New OSEM results using a displacement-doubling prism-based flag

N.A. Lockerbie, K.V. Tokmakov, and S. Jawahar.

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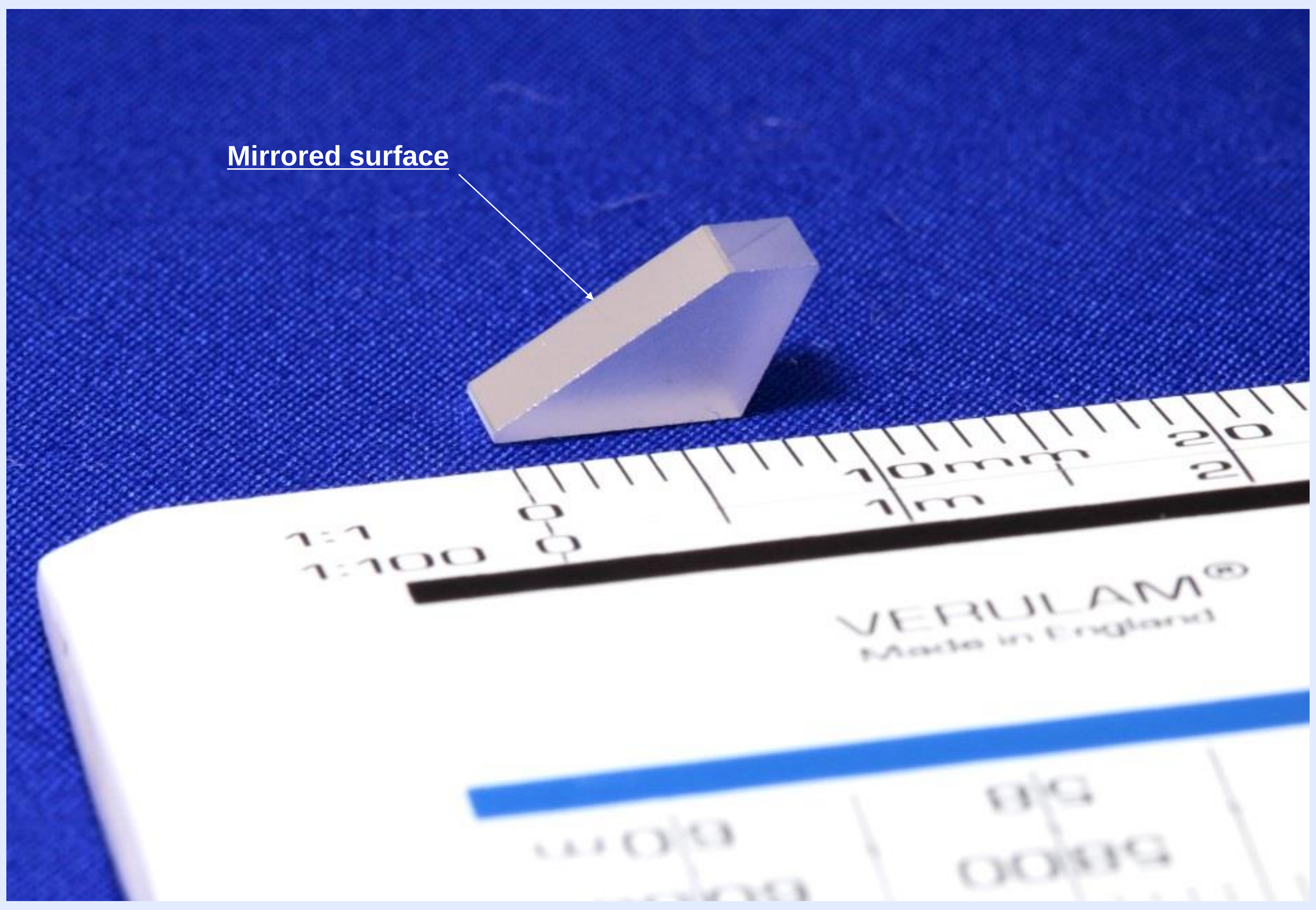
Introduction

