Impact of Passive EDF Length on the Performance of Linear Cavity BEFL

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***Abstract*— We experimentally demonstrate the impact of a section of passive Erbium doped fiber (EDF) within linear cavity multiwavelength Brillouin Erbium fiber Laser (MBEFL). The influence of such passive EDF section length on the tuning range and the lasing cavity threshold is experimentally presented. The lasing threshold of the MBEFL in case of without and with different passive EDF2 section lengths is presented. A comparison is made between the traditional linear BEFL cavity and the BEFL cavity that utilized different passive EDF lengths of 1m, 3m, and 5m. Different 1480 pump power range (25-150) mW is used in the investigated study. The proposed configuration show significant increment in the tuning range for all passive EDF2 lengths as compared to the conventional BEFL cavity. 5m of passive EDF2 length exhibits higher tuning range of about 28nm at 100mW as compared to the 24.4nm tuning range at the same 1480 pump power using 1m of passive EDF2. All passive EDF2 lengths were compared in term of tuning range at different 1480 pump power range (25-150) mW.**

Keywords— Multiwavelength fiber laser, Brillouin-erbium fiber laser, stimulated Brillouin scattering, passive erbium doped fiber, laser tunability.

I. INTRODUCTION

Multiwavelength Brillouin Erbium fiber laser (MBEFL) has a great interest in last decades due to its potential applications in dense wavelength division multiplexing (DWDM) communication system and fiber sensor [1]–[4]. One of the major drawbacks in MBEFL is the presence of unwanted self lasing cavity modes at the output comp spectrum as a result to the high EDF pump power. Many techniques since that time have been proposed to overcome this essential problem [5]–[10]. High Brillouin pump power was reported by [5] in order to achieve wide tuning range. Although wide tuning range was achieved but the limitation in generated Stokes signals was observed due to the EDF gain saturation as a result to the high input signal power. Optical filters and Sanganc loop mirrors were also have been proposed to enhance the tuning range by eliminating the unwanted self lasing cavity modes outside the cavity [6]–[8]. However, using such optical filters can be resulted in more cost and more complexity. In addition the laser cavity performance will be restricted to the filters characteristics. Virtual mirror was another proposed approach that enhances the tuning range of the laser cavity though totally suppresses the unwanted self lasing cavity modes [9], [10]. This approach suffers from low Brillouin gain inside the cavity and producing low Stokes signals. Passive EDF booster section with variable optical attenuator (VOA) was proposed by [11] in which the VOA was inserted between the passive and active EDF in order to attenuate the backward ASE to be inserted into the passive EDF. However, the simple laser structure reported in [11] exhibits good increment in cavity tunability but both the generated stokes signals and Stokes power was reduced as a results to the VOA. The need of VOA and optical filters which have been used to enhance the cavity tunability were overcome in the proposed scheme presented by [12]. However, the effect of the single passive EDF absorber section length was reported in [12] so far the influence of the passive EDF length under the pump power variations was not covered. In this paper the influence of the passive EDF length on the performance of linear cavity BEFL is experimentally demonstrated. A compression between MBEFL cavity structure that utilizes different passive EDF length is conducted and all lengths have shown significant increment in the tuning range compared to the traditional BEFL. Long passive EDF length of 5m illustrates higher increment in cavity tunability as compared to the shorter passive EDF of 1m.

II. EXPERIMENTAL SETUP AND OPERATING PRINCIPLES

The experimental configuration of the linear cavity BEFL is depicted in Fig. 1. Brillouin gain medium was achieved through a 10 km length of SMF-28. 10m length of an active EDF1 with 1480 nm pump laser was used to amplify the oscillated Brillouin pump (OBP) power as well as the generated Stokes signals. An external-cavity tunable laser source (TLS) with a maximum power of 10 dBm and 100 nm wavelength range (1520-1620) nm was used to provide BP signal. The isolator (ISO) was used to make sure that there is no reflected light back into the TLS. A high reflectivity optical mirror, M1 was used at the end of the resonator cavity. An optical spectrum analyzer (OSA) was connected at port 4 of the 3-dB coupler in order to measure the output spectrum of the generated Stokes signals. In order to show the impact of the free running laser cavity modes competition on the tuning range, different passive EDF2 lengths were connected through an optical circulator (port 3 to port 1).

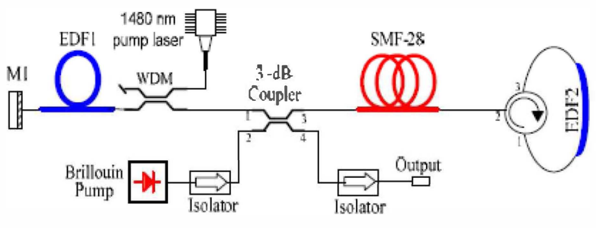

Figure 1: Linear cavity Brillouin-Erbium fiber laser with passive EDF absorber section

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