



Title: Switchable emissions of an Erbium-doped fiber laser using cascaded MZIs based on CHCF

Authors: HERRERA-PIAD, Luis, VELAZQUEZ-GONZALEZ, Felipe, DURAN-PEREZ, Oscar and BRIANZA-GORDILLO, Gerardo

Editorial label RINOE: 607-8695

VCIERMMI Control Number: 2023-02

VCIERMMI Classification (2023): 261023-0002

Pages: 16

RNA: 03-2010-032610115700-14

MARVID - Mexico

Park Pedregal Business. 3580-
Adolfo Ruiz Cortines Boulevard –
CP.01900. San Jerónimo Aculco-
Álvaro Obregón, Mexico City
Skype: MARVID-México S.C.
Phone: +52 | 55 6159 2296
E-mail: contact@marvid.org
Facebook: MARVID-México S. C.
Twitter: @Marvid_México

www.marvid.org

Holdings

Mexico	Colombia	Guatemala
Bolivia	Cameroon	Democratic
Spain	El Salvador	Republic
Ecuador	Taiwan	of Congo
Peru	Paraguay	Nicaragua

Content

Background and Introduction

Goals

Fabrication and Setup

Results

Conclusions

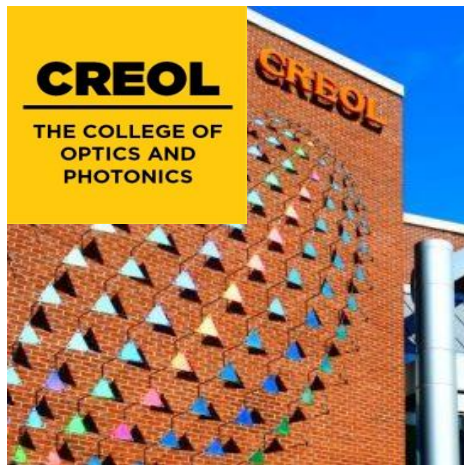
Academic Background



**Ing. en Telecomunicaciones y Electrónica
por la Universidad Tecnológica de La Habana, Cuba**



**Maestría y Doctorado en Ingeniería Eléctrica (Física: Fibras Ópticas)
por la Universidad de Guanajuato, México**



**University of Central Florida, US
Universitat de Valencia, España**



Fiber Optics

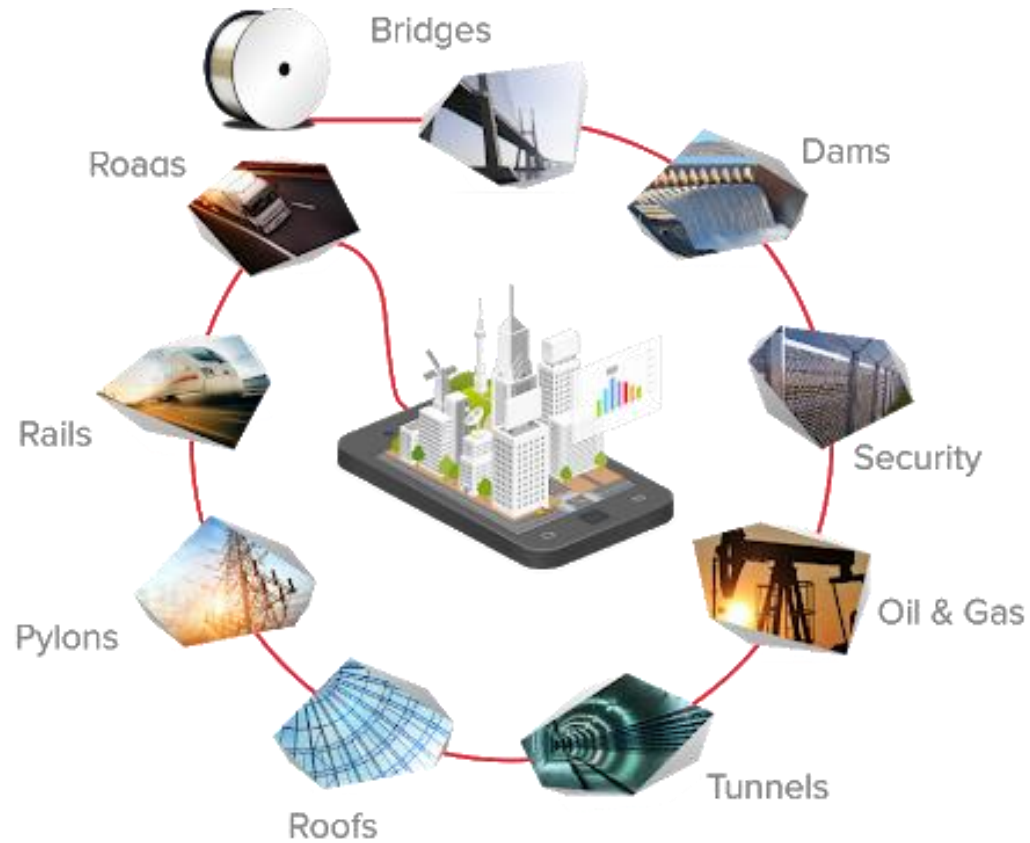


Fig. 1. Fiber Optics Applications.

