length range, the petawatt laser's short-lived plasma has sufficient density to reflect the laser pulse. Because the pulse is so short, the plasma does not have time to expand during the remainder of the main body of the pulse which is reflected. (Besides reflecting this higher power density, the short-lived plasma protects the remaining mirror surface and other delicate optical and diagnostic instruments down the line, which could be damaged by radiation generated when the petawatt laser pulse hits a target.)

This breakthrough in optics indicates that those who criticized the original Strategic Defense Initiative in the 1980s, may have underestimated the potential for plasma "optics" in the case of the X-ray laser.

Using lasers in machining

Machining with conventional lathes and machine tools is limited to cuts down to 100 microns width at depths on the order of one millimeter. Below this level, laser and

LaRouche explained 'tuning' lasers in 1983

The following are excerpts from a presentation by Lyndon H. LaRouche, Jr. to a Washington, D.C. conference of the Fusion Energy Foundation, on April 13, 1983. The full text appeared in EIR*, April 26, 1983.*

It is true that many voices, such as the *New York Times,* insist that this is all unworkable "star wars" technology; it should be remembered that the *New York Times* said the electric-light bulb should not be developed, and that people of the same views said such silly things as that it would be ten years after World War II before the Soviet Union could develop a fission-weapon, and that thermonuclear fusion was impossible. Others say this is all music of the future, no earlier than 20 years ahead. In some cases, they could know the facts, but refuse to discover those facts; in other cases, even among some professionals, they are sincerely ignorant of some basic principles of Riemannian physics. We limit our brief discussion of the point here to the case of lasers and both the military and civilian-economy feasibilities involved.

There are two broadest relevant features of lasers and laser-like systems. First, if we concentrate even a fairly small quantity of wattage on a sufficiently small area, the concentration of energy, which we call its energy-flux density, can be made sufficient to "boil," so to speak, any material. This much seems to be explainable in terms of widely acceptable theory of heat; the second principle can not be so explained. Second, lasers have a property which is sometimes called "self-focusing." This is described more accurately by reporting that each range of the upper electromagnetic spectrum has very distinct qualities of harmonic resonance. In one case, this focuses the energy on the molecular scale, in another the atomic scale, in another the nuclear scale, and in higher ranges, the subnuclear scale. To cause a laser to work as desired, one must tune the laser to monochromatic frequencies such that very little of the laser's beam is absorbed by the medium through which it is transmitted, and the beam is tuned at the same time to the part of the spectrum of matter of the target selected. Thus, what is called "self-focusing" of lasers at the point of contact with targets, is actually a reflection of the indicated harmonic-resonance principles.

There is a precise analogy for this from *bel canto* methods of singing. A master of *bel canto* methods should be able to break a glass, but at the same time, the singer's breath will not disturb the flame of a candle in front of his mouth.

By aid of these self-focusing properties of lasers and laser-like particle-beams, we are able, in effect, to concentrate the wattage of a beam into areas measurable, in some instances, in fractions of Angstrom units. No material can withstand such impact for even microseconds. . . .

The principles governing the way in which a coherent, directed beam does work on its target, are, most immediately, the principles defined by Bernhard Riemann's 1859 paper, "On the Propagation of Plane Air Waves of Finite Magnitude," Riemann's proof of Leonardo da Vinci's earlier definition of the hydrodynamic generation of acoustical shock-waves. The principles of this 1859 paper apply not only to such things as the "sonic boom" of a supersonic projectile; they are a universal principle of action in our universe, a principle which the Soviet literature terms "Riemann waves.". . .

If we examine the kinds of processes which lasers and laser-like beams involve from any standpoint but Riemann's, progress in this field is not altogether impossible, but is very cumbersome, and is a succession of fits and starts, as one attempts to interpret the phenomena by varieties of mathematical-physics doctrines which are not the most appropriate for this work. From Riemann's standpoint, the whole domain is wonderfully simple to understand. . . .