I. N. Sisakyan and A. B. Shvartsburg. *Nonlinear waves in fiber-optics information systems.* The development of computers and communications technology has stimulated the creation of fiber-optics light pipes. The unique possibilities of such devices are attracting the attention of specialists. At the present time the Bell Telephone Laboratories are discussing use of the nonlinear regime of propagation of soliton pulses in communication channels.[1] IBM reports a record (twelve-fold) compression of a picosecond pulse in a fiber.[2]

In the present work we discuss new possibilities of programmable nonlinear tuning and stabilization of picosecond signals. Here we note the promise of selection of an optimal system of signals in a nonlinear channel, determined by the transmission distance and the channel geometry.

1. *Programmable nonlinear tuning of picosecond signals in a light pipe.* The structure of short signals in a light pipe is formed by the action of the nonlinear response of the light pipe and its dispersion. The dynamics of this process is sensitive to the initial amplitude and phase structure of the pulses and their mode of propagation. This sensitivity determines the energy characteristics and the spatial scales of the programmable processes, which depend substantially on the geometry of the light pipe and on the mode composition of the radiation. Specific results have been obtained for gradient light pipes.

2. *Dynamical stabilization of* TE- *and* TM-*polarized signals.* The competition of nonlinear and dispersion distortions of a pulse determines for each initial envelope the threshold energy of the pulse corresponding to formation in the final state, in the interior of the medium, of quasistationary states of picosecond pulses. In the higher modes of TE and TM signals this threshold, which is determined by the

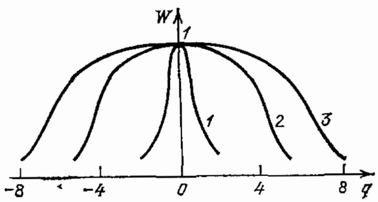

FIG. 1. Broadening of solitons of higher modes in a gradient fiber. Curves 1–3 are the amplitude envelopes of solitons of the modes TM_{01}, TM_{11}, and TE_{01}.

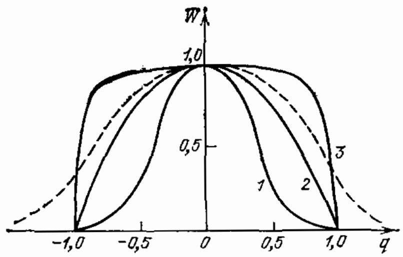

FIG. 2. Amplitude envelopes of nonsoliton pulses of identical amplitude but arbitrary width. The dashed line is the soliton profile of the same amplitude.

method of the inverse problem of scattering theory, increases.[3] It is important that the stabilization of signals near the threshold in TM*mn* modes requires 10—30 times less energy than stabilization of the same pulses in similar TE modes.[4,5] Additional possibilities of controlling such near-threshold stabilization appear on joining sections of light pipe of different geometry. Still another possibility of stabilization involves special modulation of pulses.[6]

3. *Nonsoliton and soliton signals for fiber communication over short and long distances.* We note that the soliton regime, which is characterized by a unique coupling between the energy and width of a pulse, is only a special case of a number of nonlinear regimes. The advantages of both soliton and nonsoliton regimes can be utilized in different portions of a light pipe.

Transmission of information with a binary code by means of soliton signals shaped at the input of a light pipe requires special control of the shape of the envelopes. The information-carrying ability of such signals is limited as a result of the unique coupling mentioned above between the duration and energy of the soliton; this same coupling leads to a rapid deterioration of the time distribution of the soliton signals with their spreading under the influence of damping and random inhomogeneities of the fiber in distances of a few kilometers. Increase of the initial energy of the solitons leads to their periodic stratification with a period of 1 km. It is expedient to use soliton signals, which do not involve threshold effects, at large distances. Here interest is presented by TM solitons, in which the localization of the energy is more efficient (Fig. 1).

In contrast to this, the energy of nonsoliton signals (Fig. 2) is a free parameter which is convenient for control. This property of nonsoliton pulses is important also for stabilization of the signals being transmitted.[7] We have noted the possibility of stabilization of nonsoliton signals and their maxima in a medium with damping. Nonsoliton signals in the near-critical regime, in contrast to solitons, are not subject to stratification and therefore can be received at any point of the route within several kilometers, as long as the damping does not reduce the energy of the signal below the threshold value. This distance can be increased by several times by joining fibers of different geometry. Experiments which have been carried out on stabilization of picosecond signals in fibers with a positive dispersion of the group velocity[7] indicate the promise of use of such stabilized nonsoliton signals and permit one to raise the question of the information possibilities of nonlinear communication channels.

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