-Military Industry (Security, cameras)

-Exploration (Oil, Gas)

-Medical field (Surgical, Diagnostic)

-Special Biomedic applications (Coagulation, Glucose, Protein, Drug identification)

-Aeronautics

Fiber Optics

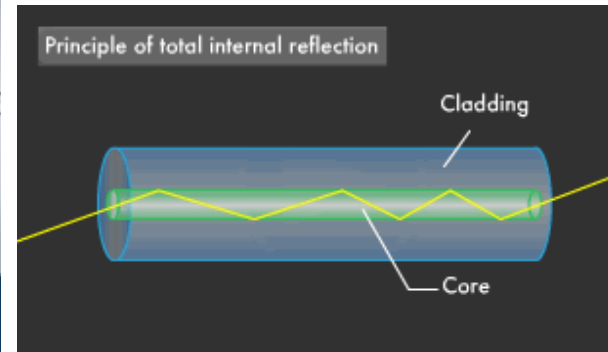
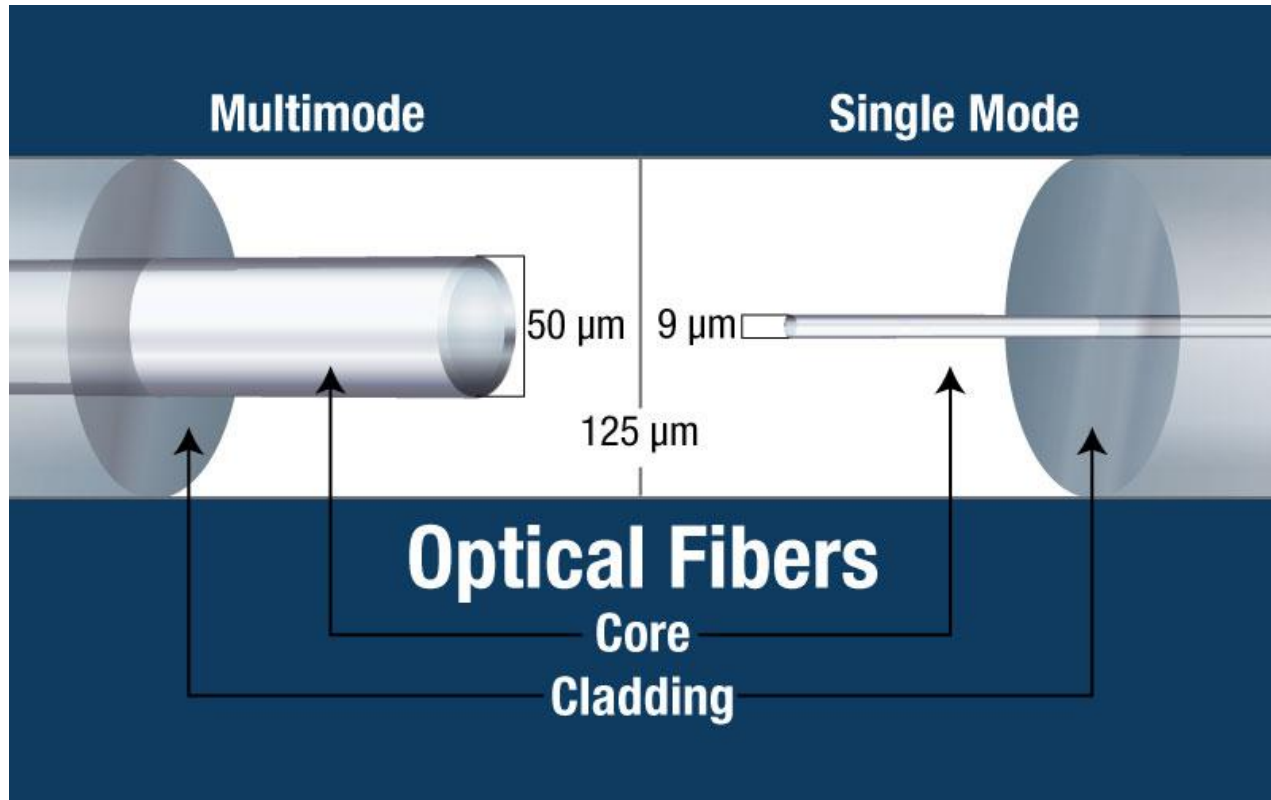


Fig. 2. Optical Fiber.

Goals

- Fabrication of an Erbium-doped fiber laser using cascaded MZIs based on CHCF.
- High signal noise to ratio (SNR) for laser lines.
- Stable output.
- Emissions at precise wavelength positions.

