

Acousto-optical mode-locking of a cw Nd:YAG laser

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A cw Nd:YAG laser was mounted on an optical rail with very good stiffness. The YAG rod used had a diameter of 3 mm and a length of 56 mm. Both ends of it were AR coated. A Kr lamp and the crystal rod were placed on the two focuses of the single elliptical cavity between two parallel plates. The reflectivity of the wedge-type output mirror was measured to be 95% at the wavelength of $1.06 \mu\text{m}$. A Brewster window and a field stop were inserted into the resonator. These Bragg acousto-optical modulators could be made of ZF_6 glass or PbMO_4 media. A driving frequency of 100 MHz was chosen for the transducer. The two mirrors of the cavity were placed at a distance of 750 mm. In order to realize small changes of the length of the resonator, a special mirror support and a vernier micrometer gauge with increments of $1 \mu\text{m}$ were designed.

When the acousto-optical modulator was placed near the output mirror and at a Bragg angle with the laser device, polarized TEM₀₀ output could be achieved by fine adjustment of the resonator. The driver was allowed to warm-up for 40 minutes. Then stable mode-locking pulse trains were detected on a SAS-5009B sampling oscilloscope by a FO-RAPD avalanche diode with pulse width of 200 ps and pulse separation of 5 ns. Average detuning was observed on a BP-1411 spectrum analyser. When single pass losses of the modulator δ_L were less than 3%, these mode-locking pulse trains became unstable, but they turned stable as soon as δ_L equalled 6~10%. It was noted that etalon effects were deliberately suppressed. As the driver was switched off, a series of self-locking pulse trains appeared.

连续 Nd:YAG 声光锁模激光器

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连续 Nd:YAG 锁模激光器放在刚性很好的导轨上。整个实验期间用一根 3 毫米 × 56 毫米的 YAG 晶体棒, 两端面镀 1.06 微米增透膜。连续氩灯和晶体棒分放在单椭圆腔的焦点上, 采用平行平面谐振腔, 楔形输出镜对 1.06 微米反射率为 95%, 腔内插入布儒斯特玻璃片和光阑。声光调制器的介质分别为 ZF_5 玻璃和 $PbMO_4$ 晶体, 换能器的驱动频率为 100 兆赫。谐振腔镜间隔为 750 毫米。为了腔长有微量变化, 特殊设计了镜片固定架和 1 微米微调计。

当声光调制器与激光器光轴成布拉格角放置, 并靠近输出反射镜时, 精心调整激光器达到 TEM_{00} 模偏振光输出。驱动电源预热 40 分钟以后, 输入电功率 1.6 千瓦, 用 SAS-5009 B 取样示波器和 FO 型 RAPD 雪崩二极管观测到脉宽为 200 微微秒, 脉冲间隔为 5 毫微秒的稳定锁模脉冲列。脉冲列平均功率 180 毫瓦。实验中用 BP-1411 频谱仪已观测到正负失调时的差拍频谱。当调制器单程损耗 $\delta_L < 3\%$ 时, 锁模脉冲很不稳定; $\delta_L = 6 \sim 10\%$ 时得到稳定的锁模脉冲, 整个系统注意到消除标准具影响。当断开调制器驱动电源时, 获得自锁脉冲列。