Fiber fuse behavior veiled in its strong light emission

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Everything has its limitations, and silica glass fibers for optical communication are no exception. They are easily broken by a bright spot running through the core at ~ 1 m/s to the light source, called fiber fuse [1,2]. It is initiated by a local heating of the fiber transmitting several watts of light, which is converted to heat by thermally deoxidized SiO_2. Its temperature is estimated to be several thousand K. Its physical scheme resembles a grass fire (see the left of Fig. 1), namely, a solitary fire wave or a bright spot persists as an irreversible reaction region that is fueled from the front, emitting light and heat all around, and leaving cinders or damage behind it. It was discovered in 1987 [1] and now poses a dilemma to the optical communication industry as a result of the expected saturation of communication capacity and the potential risks of high-power light manipulation. As long as we have no choice but to use silica glass fibers in the future, we have to elucidate this phenomenon in order to escape this dilemma.

The major hurdle of this elucidation is that it moves quickly with strong light emission. However, I noticed a important fact; namely, the periodic void train left behind is a record of its energy state that can be modified by some external conditions including the pump power, the coating condition of the cladding surface, and the geometry of optical paths for re-absorption of its emission. A typical example is shown in the right of Fig. 1. The interval of the void train increases in a segment where re-absorption occurred.

[1] R. Kashyap and K. J. Blow, *Electron. Lett.*, **24** (1988) 47-49. [2] S. Todoroki, "Fiber fuse", Springer (2014).

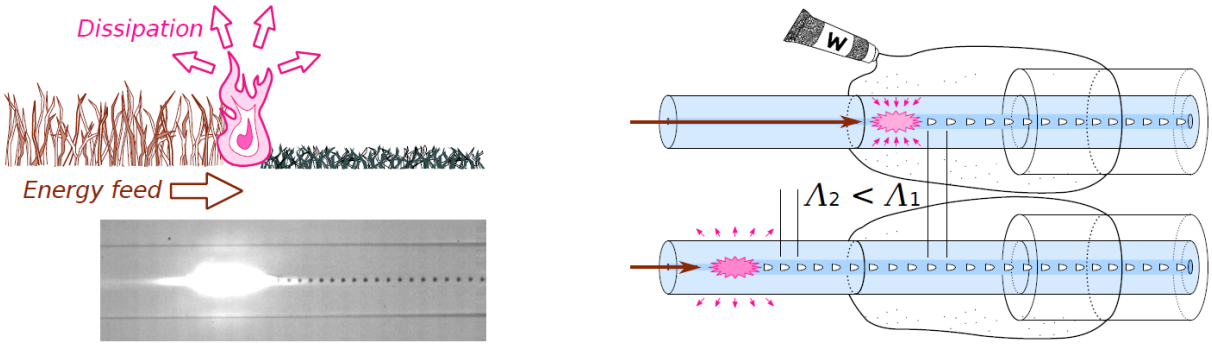

Fig.1: (left) Two examples of dissipative soliton; grass fire and a fiber fuse running through a single-mode optical fiber made of silica glass. (right) Self-pumping effect: Re-absorption of scattered emission at the surface of white oil paint surrounding the cladding brings about an increment of the interval of periodic voids.