Fabrication

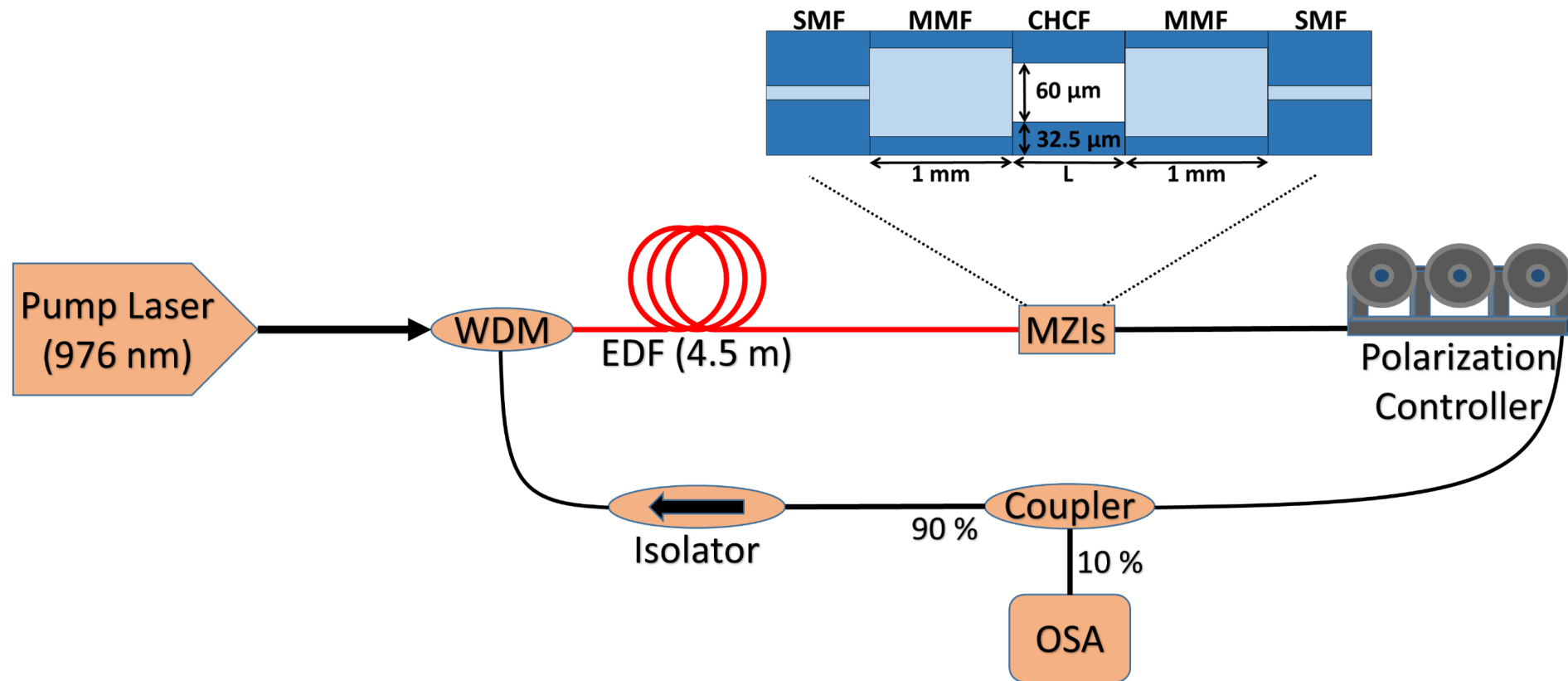


Fig. 3. Setup.

MZIs

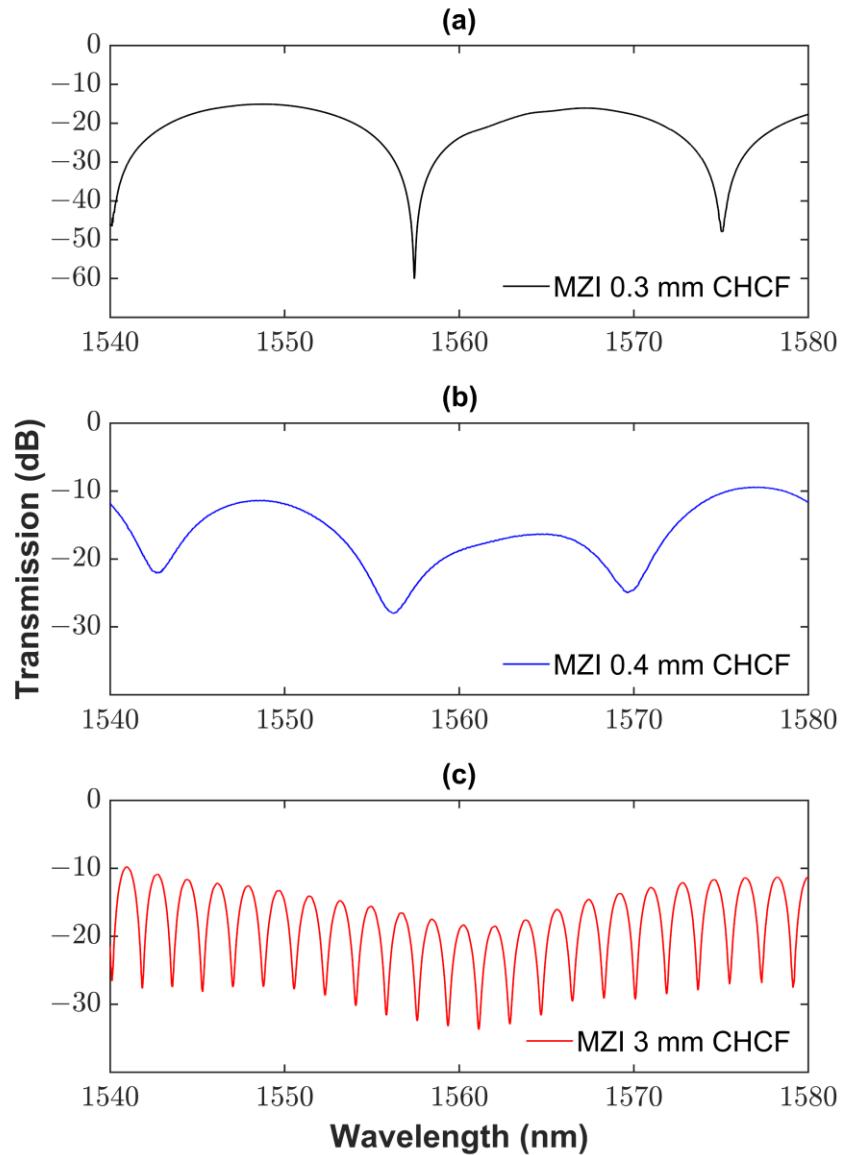


Fig. 4. Transmission spectra of (a) MZI1a, (b) MZI1b, (c) MZI2.

