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OPTICAL SYSTEM COMMISSIONING FOR ZIRCONIUM (0001) PHOTOCATHODE TRANSVERSE ENERGY DISTRIBUTION MEASUREMENTS AT DIFFERENT TEMPERATURES

D.P. Juarez-Lopez* [1,2], L.B. Jones[2,3], C.P. Welsch[1,2] & T.C.Q. Noakes[2,3]

[1] Department of Physics, University of Liverpool, L69 7ZE, United Kingdom
[2] The Cockcroft Institute, Daresbury Laboratory, Warrington WA4 4AD, United Kingdom
[3] STFC ASTeC, Daresbury Laboratory, Warrington WA4 4AD, United Kingdom
*D.P.Juarez-Lopez@liverpool.ac.uk

ABSTRACT

Photocathode electron emission is strongly affected by the light source an particularly the illumination wavelength. Optimisation of the light source system is critical to minimise Mean Transverse Energy (MTE) of an electron source. We present commissioning studies for an upgrade to the Transverse Energy Spread Spectrometer (TESS) [1] light source system showing this effect on the MTE for photoelectrons emitted from Zr (0001) single crystal photocathodes as a function of illumination wavelength at room and cryogenic temperatures.

1.- L.B.Jones,K.J.Middleman *et al.*; Proc.FEL'13,TUPS033, 290 – 293

NEW DETECTOR

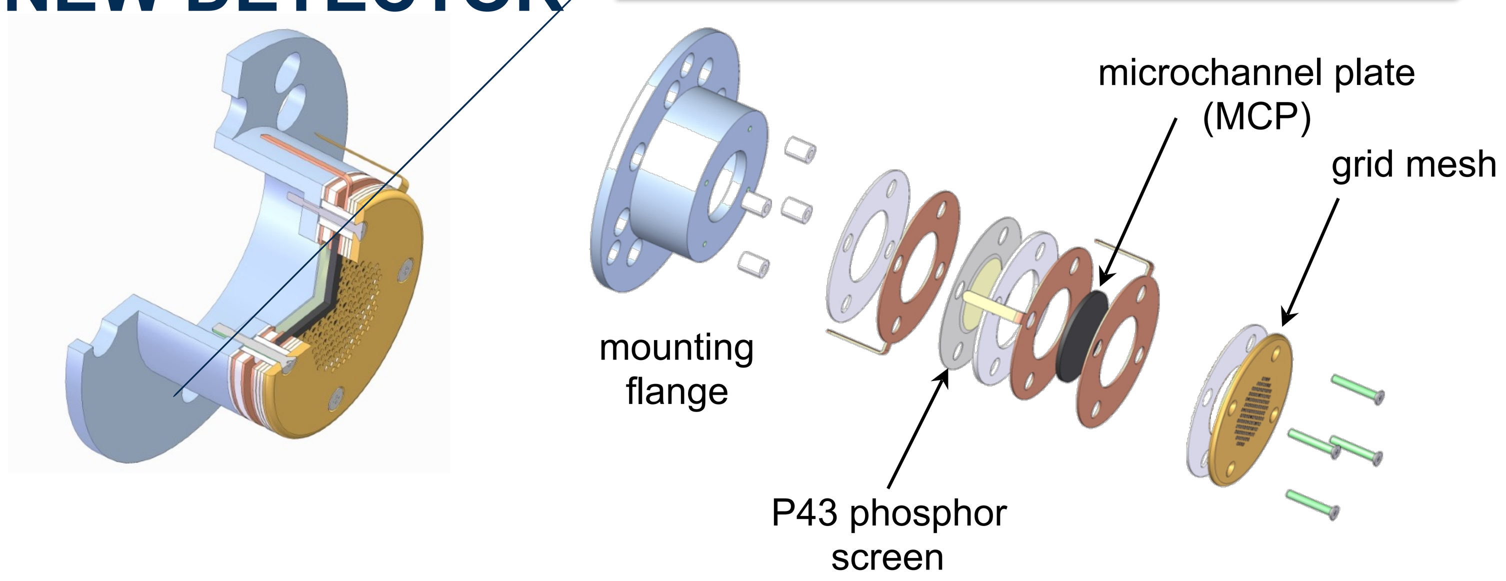

Figure 1: Schematic diagram of the modified TESS photoemission electron detector. LEFT: mounted detector assembly. RIGHT: exploded view shown.

