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Neutron Flux and Soft X-Radiation Created by Heterogeneous Plasmoid

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Abstract Experimental results on registration of different radiations from a heterogeneous plasmoid (HP) created by pulsed- repetitive discharge in the experimental set up PVR are considered in this work. Intensive cold neutron flux, optical radiation and soft X- radiation ($E < 10$ KeV) were measured in the HP. It was revealed that there is a high voltage threshold $U_d > 3.8$ kV in the electric discharge for stable generation of intensive cold neutron flux.

1. Experimental set up

Heterogeneous plasmoid (HP) is created by a pulsed repetitive electric discharge in a swirl gas flow in the plasma vortex reactor (PVR) [1-4]. Experimental setup and diagnostic instrumentation were described in the works [1, 2] in detail. The typical HP (3) in a water steam swirl flow is shown in the Figure 1. This HP consists of nucleus (5, metal micro-droplet) and plasma halo (6, metal nano-particles) around it. Note that cathode and anode are manufactured from Nikole.



Figure. 1. Heterogeneous plasmoids (3) created by pulsed- repetitive electrical discharge (2) in the experimental setup PVR. Cathode-injector (4) - right, anode (1)- left. Erosive metal micro droplets-5, plasma halo-6. Testing gas flow- water steam

The experimental conditions are the followings:

- Argon mass flow rate 1,4-2 G/sec
- Water steam mass flow rate 1- 2 G/sec
- Mean electric current 2 A
- Mean input electrical power 1 kW
- Cathode electrode mass flow rate 1mG/sec.



Argon flow is used for stable electric discharge ignition and stable PVR's operation at the first step of our experiment (during several seconds). There is high water steam condensation in the cold PVR. So, it is necessary to heat of this reactor by hot argon flow preliminary. Then argon injection switches off (standard regime) or switches on (non-standard regime) and water steam injection switches on simultaneously.

The following diagnostic instrumentation is used in our experiments:

- Neutron radiometer KRAN-1 designed on the base of luminescence of plastic scintillator covered by B_{10}^5F and photomultiplier (receiver),
- γ - detector KRAN-1 for registration of γ - photons with high- energy $E_\gamma > 50$ KeV.
- Neutron detector SPRS on the base of He^2_3 (10 detector tubes),
- γ - detector SPRS for registration of γ - photons with high- energy $E_\gamma > 20$ KeV.
- RF-films with thin aluminum filters for registration of γ - quantum flux ($E_\gamma \sim 1-10$ KeV). These films were covered by black paper list.
- X- ray spectrometer AMPTEK X-123 (USA) and X- ray spectrometer BDER (Russia) for registration of γ - quantum flux ($E_\gamma = 0,1 - 30$ KeV)

Window with thin beryllium film (10 μm width) is used in the quartz tube (5, Figure 2a) for registration of soft X-ray radiation by spectrometer X-123 from the HP.

2. Registration of Low Energy Neutrons and γ - Radiation

Neutron detector SPRS on the base of He^2_3 -detector and γ - detector SPRS are used in these experiments. Radiometer KRAN-1 and γ - detector KRAN-1 are used for neutron registration and γ - registration also. These detectors were calibrated by radioactive tablet

Am^{95}_{243} with Be^4_9 -converter in Nuclear Center (Dubna). Scheme of our experiment is shown in the Figure 2. Detectors SPRS and KRAN-1 are arranged behind PVR's nozzle (6). The distance L of their