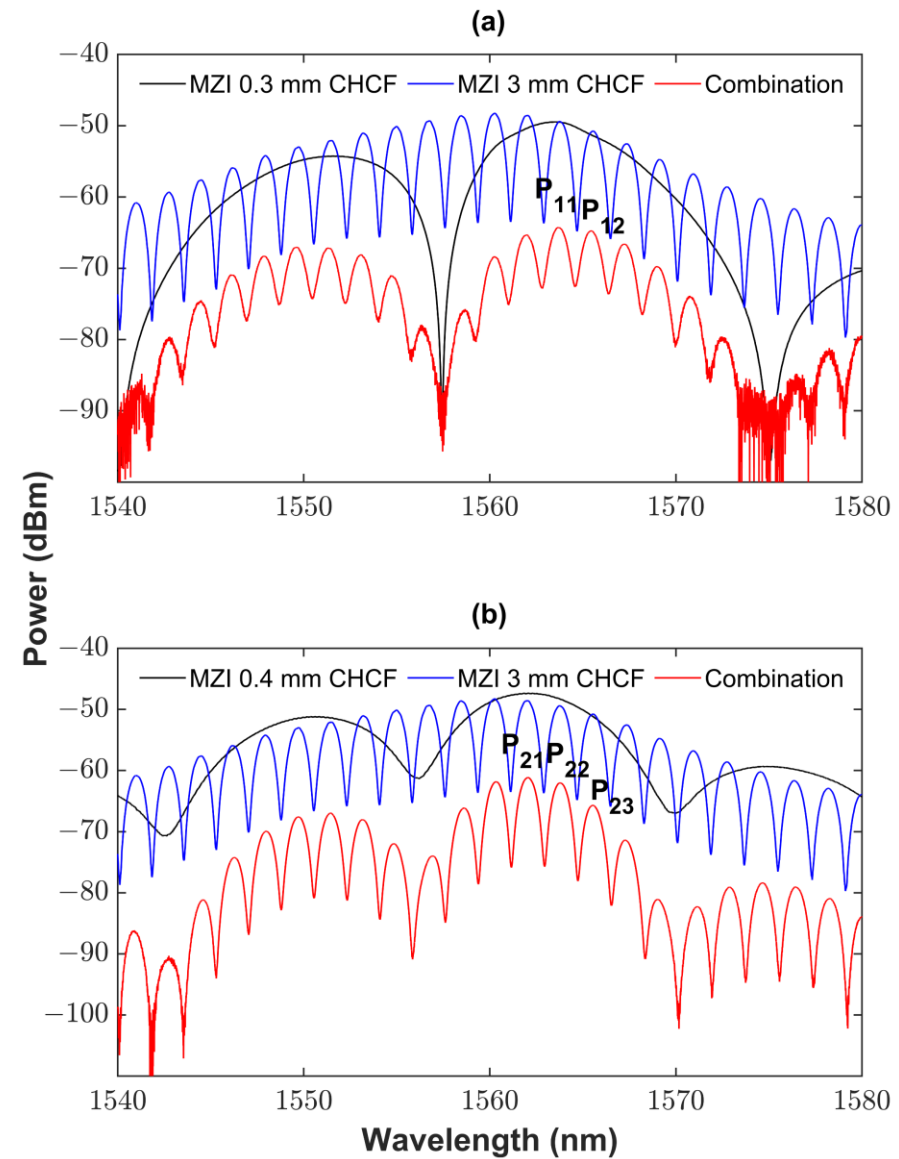
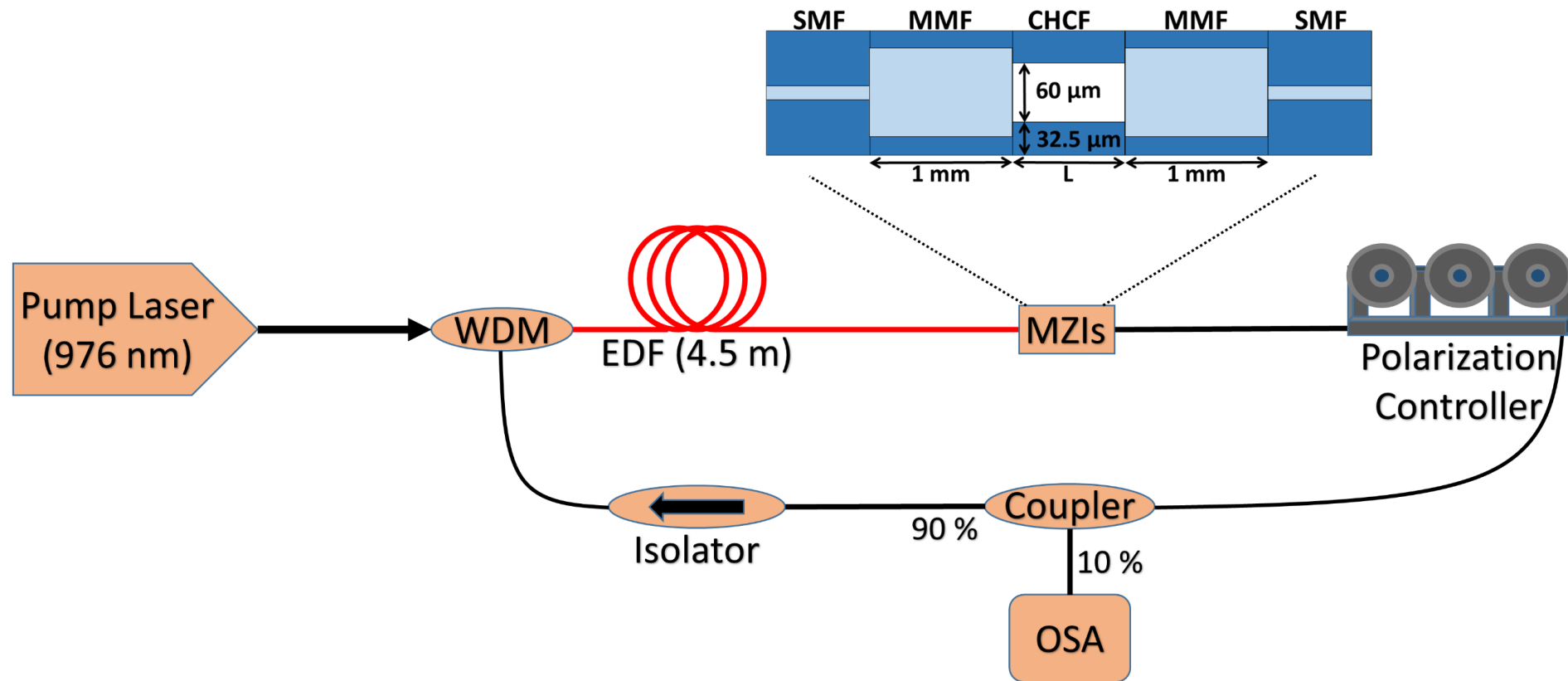
