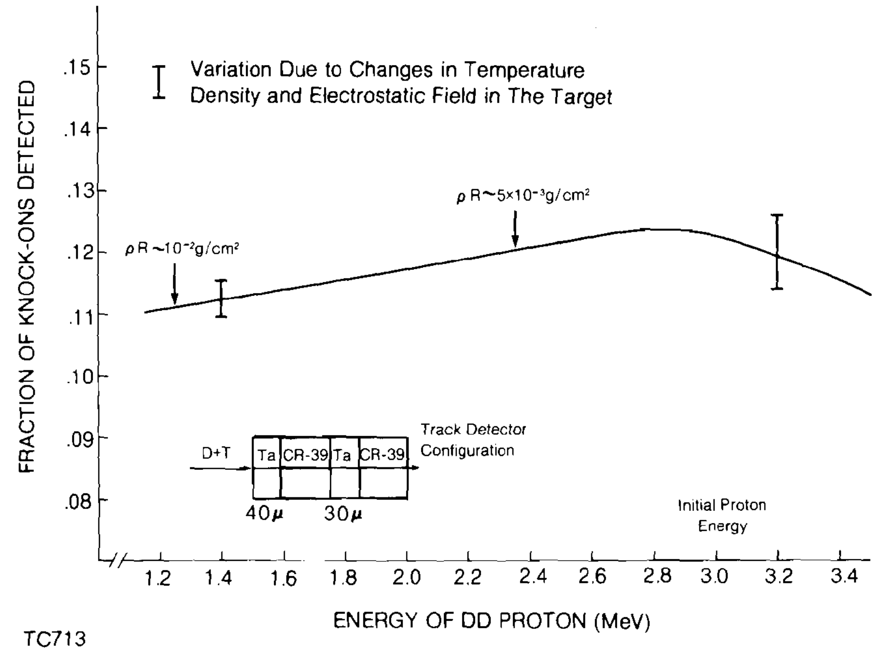

Figure 9 *Correlation between the fraction of D and T knock-ons detected and the energy of DD protons. To first order the DD proton is proportional to the ρR of the fuel plus tamper. Note the fraction varies less than ten percent from ρR of 0.02 down to ρR of 10^{-4}.*

numerous for detection. With these, the diagnostic can be extended to the threshold of thermonuclear ignition, $\rho R \sim .2\ g/cm^2$. Above this value knock-on particles will generally not escape the target.

2.B Advances in Target Characterization Computerized Methods for Laser Fusion Target Analysis

A new technique has been developed for characterization of transparent laser fusion targets. Target microballoons are placed in one arm of a modified Mach-Zehnder interferometer as shown in Figure 10. The interferometer is different from conventional interferometers in the manner with which the wave front is measured. Conventional interferometers use photographs of the fringe pattern which are interrogated with a microdensitometer and a computer to reconstruct the wave front. The disadvantage of this is the long time (~ hours) required for measurement. The modified interferometer[8] uses a modulated mirror to vary temporally the phase of the wave front. The mirror is

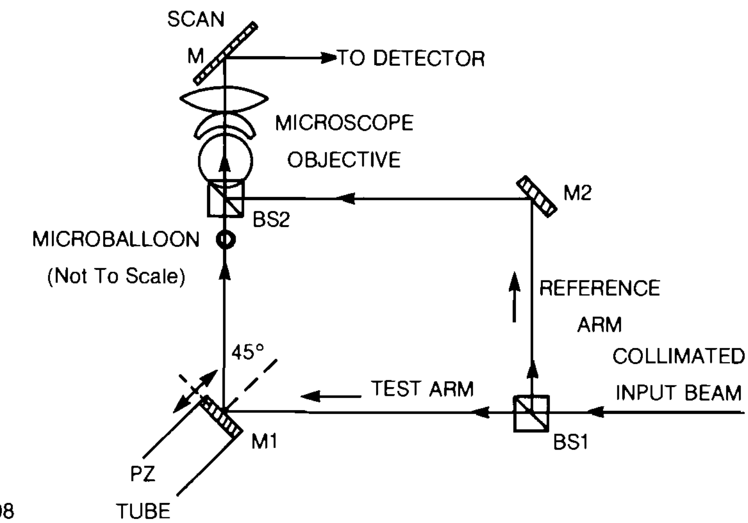

Figure 10 *Optical arrangement for AC interferometry of microballoons.*

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driven at 20kHz over a fraction of a wavelength by a piezoelectric crystal. A photodiode detecting the modulated wave front is used to determine the phase at a point in the wave front. The image of the wave front is scanned across the detector creating a map of the wave front in real time.

