
# Track-Pits in the Plastic Track Detectors Exposed in Space

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With the aim of further investigation firstly observed [1] and than explanation with help of the suggested cosmic ray Erzion mechanism [2-5] in film piles of Plastic Solid State Track Detector (PSSTD) exposed in a free Space on the satellite orbit it was discovered the new kind of track-pits, tracks with specific pit form and very small size. For their study the depth in stacks of cellulose nitrate CN-85 intensity distribution of such pits and all other kind of observed tracks were measured. Total results, obtained by means of an optical microscope observation, for different pits diameters has been in more detail investigated and presented in Table 1.

For precise interpretation of the obtained FB-19 column-depth track-pit density distribution it was considered two main very short (length L < 3 μm) track sources.

(a) Possible formation of chemically etchable tracks from the solar cosmic ray protons before their stopping in CN-85, and (b) formation of short tracks due to recoil nucleus.

In Table 2 the results of theoretical estimation of the surface pite-density, which can be formed by the stopping cosmic ray protons, are presented.

Comparison of these results with the experimental data in Table 1 indicate , that the possible contribution due to stopping cosmic ray protons in observed track-pite density of D = 2-3 μm is by the 2-3 orders of magnitude lower of the detected values.

Results of theoretical estimation of the possible addition formation from recoil nucleus, that are contained the CN-85 material, are given in Table 3.

Results of theoretical estimation of the possible addition formation from the pit-like track-density of D = 2-3 μm, which can be formatted by the recoil nucleus in CN-85 plates, is practically the same for pits to experimentally determined values (see the column plates No 2, Table 1.

Thereby, the precision investigation of depth-dependent the pit-like surface-average track-density distribution indicate on non-registrability of some additional radiation effects, partially conditioned with the Erzion hypothesis. Provided that, to proof this hypothesis the further measurements of the pit-groups, discovered in our investigation of the cosmic ray exposed CN-85 column and CR-39 PSSNTD's has been presented in the second report in this Conference.

**References:**

1. N. Grigorov, N. Alekseev, Ch. Tretyakova et al., 20-th International Cosmic Ray Conference Proceedings, Moscow, Nauka, 3, 264-266, 1987.
2. Yu. Bazhutov, G. Vereshkov, New Stable Hadrons in Cosmic Rays, their
Theoretical Interpretation & Possible Role in Catalysis of Cold Nuclear Fusion, Preprint No.1, Central Research Institute of Machine Building, 1990.
3. Yu. Bazhutov, G. Vereshkov, A Model of Cold Nuclear Transmutation by the Erzion Catalysis, Proceedings of ICCF-4, Hawaii, 4, 8-1, 1993.
4. Yu. Bazhutov, G. Vereshkov, V. Kuksa, On a Possibility of Existing New Stable Hadrons-Hypothetical Catalyst of Cold Nuclear Transmutation, RCCF&NT-3 Proc., Dagomys-1995, Moscow, pp.157-201, 1996.
5. Yu. Bazhutov, [A. Kuznetsov], E. Pletnikov, Spectroscopy of Erzion Catalytic Nuclear Transmutation, Preprint № 1 SRC PhTP «Erzion», CSRIMash, 1-172, 1993.

| No plate | n (*) | D, μm | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | ~ 2 | | ≈ 3-4 | | ≈ 5-10 | | ≥ 10 | |
| | | N | ρ, см$^{-2}$ | N | ρ, см$^{-2}$ | N | ρ, см$^{-2}$ | N | ρ, см$^{-2}$ |
| 19-2 | 100 | 325 | $8{,}1\times10^{5}$ | 101 | $2{,}5\times10^{5}$ | - | - | - | - |
| | $5\cdot10^{3}$ | - | - | - | - | 195 | $9{,}8\times10^{3}$ | 61 | $3{,}05\times10^{3}$ |
| 19-5 | 100 | 156 | $3{,}9\times10^{5}$ | 61 | $1{,}5\times10^{5}$ | - | - | - | - |
| | $5\cdot10^{3}$ | - | - | - | - | 165 | $8{,}25\times10^{3}$ | 41 | $2{,}05\times10^{3}$ |
| 19-10 | 100 | 141 | $3{,}5\times10^{5}$ | 33 | $0.8\times10^{5}$ | - | - | - | - |
| | $5\cdot10^{3}$ | - | - | - | - | 68 | $3{,}4\times10^{3}$ | - | - |
| | $1\cdot10^{4}$ | - | - | - | - | - | - | 34 | $8{,}5\times10^{2}$ |
| 19-15 | 100 | 128 | $3{,}2\times10^{5}$ | 31 | $0{,}8\times10^{5}$ | - | - | - | - |
| | $5\cdot10^{3}$ | - | - | - | - | 67 | $3{,}35\times10^{3}$ | - | - |
| | $1\cdot10^{4}$ | - | - | - | - | - | - | 16 | $4{,}0\times10^{2}$ |
| 19-20 | 100 | 121 | $3{,}0\times10^{5}$ | - | - | - | - | - | - |
| | $1\cdot10^{3}$ | - | - | 241 | $0{,}6\times10^{5}$ | - | - | - | - |
| | $5\cdot10^{3}$ | - | - | - | - | 65 | $3{,}25\times10^{3}$ | - | - |
| | $1\cdot10^{4}$ | - | - | - | - | - | - | 11 | $2{,}8\times10^{2}$ |
| 19-25 | 100 | 112 | $2{,}8\times10^{5}$ | - | - | - | - | - | - |
| | $1\cdot10^{3}$ | - | - | 103 | $0{,}25\times10^{5}$ | - | - | - | - |
| | $5\cdot10^{3}$ | - | - | - | - | 64 | $3{,}2\times10^{3}$ | - | - |
| | $2\cdot10^{4}$ | - | - | - | - | - | - | 14 | $1{,}75\times10^{2}$ |
| 19-30 | 100 | 98 | $2{,}4\times10^{5}$ | - | - | - | - | - | - |
| | $1\cdot10^{3}$ | - | - | 112 | $0{,}28\times10^{5}$ | - | - | - | - |
| | $5\cdot10^{3}$ | - | - | - | - | 52 | $2{,}6\times10^{3}$ | - | - |
| | $2\cdot10^{4}$ | - | - | - | - | - | - | 17 | $2{,}1\times10^{2}$ |
| 19-34 | 100 | 104 | $2{,}6\times10^{5}$ | - | - | - | - | - | - |
| | $1\cdot10^{3}$ | - | - | 73 | $0{,}18\times10^{5}$ | - | - | - | - |
| | $5\cdot10^{3}$ | - | - | - | - | 54 | $2{,}7\times10^{3}$ | - | - |
| | $2\cdot10^{4}$ | - | - | - | - | - | - | 15 | $1.9\times10^{2}$ |

