



The Role of Data Driven Models in Optimizing the Operation of the National Ignition Facility

Presentation to
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NIF Laser performance modeling is a team effort, led by Brian MacGowan

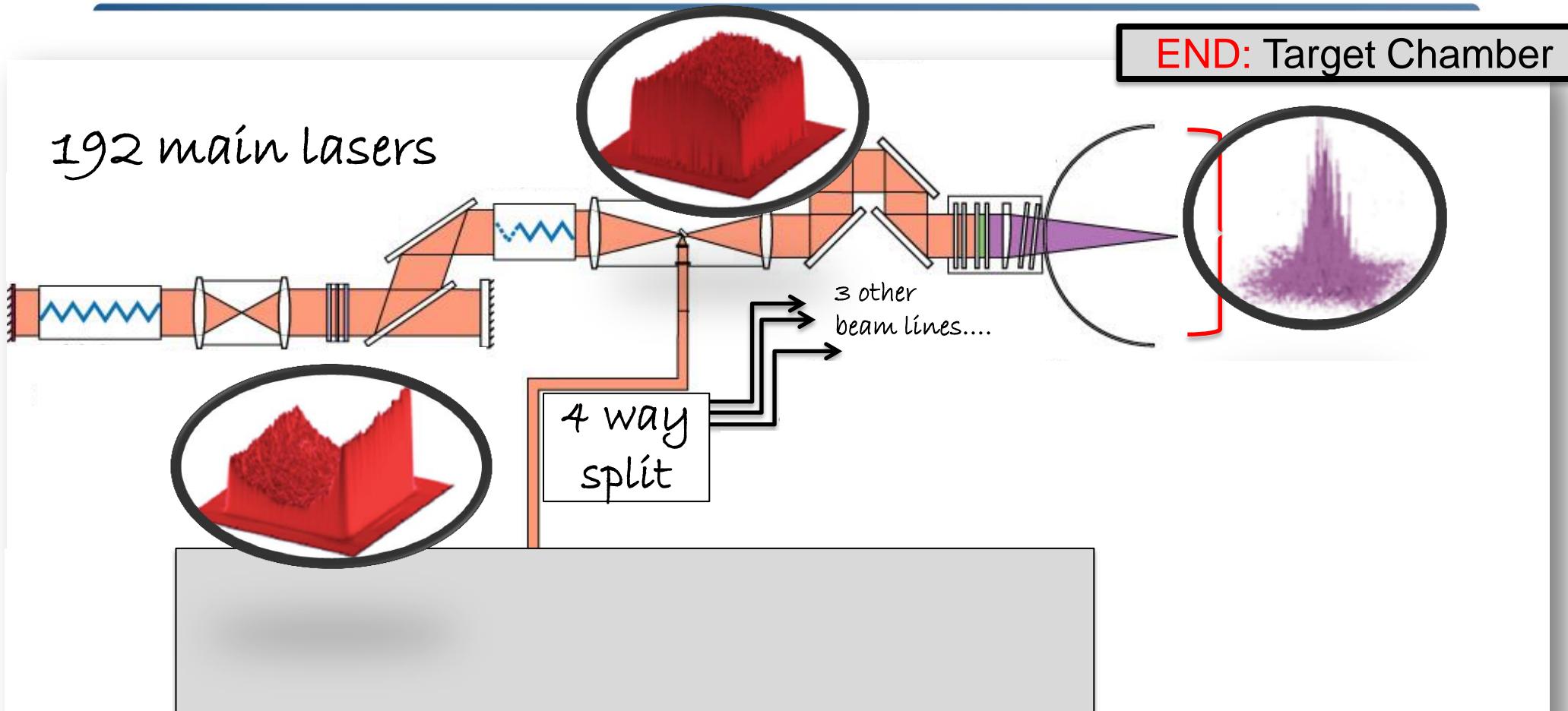
	Jean-Michel Di Nicola	Sham Dixit	Eyal Feigenbaum	Ron House
Brian MacGowan				
Program Leader				
	Rick Sacks	Mike Shaw	Clay Widmayer	Steven Yang
				

The National Ignition Facility

**August 13th, 2013, 1.7MJ shot, we achieved the highest DT neutron yield,
estimated at nearly 3×10^{15} (three quadrillion!)**



To deliver an accurate energy and pulse shape, we require a physics based simulation engine



