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Toward Quantum Plasmonics with Plasmon Drag Effect. Theory and Experiment MAXIM DURACH, MATTHEW LEPAIN, ZOE MAPES, Georgia Southern University, VINCENT RONO, NATALIA NOGINOVA, Norfolk State University — Giant plasmon drag effect observed in plasmonic metal films and nanostructures brings new fundamental insights into ways in which light-matter interaction occurs. We demonstrate analytically, numerically and experimentally that rectified drag forces acting upon electrons in plasmonic metals are intimately related to the absorption of plasmonic excitations. The plasmon energy quanta absorbed by the metal plasma are associated with momentum quanta, which are also transferred to electrons upon energy absorption. We show that this picture directly applies to plasmon drag effect in a variety of systems, and, to our knowledge for the first time, is capable to explain and predict the magnitude of the effect not only qualitatively, but with close quantitative agreement. The plasmon drag effect opens new avenues for plasmonic-based electronics providing opportunities for incorporation of plasmonic circuits into electronic devices, and for optical sensing offering a new operational principle and an opportunity to substitute the bulky optical set-ups with diffraction limited sensing by electronics. Our work not only adds more clarity into the mechanism behind the plasmon drag effect but also contributes to the emerging field of quantum plasmonics.

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