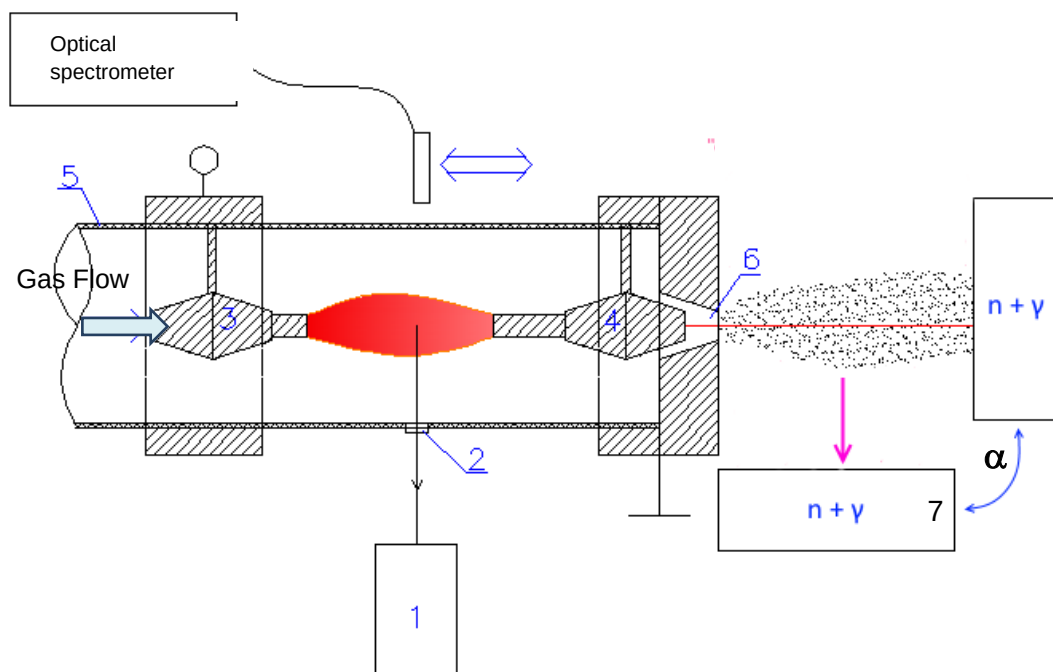


Figure 2a. Scheme of the experimental set up PVR for measurement of the different radiations created by HP. 1- soft X-ray spectrometer Amptek X-123, 2- Be-window, 3-anode, 4 – cathode, 5-quartz tube, 6- nozzle, 7- SPRS (KRAN-1 or X-123)

locations are varied from $L_1=2$ cm up to $L_2=200$ cm from plasma jet axis. The angle of radiation registration is varied in the range of $\alpha=0^\circ - 90^\circ$. The different neutron absorbers are used near these detectors (such as Polyethylene plates, water cells and others) in some experiments.



Figure. 2b. General view of the experimental set up PVR with detector SPRS (1- γ -detector, 3- neutron detector) and neutron radiometer KRAN-1 (2)

The typical signals obtained by these detectors are shown in the Figure 3, 4. One can see that there is a non-stationary neutron flux created by HP. There are some maximums and minimums in this neutron's signal. Note that neutron signal has the time delay $\tau \sim 30 \div 140$ sec after plasma on. Strong γ -photons ($E > 20$ Kev) are not created by the HP.