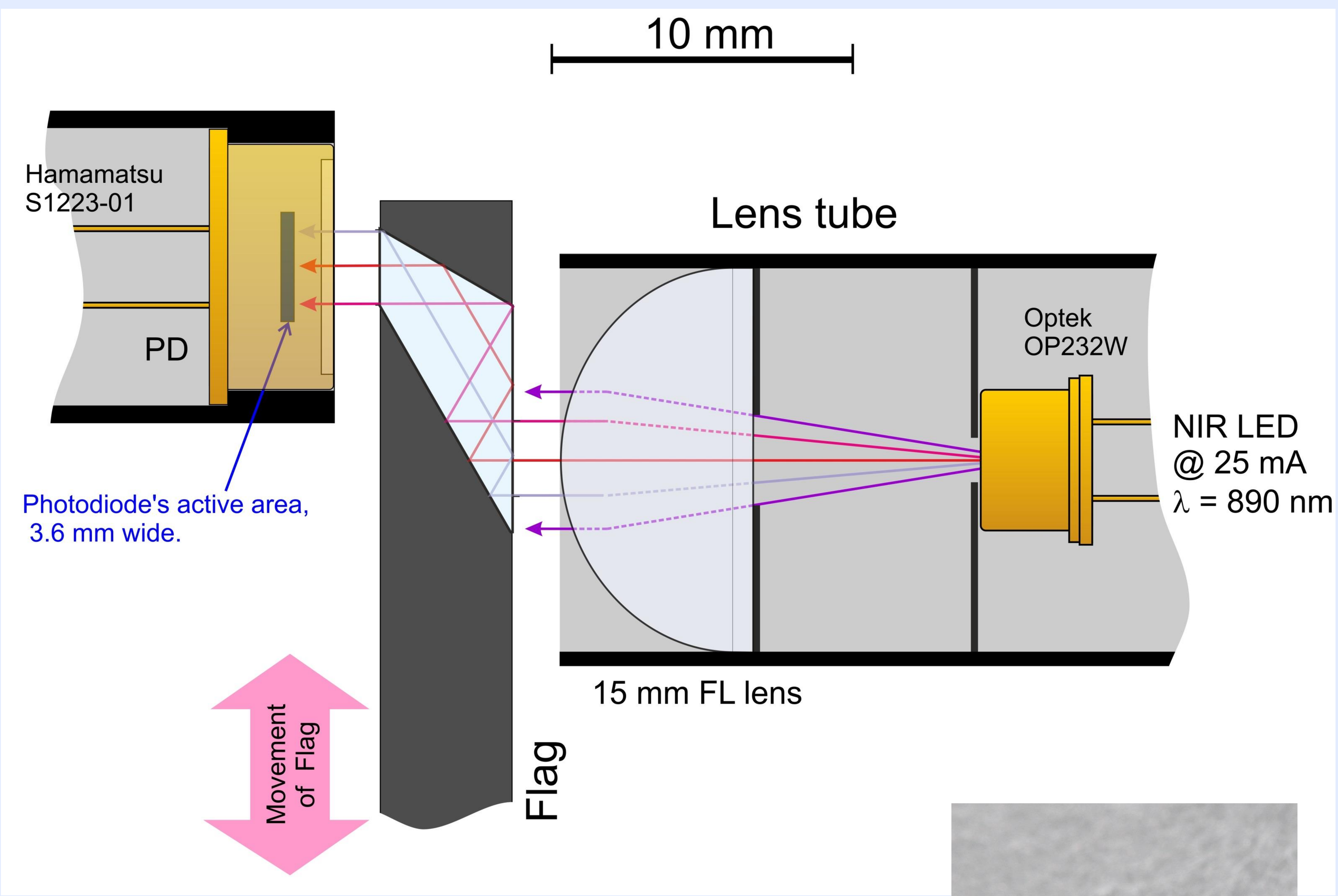
The suspension systems for future Gravitational Wave (GW) detectors require an improved level of immunity to sources of perturbation of their suspended test-masses —perturbations that could mimic, or mask, gravitational wave signals. An important sources of perturbation is being addressed at the University of Strathclyde, with a view to mitigating: low-frequency vibrational motion.

