Norton waves in Plasmonics

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We present analytical results for the electromagnetic fields at the surface radiated by an aperture (both 2D, like a slit and 3D, like a hole) in a metal film. The expressions are valid for any metal, from the optical to the THz regime, and for distances to the aperture larger than a few tens of nanometers. The field pattern presents a rich behavior, which depends strongly on both distance to the aperture and angle with respect to the incident field. In the optical regime, surface plasmon polaritons (SPPs) have been thought to dominate the fields at the surface, beyond a transition region comprising 3–4 wavelengths from the source. In this work [1, 2], we demonstrate that at sufficiently long distances SPPs are not the main contribution to the field. Instead, for all metals, a different type of wave prevails, which we term Norton waves (NWs) for their resemblance to those found in the radio-wave regime at the surface of the Earth. Our results show that NWs are stronger at the surface than SPPs at distances larger than 6–9 SPP absorption lengths, the precise value depending on wavelength and metal. Moreover, NWs decay more slowly than SPPs in the direction normal to the surface.

References

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