



UNIVERSITY  
OF TRENTO - Italy  
Department of Physics

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2024, May 22 – 2:00 p.m., Room A102 – Polo Ferrari 1

# Photovoltaics: Current Landscape and Future Directions in Solar Energy

### Abstract

In an era marked by an ever-deepening commitment to renewable energy sources, solar energy represents tangible hope for reducing CO<sub>2</sub> emissions and addressing the challenges of climate change. However, within this realm of solar technologies lies a rich mosaic of innovations characterized by a multitude of considerations spanning efficiency, cost-effectiveness, and environmental sustainability. Beginning with an exploration of how and why silicon solar cells are the most cost-effective technology for producing sustainable electricity using renewable solar energy, we will proceed to discuss the main aspects of other types of solar cells on the market and in the research and development stage. We will delve into promising emerging inorganic thin-film photovoltaic technologies, such as kesterite Cu<sub>2</sub>ZnSnS<sub>4</sub> (CZTS), and the pioneering frontiers of photovoltaics with perovskite. Furthermore, we will explore the properties of various absorber materials and PV devices in light of the different and future fields of application of solar technology, such as floating PV, agrivoltaics, and vehicle-integrated PV.

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