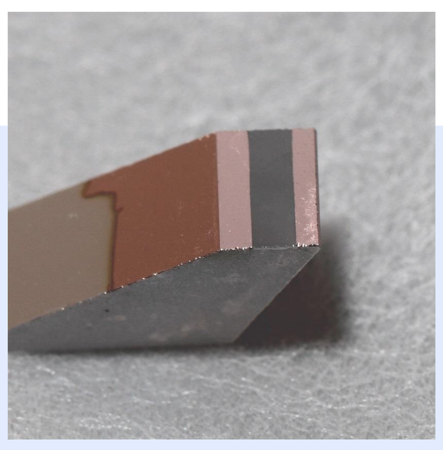
The displacement-doubling prism



The displacement-doubling prism [1]. Its entrance- and exit- windows—whose designation is interchangeable—are plane-parallel, and light enters and exits these at normal incidence, so that the prism is non-dispersive. When the prism is displaced laterally relative to an incident light beam by an amount Δx, say, then the exit beam will be displaced laterally by $2\Delta x$.

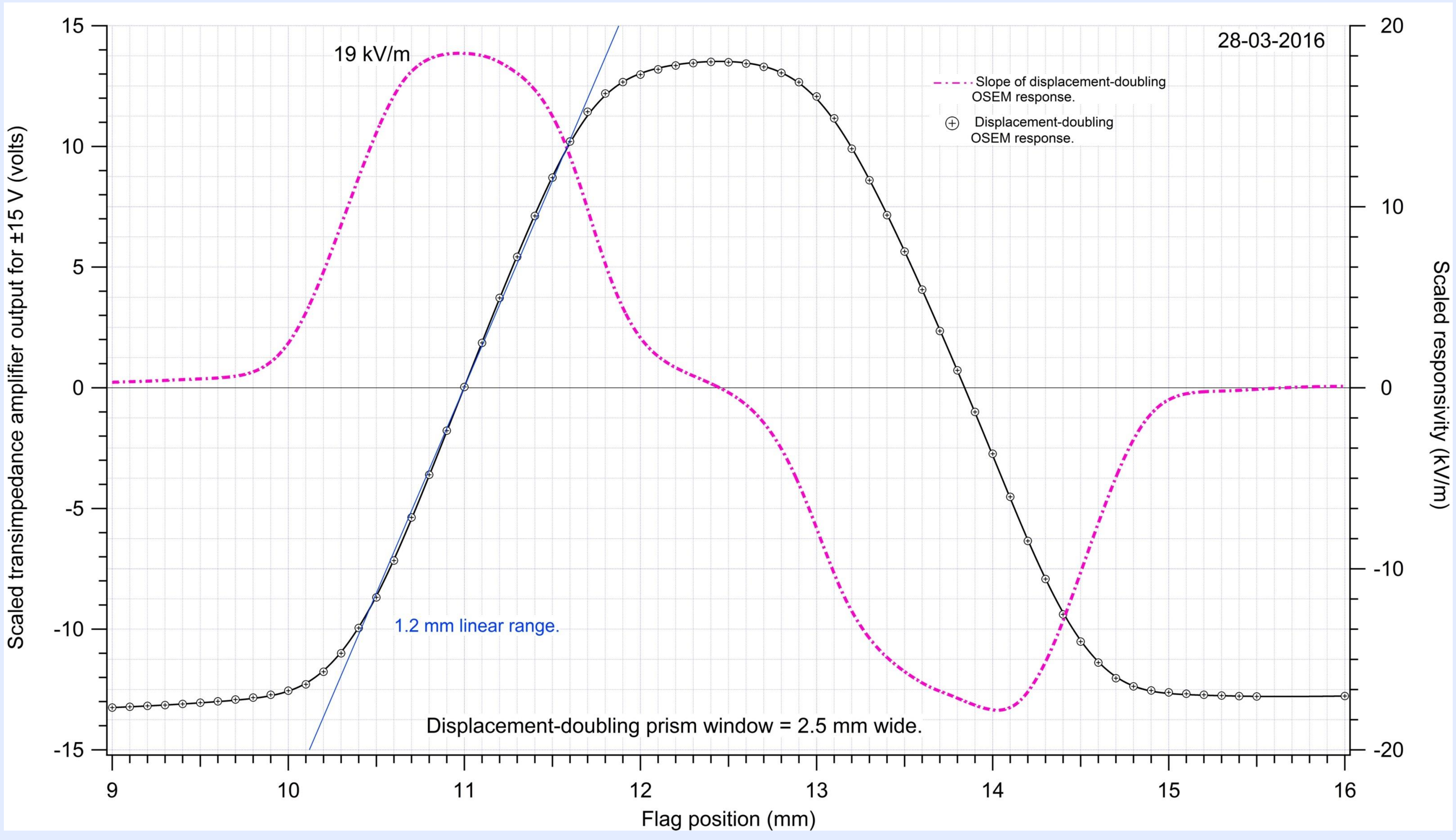
OSEMs—using a displacement-doubling prism



