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**New frontiers in controlling the motion of matter with light:
from single atoms to neurons**

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In this overview talk I will discuss recent experiments in my group on the interactions and control of matter with light. At the atomic level we have been studying the interface between quantum mechanics and nonlinear dynamics. I will describe some recent experiments on atomic motion in "optical billiards", a new system that we developed, and indicate some future directions for quantum dynamics and control in many-body systems. In the past two years we have also extended our work to the realm of biophysics in collaboration with the group of Josef Kas. We have shown experimentally that we can use weak light forces to precisely guide the direction of neuron growth, which opens many exciting directions for the future.