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Beam Quality Deterioration Due to Angular Dispersion SERGIY MOKHOV, Univ of Central Florida — Laser pulses are often manipulated by different optical elements in free space for purposes of filtering, stretching/compression, shaping, and splitting. This is due to the impossibility of using fiber optical components to withstand high energy pulses. The beam quality factor for free-space propagating optical beams, M2, is typically used to characterize the performance of optical elements. Optical element which preserves M2 in the CW regime may in fact worsen M2 for pulses with the same time-averaged power if this optical element exhibits dispersion in the spectral range of the pulse's bandwidth. Basic dispersive effects can be expressed in terms of aberration-free monochromatic beam optics, and they are longitudinal shift of the waist position, transversal shift of the waist center and angular shift of the propagation direction with wavelength tuning. The first two effects are negligible for optical elements much shorter than the Rayleigh length. We have found an analytical expression for the deterioration of M2 from unity due to angular dispersion for a test pulse which has transverse Gaussian beam profile. This expression depends on both the transverse size of the pulse and the mean square variation of the spectral-angular characteristic of the optical element averaged with the spectral weight distribution of the pulse. In particular, with decreasing of beam size, the M2 deteriorates less because the spectral-angular variation of the propagation direction is mitigated by increasing beam divergence due to diffraction. In our judgment, an optical element should be characterized by its angular dispersion properties rather than measurements of M2.

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