Topological plasmonics and twistronics: Ultrafast vector movies of plasmonic skyrmions, merons, and skyrmion bags on the nanoscale

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Here we introduce a new technique, time-resolved vector microscopy, that enables us to compose entire movies on a sub-femtosecond time scale and a 10 nm scale of the electric field vectors of surface plasmon polaritons. By using our vector microscopy technique, we are able to image the plasmonic spin-momentum-locking and the plasmonic skyrmion dynamics. Depending on the shape and geometrical phase, in combination with the helicity of the excitation beam, topological plasmonic quasiparticles are created: skyrmions, merons, as well as quasicrystalline excitations. We observe their complete field vector dynamics at subfemtosecond time resolution [1-6]. Figure 1 shows a snapshot of the skyrmionics electric field vector arrangement with sub-10 nm resolution on a single crystalline, atomically flat gold surface.

When applying the concept of twistronics to plasmons, intriguing topological excitations arise, such as skyrmion bags. We find magic angles similar to twisted graphene which defines exceptional topological features. Utilizing topological plasmonics and twistronics will open the door to linear optical features on the few nm length scale [7], without the need for techniques such as STED.

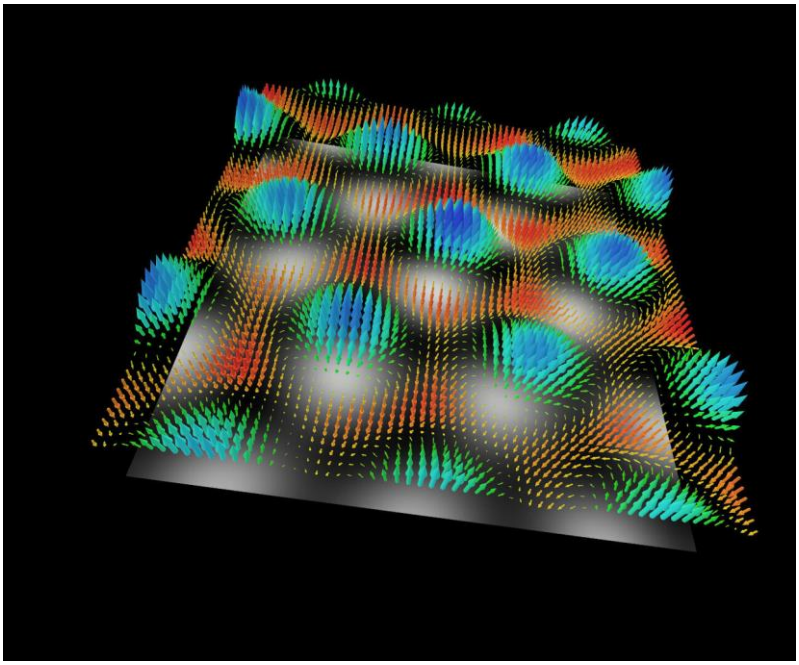

Fig. 1 Experimentally obtained snapshot of the vector components of the E-field of a plasmonic skyrmion on a monocrystalline, atomically flat gold surface.

References

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