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## Density matrix in the description of the collision of an atomic particle with a solid film

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Calculation and further analysis of density matrix (DM) for a projectile which collides with a solid film reveal some new representations which hard to be anticipated without the calculation. Namely:

1. The coherence properties in the projectile's wave field are describing through the special function of coherence.

$$f(\vec{x}_1, \vec{x}_2, t) = \frac{2\Gamma(\vec{x}_1, \vec{x}_2, t)}{\Gamma(\vec{x}_1, \vec{x}_1, t) + \Gamma(\vec{x}_2, \vec{x}_2, t)}$$
, where  $\Gamma(\vec{x}_1, \vec{x}_2, t)$  - density matrix of the projectile depending on two spatial points  $\vec{x}_1, \vec{x}_2$  and the time  $t$ .

2. The collision with the solid leads to a significant decrease in the total coherence length of the projectile's wave field. The coherence length can become much smaller than the initial size of a wave packet of a particle passing through the film.

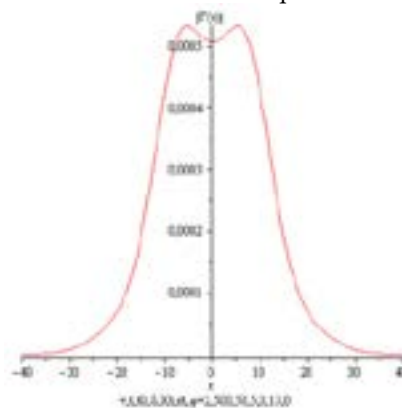
3. During the collision with solid, the number of different spatial areas where the mutual coherence in the projectile's wave field is supported can be multiplied.

4. Every part of projectile's wave field can be individualized as the separate particle having own property in its inner quantum state. The procedure which has a responsibility for such a transformation can be characterized as a spontaneous breaking of symmetry.

5. The process described in point 3 can be considered as a special form of breaking in quantum mechanics.

6. Knowing the wave packet evolution during the passage through the solid film allows one to explain experimental results on the pore formation during the passage of high charged atomic ions through the thin carbon nano-membranes.

7. The parts of the wave field considered above can be stabilized in its quantum state after been captured in its own polarization well.



## Biography

Gennadiy Filippov has his expertise in particle-solid interaction physics. He has completed his PhD at the age of 54 years from Tomsk State University (Russia). He is head of the Laboratory of Biophysics and Bio-nanotechnology in the Chuvash State Agricultural Academy and professor in the Chuvash State Pedagogical University in Cheboksary, Russian Federation.

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