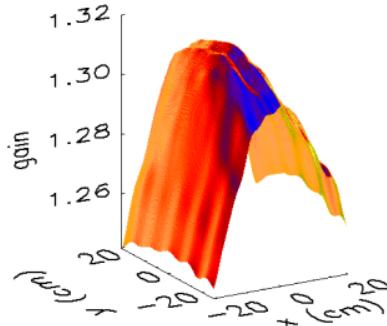
48 injection laser systems

BEGIN: Master Oscillator Room

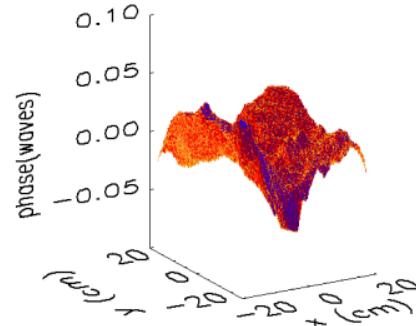
To achieve the desired pulse shape at the target chamber center **A**, we use a laser performance operations model (**LPOM**) to derive the input pulse shape **B**

LPOM provides the Virtual Beam Line (VBL) code with quantitative measurements from laser components

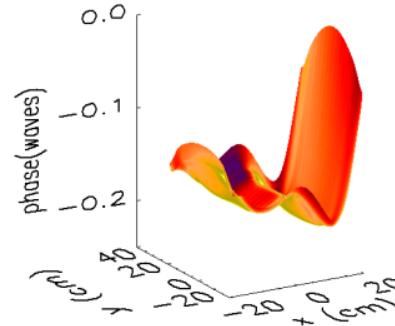
Gain Profiles



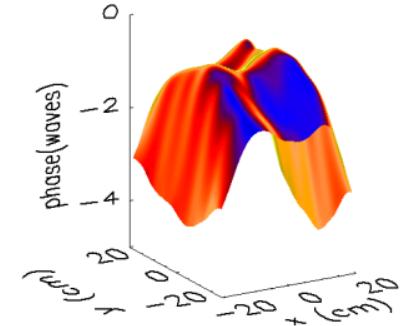
Optical Aberrations



