 

***PERSONALIA***

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# Sergei Mikhailovich Stishov (on his 70th birthday)

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December 12, 2007 was the 70th birthday of the outstanding Russian physicist, Corresponding Member of the Russian Academy of Sciences (RAS), DSc in physics and mathematics, Professor Sergei Mikhailovich Stishov.

Sergei Mikhailovich Stishov is a world-class authority in the physics and technology of high pressures. He is known for his deep-rooted interest in the key problems of condensed-matter physics, and as a wonderfully accomplished experimenter with profound physical intuition.

S M Stishov was born on December 12, 1937 in Moscow where, upon graduating from high school in 1955, he enrolled in the Geology Department of Moscow State University. He started research activities while still a student and published a number of papers on the nature of color centers in various minerals.

Having graduated cum laude from Moscow State University, S M Stishov continued in postgraduate courses; his interest in the internal structure of the Earth and planets triggered the beginning of his experimental activity in high-pressure physics. In 1961, S M Stishov obtained and investigated a new dense modification of silica; it was soon discovered at Meteor Crater in Arizona and was given his name — 'stishovite'. In 1962, S M Stishov presented the results of this work as his thesis for Candidate of Physico-mathematical Sciences and defended it. His further life in science, for more than 30 years, was inseparable from the Institute of Crystallography in Moscow, where he rose from junior researcher to head of a large laboratory. Some years ago, Sergei Mikhailovich Stishov moved to the directorship of the RAS Institute for High Pressure Physics (IHPP).

Sergei Mikhailovich Stishov

S M Stishov's work in the field of phase transitions and high-pressure physics enjoyed international recognition. This is true first and foremost of his work on the ultradense modification of silica and his studies in the physics of melting. S M Stishov showed experimentally that the concept of silicon's transition to sixfold coordination at high pressure leads to a noncontradictory model of the Earth's lower mantle. Therefore, he obtained for the first time experimental proof of the decisive role of phase transitions in the formation of the internal structure of the Earth and planets.

At the beginning of the 1960s, S M Stishov and colleagues published a series of papers on the discovery and study of temperature maxima in the melting curves for a number of materials. This work initiated a research into the problem of 'phase transformations' in liquids, which is presently being actively pursued.

At the end of the 1960s and the beginning of the 1970s, S M Stishov obtained results of fundamental importance when studying the equations of state and melting of simple substances. In a series of experiments and using unique equipment specially designed for the purpose, he established the universal behavior of thermodynamic quantities in the melting of argon and alkali metals. It was found that the relative jumps in volume and entropy in melting tend to finite limits under unlimited compression of these materials. This fact proved to be crucial for concluding that repulsive forces play the decisive role in melting and crystallization. The importance of these conclusions becomes obvious if one takes into account that, regardless of its specific nature, practically any system composed of many particles (beginning with colloidal systems and ending with systems of elementary particles) possesses the property of crystallization.

In subsequent years, S M Stishov's interest focused on studying the equation of state of liquid and solid alkali metals; this was an exceptionally complicated experimental problem in view of the high chemical reactivity of alkali metals. S M Stishov and his colleagues, using specially developed technology, were able to obtain for the first time high-precision experimental data that characterized the equations of state of all liquid and solid alkali metals at pressures up to 20 kbar.

When investigating phase transitions in liquid-crystal systems, S M Stishov and his coworkers obtained for the first time the experimental data that characterize the thermodynamics of the nematic phase transition at high pressures; he

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discovered a new type of polycritical point in the smectic A — smectic B transition curve, at which the first-order phase transition transforms into a weak orientational transition, and studied the 2D – 3D crossover in the melting of smectic B.

S M Stishov and his team conducted a series of high-precision experiments investigating tricritical phenomena in ferroelectrics. This work proved the validity of applying the Landau theory to ferroelectric phase transitions in a wide range of pressures and temperatures.

S M Stishov initiated in the USSR a novel field of research — the physics of substances compressed to megabar pressures. Using the technology of diamond anvils, S M Stishov and his coworkers obtained and reliably measured pressures exceeding 2 million atmospheres, and developed methods of studying optical Raman spectra, as well as X-ray and neutron diffraction spectra under ultrahigh pressures (in collaboration with the I V Kurchatov Institute of Atomic Energy). When studying the equations of state for isoelectronic pairs Kr – RbBr and Xe – CsI, they discovered an unusual phenomenon of chemical degeneracy under ultrahigh pressures (compression isotherms of isoelectronic pairs become indistinguishable).

