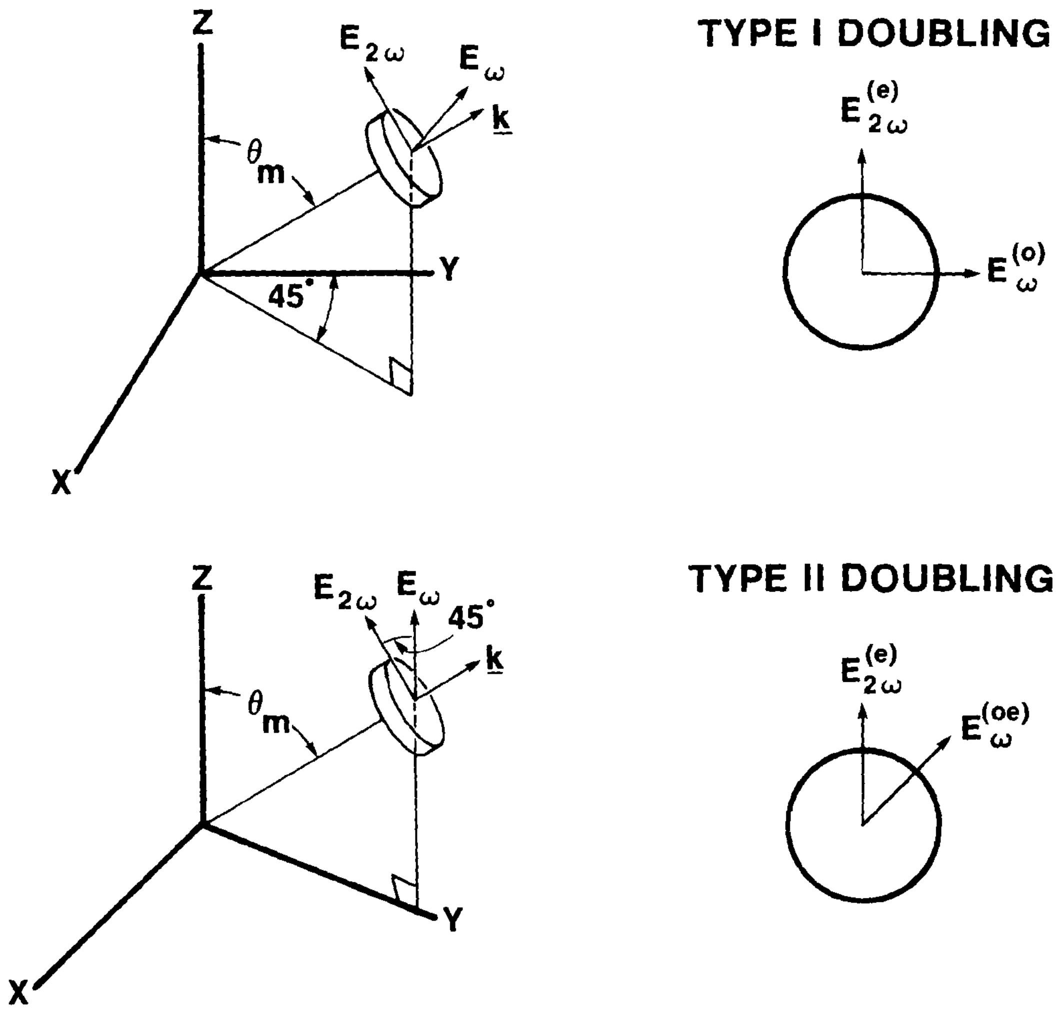

Figure 8 *Type I and type II doubling with KDP crystals. In both cases, the Z axis is the extraordinary (optic) axis of the crystal while the X and Y axes are the ordinary axes of the crystal. The propagation direction of all waves is given by the vector* **k**. *In type I doubling, the incident E vector of frequency* ω *has only ordinary components. In type II doubling, the incident E vector has a component along the extraordinary direction.*

intensity for several tilt angles $\Delta\theta$ of the crystal. It can be seen that for $\Delta\theta=0$, conversion efficiencies to 2ω of over 80% are obtained. These results are in excellent agreement with predictions of the code MIXER. Beam spatial and temporal profiles are incorporated into these simulations. When the crystal is tilted slightly, the conversion efficiency drops, again in very good agreement with MIXER. One way of obtaining the optimum 67% conversion efficiency to 2ω (for later conversion to 3ω) is to tilt the crystal about 0.6 mrad as indicated in Figure 9. By doing this, the correct conversion efficiency is obtained, and the response is relatively insensitive to intensity which is advantageous if there are spatial variations in the beam profile. The results obtained to date (> 80% conversion to 2ω) coupled with the superb agreement between simulation and experiment are very encouraging. Preliminary results for 3ω conversion appear equally promising. The prospects for short wavelength laser fusion experiments are good.

2.B Laser Plasma Interaction Experiments

Basic studies of the laser plasma interaction are continuing on the GDL laser system at LLE. During this quarter, two consequences of energetic (suprathermal) electron production during high intensity laser light absorption have been studied: hard x-rays and fast ions. By measuring these signatures of suprathermal electrons, properties of the suprathermal distribution can be inferred, such as the effective suprathermal temperature, T_H. These experiments examined the effect on T_H of a carefully controlled prepulse of variable energy preceding the main 50 psec pulse. The properties of the suprathermal distribution are of considerable importance to laser driven implosions. If an excessive amount of the absorbed energy appears in very energetic electrons, detrimental preheat of the DT fuel can occur. Energetic electrons also