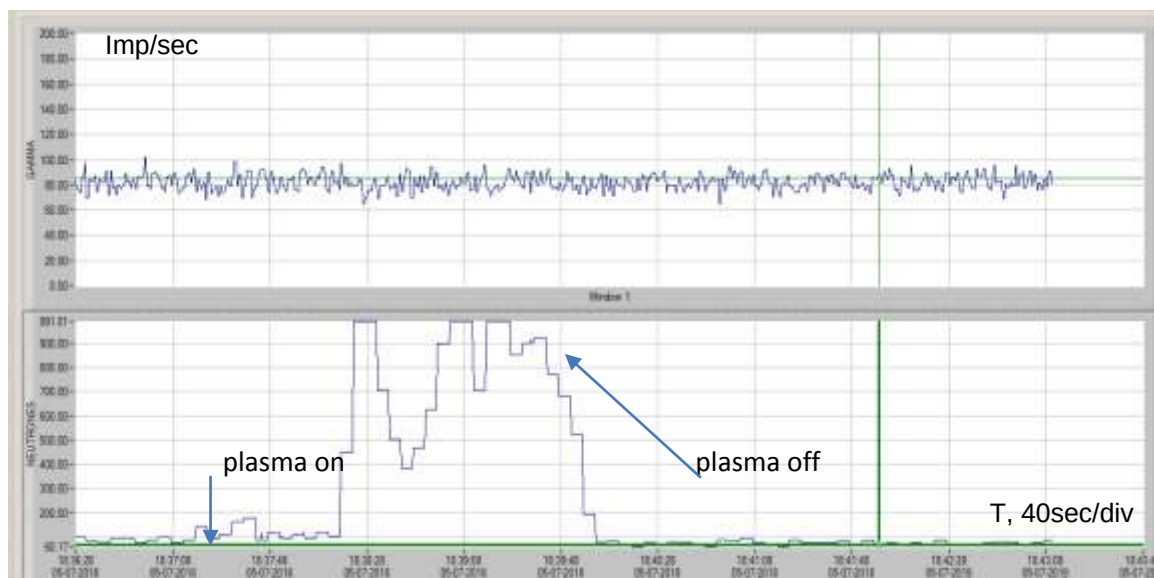


Figure 3. Neutron's signal (down) and γ -radiation signal (top) measured by SPRS-detector

It is revealed that neutron's signal amplitude is higher than background one at the definite conditions only:

- Distance $L < 30 \div 40$ cm.
- Angle $\alpha = 90^\circ$. Measurement' direction of this detector is perpendicular to plasma jet axis. The signal amplitude equals to background level at the angle $\alpha = 0^\circ$.
- Neutron absorber is absent.
- Strong X-ray radiation ($E > 20$ KeV) is absent in these experiments.

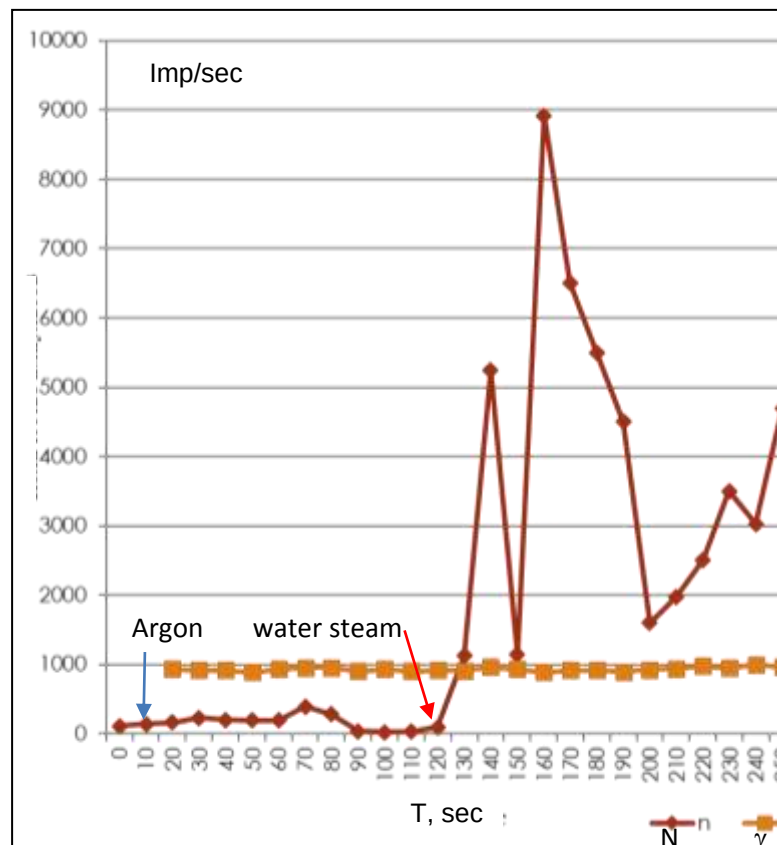


Figure.4. Neutron's signal (down, brown) and γ -radiation signal (top, yellow) measured by detector KRAN-1. Plasma on at $T=0$ sec, plasma off at $T=250$ sec

The second result proves the absence of electromagnetic interference on diagnostic instrumentation in our experiments. Really, EM-noise radiation created by pulsed discharge is isotropic one. EM noise's parameters measured by standard EM receiver prove this conclusion. Remind that battery power supplies are used in these detectors. So, electromagnetic interference of EM-noise on the detectors should be small in these experiments.

It is revealed that there is voltage threshold $U_d^* > 3,6 \div 4,2$ kV in the pulsed electric discharge for the stable neutron flux creation, Figure 5. Note that mean value $U_d \sim 3.9$ kV in this discharge is closed to Feynman's quantum potential $U_q \sim 3.73$ kV $= M_e c^2 \alpha = 0.5 \text{ MeV} / 137$.