LIGHT SOURCE UPGRADE

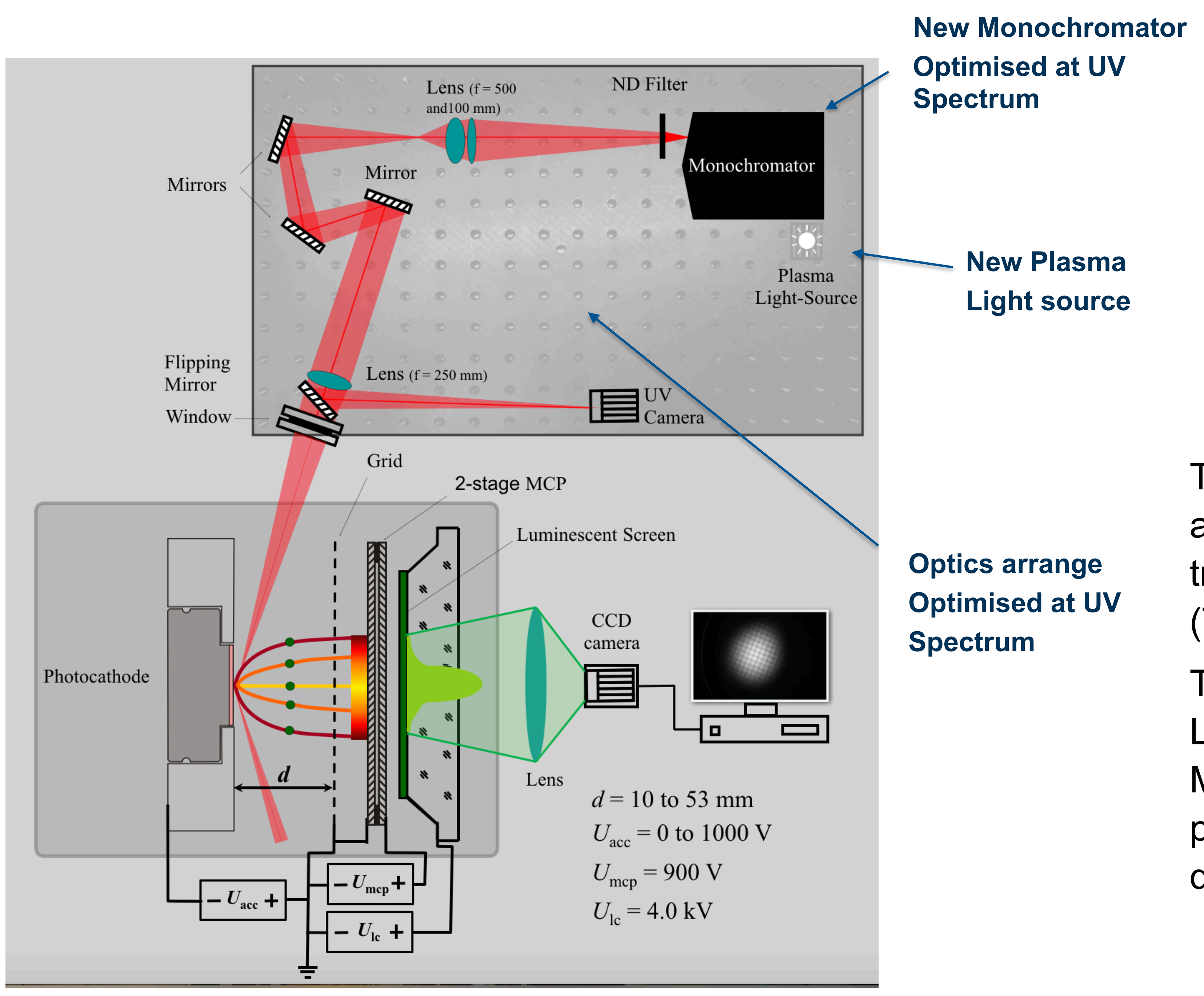

Figure 2: TOP. Optics board, implementing the new plasma light source connected to the new monochromator, passing through the optical lens optimised for UV. BOTTOM. TESS system.

