

## Re: Kohler illumination question...

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GTO wrote:

Aaron:

If the geometry of the coiled filament were the problem, I do not understand why Nikon's new scopes still use a frosted glass. The new Eclipse series scopes use a diode array instead of a filament.

I think that one of the imperfections of all implementations of Koehler illumination has something to do with the fact that the coherence length of the incandescent light source is limited to around 30cm ( $l = c \cdot t$ , assuming the optical transition lasts for roughly  $10^{-9}$  sec). Since all forms of interference in light microscopy require rays that are partially coherent, the longer the coherence length the better Koehler will function. This makes me think that in order to create a truly Koehler illumination, I would have to use light generated by metastable optical transitions (see laser).

This is absolutely wrong. You are confusing spatial with temporal coherence (which is a common error, to be fair). Critical and Kohler illumination (as well as confocal!) involve the spatial coherence of the source, which is related to the *size* of the source. Spatial coherence is measured with a Young's double slit interferometer (temporal coherence is measured by a Michaelson interferometer).

The temporal coherence of a laser is about 2X the cavity length, as a rule of thumb. For diodes, it's a fraction of a millimeter, while for a Nd:YAG, it can exceed many meters. For a halogen bulb, the coherence length is basically zero. The spatial coherence length (sometimes called transverse length or coherence area) is inversely proportional to the solid angle subtended by the source- a point source has infinite spatial coherence. Sunlight has a transverse coherence length of about a millimeter.

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Critical and Kohler illumination rely on the spatial coherence of extended sources: Kohler illumination essentially allows each luminous point of the source to uniformly illuminate the sample, while critical illumination uses a coherent image of the source to illuminate the sample.

Using a laser for wide-field microscopy is a bad idea: laser speckle is from the poor spatial coherence of an (unfiltered) laser beam, and will obliterate an image.

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