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GROUP-1
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CONTRACT [ ]

25X1

PAR 217

1 June 64

SUBJECT: Optimization of the Laser

TASK/PROBLEM

1. Explore the production of 0.5 micron (blue-green) laser radiation by harmonic doubling in KDP and AOD crystals.

DISCUSSION

2. Work on this project was authorized 2 March and study began in early April. A laboratory setup has been made to generate and detect the 5300A second harmonic component from a neodymium laser.

3. The set-up consists of a 12-inch neodymium laser mounted on one end of a heavy duty optical bench and enclosed in a "light-tight" cavity. At the output end of the cavity is a one-inch aperture covered with a visibly opaque, infrared transmitting filter flass. This
25X1 filter material, [ ]2540, transmits about 80% of the fundamental 1.06 micron radiation. Outside of this light-tight cavity, but also mounted on the optical bench, is the one-inch square, 5mm thick K.D.P. crystal held in a micrometer controlled precision gimbal mount. A piece
25X1 of [ ] 2043 heat absorbing glass is placed in the beam between the crystal and the green light detector to filter out the residual 1.06 micron radiation. The detecting element currently being used is a 929 photocell with an integrating circuit which provides a D.C. voltage proportional to the incident 5300A radiation.

4. The initial results from this study indicated that our K.D.P. crystals were not optimally oriented. Further, measurements indicate that the angle between the surface normal and the optical axis of the crystal should be approximately 46°, rather than the present 41°.

5. Measurements were also made to determine the 5300A output as a function of the crystal rotation. The results, which we believe to be accurate to 10% show this output decreasing to 50% of peak in 1/6° rotation with a further decrease to 10% of peak in less than 1/2° rotation as shown in Figure 1. This agrees well with available published data.

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Graph of relative output vs crystal orientation
in harmonic doubling of laser radiation

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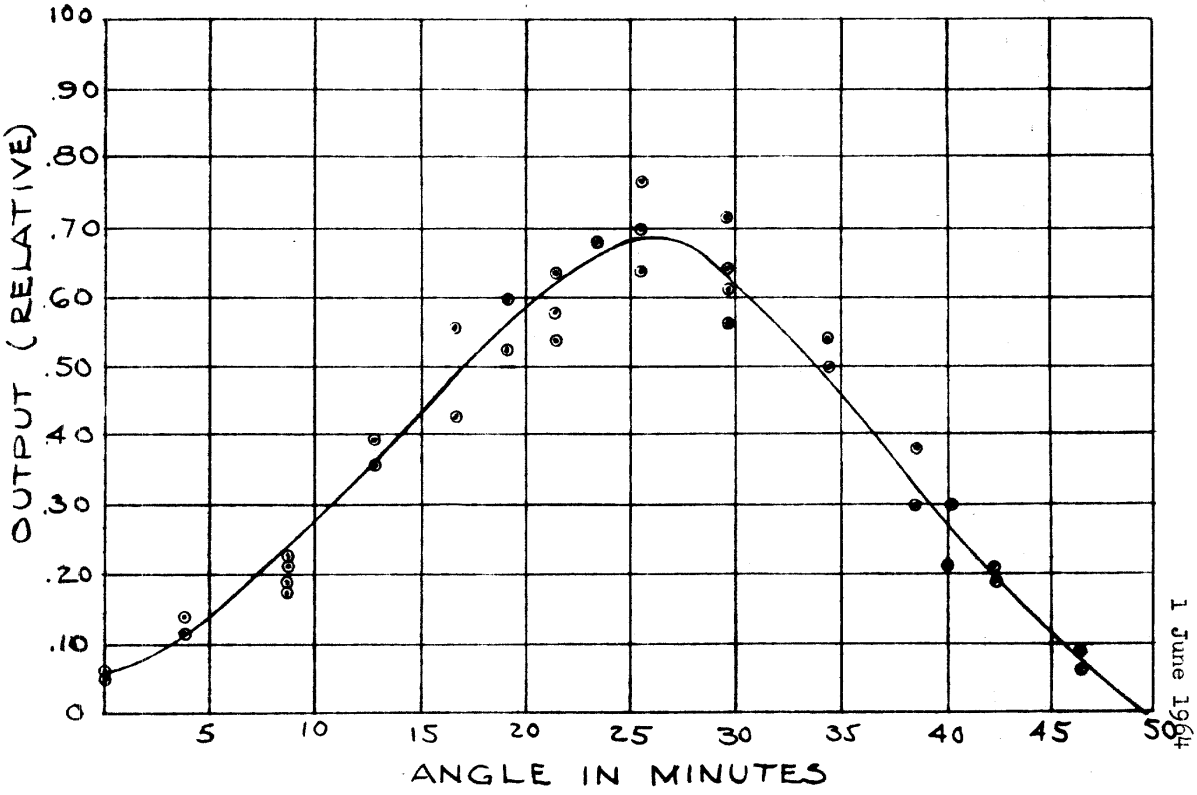

Figure 1

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6. Currently we are awaiting three more K.D.P. crystals from 25X1 [redacted] with the optical axis oriented at 46° to the surface normal. Two of these crystals are 1.5 inches square and 5mm thick, the third is one inch square and one cm thick.

7. Also during the quarter, a visit was made to [redacted] 25X1 25X1 to discuss the plasma pinch experiments of 25X1 [redacted] in one of which the discharge acted as a laser pump. This approach is interesting as it provides high-intensity pumping in a very narrow spectral wavelength region as opposed to the more conventional black-body radiation pumping with flash tubes. The pinch pump has the advantage of reducing radiative heating of the laser rod. It is hoped that this technique in combination with harmonic doubling can produce 5300A radiation at high repetition rate.

PLANNED ACTIVITY

8. During the next quarter effort will be aimed at increasing the intensity of the second harmonic output. Techniques such as optimizing the incident 1.06 micron beam pattern, focusing the beam on the crystal, Q-switching, using two or more crystals in series, etc. will be tried. The results of this effort hopefully will be quantitative data on both output intensity and efficiency.

9. In addition, to this, effort will also be directed toward developing the theta or plasma pinch technique as an optical pump for high repetition rate laser operation. Discussions with [redacted] at 25X1 25X1 [redacted] have indicated feasibility in this area, and he has outlined several of the basic operational requirements. We have a power supply which will be tried as the driving source. We also have several argon-filled pinch tubes and are in the process of assembling the experimental equipment.