COMMISSIONING THE MONOCHROMATOR

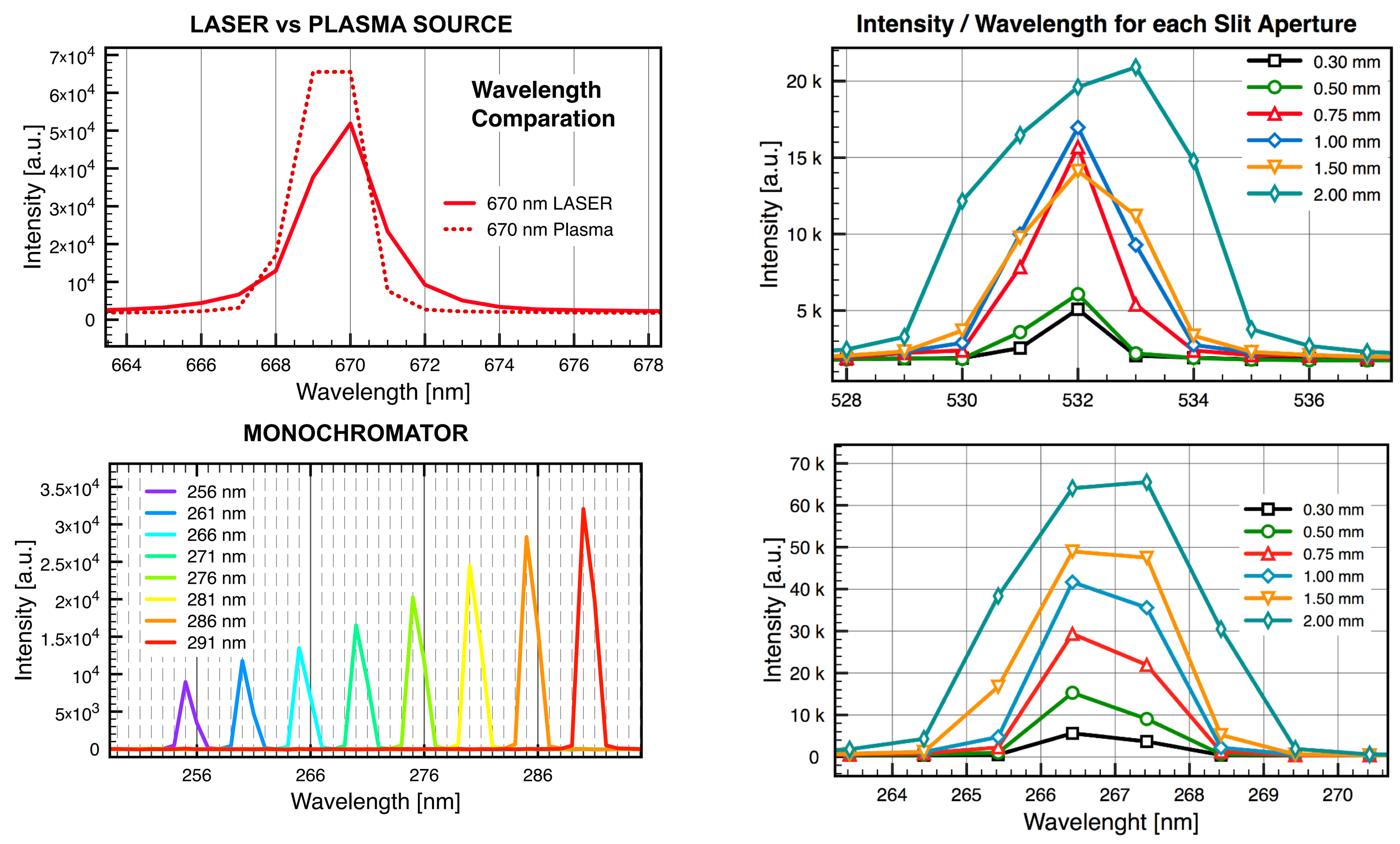

Figure 3: TOP Left: LASER comparison with plasma light source for monochromator calibration. BOTTOM LEFT: Monochromator wavelength steps vs intensity. RIGHT: Slits aperture intensities.

