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Future of multi-messenger science with the next-generation observatories

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The last five years marked the birth of the first detections of gravitational waves and neutrinos from outside the solar system opened the era of multi-messenger astrophysics. In addition to the growing and continuously upgraded GW and neutrino facilities, many observatories in the e.m. domain (optical, NIR, radio, X- and gamma-rays, VHE) worldwide are already partly or fully dedicated to the study of the Universe this amazing newly open window. But it is towards the end of this decade, and the beginning of the '30s that we will actually enter the golden-age of multi-messenger astrophysics. Indeed, as I will review in this talk, the projects for advanced second generation and third generation GW and neutrino detectors (e.g., ET, CE, KM3NeT) are flanked by the current development of the extremely large observatories in the electro-magnetic domain (e.g., E-ELT, TMT, SKA, Athena, CTA) and dedicated space mission concepts like THESEUS (ESA/M5 candidate). The synergies between these great ground and space facilities will revolutionise several fields of astrophysics and provide measurements of paramount importance also for cosmology and fundamental physics.

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