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It has been shown theoretically[1,2] that dye switched ruby laser giant pulses could be of short ~ 6 ns duration. In practice, however, such lasers generally produce 12-25 ns long pulses. Bradley et al[3] reported extensive ruby damage when they obtained a 9 ns pulse. The discrepancy between theoretical and operational pulse lengths has been explained[4,5] by the differential rate of switching in various parts of the active volume. The hypothesis has been confirmed for both passive and active switching. Ambartsumian et al[5] showed that by applying small (~ 1.5 mm) apertures within a Kerr-cell switched system, the predicted short pulses have been obtained. The usual 'long' pulses are only the envelope of such local pulses time-averaged over the whole volume. Korobkin et al[6] have time-swept the field pattern of a passive switched system with an electron optical converter. Their results also indicate that small regions are associated with short pulses. The small aperture drastically reduces the available power. For many applications it would be desirable to have such short pulses with substantial power.

Here we report the achievement of a short (4-8 ns) giant pulse effectively over the full volume of the ruby in a simple dye-switched system. This consisted of a 100% dielectric mirror, ~ 8 mm aperture, cryptocynine dye cell, a Linde S1Q Ruby 10 cm long, 1.2 cm diameter 60° orientated and a ~ 66% 3 plate resonant reflector. The purpose of the latter was to prevent mode locking and the consequent damage to components. Total cavity length was 40 cm. A typical pulse of the photodiode -519 Tektronix oscilloscope monitor is shewn in Fig.1a for the ex-focal cavity.

The likely explanation for this behaviour is the pumping light distribution of the ruby. The short pulse was obtained first with a ruby pumped in an ex-focal elliptical cavity. The same was repeated with the oscillator section of a standard Korad K-1500 system, where the ruby is pumped by a helical flashlamp, also noted for its uniformity. In this case the full aperture gave consistently ~ 8 ns pulses and by reducing it to 5.0 mm, 5 ns pulses were obtained. Fig.1b shows the pulse for full aperture. The shoulder on the pulse indicates that the outer region switched later, presumably because only the central 5.0 mm section was pumped uniformly. No shoulder was observed when the aperture was limited to 5 mm.

All components in the two experiments were identical, except for the pumping systems and the rubies. The short pulses were obtained only when maximum pumping energies were used, presumably because that also enhances uniform pumping and gain dependent pulse sharpening.

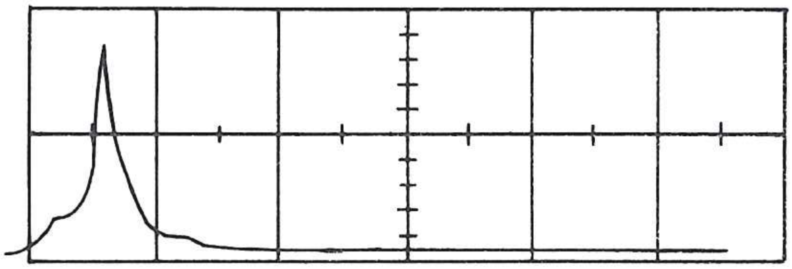

Fig.1a Pulse from Exfocal elliptical pumping cavity (1500 joules input). Energy 0.5 joules; Time scale 20 ns/division.

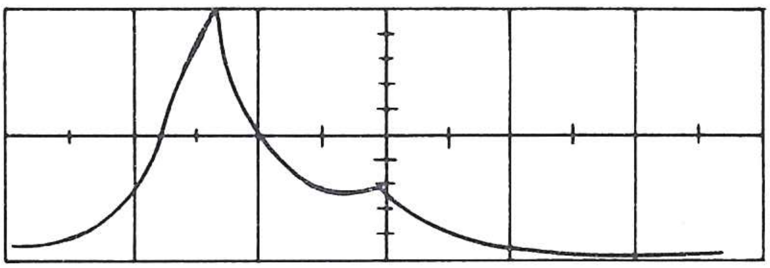

Fig.1b Helical pumping (5300 joules input) pulse energy ~1.0 joules. Time scale 10 ns/division.

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