On hard X-rays bursts from complex plasmas of nanosecond vacuum discharge

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We study x-ray emission and generation of energetic ions at random interelectrode dusty-like media in low energy nanosecond vacuum discharges [1]. The foam-like erosion "target" (nucleated clusters, nano – and micro particles of different size from anode material) is forming automatically at chosen discharge conditions after high voltage applied during the pre-breakdown stage. Current-carrying stage is accompanied by emission of hard X-rays of different intensity from interelectrode complex plasma ensembles.

High power density ensembles of clusters are possible candidates for x-rays lasing media [1,2]. Partial and essential x-ray trapping by ensembles as well as random laser behavior of potentially amplifying media of interelectrode complex plasma are considered. Last scheme with non-resonant feedback by energy have been suggested much earlier by Letokhov [3]. (Note the increased interest to random lasers during last decade and some realisations at visible spectra [4]). In our case this scheme assumes the diffusion and partial "random walk" of photons inside of x-ray "ball" due to multiple scattering and reflecting in disordered media of cold and hot "grains" of any sizes [5]. When the volume gain if available overcomes the surface losses, hard x-ray burst may take place [3-5]. The properties of ensembles with observed strong hard x-ray bursts which could be interpreted as ASE regimes [2] or random lasing with non-coherent feedback [3] are presented and analysed. Some similarity and differ from another popular scheme "reactor-laser" [6] are discussed also.

1. Yu.K. Kurilenkov, M. Skowronek, G.Louvet *et al*. *Journal de Physique* IV 10 (2000) Pr5-409 ; Yu.K. Kurilenkov, M. Skowronek and J.Dufty. *Journal of Physics A: Math.& General* **39** (2006) 4375.
2. R. C. Elton, "*X-ray Lasers*", New York, Academic Press, 1990.
3. V. S. Letokhov. *Sov. Phys. JETPh* **26** no 4(1968) 835; *Quantum Electronics* **32** (2002) 1065.
4. N. M. Lavandy, R.M. Balanchandran, A.S.Gomes and E.Sauvain, Laser Action in Strongly Scattering Media, *Nature*, **368**, p.436, 1994.; D. Wiersma and A. Lagendijk. *Physics World* **10** no. 1 (1997) 33–37; H.Cao. *Optics & Photonic News*, January 2005, p.24.
5. Yu.Kurilenkov, M.Skowronek, Yu.Konev**.** *Proceedings of XV Int.Conf. on MHD Energy Conversion and VI Workshop on Magnetoplasma Aerodynamics for Aerospace applications,* Moscow, May 24-27, 2005, pp. 174-180.
6. Yu.Kurilenkov, M.Skowronek, Yu.Konev**.** *Proceedings of XV Int.Conf. on MHD Energy Conversion and VI Workshop on Magnetoplasma Aerodynamics for Aerospace applications*, Moscow, May 24-27, 2005, pp. 174-180.
7. Гудзенко Л.И., Яковленко С.И. Атомный реактор-лазер. *Краткие сообщения по физике* ФИАН.1974,N2, с.14-15; Карелин А.В., Синянский А.А. ЯОП - лазеры и источники спонтанного излучения с ядерной накачкой. *Вестник ОФО РФ* N2, 2001 (www.uniphys.ru).