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Structural Hidden Degrees of Freedom in Aperiodic Materials. Mickaël Huard. *I.P.R. UMR CNRS 6251, Université de Rennes 1, 35042 Rennes, France.*
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Self-assembly underlies the formation of a wide variety of biological and supramolecular tubular structures [1]. One feature of these materials is to present the ultimate one-dimensional confinement for the guest molecules giving uni-axial composite crystals. Aperiodicity in these materials may appear rather naturally due to the misfit of host and guest parameters along the channels or the tubes [2]. Superspace crystallography is required to correctly describe these aperiodic structures where no translation symmetry exists in the physical three dimensions world [3,4]. These structures may present new structural and dynamical properties related to the infinite degeneracy of their ground state [5,6]. This presentation focuses on original sequences of phase transitions found in the host-guest prototype alkane urea inclusion compounds. Very high-resolution neutron diffraction recently allowed us to reveal such a phase transitions sequence in nonadecane-urea, which can only be interpreted in terms of internal dimension of the superspace [7]. We will present new results, concerning different compounds within the urea-alkane family, which illustrate the way nature may explore all the hidden degrees of freedom allowed in higher dimensional spaces.

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On the Structures of the Dense Alkali Metals. Eugene Gregoryanz[a], Christophe Guillaume[a], Lars Lars Lundegaard[a], Olga Degtyareva[a], Malcolm McMahon[a], Stas Sinogeikin[b], Malcolm Guthrie[b]. [a]*CSEC and School of Physics, University of Edinburgh.* [b]*HPCAT, APS, Argon, USA.*
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The alkali group elements are considered as textbook examples of free electron metals because of the single s electron in the valence band. However, when these metals are subjected to compression these simple systems exhibit unexpected complexity departing from the free-electron behaviour at high densities. The pressure-induced complexity is attributed to the increased role of the core electrons becoming more appreciable with decreased volume [1]. Due to the difficulties associated with the high reactivity and chemistry of the alkalis and limited set of tools available to study them at extreme conditions until very recently only the behaviour of caesium was known up to 200 GPa at 300 K. Lately the melting curve of Na measured by the x-ray diffraction techniques was shown to have unexpected minimum at 118 GPa [2] and the plethora of the new phases associated with this minimum was discovered [3] owning to the development of the single crystal techniques in the diamond anvil cell [4]. In this presentation I will discuss the common traits and differences between Na and other alkali metals at extreme compressions and make a comparison with theoretical studies.

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FA4-MS01-O3

On the Application of the Fibre Bundle Approach to the Description of the Symmetry of Magnetic Structures and Other Aperiodic Structures. Jerzy Warczewski[a], Paweł Gusin[a], Tamara Śliwińska[a], Józef Krok-Kowalski[a]. [a]*Institute of Physics, University of Silesia, ul. Uniwersytecka 4, 40-007 Katowice, Poland.*
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We present a description of the magnetic structures in terms of fibre bundles [1]. Such an approach turns out to be the most general, because it is based on the most general product of two arbitrary spaces, namely the Cartesian product, which is very suitable to the combination of two "worlds", e.g. the "world of positions" (R^3) and the "world of spins" (V_3). Thus the description of crystal structures is to be carried out in R^3, whereas the description of spin structures is to be carried out in V_3. This approach equates the symmetry analysis of magnetic structures with the method of the higher dimensional embeddings of the modulated structures. The symmetry groups appearing in the symmetry analysis become structural groups of the bundles. From the other side a higher dimensional space needed to the description of a modulated structure makes here the total space of the bundle E_6. Thus these three methods, namely the symmetry analysis, the higher dimensional embeddings and the fibre bundles are equivalent. We introduce the Gaussian factor which will play a double role: it makes the magnetization vector **M** to be a field and simultaneously makes the description of the magnetic structures more physical. The total magnetic group TG_m in the space E_6 is the tensor product of the magnetic group G_m and the space group G_Λ of the crystal structure, where m is the index which enumerates magnetic ordering (ferromagnetic, antiferromagnetic, simple spiral, ferromagnetic spiral, skew spiral and both transverse and longitudinal spin waves). It is worthwhile to mention here