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On bi-fractal structure of chromatin in rat lymphocyte nuclei

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The small-angle neutron scattering (SANS) on the rat lymphocyte nuclei demonstrates the bi-fractal nature of the chromatin structural organization. The measurements were carried out at the KWS-3 instrument in the momentum transfer range $[10^{-3} - 9 \cdot 10^{-2}]$ nm^{-1} and at the KWS-2 instrument in the momentum transfer range $[9 \cdot 10^{-2} - 2]$ nm^{-1} at MLZ, Garching, Germany.The scattering intensity from rat lymphocyte nuclei is described by power law Q^{-D} with fractal dimension approximately 2.3 on smaller scales and 3 on larger scales. The crossover between two fractal structures is detected at momentum transfer near 10^{-1} nm^{-1}. The use of contrast variation (D_2O-H_2O) in SANS measurements reveals clear similarity in the structural organizations of nucleic acids (NA) and proteins. Both chromatin components shows bi-fractal behavior with logarithmic fractal structure on the large scale and volume fractal with slightly smaller than 2.5 structure on the small scale.

Scattering intensities from chromatin, protein component and NA component demonstrate extremely extensive diapason of logarithmic fractal behavior (from 10^{-3} to approximately 10^{-1} nm^{-1}). We compare the fractal arrangement found in nuclei of the rat lymphocytes with those of the chicken erythrocytes and immortal cell line HeLa. We conclude that bifractal nature of the chromatin arrangement is inherent to nuclei of all these cells. The details of the fractal arrangement - its diapasons and correlation between nuclear acids and proteins are specific for different cells and is related to their functionality.

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