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Tunable self-healing optical state generation via atomic vapor¹ ERIN KNUTSON, JON SWAIM, KAITLYN DAVID, CHRISTIAN RIOS, ONUR DANACI, RYAN GLASSER, Tulane University — Non-Gaussian beams, such as Bessel-Gauss beams, have been shown to display self-healing after encountering an obstruction. We show that tunable non-Gaussian, partially self-healing optical modes may be produced via nonlinear interactions between light and alkali atomic vapor. A Gaussian beam is focused into hot rubidium vapor and tuned to frequencies near the atomic resonances. The resulting spatially non-Gaussian output may be controlled either by adjusting the atom temperature or the input beam power. Additionally, these modes demonstrate a degree of self-reconstruction after encountering an obstruction in the beam path, which we find to be similar to that of a truncated Bessel-Gauss mode. We show that the output mode shape, as well as the enabled tunability, ultimately result from a complex interplay of various self-action effects in the atomic vapor. The extent of self-healing is also shown to be tunable in beam power and temperature, which we optimize for the reconstruction of a non-Gaussian beam that has encountered a physical obstruction at its center. Our findings indicate that tunable, non-Gaussian light generated via atomic vapor may be useful in experiments involving near-resonant light-atom interactions, as well as to optical communication and imaging schemes.

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