Optical Isolator is a key component of photonic circuits and systems. An optical isolator requires non-reciprocal propagation i.e. breaking time inversion symmetry. Time symmetry cannot be broken in a linear optical system without magnetic field and/or gain and loss, hence all the practical isolators at this point are based on Faraday (magneto optic) effect which makes it difficult to develop isolators for planar integrated photonic circuits. Therefore, in recent years a strong effort has been mounted to develop non-magnetic isolators. A number of schemes had been proposed and demonstrated, such as devices with temporal modulation, acousto-optic and opto-mechanical isolators, various nonlinear schemes and parity time schemes with gain and loss.

In this talk we review performance characteristics of all these schemes and find them lacking any advantages in comparison to magnetic isolators. Most of the proposed schemes are severely limited in bandwidth and require high power consumption. Moreover, often they are not true optical isolators but are “optical diodes” in the sense that they do not offer full isolation.

We then make a case for the optical isolator based on second and third order nonlinearities that have good isolation and high dynamic range and offer detailed analysis of this exciting family of devices.