# Phase plates: new designs and concepts

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# Phase plates: new designs and concepts

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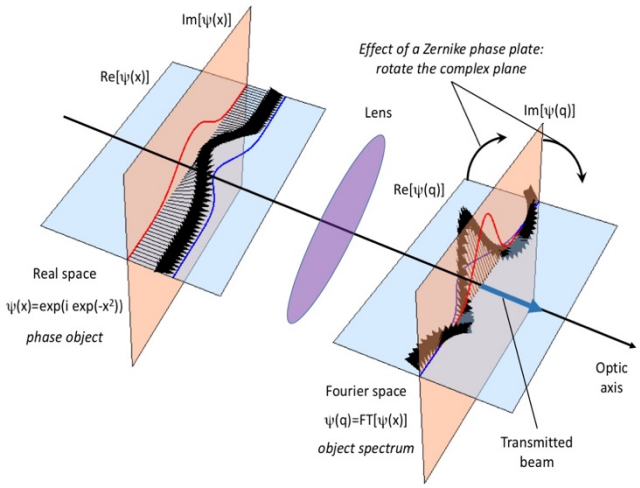
After the latest revival triggered by Danev and Nagayama [1], the field of phase plates for electron microscopy have flourished. Several new designs and concepts have been proposed to manipulate the phase of the electron wave in flexible ways [2-4]. Some designs are aimed at realizing Zernike-type phase contrast bypassing the conventional thin-film-with-a-hole setup, thinking mainly to bio-imaging applications. Others are now being explored as more general electron-optical phase-shifting elements that might prove beneficial to highlight some interesting features of samples. Achieving an ideal phase contrast where the image intensity is linearly related to the object phase shift -- $I(x)=1-2\varphi(x)$ in the case of an ideal $\pi/2$ Zernike phase plate applied to a weak phase object-- is a worthy goal as it leads to imaging dose minimization and direct interpretability. There are, however, situations where it might be more important to achieve a different type of intensity vs. phase relationship $I[\varphi(x)]$. For example, considering the archetypal phase-step samples, a pn-junction or a flux line, a differential $I[\varphi(x)]$ relationship where $I(x)=1+L\varphi'(x)$, where L is a proportionality factor with units of length, might be very useful to highlight directly the projected electric field of a pn-junction (instead of its built-in potential step) or the flux (instead of its Aharonov-Bohm shift). I will discuss in this presentation whether differential or integral $I[\varphi(x)]$ relationships, including integral transforms of the phase object, can be established by manipulation of the electron phase via non-Zernike-type phase plates.

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