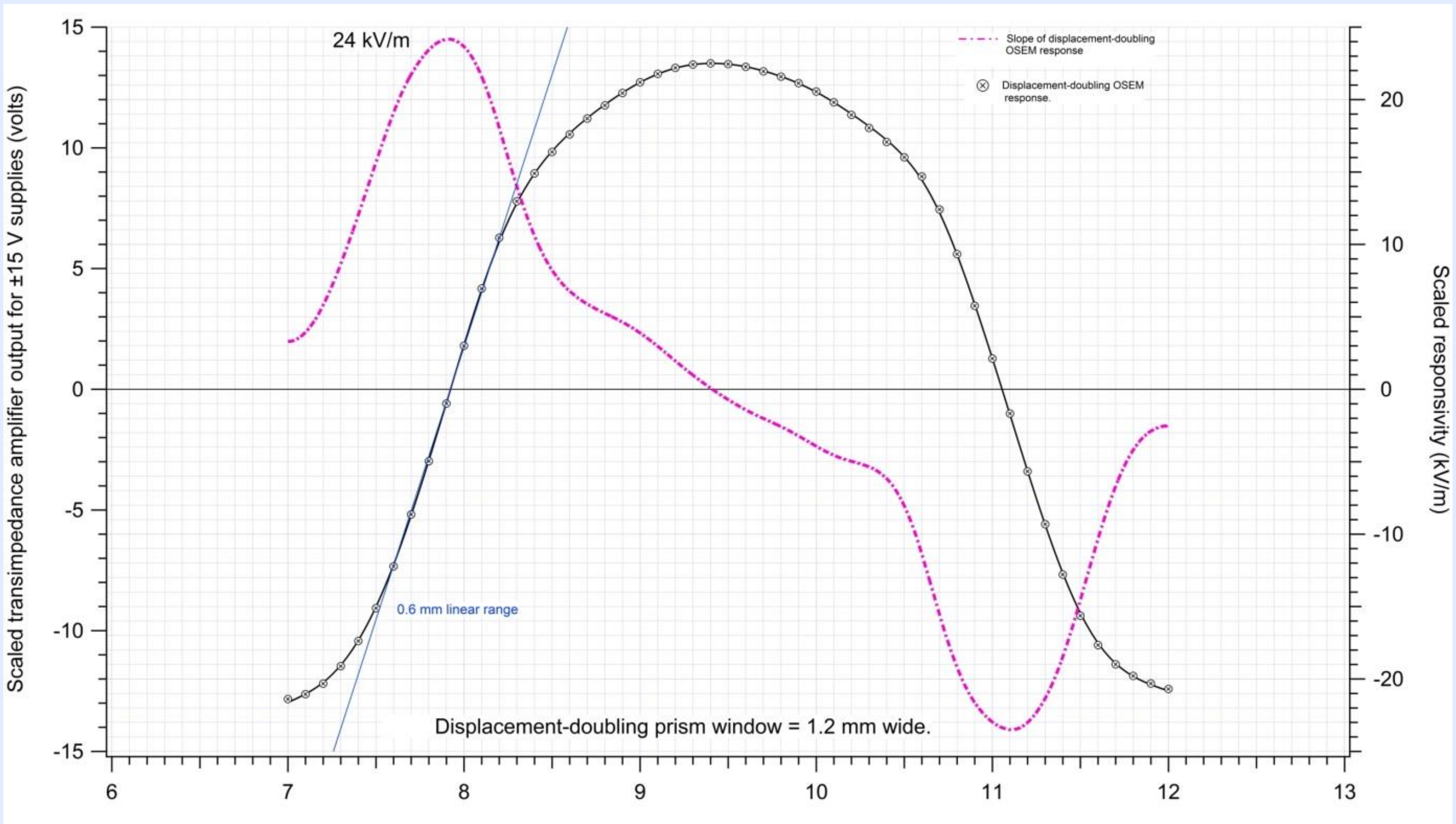


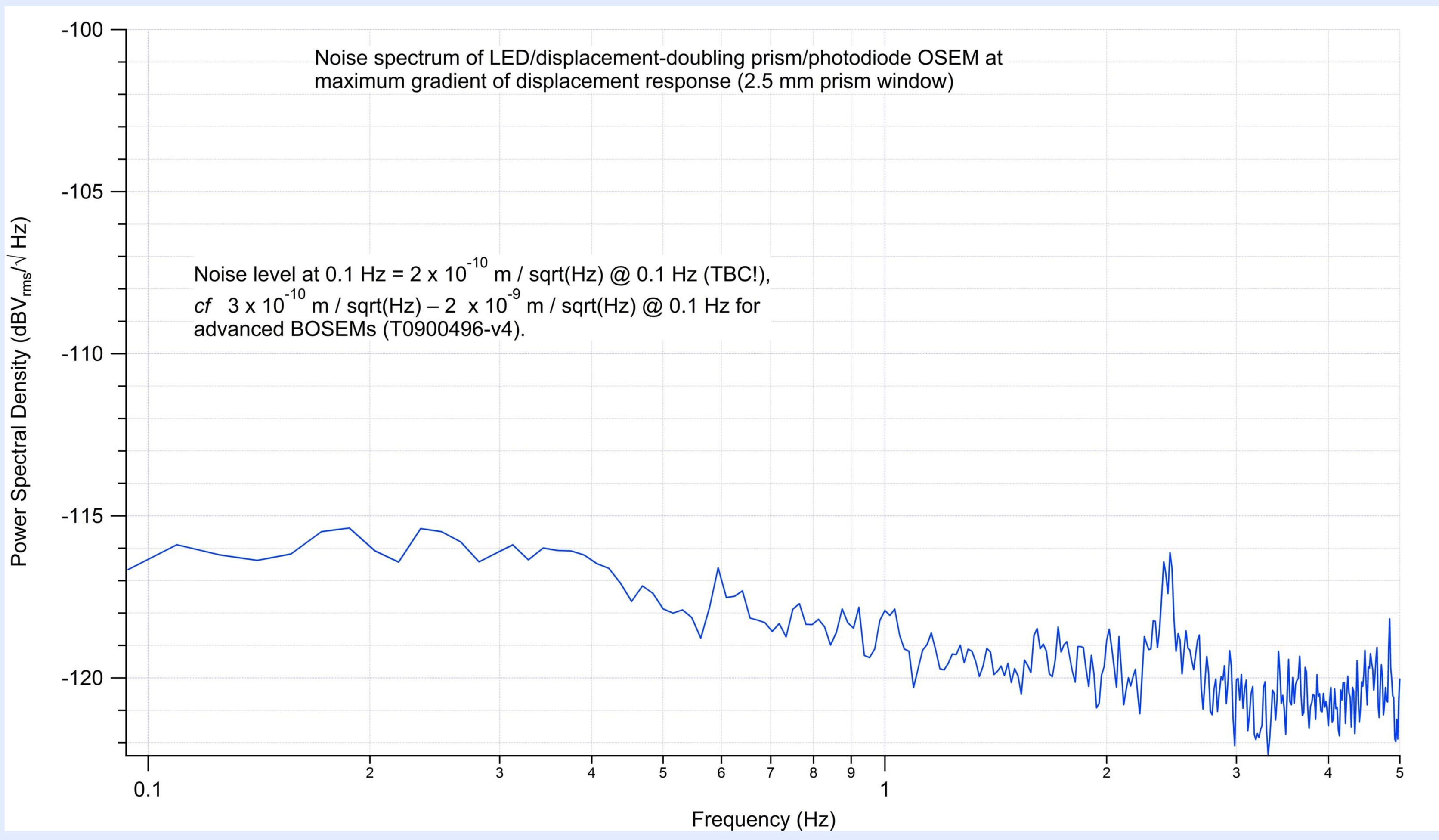
The displacement-doubling prism with its 2.5 mm-wide face masked by an evaporation of copper, so as to leave a 1.2 mm-wide clear strip.

Results using the full 2.5 mm prism window



Results using a masked prism window, 1.2 mm wide





Conclusions

The displacement-doubling prism results are very promising, and the wider prism window gives more linear results. The noise performance at 0.1 Hz is very good, and is ~4 times lower (on average) than the BOSEM results given in document T0900496-v4. Moreover, a dual PD detector should respond differentially—and simultaneously—to both the rising and falling signals as the flag is displaced. This should double the size of the signal.

References: 1. N.A. Lockerbie, Nucl. Instrum. Meth. A, 741 (2014) 192–195.