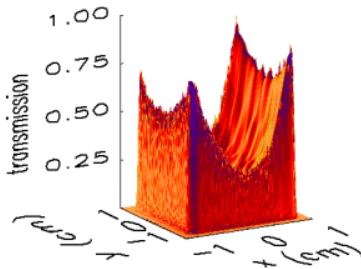
Thermal Distortions



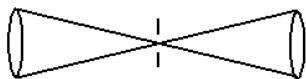
Wavefront Control



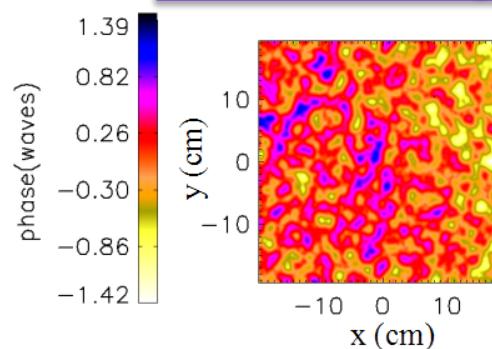
Beam-shaping Masks



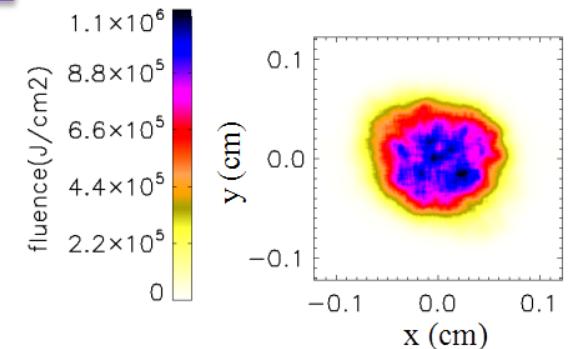
Spatial Filtering



Focal-spot Conditioning



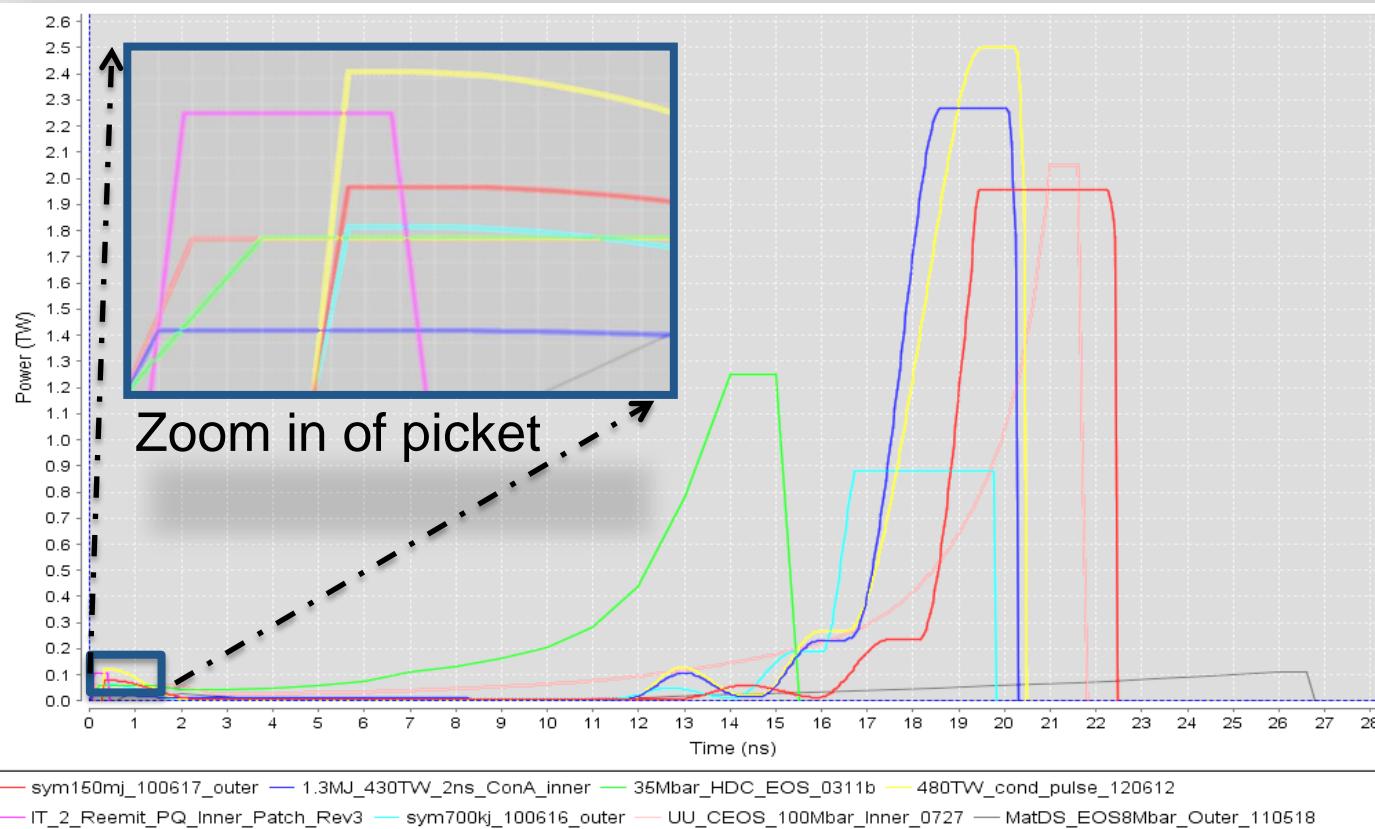
Final Focus



The **Virtual Beam Line** code simulates laser physics including: Frantz-Nodvik gain amplification, diffraction, nonlinear effects such as self focusing, and frequency conversion