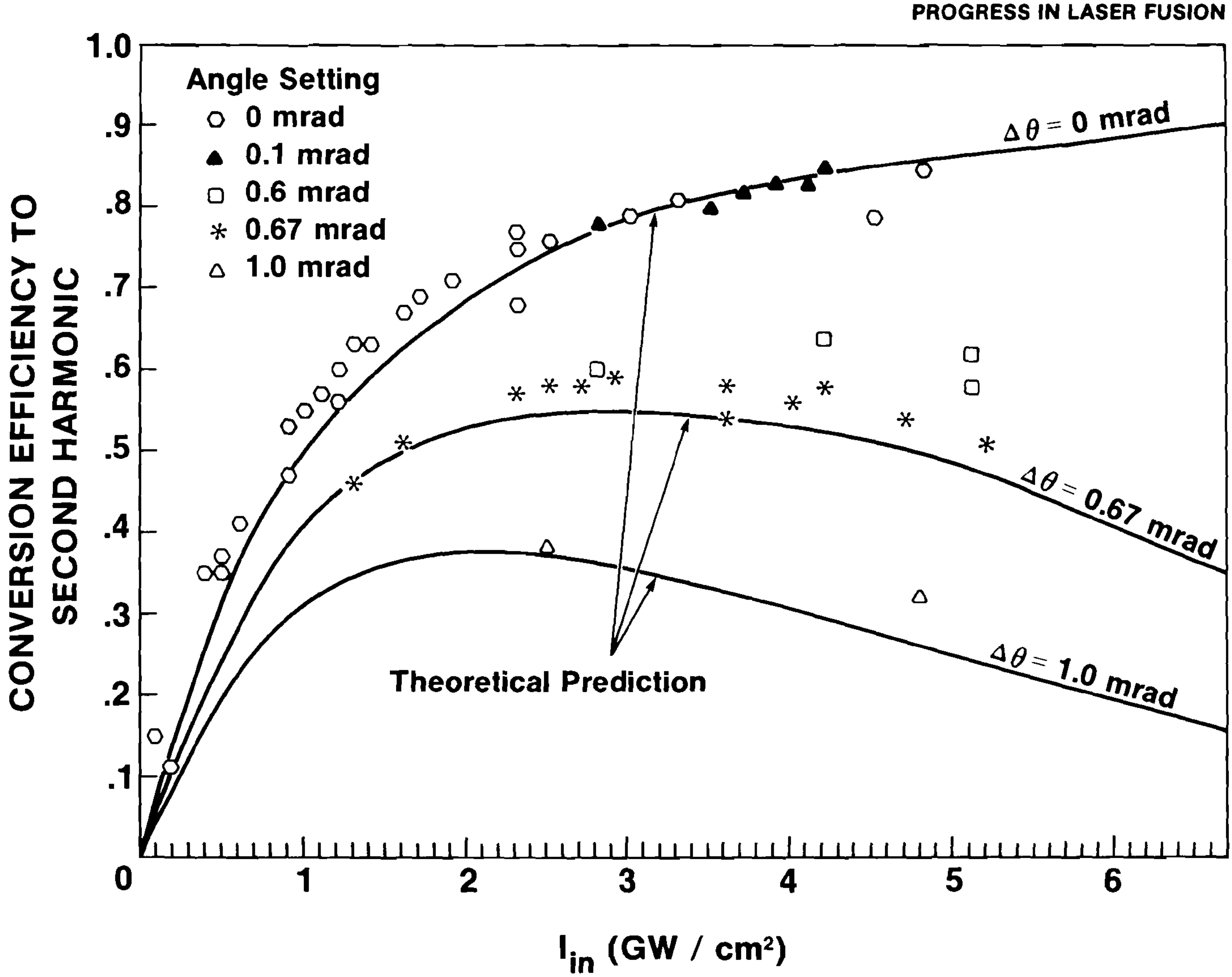

Figure 9 Frequency doubling energy conversion efficiencies obtained with a 12mm thick type II KDP crystal on GDL for various tilt angles of the crystal. The theoretical predictions were made with the computer code MIXER.

can be efficient at accelerating fast ions outward from the target, an inefficient use of energy for driving implosions. It is therefore of some interest that in these experiments prepulses have the effect of reducing T_H and of decreasing the amount of energy in fast ions. Similar effects have been indicated by experiments elsewhere[3,*].

The GDL beam was configured for two beam irradiation and surface focused onto 80μm diameter (0.8μm wall) empty glass microballoon targets. In one set of experiments, prepulses of variable energy were introduced at either 300 or 1100 psec before the main pulse; both pulses were nominally 50 psec (FWHM). The prepulse produces a low density plasma around the target, and the prepulse/main pulse combination simulates some properties of longer pulses, e.g., longer density scale lengths. Hard x-rays were detected by a K-edge filtered spectrometer[†]. The x-ray data obtained is consistent with an energetic electron distribution, in the energy range of 10-50 keV[†], which can be characterized by a single suprathermal temperature T_H. In Figure 10, T_H is given as a function of the energy ratio of the prepulse to the main pulse, where the main pulse intensity was ~5×10^{15}W/cm^2. We observe a steady drop in T_H as the prepulse energy is increased. No significant differences were noted in T_H for the two prepulse to main pulse separations.

Values for T_H were also obtained from the fast ion ($v > 10^8$ cm/sec) spectrum obtained with a Thomson parabola.

*It has been a common observation at many laboratories that unintentional prepulses on target implosions reduce the energy in fast ions and the neutron yield.

†The spectrometer was equipped with three K edge filter channels and three lead absorber ratio channels. The latter provided information on the very energetic tail of the electron distribution (energies from 50 keV to several hundred keV), where the electron distribution has a higher population than given by an extrapolation from lower energies of a single suprathermal temperature model. Effects on the x-ray spectrum from this part of the electron distribution could then be eliminated in the determination of T_H.