Orbital Magnetism By Light

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Orbital degree of freedom in solids is attracting ever increasing attention owing to possible diverse applications in the areas of magnetization control and angular momentum current generation [1,2]. So far, the properties of non-equilibrium orbital magnetism and orbital currents has been explored predominantly in the regime of weak perturbations, while the orbital physics is expected to be particularly rich in the realm of excitations brought by light. From the fundamental point of view, the interaction of light with matter is mediated predominantly by the orbital properties of quantum states. As we shall see, in various materials this gives rise to strong orbital response in terms of orbital magnetization, which imprints a subdominant spin response, discussed and studied intensively in the past. We will show that when structural inversion symmetry is broken either intrinsically, upon deposition, or by magnetism, strong orbital coupling to the electric field of the pulse will give rise to currents of orbital angular momentum, with optical currents of spin dragged by spin-orbit interaction [3]. The currents of angular momentum can be detected in THz emission experiments [4], providing a unique insight into the temporal and spatial properties of charge, spin and orbital interconversion processes [5]. We will demonstrate that among various material platforms, structurally complex antiferromagnets present a unique niche for achieving best orbital performance with direct implications for the magnetic order control [6,7], and will discuss the prospects and repercussions of light-induced orbital magnetism.

References

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