TO THE MEMORY OF DMITRY (MITYA) DIAKONOV

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Brief personal recollections about Professor Dmitry Diakonov (1949–2012) are presented. Exact solutions to the Schrödinger equation for gluodynamics and quartic tilted anharmonic oscillator are mentioned.

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I met Dmitry (Mitya) Diakonov for the first time in the summer of 1970, when the students of the Physics Department (Faculty of Physics) of the Leningrad/Saint-Petersburg State University and the students of the Faculty of the General and Applied Physics of the Moscow Institute of Physics and Technology were sent to work together for the summer at a collective farm somewhere in Karelia, a huge region of the Soviet Union, close to the Soviet–Finnish border. We were about 20 years old, and we enjoyed the unspoiled Nature and the ability to talk to each other about anything while being surprised by our mutual understanding. Even 12–14 hours of heavy physical work did not stop us from it. Around year 1976, the Leningrad Institute for Nuclear Physics organized a conference for young scientists in Leningrad, and Mitya invited about 20 people to his apartment at Suvorov's Boulevard for a party. The party was dominated by Igor Mikhailovich Diakonov — Mitya's father, the world-famous, renowned linguist who told us incredible stories about his life and the world of languages and, in particular, how he decoded the Sumerian language, dating back to at least 2900 BC. We were young, some of us were recently married, almost nobody had defended its Ph.D. yet, but true love for theoretical physics prevailed over anything else — many of us became life-long friends after this party!

At the end of the 1970s, Mitya and myself had learned of the remarkable fact that the exponential of the Chern–Simons action,

$$\Psi_g \;=\; \exp\{-kK\}\,, \qquad K[\mathcal{A}] = \int \mathrm{Tr}\mathcal{A}\,\mathrm{d}\mathcal{A} + \tfrac{2}{3}\mathcal{A}^3\;\mathrm{d}^3x\,, \tag{1}$$

is the exact solution of the functional Schrödinger equation for gluodynamics with vanishing vacuum energy[1]. However, there was a problem with this solution: it was non-normalizable/non-square-integrable. After several unsuccessful attempts, it became clear that unlikely the exact normalizable solution exists. We disagreed strongly on how to continue: Mitya wanted to keep trying with field theory, while I wanted to take a step back to quantum mechanics by studying the one-dimensional analogue of (1)

$$\Psi_x = \exp\left\{-\frac{\omega}{2}x^2 - \frac{g}{3}x^3\right\}\,, \tag{2}$$

which was the exact but also non-normalizable solution for the so-called tilted anharmonic oscillator with potential

$$V = \left(\omega^2 - 2g\right)\,x^2 + 2\omega g\,x^3 + g^2\,x^4\,, \tag{3}$$

and energy $E_0 = \omega$. (Eventually, this led to the discovery of the quasi-exactly-solvable quantal problems [1–3], while a normalizable solution of (3) was written only recently, in an approximate form, and is still unpublished.) After that time, we never discussed science again, although we remained good, very close personal friends for many years[2].

Last time I saw Mitya was in 2001 at Gif-sur-Yvette, France where we celebrated the 75$^{\text{th}}$ anniversary of Boris Lazarevich Ioffe, see [5] — one of the close L.D. Landau disciples and one of our beloved teachers. At the reception, Mitya was sitting next to me together with Natasha, his second wife, and several times he repeated: "What happened with us!? We were such good, such close friends for so many years! Why relations were stopped?" I was only able to say: "That is life. We live so far away from each other, and with such different lives ..."

Memory about Mitya — one of the most non-trivial persons I ever met — lives with me and it will live forever.

[1] This fact was already known to Sasha Polyakov and V.N. Gribov.

[2] Alternative direction in field theory was pursued by M. Claudson and M.B. Halpern [4].

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