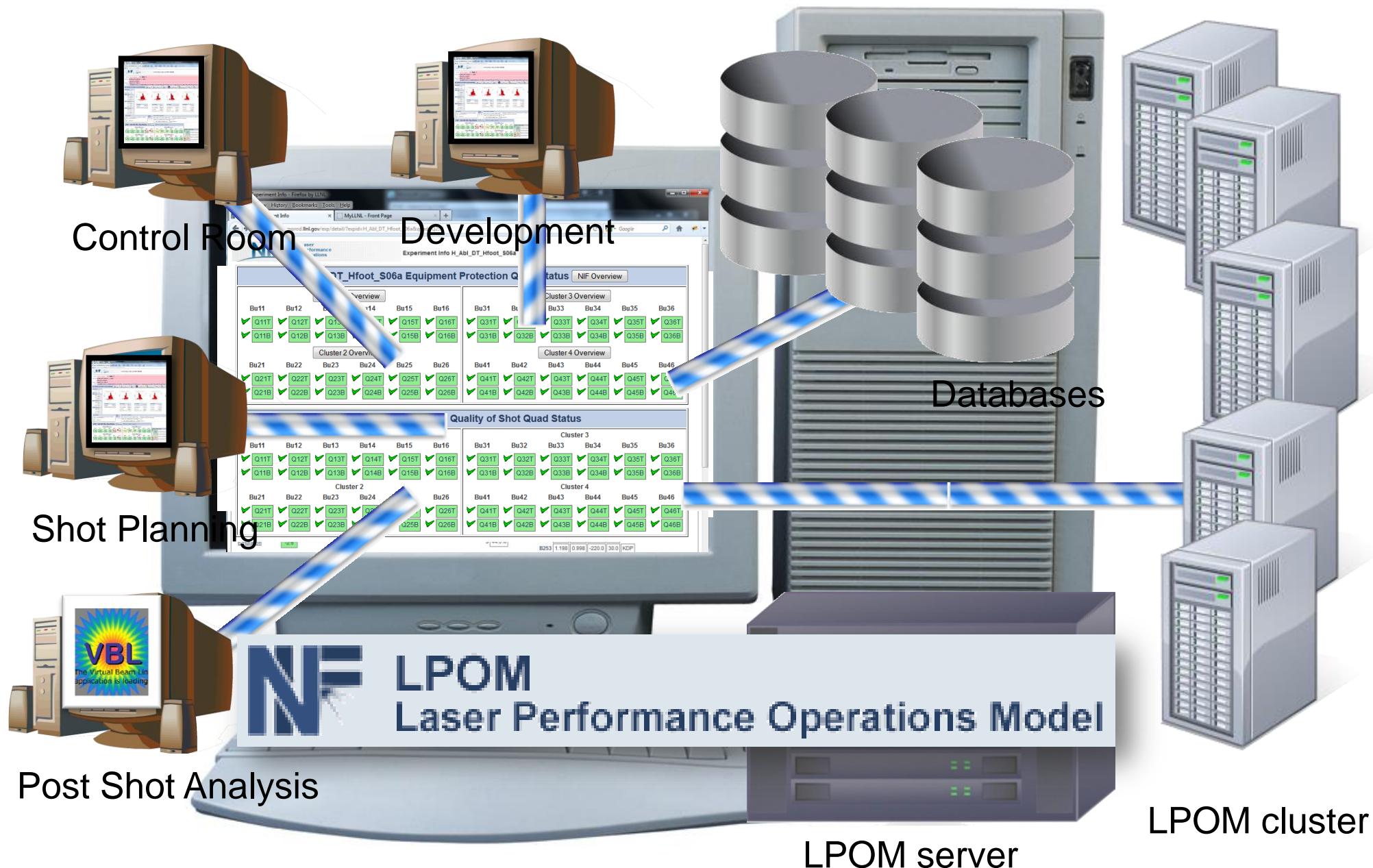
Delivering the pulse shape requires a detailed laser energetics model which is provided by LPOM

NIF operations require precisely specified energy waveforms from 192 beams for a variety of pulse lengths and temporal shapes

