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Time-Resolved Two-Photon Spectroscopy: Applications in Quantum Physics and Photonics

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Abstract: *Time-resolved two-photon spectroscopy (TR2PS) is a powerful technique for investigating the dynamics of photo-excited states in materials with fem to second time resolution. TR2PS has been applied to a wide range of materials, including inorganic and organic semiconductors, perovskites, and magnetic materials. This technique can provide valuable insights into the underlying physics and chemistry of these materials, as well as their potential applications in optoelectronics, energy conversion, and quantum technologies. In this review, we compare TR2PS with other time-resolved spectroscopy techniques, including resolved fluorescence spectroscopy, transient absorption spectroscopy, time-resolved Raman spectroscopy, time-resolved X-ray diffraction, and time-resolved optical Kerr effect spectroscopy. We also discuss the different materials that have been studied using TR2PS, including the types of dynamics that have been observed in each material, potential applications, and challenges associated with studying these materials. Finally, we compare different data analysis and interpretation techniques for TR2PS data, considering factors such as the level of expertise required, computational resources needed, and types of information that can be obtained using each technique. Overall, this review highlights the versatility and importance of TR2PS in materials science and provides a comprehensive overview of the current state of research in this field.*

Keywords: Time-resolved two-photon spectroscopy, quantum physics, photonics, spectroscopy techniques, quantum optics, nonlinear optics

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