

Advances on Integrated Optics

Andrea Melloni

DEIB – Politecnico di Milano, Piazza Leonardo da Vinci, 32 - 20131 Milano, Italy

e-mail: andrea.melloni@polimi.it

<http://photonics.deib.polimi.it>

<http://www.polifab.polimi.it>

The analysis and design of advanced and complex photonic integrated circuits is an art that has to take into account subtle aspects, technological details, tricks and skills that experts accumulate in years of activity. Well aware that in a short time it is impossible to cover exhaustively the various aspects related to technologies, passive and active devices, linear and non-linear, and so on, the aim of this lecture is to consider with some detail aspects apparently trivial or negligible that can have a large impact on the overall performance of the entire circuits.

The topics include aspects related to the index contrast and effective and group index with a comparison between technologies, the surface of the waveguide, backscatter, crosstalk and attenuation. Ring resonators will be treated in detail, starting from an historical survey and going through the theory and applications with potentials and limits. The combination of basic building blocks towards the design of complex circuits will be considered with an introduction towards circuit analysis and synthesis. The effect of tolerances will be introduced and simple considerations on robust design, statistical analysis and yield estimation mentioned.

Several arguments have the scope and are essential to introduce the other lectures.

Some References

D. Melati, A. Melloni, and F. Morichetti, “Real photonic waveguides: guiding light through imperfections,” *Adv. Opt. Photon.* 6, 156-224 (2014)

S. Grillanda, F. Morichetti, “Light-induced metal-like surface of silicon photonic waveguides”, *Nature Communications* 6, Article number: 8182, 2015.

D. Melati, F. Morichetti, G.G. Gentili, and A. Melloni, “Optical radiative crosstalk in integrated photonic waveguides”, *Optics Letters* Vol. 39, Iss. 13, pp. 3982–3985 (2014).

D. Melati, F. Morichetti, and A. Melloni, “A unified approach for radiative losses and backscattering in optical waveguides”, *J. Opt.* 16 055502 (2014), (Featured Article)

A. Melloni, P. Monguzzi, R. Costa, and M. Martinelli, “Design of curved waveguides: the matched bend,” *J. Opt. Soc. Am. A* 20, 130-137 (2003)

D. Jalas, A. Petrov, M. Eich, W. Freude, S.H. Fan, Z.F. Yu, R. Baets, M. Popovic, A. Melloni, J.D. Joannopoulos, M. Vanwolleghem, C.R. Doerr and H. Renner, “What is: and what is not an optical isolator” *Nature Photonics* 7(8), 2013