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EVIDENCES FOR AND THE MODELS OF SELF-SIMILAR SKELETAL STRUCTURES IN FUSION DEVICES, SEVERE WEATHER PHENOMENA AND SPACE

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A review is given of

(i) evidences for self-similar structures of a skeletal form (namely, tubules and cartwheels, and their simplest combinations), called Universal Skeletal Structures (USS) [1(A)], observed in the range 10^{-5} cm - 10^{23} cm [1(B)] in

- high-current electric discharges in various fusion devices (tokamaks, including the dust deposits in tokamaks; Z-pinches, plasma foci; laser-produced plasmas) [1(C), 2(B)],
- severe weather phenomena (tornado, hailstones, lightning-born long-lived luminous objects) [1(B,D,E)],
- space (supernova remnants and some galaxies of similar form, “colliding galaxies”, etc.) [1(B,F)];

(ii) models for interpreting the phenomenon of skeletal structures:

- a fractal condensed matter (FCM), assembled from nanotubular dust [1(C)] and possessing an enhanced longevity in the ambient plasma due to the shielding of FCM by the EM waves [1(G)] (including the novel data on observations of anomalous electrodynamics properties of carbon nanotubes-composed materials and some results on numerical modeling of the respective FCM),
- various types of conventional (i.e. FCM-free) plasma filaments of electric current [3],
- strongly twisted magnetic flux ropes (“heteromacs” [1(H),4]) which require an enhanced internal magnetic coupling,
- aggregation of a fractal, assembled from nanoparticles, in a decaying/cooling plasma [5], or in a cold peripheral plasma [6];

(iii) probable applications -- both inside and outside the fusion science -- of the FCM which might be responsible for the USS phenomenon:

- facilitation of electric breakdown of the working gas in the discharge chamber,
- control of the nonlocal, non-diffusional component of heat transport in magnetically confined fusion plasmas,
- production of a new type of nanomaterial [2],
- early diagnostics of tornado [1(D)], reproduction of ball lightning [1(E)] and waterspout [7],
- reconsideration of the “dark matter” problem in astrophysics and cosmology [1(F)].

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