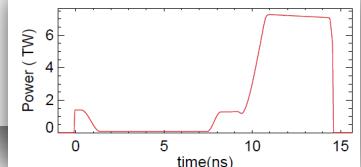
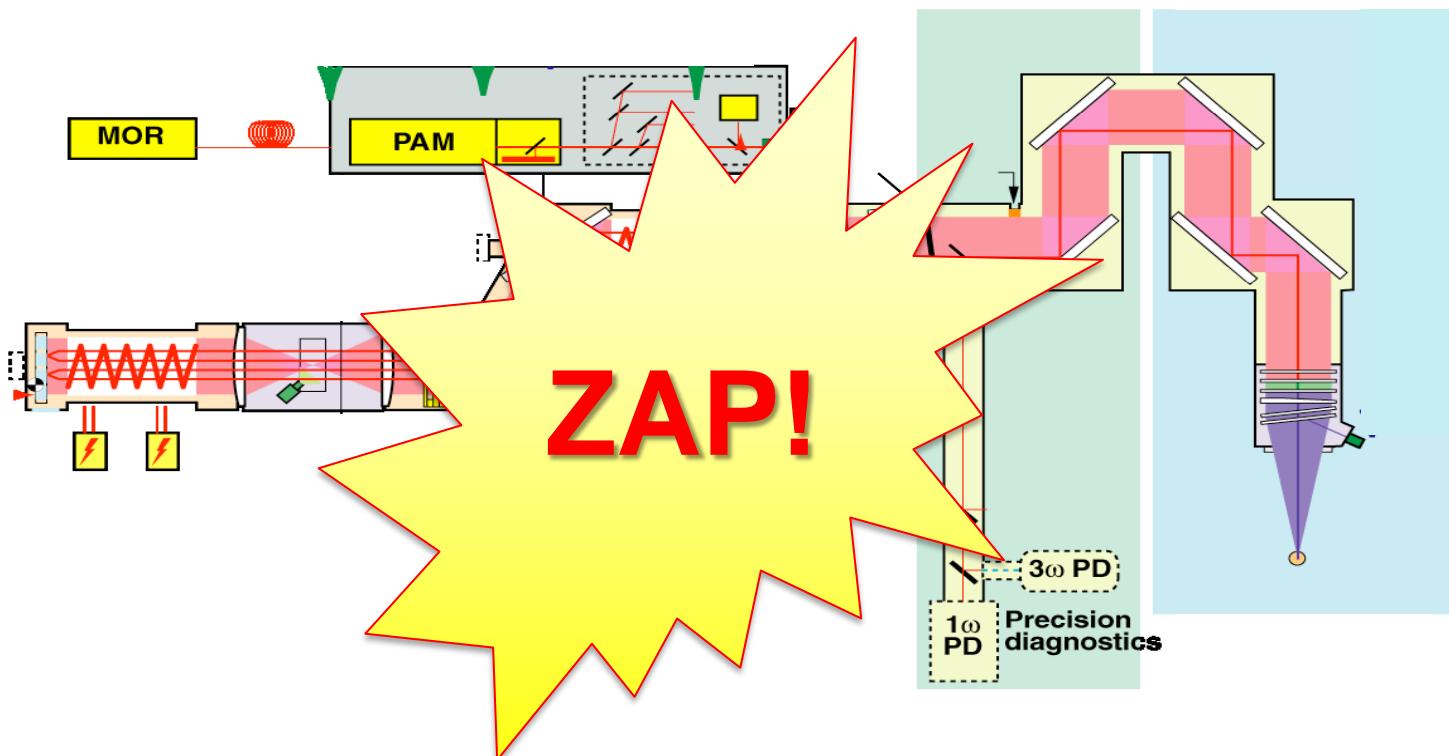


We need to operate at very high energy and power, but with low risk of optical damage

The Laser Performance Operations Model is used for planning, executing and interpreting each experiment

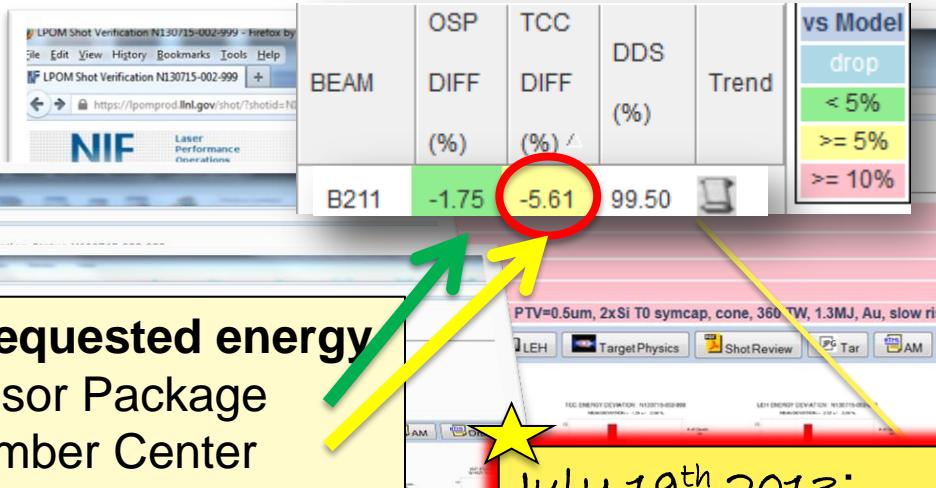


Results of shot performance are fed back into the LPOM/VBL model to improve subsequent shots



Shot performance is tracked with a dashboard web interface and the ability to drill into beamlines and quads.