ZIRCONIUM PHOTOEMISSION

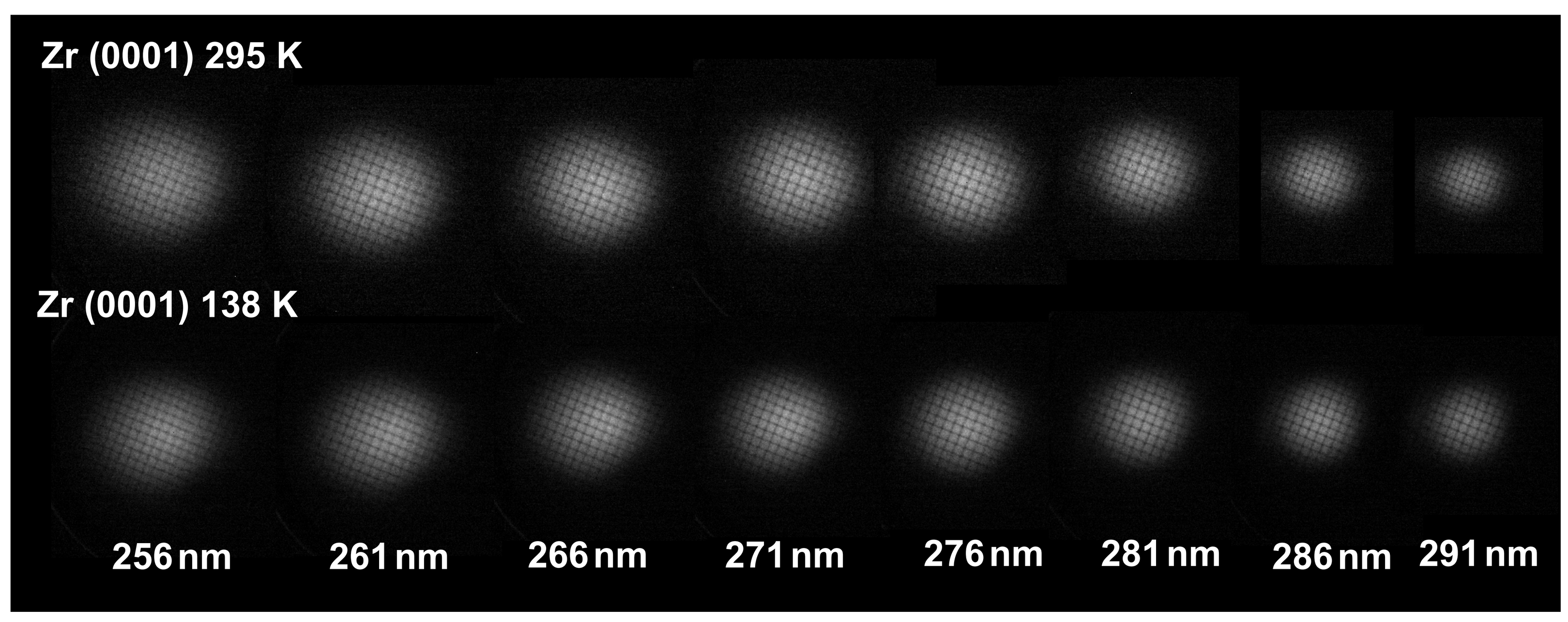

Figure 4: Electron emission images for two different temperatures at different illumination wavelengths. The accelerating voltage and flight distance are the same for all images, the image size being governed by photoelectron MTE and brightness by photocathode QE.

The electron emission data were analysed to generate a series of transverse energy distribution curves (TEDC) for each temperature.

The photocathode was cooled with LN2 in TESS. Figure 5 shows the MTE values vs wavelength of the photocathode Zr (0001) at two different temperatures.

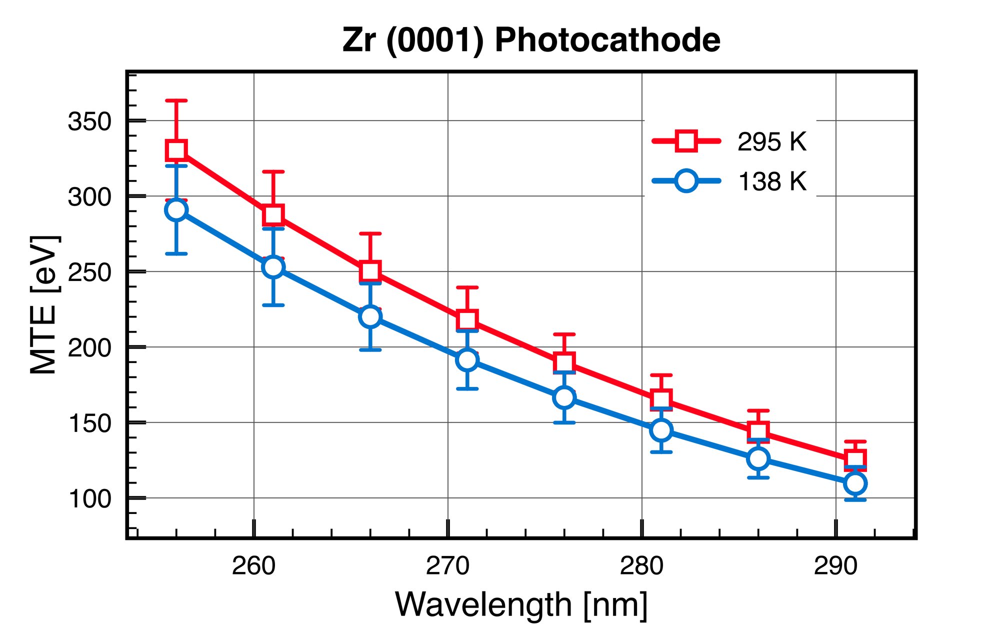

Figure 5: MTE as a function of illumination wavelength for a Zr (0001) photocathode at room and cryogenic temperatures.

CONCLUSION

The optical system was compared with a laser to calibrate the change in the wavelength of the monochromator, measuring the light intensity at the end of the system.
This work demonstrates the impact on MTE for Zr (0001) at two different temperatures.
Our MTE measurements on Zr (0001) decrees with temperature.
This work helped to be prepared for a collaboration with CERN, which will include working with Cs-Te and Cs-K-Sb photocathodes grew in CERN and transported to Daresbury Lab. Working with these kind of photocathodes requires the versatility of changing wavelengths from the visible to UV spectrum, this is why a commissioning of the optical system is so important.

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