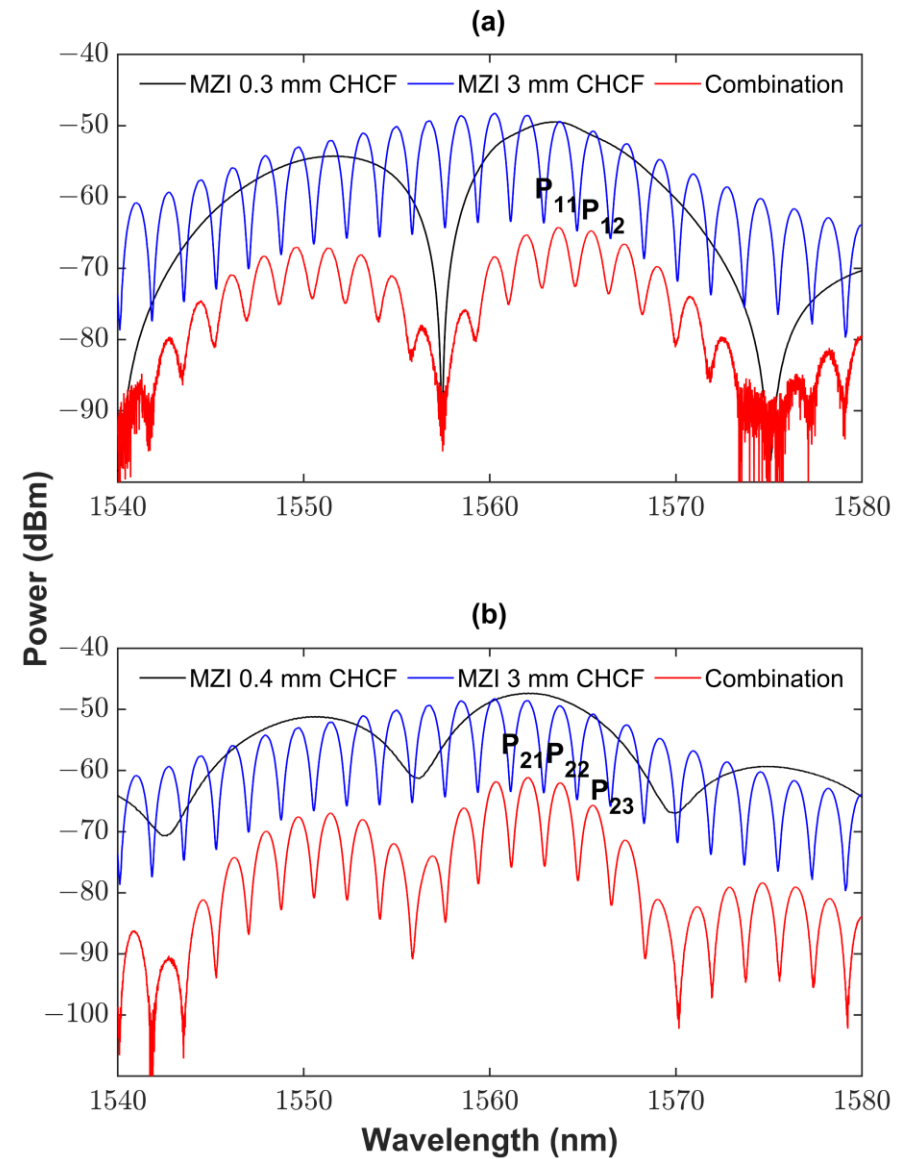
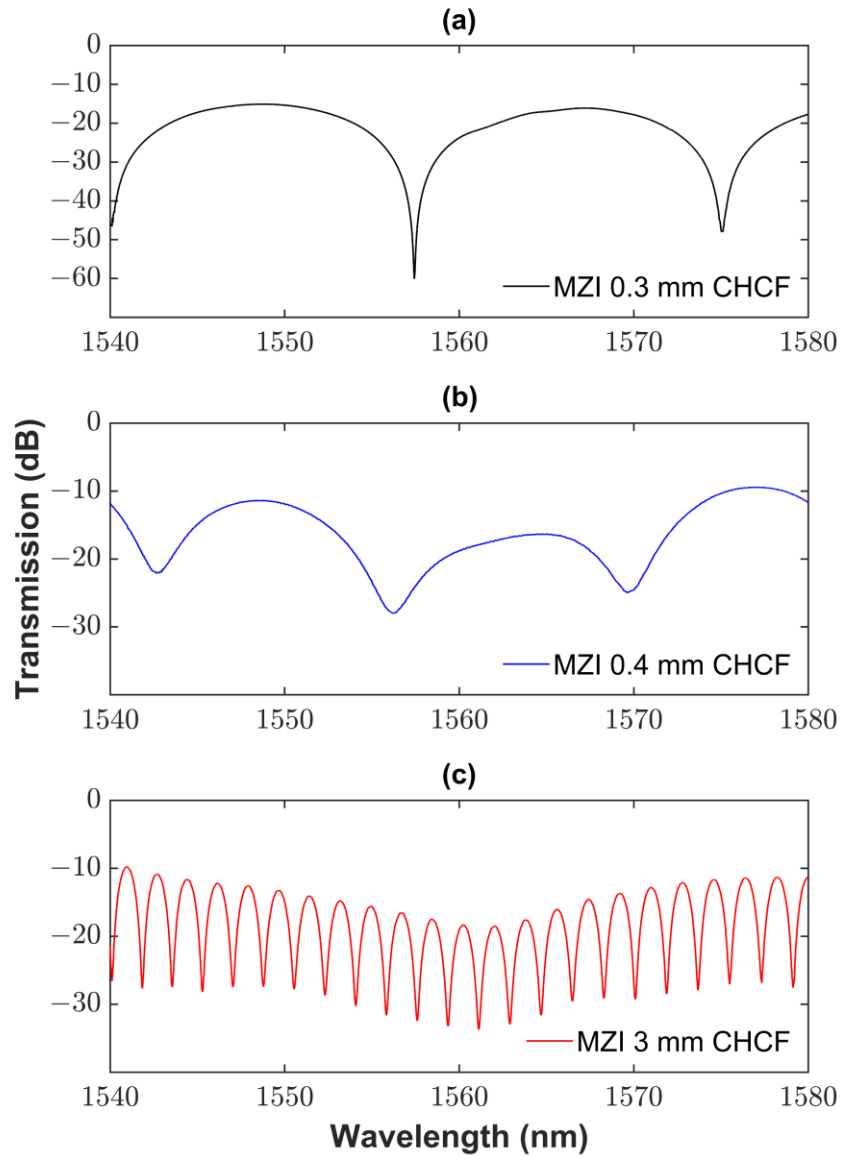


