

Article

# POL-MUX System for Noncoherent Optical Networks

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**Abstract:** This paper is focused on applying a polarization multiplex to passive optical networks to double their transmission bandwidth without significant changes in the distribution network. Although polarization multiplexes are already employed for high-speed optical transport networks with digital signal processing and coherent detection, we propose a system that could be used in existing older optical networks using a dynamic polarization controller in combination with a wavelength division multiplex.

**Keywords:** WDM; polarization; PDM; POL-MUX; PON; crosstalk; BER; DPC



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## 1. Introduction

The demand for wider bandwidth in transport optical networks, as well as in optical access networks, increases every year. For this purpose, many multiplexing techniques have been developed, and some of them have been deployed for real data traffic. The most important multiplexing techniques in transport optical networks are the dense wavelength division multiplex (DWDM) and time division multiplex (TDM) [1]. The second generation of passive optical networks (PONs) uses both WDMs and TDMs [2]. Optical transport networks combine a DWDM with a polarization division multiplex (PDM) and coherent detection, thereby doubling the bandwidth. Although these systems are effective, it is not possible to use them for PONs due to digital coherent detection (DCD), which is the most expensive part. Nevertheless, there is a way to use a polarization multiplex without coherent detection.

Other multiplexing technologies have prospects for future deployment, but many of them are difficult to enforce because of the difficulty of implementation and necessity of intervention for the active components and distribution networks. This does not apply for polarization multiplexes, which can double the bandwidth without any intervention regarding the existing optical network, and in addition, such a multiplex is partially immune to polarization mode dispersion (PMD) [3]. The polarization multiplex (POL-MUX) is based on the transmission of two different optical signals in one optical fiber using polarization division. The optical beam in a single-mode fiber spreads in two polarization planes  $x$  and  $y$  that are orthogonal to each other. With a polarization beam splitter (PBS), it is possible to align independent optical signals into both polarization planes and transmit two different polarization-divided optical signals in one fiber.

The principle of polarization multiplexes can be compared with technologies used in radio systems, where radio signals are also transmitted in two orthogonal polarization planes and for receivers, two differently oriented antennas are used. Detection is possible only if the orthogonality of both signals is preserved. This is not possible in real optical fibers due to fiber imperfections (circular asymmetry of the fiber) and birefringence [4]. The basic scheme of the POL-MUX is shown in Figure 1.

# Noncoherent Optical Processing

**Gordon Leonard Rogers**



## **Noncoherent Optical Processing:**

*Noncoherent Optical Processing* Gordon Leonard Rogers, 1977 Good No Highlights No Markup all pages are intact Slight Shelfwear may have the corners slightly dented may have slight color changes slightly damaged spine *Optical Processing and Computing* Henri Arsenault, 2012-12-02 *Optical Processing and Computing* is a collection of research from the USA Canada Russia and Poland on the developments in the fields of digital optical computing and analog optical processing This book is organized into 15 chapters and begins with an overview of the hierarchy of interconnect problems Some chapters deal with the fundamental limitations and capabilities of optics in relation to interconnections switching computing materials and devices Other chapters explore the architectures technology and applications of the field The topics range from promising areas in the early stages of development such as nonlinear effects in fibers that could bring about the optical transistor to developments in areas ready for technology such as the production of optical kinoforms an important type of computer generated optical component With a strong focus on the fundamental aspects of the field this book is of interest to specialists researchers and students who need a broad coverage of the principles of optical computing and of the underlying physics *Proceedings of the International Optical Computing Conference* ,1977 *Proceedings of the International Optical Computing Conference '77* ,1977 *Scientific and Technical Aerospace Reports* ,1973 *Selected Papers on Coherent Optical Processing* Francis T. S. Yu, Shizhuo Yin, 1992 *Progress in Optics* ,1987-08-01 *Progress in Optics* is a well established series of volumes of review articles dealing with theoretical and applied optics and related subjects Widely acclaimed by numerous reviewers as representing an authoritative and up to date source of information in all branches of optics the series continues to fulfil a genuine need within the scientific community Articles are contributed by leading scientists including two Nobel Prize winners chosen by the Editor with the advice of an international panel of experts constituting the Editorial Advisory Board Many of the articles appearing in these volumes have since been established as basic references in their respective fields *Optical Pattern Recognition* David Paul Casasent, 1979 **Linear Ray and Wave Optics in Phase Space** Amalia Torre, 2005-11-11 Ray wave and quantum concepts are central to diverse and seemingly incompatible models of light Each model particularizes a specific manifestation of light and then corresponds to adequate physical assumptions and formal approximations whose domains of applicability are well established Accordingly each model comprises its own set of geometric and dynamic postulates with the pertinent mathematical means At a basic level the book is a complete introduction to the Wigner optics which bridges between ray and wave optics offering the optical phase space as the ambience and the Wigner function based technique as the mathematical machinery to accommodate between the two opposite extremes of light representation the localized ray of geometrical optics and the unlocalized wave function of wave optics At a parallel level the analogies with other branches of both classical and quantum physics like classical and quantum mechanics quantum optics signal theory as well as magnetic optics are evidenced by pertinent

