Generation of undamped traveling temperature waves and stimulation of controlled (dd) nuclear fusion in experiments with water jet cavitation

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In the report two new and previously unknown phenomena are presented and discussed:

a) process of generation, detection and application of fundamentally new physical phenomena - *undamped high frequency temperature waves*, that are generated during bubble cavitation of water jet;

b) effective controlled nuclear dd-fusion stimulated in distant targets by action of these waves.

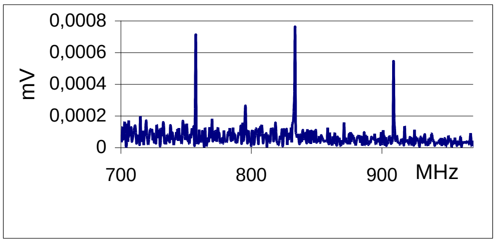
Several years ago we have shown [1-3] that the "traditional" equation of thermal diffusivity $\partial T(r,t)/\partial t = G div\{grad[T(r,t)]\}$ is incorrect in any realistic media with thermal relaxation time τ. The solution of this "traditional" equation is a superposition of contradirectional traveling temperature waves

$$T(\omega,x,t) = A_\omega e^{-\delta x} e^{i(\omega t-\kappa x)} + B_\omega e^{\delta x} e^{i(\omega t+\kappa x)},\ \kappa = \sqrt{\omega/2G},\ \delta = \sqrt{\omega/2G}$$

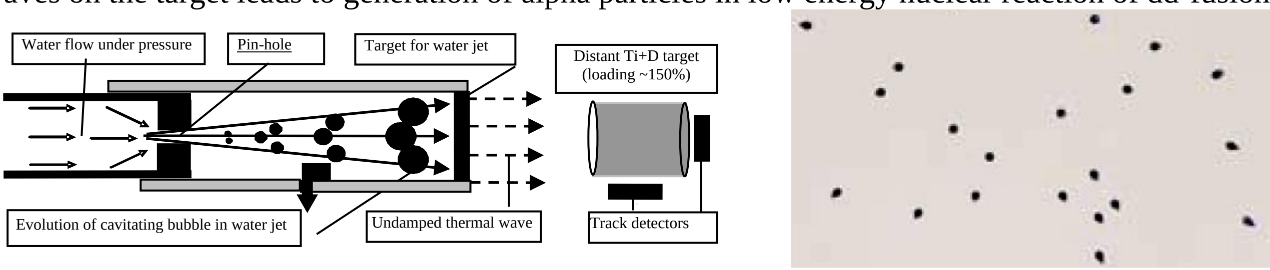
These temperature (thermal) waves are characterized by a very strong damping at high frequency with a factor $\delta = \sqrt{\omega/2G}$, which is equal to the wave number κ. Here G is a thermal diffusivity coefficient. The solution of modified [1-3] equation of thermal diffusivity $\partial T(r,t+\tau)/\partial t = G div\{grad[T(r,t)]\}$ is

$$T(\omega,x,t) = A_\omega e^{-\delta^* x} e^{i(\omega t-\kappa^* x)} + B_\omega e^{\delta^* x} e^{i(\omega t+\kappa^* x)},\ \kappa^* = \kappa\cos\omega\tau/\sqrt{1+\sin\omega\tau}\ ,\ \delta^* = \kappa\sqrt{1+\sin\omega\tau}$$

For the waves with frequencies $\omega_n = (n+1/2)\pi/\tau$, which correspond to condition $\cos\omega_n\tau = 0$, the damping coefficient δ is equal to zero, and the general solution of this equation has the form of a superposition of contradirectional undamped temperature waves. In air, under normal conditions, the minimal frequency of such wave corresponds to 70÷90 MHz, in metals and semiconductors it is 1÷100 THz, in water about 1 THz. In our experiments these waves are generated via water cavitation processes and registered in air at a large distance L. The high frequency part of spectrum of these waves recorded by acoustic detectorin at L=198 cm in air is shown in Fig.1.



We have conducted experiments on study of action of these undamped thermal waves on distant target made of deuterated polycrystalline titanium (loading -150%). The diameter and length of cylindrical target were about 1 cm. It was shown that the action of such waves on the target leads to generation of alpha particles in low energy nuclear reaction of dd-fusion.



Experimental setup and photo of fragment of track detector are shown in Fig. 2. It is seen from Fig. 2 (right) that the trajectory of motion of the detected particles was characterized by a central symmetry, which agrees well with the assumption of an axially symmetric expansion of the products of the nuclear reaction in cylindrical target. The possible mechanism for low energy reaction optimizing and the course of this reaction is associated with the formation of coherent correlated states [4,5] of deuterons in nonstationary microcracks (formed during loadind and migration of deuterium in the matrix of titanium that change under the action of shock waves generated by action of thermal wave.

1. Vasylenko A.O., Vysotskii V.I., Vassilenko V.B. *IJSBAR*. v. 12, No. 1, 160-166, (2013).
2. Vysotskii V.I., Vasilenko A.O., Vassilenko V.B., Vysotskyy M.V. *Inorganic Materials: Applied Research*, v. 6, No. 3, 199–204, (2015).
3. Vysotskii V.I., Kornilova A.A., Vasilenko A.O. *Current Science*, v.108, 114-119, (2015).
4. Vysotskii V.I., Vysotskyy M.V., *Eur. Phys.Journal*. A 49, 99 (2013).
5. Vysotskii V.I., Adamenko S.V., Vysotskyy M.V., *Ann. Nucl. Energy,* v.62, 618 (2013).