

PERSONALIA PACS number: **01.60.+q**

In memory of Vladimir Naumovich Gribov

Science has suffered a tragic loss. Vladimir Naumovich Gribov, one of the leaders of contemporary theoretical physics, died on August 13, 1997. His original ideas, his powerful theoretical techniques and his outstanding results lie at the basis of the theoretical description of particle collisions at high energies and are used the world over both by theorists and by experimenters.

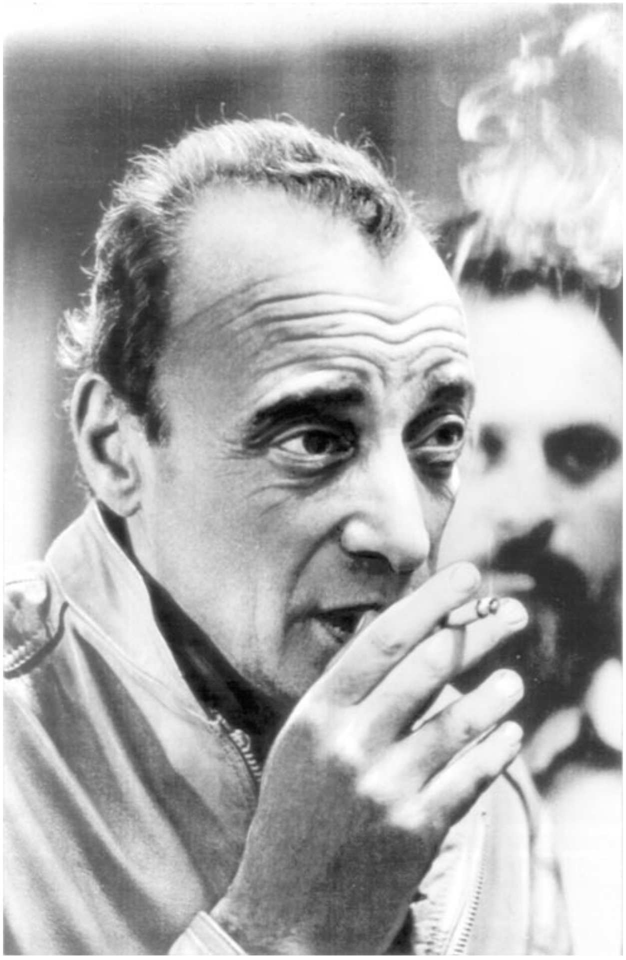
Vladimir Naumovich Gribov was born on March 25, 1930 in Leningrad. He brilliantly graduated from the Leningrad State University in 1952 in theoretical physics. However, he had to work as a teacher at a night school for adults until 1954, doing physics research only at home and attending Shmushkevich's seminars at the Physicotechnical Institute of the Academy of Sciences of the USSR in Leningrad (Fiztekh). I M Shmushkevich and K A Ter-Martirosyan were finally succeeded to enable him for a job at the Theoretical Department of Fiztekh, using the period of relative decline in state-organized anti-Semitism. Gribov's thinking was so profound and original and his ability to work hard was so outstanding that he soon became the recognized leader. In 1962 Gribov rose to be the head of the Theoretical Department.

The decisive phase for Gribov the scientist came with his regular journeys to Moscow, at the end of the 1950s, to the seminars run by L D Landau and I YaPomeranchuk; both held extremely high opinions of Gribov's talent. Landau treated him as his successor. Pomeranchuk excited his interest in hadron collisions at asymptotically high energies.

In 1961, Gribov applied poles in the plane of complex angular momentum, first considered by the Italian theorist T Regge in the framework of nonrelativistic quantum mechanics, to analyze the asymptotic behaviour of scattering amplitudes. With wonderful virtuosity, Gribov used the analyticity and unitarity of the S-matrix and predicted that the diffraction cone in elastic hadron scattering must contract asymptotically with increasing energy; this corresponds to a logarithmic growth of the interaction radius. The American theorists G Chew and S Frautschi came to similar conclusions almost simultaneously, and the French theorist M Froissart derived the limit for the rate of asymptotic growth of hadron cross sections.

In 1962, Gribov and Pomeranchuk, and independently the American theorist M Gell-Mann, showed that Regge poles exchange leads to the so-called factorization, and established asymptotic relations between the cross sections of various processes. For example, the squared cross section of pion-nucleon scattering must be equal to the product of the pion-pion and nucleon-nucleon cross sections.