The typical total neutron flux measured by the radiometer KRAN-1 is about of $S_n = 10^5 \div 10^6$ neutron/sec. The value S_n exceeds the background value S_b considerably at the time interval $20 \div 30$ sec after plasma off.

Neutron flux S_n is non-homogeneous in space and non-stationary in time (see above). Space distribution of neutron flux is not spherical. The value S_n is minimal one in the perpendicular direction to plasma jet axis. It is very strange result.

It is revealed that induced radiation of Indium sample activated by neutron flux from the HP is very small (closed to zero). This result is very strange also.

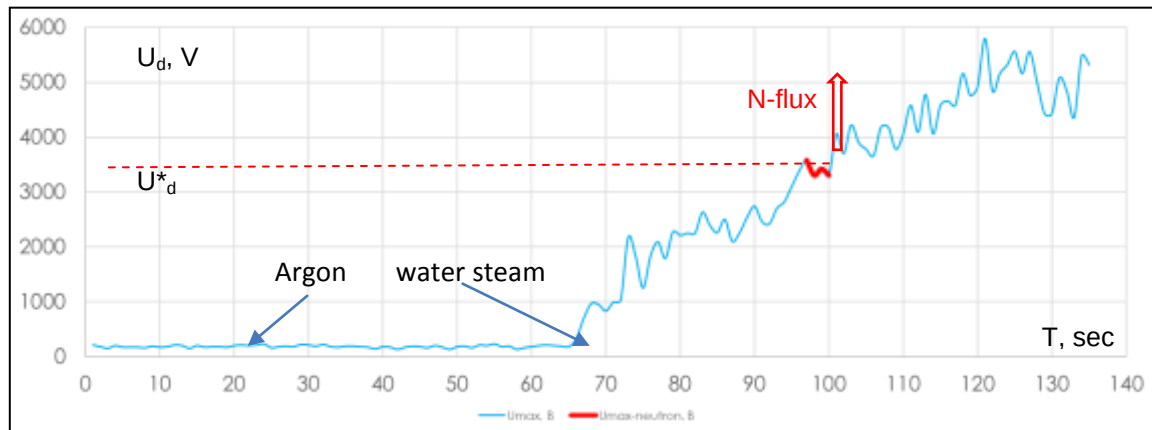


Figure.5. Neutron's signal threshold measured by detector KRAN-1 in the HP created by pulsed discharge in the PVR. Blue line- mean voltage in this electric discharge

3. Soft X-Ray Radiation

The beryllium window (5, 10 μm -width) is used in PVR's quartz tube to measure a soft X-ray radiation created by the HP (Figure 2a). The typical X-ray spectrum recorded by BDER-spectrometer is shown in the Figure 6. One can see two maximums in this spectrum: - the first one is about of $E_1 \sim 1$ KeV and the second one is about of $E_2 \sim 4\text{KeV}$. Note that these values are closed to $U_d \sim 3.9$ kV in the HP measured in this work.