The use of this type of interferometer makes possible the measurement of the wave front in a few seconds. Figure 11 illustrates a typical wave front measured in this manner.

The wave front data is processed by a mini-computer which makes use of the large number of data points to determine the average target diameter to ± 4% and average wall thickness to ± .03 microns. These tolerances are based experimentally on the use of 1000 data points in the wave front. They could be improved with more data points. The advantages this method offers over manual measurements are: a shorter measurement time, more objectivity in the measurement, automatic storage of the wave front for later study, and the potential for complete automation.

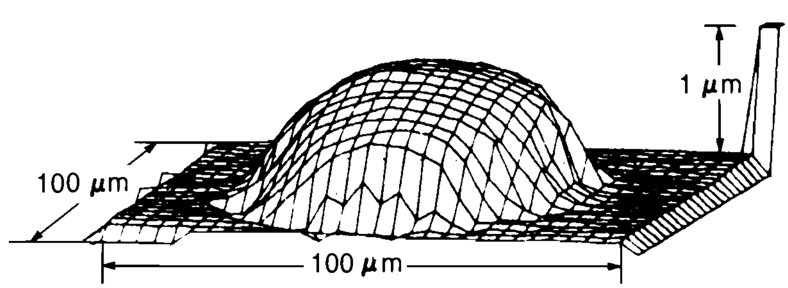

Figure 11 *Perspective representation of a microballoon wavefront.*

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In the above method no new information is obtained over that obtained with conventional[9] manual methods. Use of a microballoon manipulator[10] as shown in Figure 12 will allow characterization of the change in wall thickness over the microballoon. A manipulator of this type has been fabricated and run under computer control. The microballoon is rotated by synchronously moving the pads in opposite directions. Because there is no differential motion, the center of the microballoon remains fixed in space. The pads are made of a soft material which allows pressure to be placed on the microballoon without damaging it. With the microballoon held in the interferometer a map of wall thickness versus polar position may be generated. This technique has already been used for visual inspection of the whole surface of microballoons.

An additional use of the modified Mach-Zehnder interferometer is for measuring the pressure retention of microballoons. In a 100 micron microballoon a change of 2 atmospheres of Argon gas can be measured. This is twice the resolution of conventional interference microscopes. Three independent measurements allow an iterative solution of the fill pressure and the pressure half life. This technique is very useful in testing the effectiveness of new gas sealing methods.

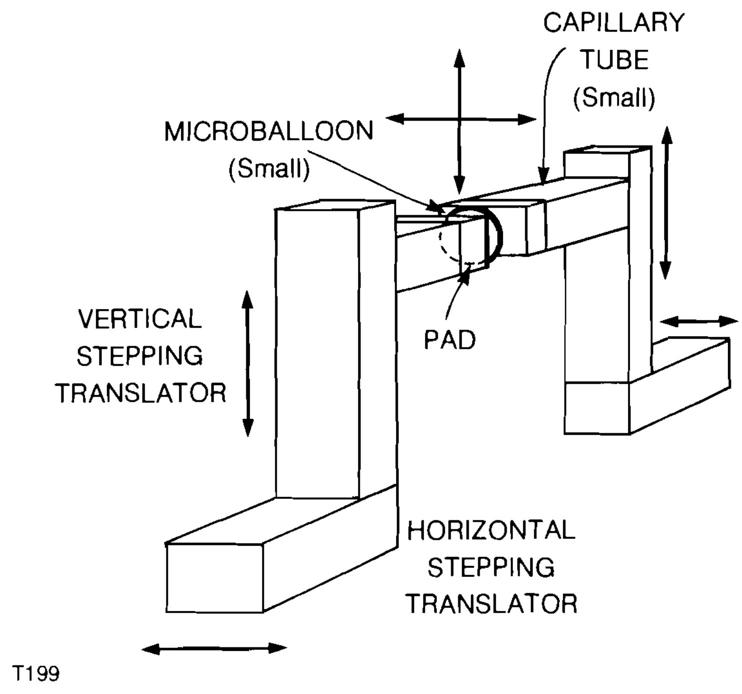

Figure 12 *Schematic arrangement of microballoon manipulator.*