

Tutorial on
“**Integrated Quantum Photonics**”
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Quantum science and technology have assumed great importance in view of their applications in quantum computing, quantum key distribution, quantum sensing, quantum teleportation and quantum information sciences. Most advanced countries, including India, are significantly investing in this domain, as it is expected to become ubiquitous in future societies.

The quantum description of electromagnetic waves in the form of photons, has played a pivotal role in the progress of the field. Integrated quantum photonics (IQP) deals with integration of photonic components operating at the quantum level (single or multiple photons) on a single chip, much like integrated electronic circuits and electrons. This enables all the advantages of integration in the form of small/low SWaP (Size, Weight and Power), novel functionalities, and the ability to make future-proof technologies that are CMOS-compatible. With its largescale adoption, we can envision the ushering in of widespread application of quantum photonics in our daily lives.

The Tutorial will start with the basics of integrated optics and the characteristics of some important photonic components, and will be followed by a deeper dive into the basics of nonlinear optics, which plays a very important role in controlling the more unusual quantum properties of light. In addition, quantization of light leading to the concept of photons, and the varied non-classical states of light that can be created, will be discussed. This will be concluded by touching on some relevant integrated quantum photonic devices and their applications.

The Tutorial, which focuses on the fundamentals, will help the participants to get introduced to the required basics of integrated optical devices, nonlinear optical effects in waveguides, important notions about quantum states of light, and will highlight some practical demonstrations. While not a necessity, a basic knowledge of optics and quantum mechanics will enable participants to strengthen and develop further, a practical foundation in the field. While being a launching board for beginners in this exciting field of integrated quantum photonics, the tutorial will also permit people already working in the quantum optics domain to get a glimpse of the possibilities that the field can provide and provide a sneak peek towards what the future holds.

General References:

Integrated optics

1. Ajoy Ghatak and K Thyagarajan, *Optical Electronics*, Foundation Books, New Delhi, 1991.
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Nonlinear Optics

1. R W Boyd, *Nonlinear Optics*, Academic Press, 2008
2. A Yariv, *Quantum Electronics*, John Wiley, 1988

Quantum optics

1. G Grynberg, A Aspect and C Fabre, *Introduction to quantum optics*, Cambridge University Press, 2010
2. C Gerry and P L Knight, *Introductory quantum optics*, Cambridge University Press, 2004