Fig. 5. Transmission spectra of the MZI2 linked in sequence with the (a) MZI1a, (b) MZI1b (Cascade configuration).

Setup



Emissions? WHERE?



Results

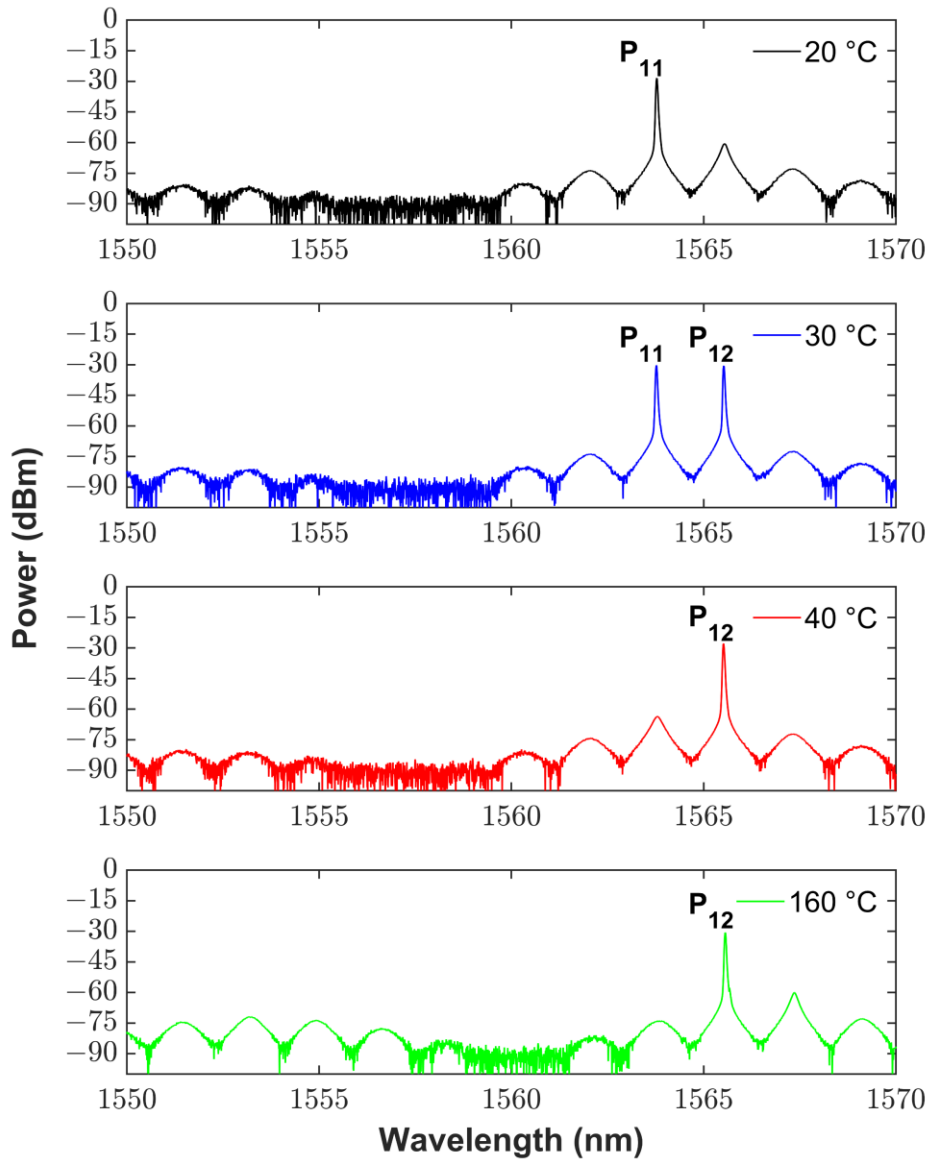


Fig. 6. Switchable operation of the EDFL using MZI2 and MZI1a.

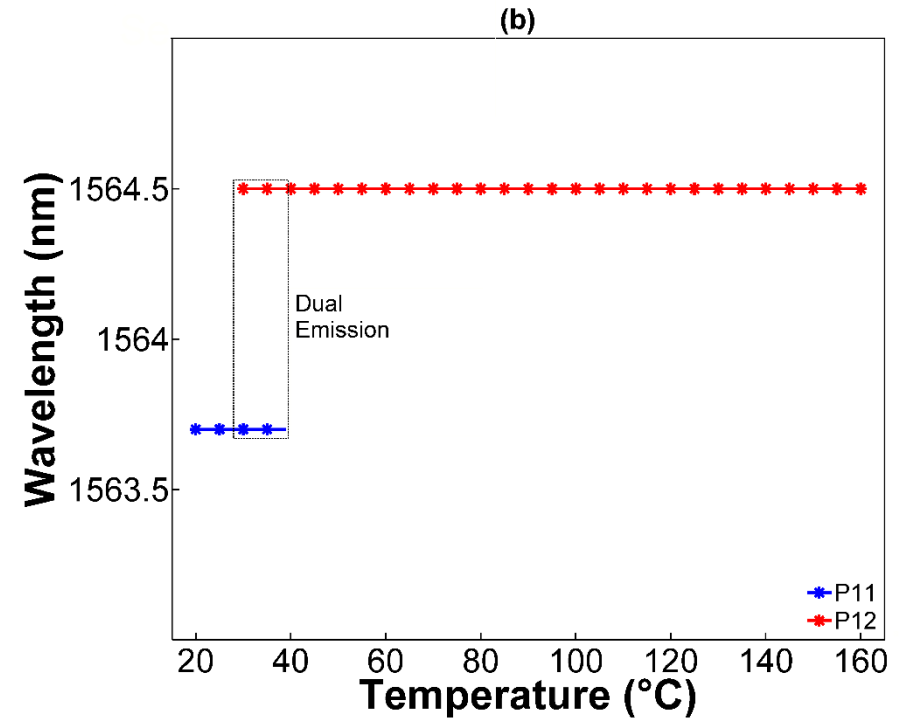


Fig. 7. Stability analysis of laser emissions against temperature changes.