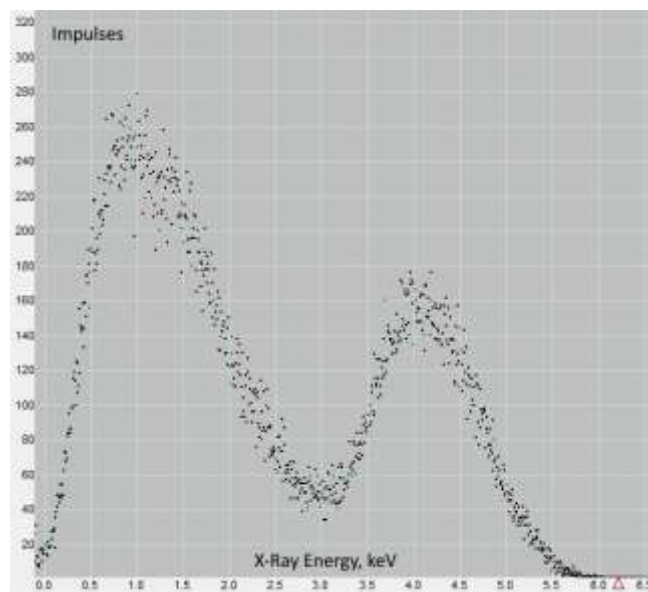


Figure.6. Soft X-ray spectrum measured by BDER- spectrometer

The general view of the experimental set up PVR with the RF-films and Al-filters for X-ray registration is shown in the Figure 8. The typical traces of a «strange X- ray radiation» are shown in the Figure 8. It is revealed that there are the two types of «strange» radiation traces. One can see many that there are many black dot traces in the picture 8 (left) and broken line ones in the picture 8 (right). The typical width of these traces was about 10- 20 μm .



Figure.7. RF-films with thin Al -filters (2) and Geiger's counter (1) near PVR' nozzle (3). Gas flow ejector- 4, thermocouple- 5

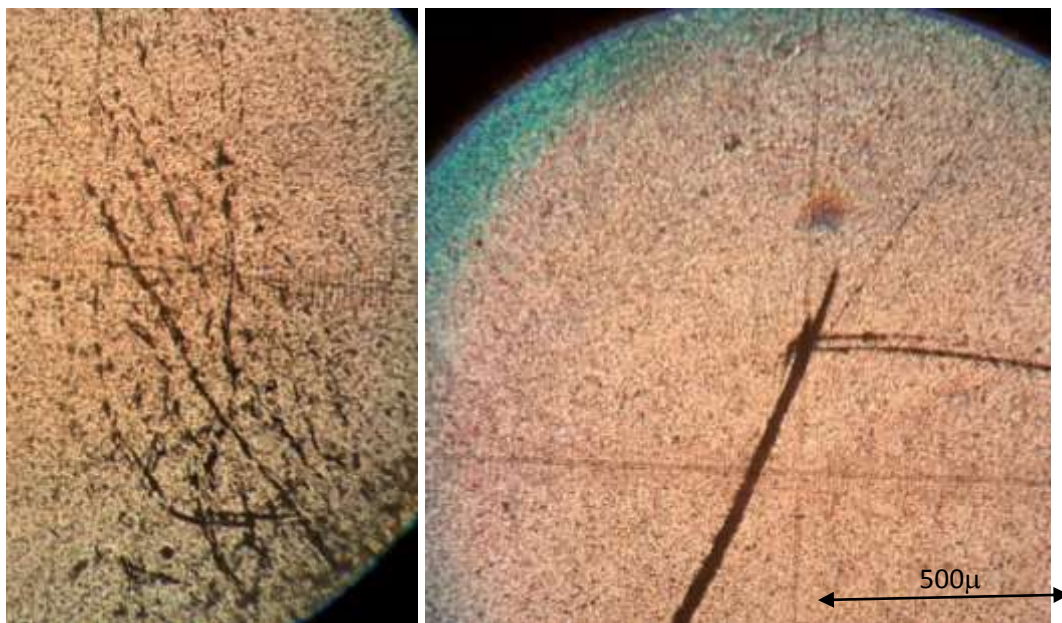


Figure.8. Exposed RF-film with black dot traces (left) and black broken lines (right)

Discussion and conclusions

1. Remind that neutron's flux and soft X-ray radiation created by MW plasmoid were measured by P. Kapitsa at the first time many year ago [7]. He named this phenomenon as «UV-catastrophe». So, our the results on neutron's flux and soft X-ray radiation obtained in this work are correlated with Kapitsa's ones.

2. None-stationary and none-isotropic neutron radiation and X-ray radiation created by the HP prove that there are none-stationary localized active plasma zones ("spots") on the HP's surface recorded in our previous work [1]. Estimation of these local intensities of N-flux and X-ray flux are very high in these active spots. Our estimation of N- flux intensity J in these active zones gives the value about of $J \sim 10^9 \div 10^{10}$ n/cm²sec at the typical diameter of "spot" $d \sim 0,3 \div 0,1$ mm.

