optical solitons through a real optical fiber (implying both attenuation and optical amplification processes of solitons) becoming:

$$i\frac{\partial q}{\partial X}+\frac{1}{2}\cdot\frac{\partial^2 q}{\partial T^2}-|q|^2\cdot q=-i\Gamma\cdot q+iG(X)\cdot q\,, \tag{9}$$

where *G(X)* is the non-dimensional coefficient of the optical gain (amplification), dependent on the non-dimensional distance *X* in the optical fiber.

The achievement of equilibrium of the losses and gain terms from the right part of equation (9) ensures the maintenance of the solitons shape and amplitude.

Additional aspects referring to: a) the computer simulations of the optical solitons propagation through different media and: b) the procedures intended to their parameters maintenance, were studied by our recent work [20].

6. Complex character of the modern optical communications networks

The usual theoretical models of the solid samples take into consideration the crystalline lattices formed by a limited number (small, usually) of micro-particles types (atoms, ions) among whom are exerted local interactions (with the nearest neighbors). When both the interactions at small distance, as well as those at rather large distances are taken into consideration, the specific statistical models (Néel, Ising, Heisenberg) lead to some power laws, e.g. of the Domb-Fisher's type for ferri-magnetic materials [21].

A high interest corresponds also to the complex networks formed by a large number of different elements, presenting specific interactions at distance (described by topological networks whose vertices represent the network elements, while their sides correspond to the interactions among these elements). Such networks involve the complex systems from table 1 [22a], the modern optical communications systems, inclusively.

The basic theoretical models of the complex networks (random graphs) can be classified as: a) *static models* (the Erdös-Renyi's (*ER*) models [23] and the Watts-Strogatz's (*WS*) one [24], mainly), b) *the linearly growing models* (the Barabási-Albert's (*BA*) model [22a-c]), c) *the generalized growing models* [22d].

Conclusions

The accomplished study pointed out the complex character both of the components of the modern optical communications systems, as well as of the whole network.

The obtained findings could contribute to a better knowledge of the components of the modern optical communications systems, as well as of the basic features of the corresponding complex networks development.

Type of the complex network	Value of the power law exponent	Correspondence topology - network specific nature	
		Vertices nature (typical examples)	Network sides nature (typical examples)
Biological networks (systems)		Proteins	Chemical interactions between proteins
Nerves system		Nerves cells	Axons
Social networks		a) private people, b) organisations, c) countries	Interactions between them
Economy networks		Companies	Business relations
Transport networks	$\gamma_{electr.\ power} \cong 4$	Cities	Vehicles or electric lines among them
Internet (web pages)	$\gamma_{exits} \cong 2.45$ $\gamma_{entries} \cong 2.1$	HTML documents	Links between some web pages
Scientific networks	$\gamma_{citations} \cong 3$	Scientific researchers	Common works or citations (oriented graphs)
Artistic networks	$\gamma_{actors} \cong 2.4$	Actors	Common movies of actors

Table 1. Features of the main types of complex networks

R E F E R E N C E S

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