



**HAL**  
open science

## Brillouin backscattering in a high-index doped silica chip waveguide

M Zerbib, V T Hoang, J C Beugnot, K P Huy, B Little, S T Chu, D J Moss,  
R Morandotti, B Wetzel, T Sylvestre

► **To cite this version:**

M Zerbib, V T Hoang, J C Beugnot, K P Huy, B Little, et al.. Brillouin backscattering in a high-index doped silica chip waveguide. Workshop on OptoMechanics and Brillouin Scattering, Campinas, Feb 2024, Campinas, Brazil. hal-04573131

**HAL Id: hal-04573131**

**<https://hal.science/hal-04573131>**

Submitted on 13 May 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial 4.0 International License

# Brillouin backscattering in a high-index doped silica chip waveguide

M. Zerbib<sup>1</sup>, V. T. Hoang<sup>2</sup>, J. C. Beugnot<sup>1</sup>, K. P. Huy<sup>1</sup>, B. Little<sup>3</sup>, S. T. Chu<sup>4</sup>,  
D. J. Moss<sup>5</sup>, R. Morandotti<sup>6</sup>, B. Wetzel<sup>2</sup>, and T. Sylvestre<sup>1,\*</sup>

1. Institut FEMTO-ST, CNRS Université de Franche-Comté, ENSMM Sup Microtech, 25030 Besançon, France

2. XLIM Research Institute, CNRS UMR 7252, Université de Limoges, 87060 Limoges, France

3. QXP Technologies Inc., Xi'an, China

4. Department of Physics, City University of Hong Kong, Tat Chee Avenue, Hong Kong, SAR, China

5. Optical Sciences Centre, Swinburne University of Technology, Hawthorn, VIC 3122, Victoria, Australia

6. INRS-EMT, 1650 Boulevard Lionel-Boulet, Varennes, J3X 1S2, Québec, Canada

\*Email: [thibaut.sylvestre@univ-fcomte.fr](mailto:thibaut.sylvestre@univ-fcomte.fr)

**Abstract:** We investigate, both experimentally and theoretically, Brillouin backscattering in a 50-cm long high-index ( $n=1.7$ ) doped-silica glass photonic chip waveguide. The Brillouin spectrum features a broad (350 MHz) acoustic resonance at 16 GHz, in good agreement with theory and numerical simulations. Brillouin gain was estimated to be around  $0.09 \text{ m}^{-1}\text{W}^{-1}$ .

Stimulated Brillouin scattering (SBS) is an invaluable tool for processing light and microwave, as well as for the development of optical sensors, frequency combs, and lasers [1]. While SBS has been exploited earlier on within optical fibers, it is only recently that it has been observed in CMOS-compatible integrated waveguides based on chalcogenide (ChG), silica ( $\text{SiO}_2$ ), silicon (Si), or silicon nitride ( $\text{Si}_3\text{N}_4$ ) [1]. Here, we report the observation of Brillouin backscattering in a 50-cm long spiral high-index doped silica glass integrated waveguide, whose cross-section is depicted in Fig. 1(a) [2]. Fig. 1(b) shows the reflectometer trace that measures total insertion loss (8.9 dB) and linear loss (0.1 dB/cm), and Fig. 1(c) is the experimental setup for measuring the Brillouin backscattering spectrum at 1550 nm. The experimental spectrum for a pump power of 18 dBm is shown in Fig. 1(d). It features a broad Brillouin peak at 16 GHz due to the high-index waveguide and a sharper one at 10.8 GHz due to the silica fibers in the setup. Fig. 1(e) is the numerical simulation of the Brillouin gain spectrum and the insets show the computed optical (top) and elastic (bottom) modes (See Ref [2] for details). As it can be seen, the agreement is quite excellent. We find a Brillouin shift at 16 GHz and a peak gain of  $g_b=0.09 \text{ m}^{-1}\text{W}^{-1}$  from simulations. These integrated waveguides could potentially find Brillouin-based applications if we find a way to increase the gain while reducing the linewidth.

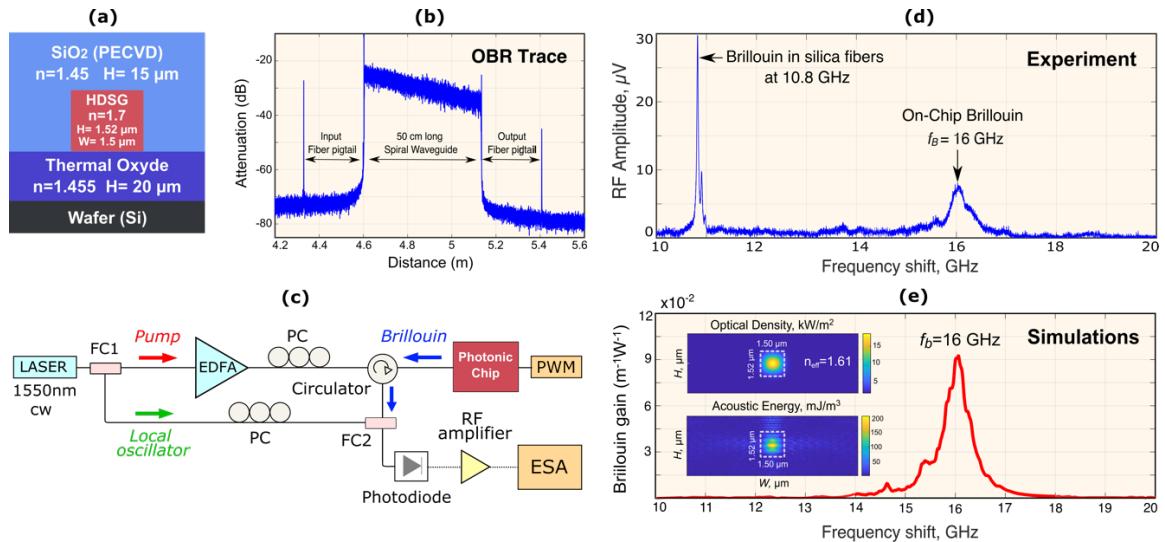


Figure 1: Results of Brillouin backscattering in high-index doped silica chip waveguide

## References

1. B. J. Eggleton, C. G. Poulton, P. T. Rakich, M. Steel, G. Bahl, "Brillouin integrated photonics," Nat. Phot. 13 (10), 664-677 (2019).
2. M. Zerbib, V.T. Hoang, J.C. Beugnot, K.P. Huy, B. Little, S.T. Chu, D.J. Moss, R. Morandotti, B. Wetzel, T. Sylvestre, Res. in Phys. 52, 106830 (2023).