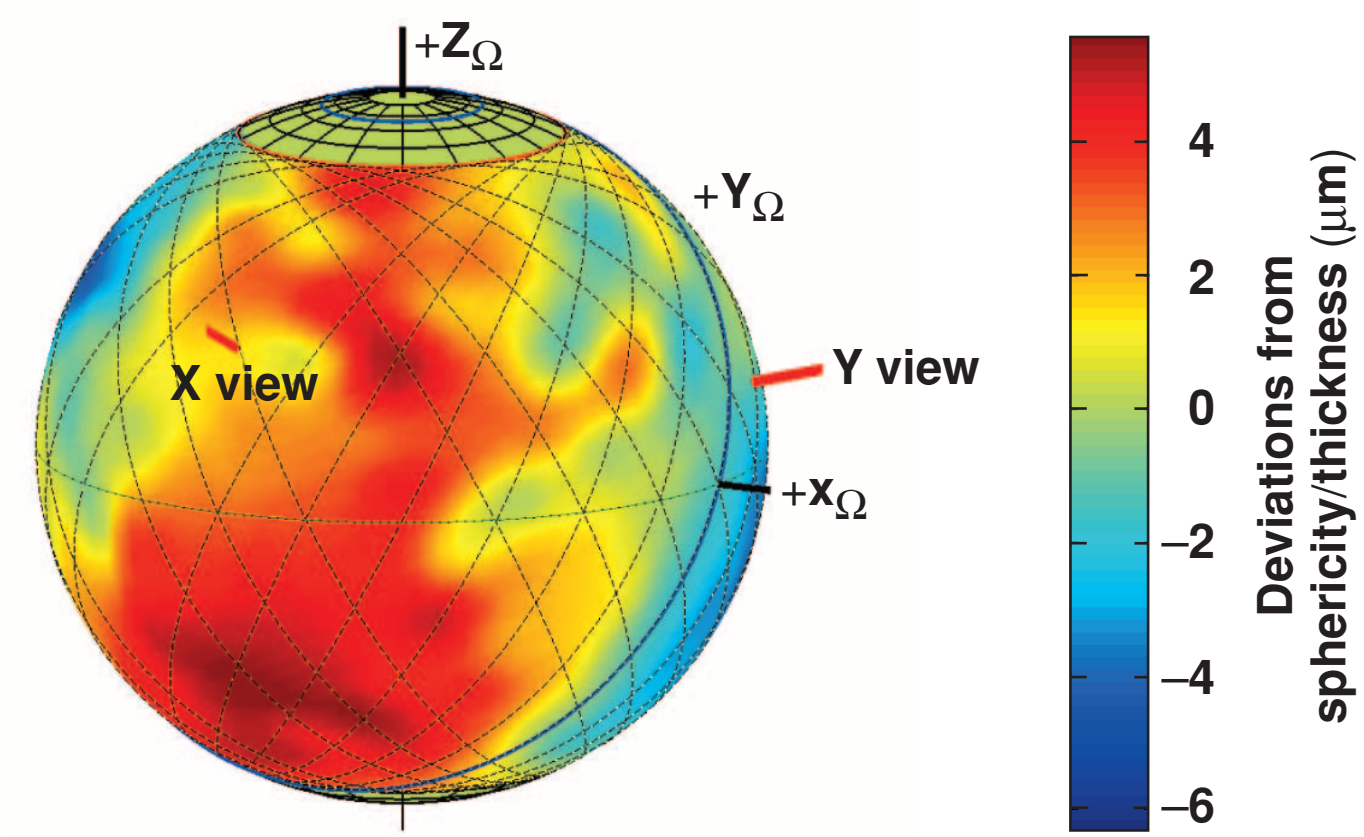
Different views give different ice roughnesses and spectra



The roughnesses from shadowgraphy are larger than from AFM – under investigation

Three-dimensional reconstructions have been obtained for cryogenic targets



- Surface position is mapped onto sphere.
- Data are smoothed.
- Information for low-order modes is provided.

