Massimo A. Ghioni

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Education

1987, "Laurea" degree (cum laude) in Nuclear Engineering - Politecnico di Milano, Italy

Positions and Employment

9/2000 – to date	Professor, Dipartimento di Elettronica e Informazione, Politecnico di Milano.
1/2010 – 12/2012	Chair of the Electronic Engineering program, Politecnico di Milano.
7/2004 – 9/2009	Member of the Board of Directors, Micro Photon Devices, Bolzano, Italy.
1/2003 – 12/2005	Deputy Chair, Dipartimento di Elettronica e Informazione, Politecnico di Milano.
11/1998 – 8/2000	Associate Professor, Dipartimento di Elettronica e Informazione, Politecnico di Milano.
1/1992 – 2/1993	Visiting Professor, IBM T.J. Watson Research Center, Yorktown Heights, NY, USA.
5/1990 – 10/1998	Assistant Professor, Dipartimento di Elettronica e Informazione, Politecnico di Milano.
8/1987 – 9/2002	Associate Researcher, Centro di Elettronica Quantistica e Strumentazione Elettronica (CEQSE) – National Research Council (CNR), Milano.

Honors, Awards, Fellowships

2004	IEEE Transactions on Power Electronics Prize Paper Award.
1996	AEI (Italian Association of Electrical and Electronic Engineers) Award.
1991	CNR-NATO Fellowship (one-year fellowship for research activity to be carried out in the U.S.).
1988	CNR Fellowship (one-year fellowship for research activity in the field "Materials and Devices for Solid State Electronics").
1987	"Fondazione Confalonieri" Fellowship (6 months post-graduate fellowship).
1987	"Italtel Award" for the best master thesis in optoelectronics.

Professional Memberships

IEEE Senior Member since 2008, Member since 1990.

Teaching Activity

1997 – to date	Power Electronics (graduate, Politecnico di Milano)
2001 – 2009	Fundamentals of Electronics (undergraduate, Politecnico di Milano)
1989 – 1999	Applied Electronics (undergraduate, Politecnico di Milano)

M. Ghioni has supervised over 100 Master's theses and 9 Ph.D. dissertations.

Research Activity

Politecnico di Milano, Dipartimento di Elettronica e Informazione

1987 – to date

The research activity has been mainly focused on the development of Single-Photon Avalanche Diodes (SPADs) and associated electronic systems for a wide range of emerging applications in chemistry, biology, medicine, material science and physics.

