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Improving detection efficiency using polycapillary optics for broadband, ultrahigh resolution spectroscopy of particle induced X-rays with TES microcalorimeter arrays

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We discuss the improvements in wide energy range, energy dispersive X-ray emission spectroscopy in the particle induced mode (PIXE) achieved by optical focusing of X-rays to high-energy resolution superconducting transition-edge sensor arrays. TES-PIXE technique offers great energy resolution for multi-element samples consisting of even hundreds of X-ray peaks with nearly overlapping energies [1]. TES-PIXE can provide orders of magnitude better detection limits and energy resolution compared to the traditional silicon drift detector (SDD), which gives the possibility to probe trace impurities within samples [2]. Here, we discuss recent progress in performing TES-PIXE spectroscopy in air, by using a polycapillary lens and an external ion beam. Such an external beam PIXE is a non-destructive technique, which can be used to measure precious museum artefacts and delicate samples that cannot go into a vacuum chamber. The use of the polycapillary lens increases the effective solid angle of the detector, increasing the number of X-rays detected up to a factor of three in the 0.5-5.5 keV energy range [3]. The polycapillary lens also removes the need for additional proton filters, enabling detection of lighter elements, down to oxygen.

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- [2] M. Käyhkö, M.R.J. Palosaari, M. Laitinen, K. Arstila, I.J. Maasilta, J.W. Fowler, W.B. Doriese, J.N. Ullom, T. Sajavaara, *Nucl. Instrum. Methods Phys. Res. B* 406, 103 (2017)
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Less than 5 years of experience since completion of Ph.D

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