# Tm:Er:Yb:Ho amplified spontaneous emission source operating from 1480 nm to 2100 nm

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*A theoretical model of an amplified spontaneous emission source based on a Tm:Er:Yb:Ho co-doped germanate glass is presented. Preliminary results show that a broad spectrum ranging from 1480 nm to 2100 nm is obtained.*
**Keywords**: amplified spontaneous emission, broadband optical source

## 1. Introduction

Many important chemicals have vibrational resonances in the infrared region of the electromagnetic spectrum. The availability of broadband optical sources operating in this region could enable potential applications in environmental monitoring, sensing and medicine. Broadband incoherent optical sources based on the generation of noise due to amplified spontaneous emission (ASE) in rare earth-doped fibers constitute a feasible alternative to much expensive solutions based on supercontinuum (SC) generation in nonlinear optical fibers. In this work, an accurate model of an ASE optical source based on a Tm:Er:Yb:Ho co-doped germanate glass [1-2] is developed. It exploits a rate equation approach [3] and is used to investigate broadband ASE noise generation.

## 2. Results

Fig. 1 shows the evolution of the power spectral density $S_{ase}^{+}(z, \lambda)$ of the forward ASE noise along the fiber. An input pump power of $P_{p0}$ = 200 mW is employed. The noise intensity progressively increases along the fiber. Four maxima at the output of the fiber, i.e. at z = L = 30 cm, are apparent. In particular, the maximum at $\lambda_1$ = 1532 nm is due to emission from erbium ions ($^4I_{13/2} \rightarrow {}^4I_{15/2}$ transition), the maximum at $\lambda_2$ = 1782 nm is due to emission from thulium ions ($^3F_4 \rightarrow {}^3H_6$ transition), and the maxima at $\lambda_3$ = 1954 nm and $\lambda_4$ = 2016 nm are due to emission from holmium ions ($^5I_7 \rightarrow {}^5I_8$ transition). The entire output noise spectrum covers a very wide band of over 600 nm, ranging from 1480 nm to 2100 nm.

## 3. Conclusions

A broadband ASE optical source based on a Tm:Er:Yb:Ho co-doped germanate glass fiber has been modeled and numerically investigated. An output noise spectrum covering a band of over 600 nm is predicted. The proposed device can find application in the fields of environmental monitoring, sensing and medicine.

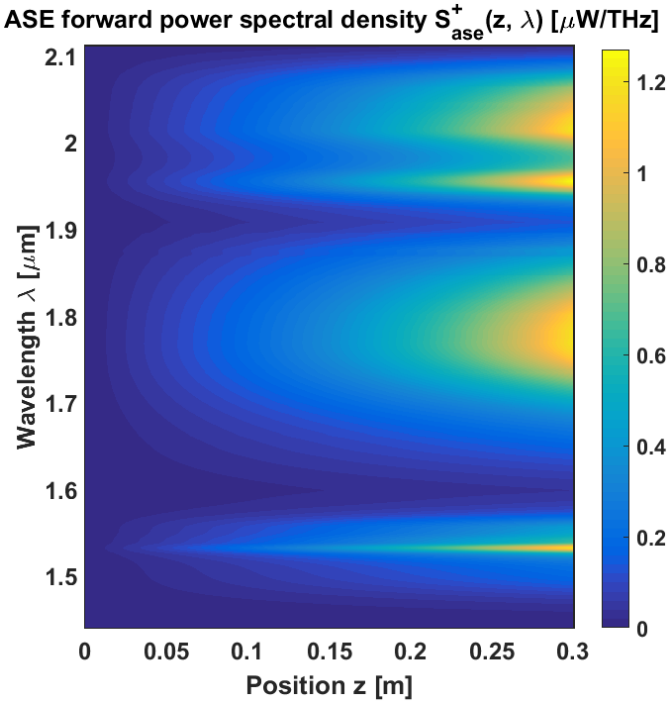


Fig. 1 Power spectral density $S_{ase}^{+}(z, \lambda)$ of forward ASE noise as a function of the position z along the fiber and the wavelength λ.

## Acknowledgements

This research has been partially developed within the projects: POR FESR-FSE 2014-2020 Innonetwork "Sinach - Integrated systems for mininvasive surgical navigation" - n. BLNGWP7; PON R\&I 2014-2020 "New Satellites Generation components - NSG" - Cod. Id. ARS01_01215 NSG.

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