Results

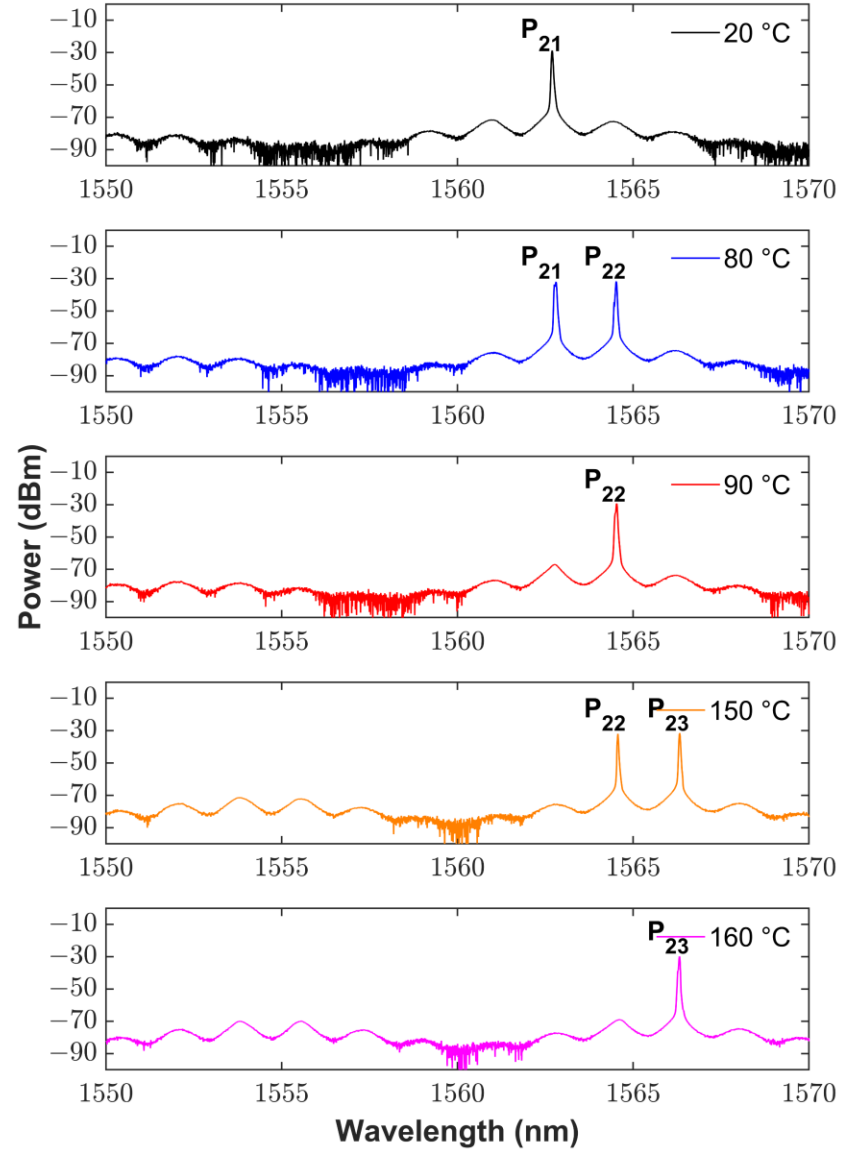


Fig. 8. Switchable operation of the EDFL using MZI2 and MZI1b.

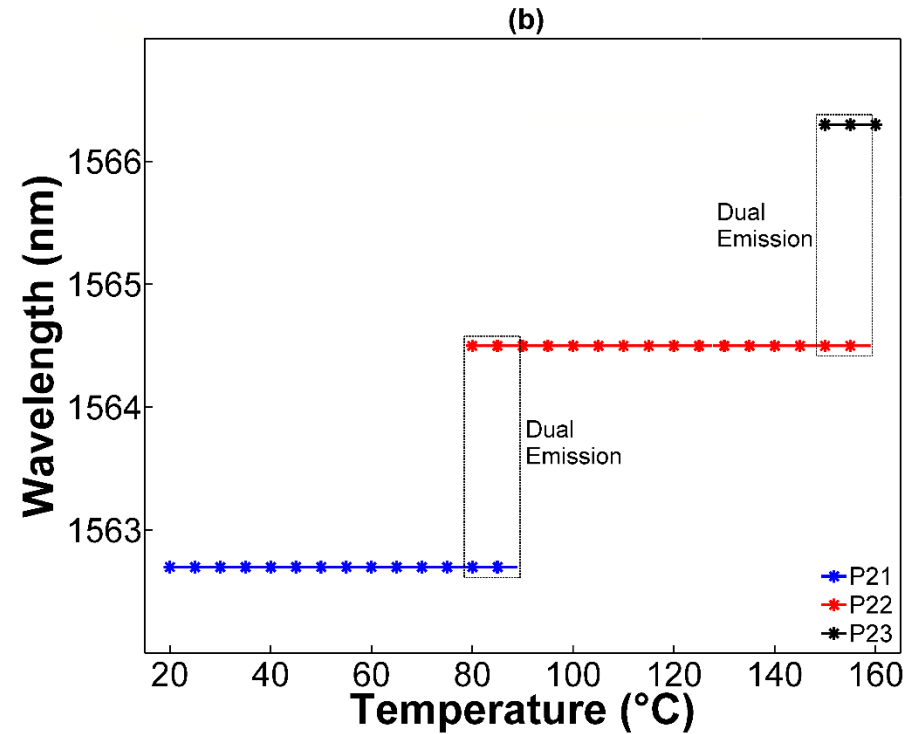


Fig. 9. Stability analysis of laser emissions against temperature changes.