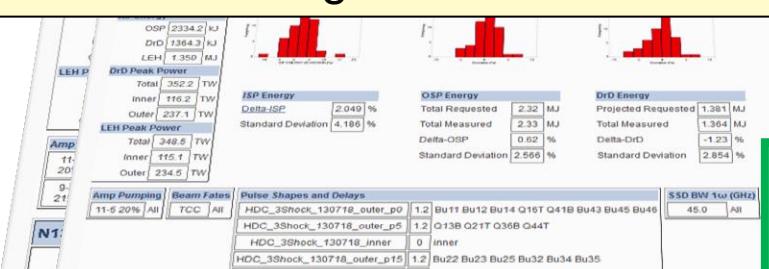
July 18th, 2013



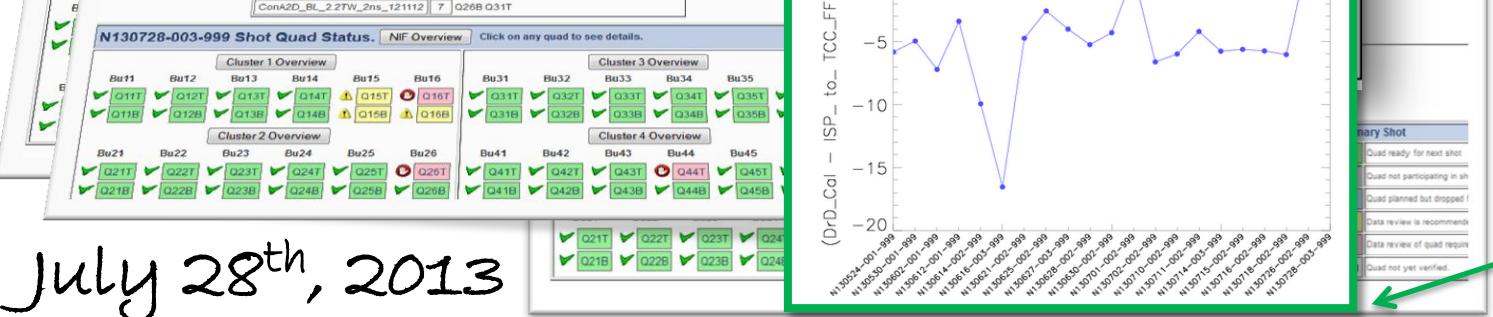
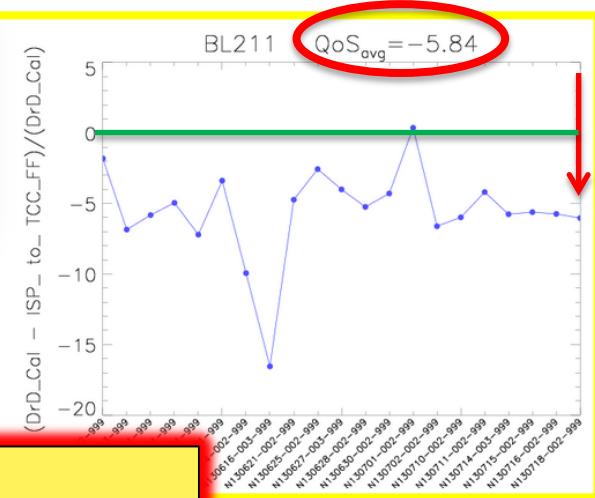
Metric: measured – requested energy