3. Experimental results on soft X-ray radiation with high energy $E\gamma \sim 1 \div 4$ KeV prove that internal electrons in the metal clusters play important role in the hydrogen ion - metal cluster interaction probably. The value $E\gamma \sim 4$ KeV is closed to the threshold value $U_d^* \sim 3,6 \div 4,2$ kV measured in the electric discharge and the value Feynman's quantum potential $U_q \sim 3.73$ kV = $M_e c^2 \alpha = 0.5$ MeV/137. Is this result accidental or expected? Author thinks that this result is expected and important. This result helps us to clear of the physics of different radiations created by the HP. Really it is very simple to calculate that coulomb electron energy $U_q = 3.73$ KeV at the radius $R = R_c \sim 10^{-10}$ cm (where R_c - Compton's radius). The possibility of creation of a relativistic hydrogen named as "hydrino" with diameter $D \sim 2R_c$ and binding energy about of the U_q is discussed in many theoretical words, for example in the work [9]. Creation of a low-momentum neutron during "metal cluster-proton" interaction is considered in the work [10]. These conditions are realized in our work namely. So, neutron-like particles (hydrino's flux or low momentum neutron's flux) are created by HP probably.

4. There is a chemical element transmutation in the HP, [1-4, 8]. The measured optical spectra prove this result [1, 8]. The electron dispersive spectroscopy (EDS) analysis of the erosive nanoparticles proves this result also [1, 2, 8]. These particles were picked behind PVR's nozzle and were precipitated by water seal. Unfortunately, these new transmuted chemical elements are unstable and could be destroyed by strong electron beam or strong γ - radiation [8]. We suppose that there is a creation of new chemical «molecules» named «binuclear atom» in our experiments [6]. There is a bound state of hydrogen ion (proton) with internal electrons of heavy metal atom in this "molecule". The typical value of this binding energy is about of $E_m = 100$ -1000 eV, [6]. The value E_m depends on metal atom and individual "internal electron-proton" interaction. So, unusual "molecules" are created by the HP but not new transmuted elements. These "molecules" could be destroyed by strong electron beam or strong γ - radiation namely [8]. It is correctly to name this new science field as internal electron chemistry.

5. Authors sure that the particles recorded by our radiometers are not real neutrons but neutron-like particles. The typical signal connected with a real neutron flux is recorded by radiometer KRAN-1, Figure 9 (left). Radioactive isotope Na₂₂ (calibrator) was used in this experiment. One can see the typical parameters of this neutron's signal are the followings: - front duration $t_f \sim 1 \mu$ s and tail duration $t_r \sim 50 \mu$ s. On the other hand, there are many different signals connected with HP and measured by this radiometer, Figure 9 (right). One can see that there are high-frequency oscillations ($F > 100$ MHz) inside of this MW signal. The typical time duration of this signal is about of $t_x \sim 0,3 \mu$ s. This MW signal is connected with EM radiation of the moving charged particle probably. It is necessary to study this question in detail in the future experiment. Another reason of our doubt is connected with

experimental result on artificial indium radioactivity activated by cold neutron flux. It is well known that this reaction is very good marker (indicator) for cold neutron flux existence. But this reaction does not take place in our experiment.

6. There is third well-known experimental result connected with absence of unstable isotopes in the typical low energy nuclear reaction (LENR) experiment [9, 10]. But there is a chemical element transmutation in this experiment simultaneously. It is very difficult to clear and understand these two results. Probably, these results could be explained by the suggestion about appearance of neutron-like particles in our experiment (but not real neutrons).



Figure 9. The typical neutron's signal (left) from the calibrator Na22 (20 μ s/div) and typical neutron-like signal (right) from the HP (50ns/ div) recorded by radiometer KRAN-1.

Main results obtained in this work are the followings:

Neutron flux (neutron-like particles) is measured by radiometer KRAN-1 and radiometer SPRS. Total particle flux is about of $S_n = 105 \div 106$ neutron/sec.

It is revealed that there is a high voltage threshold $U_d > 3,6 \div 4,2$ kV in the electrical discharge for a stable neutron flux creation in the HP.

Intensive soft X-ray radiation ($E < 4$ keV) from HP is measured by spectrometer Amptek X-123 and BDER. The convergence history is provided in Figure 9. The convergence slope is independent on the mesh size. The convergence is better for the finer grids that can be explained by the better approximation of the original problem.

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