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PERFORMANCE OF A NOVA BEAMLINE WITH HIGH DAMAGE THRESHOLD GLASS

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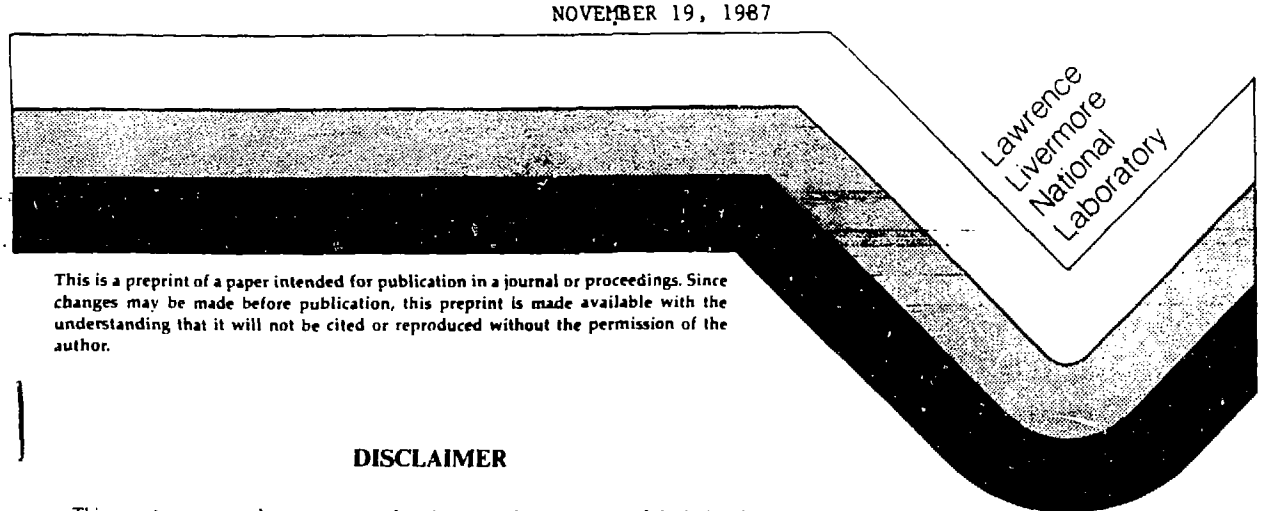

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Abstract

We report on measurements made on a Nova beamline whose output amplifier stages contain new high damage threshold, platinum particle-free laser glass. We project future operating limits for the Nova ten beam amplifier system.

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The Nova laser amplifier system at Lawrence Livermore National Laboratory was designed to deliver 80 to 120 kJ of 1.05 μm laser radiation in a 1.0 to 3.0 ns pulse to frequency conversion crystals. The crystals (Type II/Type II KDP) convert this efficiently to give 50 to 80 kJ of second harmonic or 40 to 70 kJ of third harmonic light which is focused onto fusion targets in a target chamber.[1] Single beam and full system trials done shortly after the completion of the facility demonstrated that the laser amplifier and harmonic conversion systems could easily meet these operating goals.[2] We are presently prevented from routinely operating at these levels because of the threat of damage to the glass in the output amplifier stages. The laser glass in the amplifiers and the BK-7 optical glass in other components contain a few particles per liter of small metallic platinum inclusions which cause damage to the glass at fluences exceeding 2.0 J/cm^2.[3] This has caused us to limit energy routinely available from Nova to 50 to 60 kJ at 1.05 μm which yields 20 to 25 kJ of the third harmonic on target.

Working with the laser glass manufacturers, we have developed

procedures for producing and inspecting large disks of platinum particle-free phosphate laser glass.[4] We are in the process of replacing the laser glass in the 31.5 and 46 cm aperture amplifier stages with this higher damage threshold glass and the BK-7 glass components in high fluence locations with components made of platinum-free fused silica. With the new glass in place, we will be able to significantly increase the energy routinely available for target experiments.

To test the routine operating levels possible after the changes are made, we have rebuilt and tested a single beamline as a prototype. The beamline includes a Type II/Type II crystal array and a dedicated third harmonic diagnostic station at its output.

We report on tests of this beamline at energies into the conversion array of up to 8.0 kJ in a 1.0 ns pulse and 12.0 kJ in a 2.0 to 3.0 ns pulse. We discuss both the linear and nonlinear optical characteristics of the beamline. Measurements made at low power include passive transmission, birefringence, amplifier small signal gain, and near field beam uniformity; those at high power include energy extraction and saturated amplifier performance, third harmonic conversion efficiencies, stimulated rotational Raman scattering limitations for long propagation paths in air, and power dependent near field beam uniformity.

From this data we project the energies routinely available in the future from the ten beam Nova laser and its present Type II/Type II third harmonic generation system. Limits are set by both the threat of damage to optical components and optical nonlinearities caused by the high power and energy of the beam.

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2. 1985 Laser Program Annual Report, Lawrence Livermore National Laboratory, Livermore, CA, UCRL-50021-85 (1985), pp. 5-2, 5-5

3. D. Milam, C.W. Hatcher, and J.H. Campbell, "Platinum Particles in Nd:Doped Disks of Phosphate Glass in the Nova Laser" in Seventeenth Boulder Damage Symposium, Boulder, CO (Oct. 1985) UCRL-93253

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