Self accelerating electron Airy beams

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We report the first experimental generation and observation of Airy beams of free electrons. The electron Airy beams are generated by diffraction of electrons through a nanoscale hologram, that imprints a cubic phase modulation on the beams' transverse plane. We observed the spatial evolution dynamics of an arc-shaped, self accelerating and shape preserving electron Airy beams. We directly observed the ability of electrons to self-heal, restoring their original shape after passing an obstacle. This electromagnetic method opens up new avenues for steering electrons, like their photonic counterparts, since their wave packets can be imprinted with arbitrary shapes or trajectories. Furthermore, these beams can be easily manipulated using magnetic or electric potentials. It is also possible to efficiently self mix narrow beams having opposite signs of acceleration, hence obtaining a new type of electron interferometer.

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