When S M Stishov traced the equation of state of deuterium up to 300 kbar, chambers with diamond anvils were utilized for the first time in conducting studies by neutron diffraction method. He also supervised the investigation of the equation of state and Raman scattering in diamond, cubic boron nitride, and silicon carbide polytypes. The data obtained also formed the basis of the new pressure scale in the megabar range that S M Stishov proposed in 1987; in recent years it has become universally accepted.

S M Stishov's span of interests is exceptionally wide and he frequently and decisively changes the direction of his research, each time advancing to the forefront of the field he has chosen. He achieves swift success owing to his great erudition and masterful development of original experimental techniques. Sergei Mikhailovich's talent as inventor of new unique research apparatus deserves special mention. Most of the high-pressure facilities that he created have no analogs anywhere in the world.

Among the projects started by S M Stishov in recent years we wish to single out his pioneering experimental studies on isotopic quantum effects in compressed matter. This study revealed the crucial role of the type of interparticle interaction that affects the 'quantum behavior' of matter at high pressure.

S M Stishov obtained a number of new results by studying the topology of phase diagrams of substances and its relation to the nature of interparticle interaction. He used 'collapsing' solid spheres as a case study illustrating the possibility of liquid – liquid phase transitions in systems with isotropic interaction.

At present, S M Stishov is conducting research into quantum phase transition in systems with strong electron correlation, where he has already received very important results.

All this work described above was carried out with Sergei Mikhailovich playing a most active role at every stage, beginning with the development and design of the equipment and ending with writing the papers. This signature style of our protagonist has not changed with time.

S M Stishov has headed RAS IHPP for 14 years now. During this time, which has been quite tough on Russian science, Stishov himself and his team managed not only to save the Institute but succeeded in essentially strengthening its position. For instance, impressive experiments were executed in recent years under his guidance and with his direct participation that created quite a stir in the world scientific community. This holds true most of all for the discovery and investigation of superconducting diamond. Equally deserving of mention in this context is the work carried out at the IHPP on phase transitions in liquids and glasses, on the synthesis of the ferromagnetic modification of carbon, and on growing large stishovite single crystals. The results obtained at the RAS IHPP in the last ten years are invariably included in the list of the main achievements of the Russian Academy of Sciences.

The fact that S M Stishov has for many years remained an invited science consultant at the USA Los Alamos National Laboratory is a good measure of his international status. Sergei Mikhailovich occupied on a number of occasions the most prestigious invited professor positions at the University of California, Berkeley (Miller Professorship) and Stony-Brook. We wish to specially mention the Fairchild Distinguished Scholar position that he received at Caltech in the USA.

The range of Sergei Mikhailovich's science administration activities is truly impressive. He is a member of the Bureau of the Physical Sciences Division of the RAS, is deputy chairman of the Troitsk Research Center, worked on the editorial boards of the journals *Pis'ma v ZhETP* and *High Pressure Research*, and during the last 12 years has been the Chair of Physics of Condensed State under Extreme Conditions at Moscow Institute of Physics and Technology (MFTI).

S M Stishov regularly organizes the annual Russian Conference "Strongly correlated electron systems and quantum critical phenomena". The Program of the RAS Presidium on the Physics and Mechanics of Strongly Compressed State of Matter was formed on S M Stishov's initiative and under his guidance.

S M Stishov's achievements in science were marked in 2005 by the P Bridgman Prize — the most prestigious international award in high-pressure physics.

Sergei Mikhailovich actively defends the importance of supporting fundamental science, and refuses to tolerate any manifestations of faked or pseudoscience. He is a born leader and as such is exceptionally consistent in achieving his goals both in organizing research projects and in setting up his own experiments. He is a man of impeccable integrity and responsibility, demanding very much of himself and his coworkers, and capable of carrying enormous work loads. These qualities are combined with his sincerity when offering an opinion, his open character, and his pleasant sense of humor.

Friends and colleagues wish Sergei Mikhailovich all the best on his jubilee from the bottom of their hearts and wish him good health, much happiness, and new success in science.

*S N Bagaev, V V Brazhkin, Yu M Kagan,*
*L V Keldysh, Yu A Litvin, V A Matveev,*
*S V Popova, V N Ryzhov, V A Somenkov,*
*V B Timofeev, L A Falkovsky*