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An Overview of Progress with the Study of a Structured Laser Beam for Alignment

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The Structured Laser Beam (SLB) is a pseudo-non-diffractive optical beam characterized by the low divergence of the Inner Core (IC), down to 10 µrad, and the presence of concentric rings, with the most prominent being the Outer Ring (OR). The size of the IC and OR can vary depending on the SLB generator setup. SLBs have the potential to serve as straight reference lines for long-distance alignment systems due to the small diameter of their IC and their theoretically infinite propagation distance, which has been experimentally verified up to 900 meters. However, the straightness of a light beam propagating in the atmosphere can be affected by refraction. Optical alignment systems often use a vacuum to mitigate this refraction effect. While the vacuum system provides a propagation space for the laser beam, it imposes constraints on space availability, access, and the operation of the alignment system. In the case of an SLB passing through a vacuum pipe, its intensity distribution may be modified, resulting in an apparent shift of the IC and disrupting the straight reference line. Additionally, light reflected from the vacuum pipe complicates the measurement of the IC position. This paper discusses the prospects of SLB alignment systems, including recent advancements and remaining challenges.

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