Conclusions

-An easy reproducible technique is experimentally demonstrated to implement an Erbium-doped fiber laser using cascaded MZIs based on CHCF. The all-fiber MZIs were fabricated by splicing a small piece of capillary hollow core fiber (CHCF) between two segments of MMF (low cost, no expensive fiber were used).

-Signal noise to ratio (SNR) for laser lines of more than 50 dB, even 59 dB.

-Highly stable output since no power and wavelength variations were noticed. Emissions at precise wavelengths...

-This EDFL can be used in applications of optical fiber communications systems and fiber sensing.

Education begins with life and does not end until death.

José Martí.

luis.piad@utags.edu.mx

CUBA



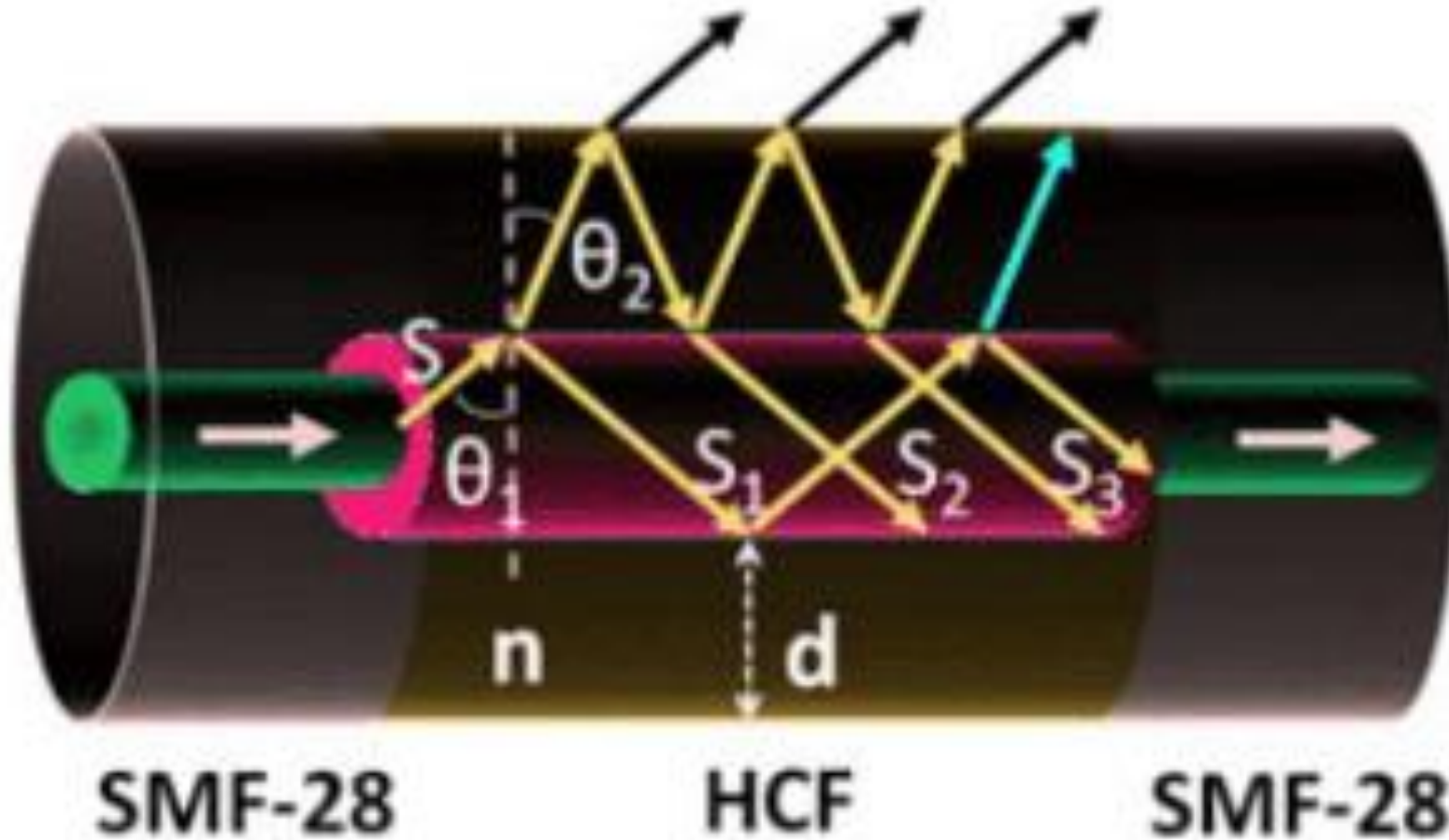
CUBA



Esta es la tierra más hermosa que ojos humanos hayan visto.

Cristobal Colón

Functioning principle



$$\lambda_r = \frac{2d\sqrt{n^2 - n_0^2}}{m}$$



© MARVID-Mexico

No part of this document covered by the Federal Copyright Law may be reproduced, transmitted or used in any form or medium, whether graphic, electronic or mechanical, including but not limited to the following: Citations in articles and comments Bibliographical, compilation of radio or electronic journalistic data. For the effects of articles 13, 162,163 fraction I, 164 fraction I, 168, 169,209 fraction III and other relative of the Federal Law of Copyright. Violations: Be forced to prosecute under Mexican copyright law. The use of general descriptive names, registered names, trademarks, in this publication do not imply, uniformly in the absence of a specific statement, that such names are exempt from the relevant protector in laws and regulations of Mexico and therefore free for General use of the international scientific community. VCIERMMI is part of the media of MARVID-Mexico., E: 94-443.F: 008- (www.marvid.org/booklets)