- In 1987 he introduced the first epitaxial SPAD photodetectors, achieving a temporal response with short diffusion tail combine with an unprecedented timing jitter of about 20 ps. FWHM. Starting from there, he developed several generations of SPAD devices and new technological processes for their manufacture in collaboration with universities, industries and research laboratories (IMM-CNR, Bologna; ST-Microelectronics Milan/Catania, Tyndall Institute Cork, Eire Boston University, USA), enabling the fabrication of large-area single SPAD detectors (up to 500 µm diameter) and monolithic SPAD arrays with wide pixels (up to 50 µm diameter). More recently he contributed to the development of new SPAD technologies providing better photon detection efficiency in the red and near infrared region of the optical spectrum (resonant-cavity enhanced and red-enhanced (RE) technologies) and dielectric isolation between pixels. He coordinated the manufacturing operations of these devices at the Cornell NanoScale Science and Technology Facility (CNF) of Cornell University, Ithaca, USA (CNF Project Number 2232-13).
- He contributed to the design of the first integrated active-quenching circuit (AQC) and its subsequent generations, which opened the way to practical application of SPAD detectors in compact photon detection modules capable of providing picosecond timing resolution at counting rates up to several Mcounts/s. He also contributed to the development of integrated AQCs with minimum hold-off time (<10ns) and to the design of integrated circuits aimed at increasing the count rate and the conversion efficiency in single-channel and multi-channel Time Correlated Single Photon Counting (TCSPC) measurements.
- He participated as PI or co-investigator in several national and international research projects focused on biomedical, biochemical and diagnostic applications of SPAD devices in partnership with universities, public bodies and high technology industries (MIUR-COFIN project "Microelectronic Devices and Micro-Analytical Systems for DNA-Sequence Diagnostics"1998; MIUR-FIRB project "Micro-systems for genetic diagnostics" 2001; 4th EC-FP project MICROSPAD "Microelectronic single photon detection and instrumentation for high sensitive analytical techniques" 1996; 6th EC-FP project NANOSPAD "Protein microarray for enhanced diagnostics at low cost by integration of new technological developments" 2005; 7th EC-FP project PARAFLUO "Parallel fluorescence spectroscopy tools for micro and nano-analytical applications down to single biomolecules" 2008; NSF grant for "picosecond resolved detection of single molecule" 2004, in collaboration with Harvard University); U.S. National Institutes of Health (NIH), grant n. 1R01GM095904 "Single-photon counting APD arrays for high-throughput single-molecule assays", 5/2012 - 2/2019, in collaboration with University of California at Los Angeles (UCLA)).
- He developed single photon detectors and systems for quantum cryptography and adaptive optics mainly in collaboration with the National Research Council (IMM-CNR), Heriot-Watt University, UK and ESO, European Southern Observatory, Germany (5th EC-FP project EQUIS "Enabling technologies for QUantum Information Systems" 1998; 6th EC-FP project SECOQC for "Development of a Global Network for Secure Communication based on Quantum Cryptography" 2004; 7th EC-FP project Q-ESSENCE "Quantum Interfaces, Sensors, and Communication based on Entanglement" 2010; ESO project STRAP "System for Tip-tilt Removal with Avalanche Photodiodes" for the new adaptive optical systems for the VLT observatory at Cerro Paranal, Chile, 1995; Italian Space Agency (ASI), project Fiber-SPAD "Single Photon Avalanche Diodes for fast read-out of scintillating fibers", 2010).

Politecnico di Milano, Dipartimento di Elettronica e Informazione

2001 - 2007

- He started and led a team in the development of digitally controlled DC-DC converters for distributed power systems (DPS). This activity was supported by ST Microelectronics (Milan, Italy) and it was mainly focused on mixed signal architectures for control of non-isolated (multiphase buck for VRMs, boost) and isolated (full and half bridge) converters. These controllers offer the full flexibility of digital techniques, while providing dynamic performance comparable to that of the best analog controllers and reduced system complexity.

IBM T.J. Watson Research Center, Yorktown Heights, NY, USA

1992 - 1993

- He designed and fabricated high-speed, VLSI-compatible silicon-on-insulator photodetectors for optical data link applications. By exploiting a lateral p-i-n structure he demonstrated a 3-dB bandwidth of 1 GHz at 3.5 V and 2 GHz at 5 V bias voltage at 850 nm wavelength along with sub-10 pA dark currents and no low-frequency gain.

M. Ghioni has authored/co-authored over 200 papers in international peer-reviewed journals and proceedings of international conferences. He holds 8 US and EU patents.
Bibliometric data (source: Scopus; date: 23/07/2019): Author ID: 57200562034; h-index: 33; documents: 218; citations: 4435. ORCID: 0000-0002-8626-3658.

Technology Transfer Activity

In 2004 he co-founded Micro Photon Devices (MPD), a spin-off company of Politecnico di Milano specialized in developing, manufacturing and bringing to the market novel photon counting modules and systems based on SPAD devices (http://www.micro-photon-devices.com/). MPD has been profitable since 2006, exporting over 95% of its production to the most demanding markets worldwide.

Current research interests

M. Ghioni is currently involved in the development of compact detection modules based on SPAD arrays and associated electronics for parallel photon counting and timing measurements at the single-molecule sensitivity level. The applications are mainly focused on micro and nano-analytical techniques currently used in the biomedical, biochemical, diagnostic and pharmaceutical fields, such as FCS (Fluorescence Correlation Spectroscopy), FLIM (Fluorescence Lifetime Imaging), sFLIM (spectrally-resolved FLIM), FRET (Fluorescence Resonant Energy Transfer). In all these applications, the fundamental objective is to increase both the throughput and the miniaturization of the measurement system, making these methodologies attractive for point-of-care diagnostics and for large-scale screening tests used in the field of biotechnology and in the pharmaceutical industry.