Optical Characteristics and Applications of Mirror-Like Cylinders Under Laser Beams

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Propose of Project: It has been found that, during classes, a wonderful light band is generated on the blackboard when a laser pen irradiates light beams onto a metal pointer. The objective of this project is to explore causes and potential applications of this interesting phenomenon. Procedure: (1) The phenomenon was idealized as a laser beam impinging onto surfaces of a mirror-like cylinder. Then characteristics of the scattered-light images on the blackboard are analyzed. (2) A novel device for conic curves was developed to control the eccentricity of the light band accurately. (3) We separated the energy of stray light from the total energy of the light band, then calculate the energy ratio, R=I(stray)/I(total), which can be used to characterize the surface roughness quantitatively. Data: The device for conic curves was employed to study the shape and width of the light band quantitatively. Some typical parameters were adjusted to verify the correctness of the proposed expressions. The surface roughness gradually worsens when the R value increases. Results demonstrate that the R value remains stable under typical testing environments. Conclusions: It is the first time to demonstrate that the shape of light bands is the conic curve. Mathematical expressions of the eccentricity of the light band were proposed. The novel device for conic curves was designed, and can be used as teaching aids to demonstrate characteristics and properties of conic curves. An online rapid method based on measuring the R value was proposed to determine the surface roughness of cylindrical objects quantitatively.

Awards Won:

Thirty Meter Telescope: Fourth Award of $500