Table 1. Track-density (ρ, cm$^{-2}$) in four track-pit groups of different diameters (D ) on the CN-85 plate surfaces from the satellite exposed column FB-19 in 1995 year.
(*) Number of accounted microscope field of view of the surface area $S_{n=1} = 4\times10^{-6}$ cm$^2$.

| Number of plate in the column | E, MeV (*) | | J, proton fluence | | | | Track-pit density (****) ×10$^2$ | |
|---|---|---|---|---|---|---|---|---|
| | | | J ×10$^{-5}$ (**) | | $J_{70,2\pi}\times10^{3}$ (***) | | | |
| | head | lower | head | lower | head | lower | head | lower |
| 2 | 2.8 | 4.3 | 30.0 | 8.3 | 11.4 | 3.15 | 6.56 | 1.81 |
| 5 | 6.4 | 7.4 | 4.3 | 3.7 | 1.63 | 1.41 | 0.73 | 0.63 |
| 10 | 10.2 | 10.8 | 2.7 | 3.0 | 1.03 | 1.14 | 1.43 | 1.58 |
| 15 | 13.1 | 13.6 | 3.7 | 3.9 | 1.41 | 1.48 | 1.96 | 2.06 |
| 20 | 15,5 | 16.0 | 4.25 | 4.35 | 1.61 | 1.65 | 2.24 | 2.29 |
| 25 | 17.5 | 18.0 | 4.6 | 4.7 | 1.75 | 1.79 | 2.43 | 2.49 |
| 30 | 19.6 | 19.9 | 5.05 | 5.1 | 1.92 | 1.94 | 2.67 | 2.70 |
| 34 | 21.0 | 21.3 | 5.23 | 5.28 | 1.99 | 2.01 | 2.77 | 2.79 |

Table 2. Theoretically estimated numbers of the cosmic ray protons stopping in the layers of h ~ 10 μm on the head and lower surfaces of CN-85 in FB-19 column.
(*) Energy of protons, at which they run up to head and lower surfaces of each plate;
(**) Flow of the solar and galactic cosmic ray protons J in units of (cm$^2$ ·s ·sr· MeV)$^{-1}$;
(***) Flow of these protons $J_{70,2\pi}$ in units of (cm$^2$ · MeV)$^{-1}$, corresponding to 70 days of FB-19 column exposure at 2π sr; $J_{70,2\pi} = 6.048\cdot10^{6}\times6.28 = 3.8\cdot10^{7}\times J$;
(****) The surface track-pit density of D = 2-3 μm (in units of cm$^{-2}$). The effective thickness of plate surface, in which the stopping protons can be registered as short pit-like tracks, estimated from the data: $\rho = J_{70,2\pi}\times\Delta E$, where ΔE – energy interval, corresponding to plate layer thickness of $\Delta h \approx 2D$, that is smaller of 5 μm, and in average for used CN-85equal to ~ $5\times10^{-2}$ MeV.

| Target [*] nuclei | Concentration, % | Recoil nuclei tracks | | Effective cross section ($\sigma_{H,Z}$), $\times 10^{-24}$ см$^{2}$ [****] |
|---|---|---|---|---|
| | | D, μm [**] | ρ, cm$^{-2}$ [***] | |
| H | 33 | 2-3 | $(8\text{-}3)\cdot 10^{5}$ | $(2\text{-}5)\cdot 10^{5}$ |
| C | 25 | 3-5 | $(20\text{-}2)\cdot 10^{4}$ | $(4.6\text{-}2.3)\cdot 10^{-1}$ |
| N | 8 | 5-10 | $(10\text{-}4)\cdot 10^{3}$ | $(2.5\text{-}5)\cdot 10^{3}$ |
| O | 33 | 5-10 | | |

Table 3. Theoretical estimation of the pite-like track-density due to recoil nucleus in CN-85 track-detector plates.
(*) Atomic contents of CN-85: H(8)-C(6)-N(2)-O(8);
(**) Registered the track-length of pites L < 2D;
(***) Measured the pite-track density intervals for the whole column depth;
(****) Semi empirical effective cross section value for the recoil nuclei formation ($\sigma_{H,Z}$) = ρ/ $J_{70,2\pi}\cdot N_{at}$ , where $N_{at}$ – number of atoms of each elements in the PSSTD CN-85 volume V = $10^{-3}$ cm$^{3}$ of the material density 1.52 g/cm$^{3}$.