Uspekhi Fizicheskikh Nauk **168** (4) 471 – 472 (1998)
Translated by V I Kisin



Vladimir Naumovich Gribov

The Regge pole with the quantum numbers of the vacuum was called the Pomeranchuk pole or pomeron, since it led in a natural manner to the Pomeranchuk theorem on the equality of the cross sections for a particle and its antiparticle scattering by a given target. A straightforward path led from the pomeron to poles with other quantum numbers, such as those of the ω-meson, ρ-meson, and nucleons.

After Stanley Mandelstam discovered the Regge cuts (branching points), Gribov developed the Reggeon diagram technique (Reggeon calculus) in mid-1960s. It not only made possible the solution of complicated problems of hadron physics but also played an important part in statistical physics, for the calculation of critical exponents of second-order phase transitions.

In addition, Gribov and his colleagues applied their techniques to the summation of high-order terms of perturbation theory in quantum electrodynamics. They calculated the cross sections of such processes as the scattering of photons and positrons by electrons at high energies in the leading doubly logarithmic approximation. (It was shown, among other things, that they contain the Bessel functions and do not necessarily have a simple exponential form.)

In 1972, V Gribov and L Lipatov published the work on the theory of deep inelastic scattering and electron – positron annihilation into hadrons in the framework of quantum-field theory of strong interaction, which preceded quantum chromodynamics. As a parameter of the theory they employed the constant g^2 of the meson-nucleon interaction times squared logarithm of energy or momentum. In 1977 this approach was implemented in quantum chromodynamics by Yu Dokshitser and independently by G Altarelli and J Parisi. These equations, referred to as DGLAP, are widely used to describe hard collisions at high energies. Of special interest is the kinematic region of soft partons which is studied at the ep-colliders HERA (DESY). This kinematic region was analyzed by Leonid (Lenya) Gribov, an exceptionally talented theoretical physicist. The death of their only child in 1984 in the Pamir mountains was a tragic blow for his parents.

Lenya was one of a large group of young theorists who were attracted by the beauty of theoretical physics that Vladimir Naumovich Gribov opened for them both at his seminars and during his lectures at the Leningrad State University. Gribov's physics school and his seminars — at the Ioffe Physicotechnical Institute and then at the Leningrad Nuclear Physics Institute since early 1970s — became world-famous. These were very special, inimitable seminars. The duration of the seminar was not fixed. Stormy critical discussion lasted until the situation became fully clear: the paper under discussion was either correct or incorrect. The speakers were glad to pass through this purifying torture; many came from abroad.

In the 1970s Gribov was elected to the USSR Academy of Sciences and to the American Academy of Arts and Sciences. He was the first to win the L D Landau prize and later received other international prizes (the Gumboldt Prize in Germany, the Sakurai Prize in USA) and honorary degrees (thus he was elected an honorary member of the Hungarian Academy of Sciences).

The scope of Gribov's interests was very wide. Thus he suggested, together with B Pontecorvo, a scheme of muon and electron neutrino oscillations that contained the minimum number of neutrino components. (This was in 1969 when the τ-lepton was not yet known). Gribov discovered and formulated the problem of gauge copies in non-Abelian theories. 'Gribov copies' are quoted in current works considering theories on lattices and topological theories. Unfortunately, he often left his ideas and results unpublished. For example, long before S Hawking he insisted in a discussion with Ya Zel'dovich that black holes must emit particles via quantum tunnelling. He was also the first to conjecture that instantons describe tunnel transitions in vacuum.

In 1980 Gribov moved from Leningrad to Moscow, to the L D Landau Institute of Theoretical Physics. Over the years he concentrated his efforts almost completely on the problem of confinement in quantum chromodynamics, especially on the role played by light quarks. He thus carried out a thorough analysis of the general problem of bound states of massless particles. His last paper, "QCD at long and short distances", which appeared in the hep-ph electronic archive in August 1997, as well as his preceding papers and lectures await serious analysis.

Vladimir Naumovich Gribov possessed a rare charm that pulled people towards him. He was never able to take for granted any 'common wisdom'. He exposed any statement, and not only in physics, to creative criticism. His thinking was extraordinarily profound, original, and witty. This high intellectual power was combined with unlimited devotion to science, to a constant search for truth. Friends and colleagues the world over grieve the death of Vladimir Naumovich Gribov. He will be remembered with admiration and gratitude.

A A Ansel'm, V L Ginzburg, Yu L Dokshitser,
I T Dyatlov, V E Zakharov, B L Ioffe,
L N Lipatov, N N Nikolaev, L B Okun',
Yu V Petrov, K A Ter-Martirosyan, I M Khalatnikov