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Fibre-optics taper for high resolution neutron imaging

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The increased demand of high-resolution neutron imaging has not been followed by a correspondingly increased availability of high-resolution options, due to the technical challenges and high costs of designing and manufacturing such systems. Neutron flux limitations are also a key factor that hinders the adoption of traditional high resolution solutions.
To overcome this situation and to open up the possibility to perform high resolution investigations to a larger number of facilities (thus widening the pool of potential users by this increased availability), we propose the use of a fibre optics taper as add-on to existing standard-resolution systems 1.
A fibre optics taper is a bundle of tapering optical fibres that are bunched together to preserve their relative arrangement. Such a device can transport light from one end to the other very efficiently, while providing a substantial magnification of the incoming image.
By constructing a suitable holder that attaches to the existing imaging setup to one end and to a high-resolution scintillator to the other (figure 1), one can achieve spatial resolutions of 20 µm with relative ease, while keeping the counting time low due to the high transport efficiency.
Sub-20 µm resolutions have also been achieved with such a system by using zoom lenses and, by employing a specially designed 157-Gd enriched scintillator, resolutions approaching 10 µm have been measured.
In this presentation we will show the results of our systematic investigations regarding achievable resolution, conformality of the recorded images and light transport efficiency and we will discuss about shortcomings and advantages of such a setup.
In the second part of the presentation, we will show a use case of such a setup, outlining the reasons why the taper was used and presenting the results obtained by such investigation.

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1 M. Morgano, et. al., "Unlocking high spatial resolution in neutron imaging through an add-on fibre optics taper," Opt. Express 26, 1809-1816 (2018)

Primary author(s) : MORGANO, Manuel (Paul Scherrer Institut)

Presenter(s) : MORGANO, Manuel (Paul Scherrer Institut)

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