comments and or rigorous mathematics So the Lie algebra and group methods are introduced and explained through the elementary optical systems within both the ray and wave optics contexts the former being related to the symplectic group and the latter to the metaplectic group In a like manner the Wigner function is introduced by following the original issue to individualize a phase space representation of quantum mechanics which is mirrored by the issue to individualize a local frequency spectrum within the signal theory context The basic analogy with the optics of charged particles inherently underlying the ray optics picture in phase space is also evidenced within the wave optics picture in the Wigner phase space amalgamation of a great deal of contributions having witnessed the phase space picture of optics over the past 30 years introduces abstract concepts through concrete systems hosts of figures and logical diagrams to favour intuition and to introduce mathematics emphasis on the interrelations with quantum optics signal theory and magnetic optics feeds a feeling for genuine issues in higher mathematics and theoretical physics

### **Introduction to Fourier Optics** Joseph W.

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### **Table of Contents Noncoherent Optical Processing**

1. Understanding the eBook Noncoherent Optical Processing
  - The Rise of Digital Reading Noncoherent Optical Processing
  - Advantages of eBooks Over Traditional Books
2. Identifying Noncoherent Optical Processing
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in a Noncoherent Optical Processing
  - User-Friendly Interface
4. Exploring eBook Recommendations from Noncoherent Optical Processing
  - Personalized Recommendations
  - Noncoherent Optical Processing User Reviews and Ratings

- Noncoherent Optical Processing and Bestseller Lists
- 5. Accessing Noncoherent Optical Processing Free and Paid eBooks
  - Noncoherent Optical Processing Public Domain eBooks
  - Noncoherent Optical Processing eBook Subscription Services
  - Noncoherent Optical Processing Budget-Friendly Options
- 6. Navigating Noncoherent Optical Processing eBook Formats
  - ePub, PDF, MOBI, and More
  - Noncoherent Optical Processing Compatibility with Devices
  - Noncoherent Optical Processing Enhanced eBook Features
- 7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Noncoherent Optical Processing
  - Highlighting and Note-Taking Noncoherent Optical Processing
  - Interactive Elements Noncoherent Optical Processing
- 8. Staying Engaged with Noncoherent Optical Processing
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Noncoherent Optical Processing
- 9. Balancing eBooks and Physical Books Noncoherent Optical Processing
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Noncoherent Optical Processing
- 10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
- 11. Cultivating a Reading Routine Noncoherent Optical Processing
  - Setting Reading Goals Noncoherent Optical Processing
  - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Noncoherent Optical Processing
  - Fact-Checking eBook Content of Noncoherent Optical Processing
  - Distinguishing Credible Sources

13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
  - Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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