

Renaissance of Travelling Wave Tube Technology for sub-THz Applications

IEEE Electron Devices Society Distinguished Lecture

Prof. Claudio Paoloni
School of Engineering
University of Lancaster, UK

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Abstract

Sub-THz Traveling Wave Tubes (TWTs) are an emerging solution for enabling long range high capacity links at sub-THz frequency.

TWTs are substantially three dimensional metal devices with dimensions proportional to the operation wavelength. At sub-THz frequencies the short wavelength poses substantial fabrication challenges. No commercial sub-THz TWT is available due to the challenging technology. Presently, only a few prototypes were built worldwide.

A TWT consists of an electron gun, a specific waveguide topology as slow wave structure (SWS), a collector, a periodic permanent magnets (PPM) system and RF windows to vacuum seal the input and output ports. The electron gun generates a beam with given current, voltage and radius traveling along the SWS in ultra-vacuum, confined by a magnetic focussing system. The amplification mechanism is based on the transfer of energy from the high energy electron beam generated by the electron gun to the RF field propagating in the SWS with phase velocity similar to the electron velocity. This mechanism permits to achieve more than one order of magnitude output power than solid state amplifiers at the same frequency.

This talk will introduce the emerging perspectives in the adoption of TWTs in new high capacity network architecture and describe the TWT working principle, the main fabrication processes at sub-THz frequencies, the design process and the state of the art of sub-THz TWT technology.

Bio Claudio Paoloni

School of Engineering, Lancaster University, Lancaster, UK

Claudio Paoloni since 2012 has been full professor and Cockcroft Chair with the School of Engineering at Lancaster University. He was the Head of School of Engineering (2015 – 2022).

He is Associate Editor of IEEE Transaction of Microwave Theory and Techniques and vice-Chair IEEE EDS Region 8.

He was member at large of the Board of Governor of the IEEE Electron Devices Society. He was Chair of the IEEE Electron Devices Society Vacuum Electronics Technical Committee (2017 – 2020).

He is IEEE Senior Member and Senior Fellow of the Higher Education Academy in the UK.

He was Guest Editor in Chief of the Special Issue of IEEE Transaction on Electron Devices on Vacuum Electronics published in June 2023.

He was coordinator of two European Commission Horizon 2020 projects, TWEETHER and ULTRAWAVE.

He published about 260 reviewed articles. He is author of four book chapters.

He has established at Lancaster University the “TWT Fab” a unique in Europe distributed laboratory for sub-THz Traveling Wave Tube fabrication.

Email. c.paoloni@lancaster.ac.uk

Website: <http://www.research.lancs.ac.uk/portal/en/people/claudio-paoloni>

Twitter: @CIPaoloni

Linkedin: <https://www.linkedin.com/in/claudio-paoloni/>