

**Self-insulation of a high-power Cherenkov oscillator,
operating in the X-band***

*Philip MacInnes[#], Simon J. Cooke[†], Igor A. Chernyavskiy[†],
Kevin Ronald[#], Alan D.R. Phelps[#]*

[#]SUPA, Physics Department, University of Strathclyde, UK

[†]Naval Research Laboratory, USA

We present initial predictions for the performance of a novel High-Power Microwave (HPM), X-band, Cherenkov oscillator, termed the ‘Self-Insulating Backward-Wave Oscillator (SIBWO)’ due to its close resemblance, in appearance, to the conventional (magnetically insulated) BWO. Conversion efficiencies (i.e. energy extracted from the electron beam, to the electromagnetic wave) in excess of 30% have been predicted by simulations using CST Studio Suite. This corresponds to output powers in excess of 300MW, from a 500keV, 2kA beam, when operating in the TM₀₁ mode at ~9.4GHz.

The operation of the SIBWO is intrinsically tied to the quality of the propagated electron beam. A tolerance study has been performed, varying the critical beam parameters (energy spread, variation in divergence angle, etc.), over the range expected in experiments. The results show the efficiency remains better than ~20%, even when operating with a relatively poor-quality beam. The resonant frequency of the source is also found to be relatively insensitive to variation in the electron energy over an extended range (400 – 600keV), with the efficiency of the source remaining above 20%, across this range, when operating with a high-quality beam. As the SIBWO relies solely on the self-fields of the electron beam for propagation, the conversion efficiency is closely linked to the overall energy efficiency of the source.

* Work supported by the Office of Naval Research, Grant No. N62909-18-1-2122– GRANT12538355, N00014-18-S-B001