Generation of Colorful Light Pulses by Femtosecond Bessel Laser Beam

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When near infrared femtosecond Bessel laser beam (fs-BLB) is obliquely incident on the silica glass, annular beams (ABs) with bandwidths of several tens of nanometers and different peak wavelengths discretely distributed in visible and near infrared range are generated simultaneously. It is considered that four-wave mixing (FWM) and corresponding cascaded parametric processes are responsible for the generation of multi-wavelength ABs. It has also been found that the broken symmetry of the optical setup due to the obliquely oriented silica glass and the absorption band of the sample significantly enhance the generation efficiency of multi-wavelength ABs. Compared with the case using a single Bessel laser beam, the generation efficiency of these multi-wavelength ABs is greatly enhanced due to the interference of double Bessel laser beams. Experimental results show that as the time interval between double fs-BLBs gradually approaches zero, the generation efficiency of ABs increases significantly. These colourful annular beams have important applications where multi-wavelength ultrashort pulses are needed, such as multidimensional multiplexing optical communications, nonlinear dark-field microscopy and multiphoton imaging to further suppress the background noise and improve resolution.