OSP: Output Sensor Package

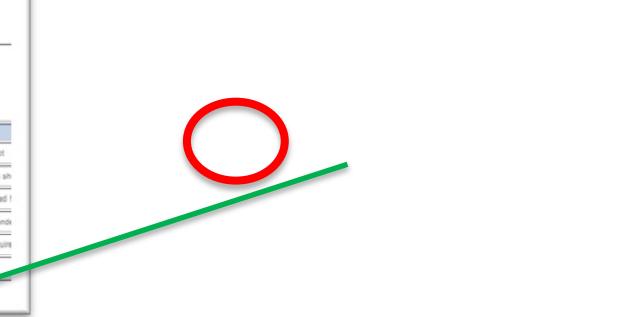
TCC: Target Chamber Center



July 19th 2013:
BL211 3w model adjusted

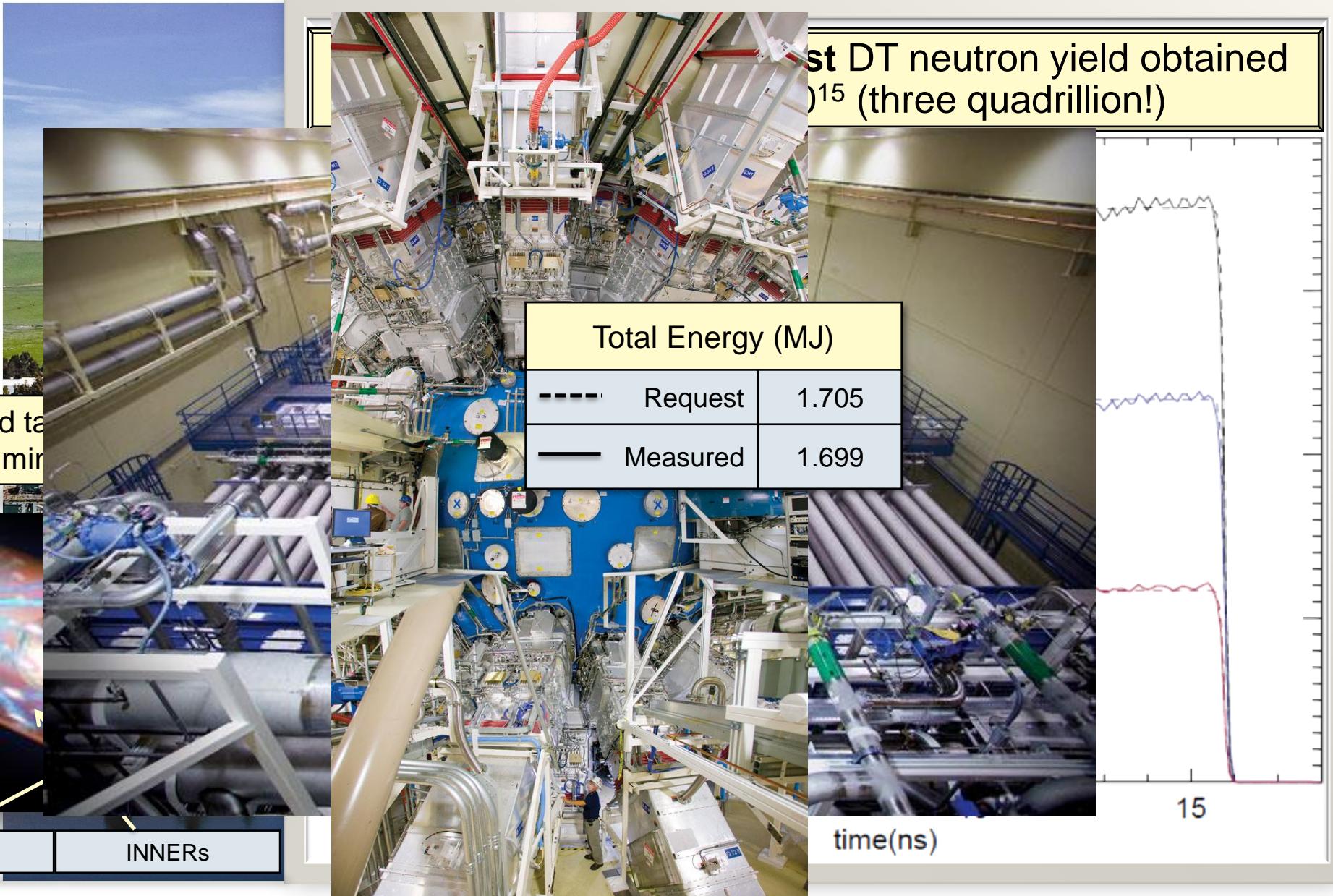


July 28th, 2013



Quality of shot **trending over time** by beamline is critical to adjusting dynamic laser performance to accurately deliver all 192 pulses

Our live physics model of the laser (LPOM/VBL) is key to our ability to deliver continued success!



NIF