A spherical-harmonic ($Y_{\ell m}$) decomposition up to $\ell = 8$ and including all m's has been carried over

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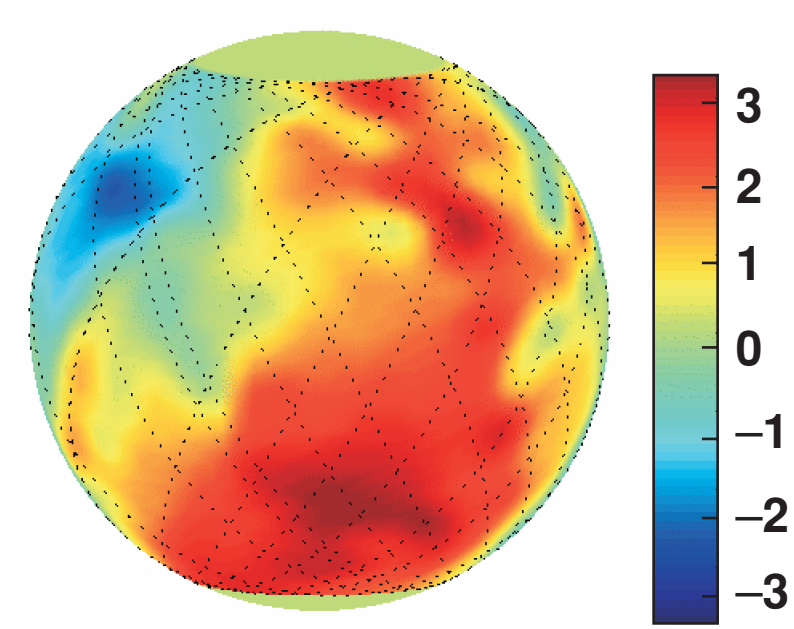
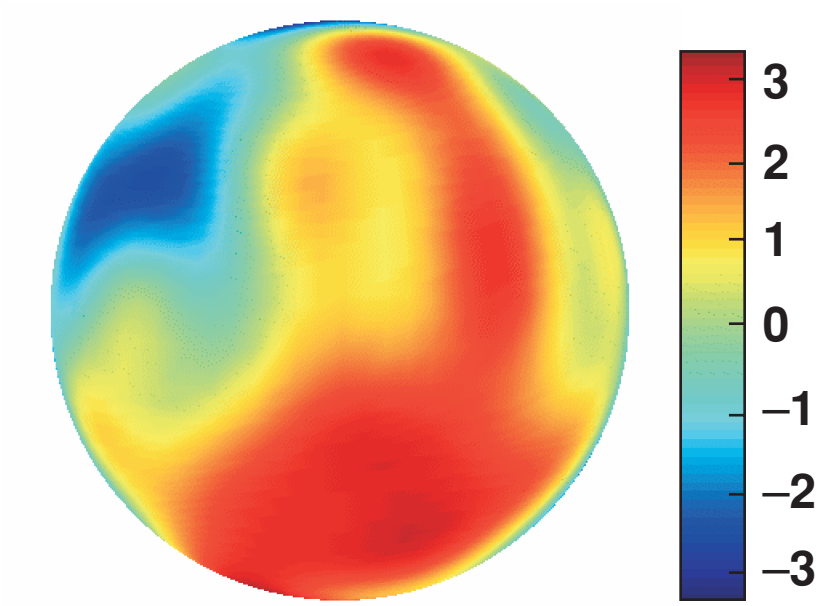
3-D reconstruction



Result of $Y_{\ell m}$ decomposition



E12608

A spherical-harmonic ($Y_{\ell m}$) decomposition up to $\ell = 8$ and including all m's has been carried over

