

A TECHNICAL PRIMER ON LASERS

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ABSTRACT

At the ripe age of 40 years, the laser has become a mature technological device with many varied applications. This was not always true of course. For many years the laser was viewed as "an answer in search of a question." That is, it was seen as an elegant device, but one with no real, useful application outside of fundamental scientific research. In the last two decades, however, numerous laser applications have moved from the laboratory to the industrial workplace or the commercial market.

Lasers are unique energy sources characterized by their spectral purity, spatial and temporal coherence, and high average and peak intensity. Each of these characteristics has led to applications that take advantage of these laser qualities. For instance, spatial coherence, which allows a highly collimated laser beam, has spawned remote sensing, range finding, and target designation applications. Other applications based on coherence include interferometry and holography. Likewise the property of monochromaticity (spectral purity) enables chemical and physical sensing techniques based on high-resolution spectroscopy. Many other unique uses of lasers include communications, information storage and manipulation, and entertainment. All of these "high-tech" applications have come to define everyday life in the late twentieth century.

One property of lasers, however, that of high intensity, did not immediately lead to "delicate" applications but rather to those requiring "brute force." That is, the laser was used in a macroscopic way either for material removal or heating. The first realistic applications involved cutting, drilling, and welding and the laser was little more advanced than a saw, a drill or a torch. In a humorous vein, A. L. Schawlow proposed and demonstrated the first "laser eraser" in 1965. The different absorbencies of paper and ink allowed the laser to selectively remove typewriter print without damaging the underlying paper. It is this property of lasers and this application that has led to today's application of lasers to art conservation. Laser ablation cleaning of such disparate objects as paper, wood, metal, stone, stained glass and paintings is an active area of conservation research.

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