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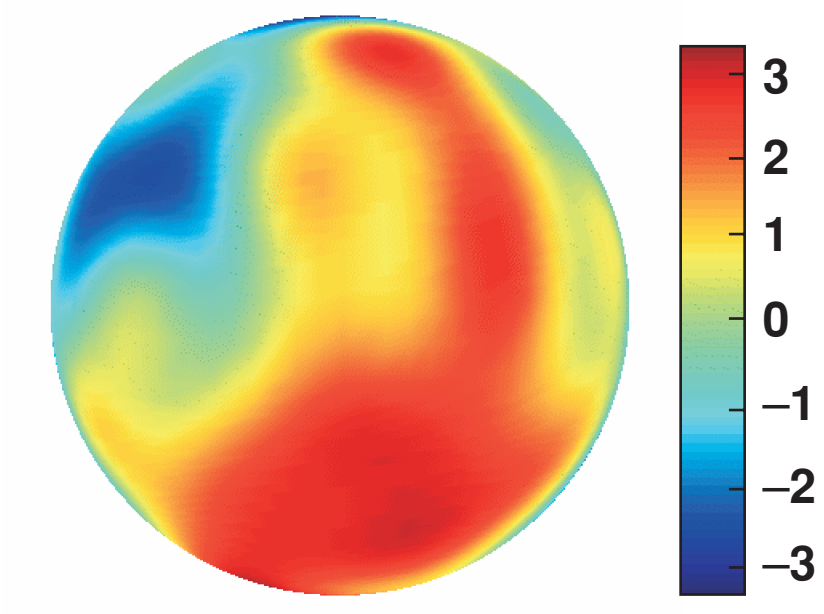
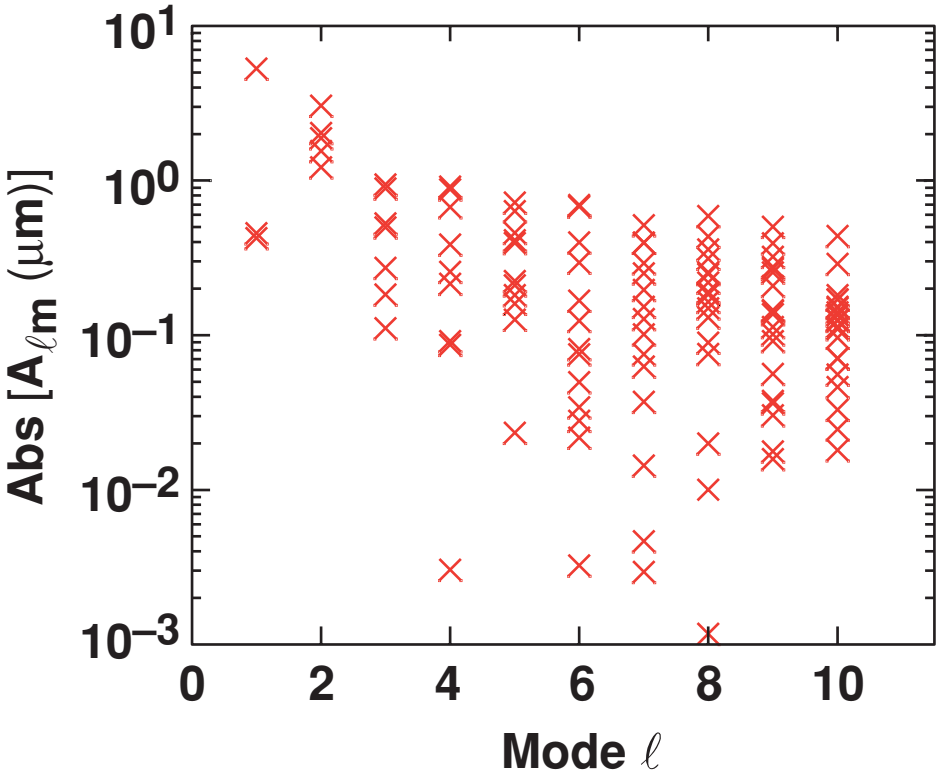
Result of $Y_{\ell m}$ decomposition



$A_{\ell m}$ coefficients for $\ell_{max} = 8$, target: cryo2038-220



E12609

Shadowgraphs are also taken of targets at shot time

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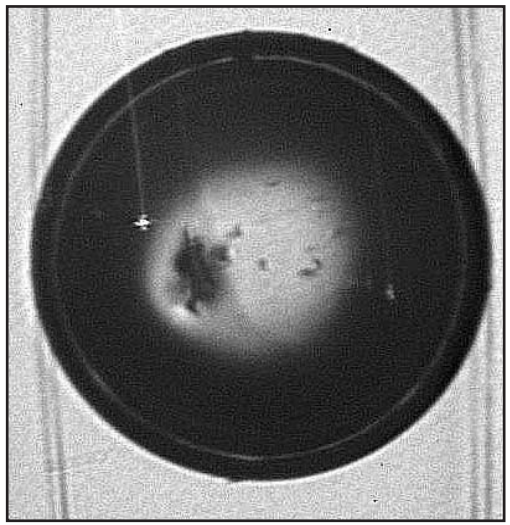
- A shadowgraphy system has been installed on the OMEGA target chamber.
- The target is observed after shroud removal, ~10 ms before the shot.
- Even though it is a static camera, the finite readout allows vibrational amplitude to be inferred.



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