Non-equilibrium Infra-red Emissions of Planetary Atmospheres: Modern Analysis Techniques, Resolved and Unresolved Problems

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Abstract: What can we learn about the mass and intrinsic spin of dark matter particles from astrophysical observations? I will discuss how spin can determine the lightest mass dark matter particles can have. When dark matter is a sufficiently light boson, it becomes wavelike — I will show that in this case its intrinsic spin angular momentum can impact the (i) variation of dark matter density inside halos, (ii) lead to formation of solitons with macroscopic intrinsic spin, and (iii) leave clues in initial conditions for formation of structure in the early universe. Time permitting, I might briefly discuss direct detection prospects for such dark matter, and novel connections to "spinor" Bose-Einstein Condensates in the laboratory.

Bio: Dr. Alexander Kutepov studied physics at the University of Leningrad, one of the two top universities in the Soviet Union. He continued his studies at the Department of Atmospheric Physics and the Department of Astrophysics of the University of Leningrad, the doctoral thesis "The non-LTE in CO2 in the Earth's mesosphere", 1975. His teachers were the top Soviet scientists in atmospheric physics and astrophysics (academician Victor Sobolev - one of the founders of modern radiative transfer theory and academician Kirill Kondratyev - the founder of the Soviet program of remote sensing of the atmosphere from space). Later he worked at the Department of Atmospheric Physics as a research associate and assistant professor. In 1989, A. Kutepov was invited to join the research team of Professor Rolf-Peter Kudritski at the Institute of Astrophysics of the University of Munich, Germany, at that time the world's leading team in the development of non-LTE radiative transfer methods. In 2001, he received a National Science Foundation grant to join the Planetary Science Branch of NASA GSFC, and later obtained the Research Associate then Research Associate Professor positions at the Physics Department of the Catholic University. His work since then has focused on the development and application of numerical methods for the analysis of infrared observations of the Earth and planetary middle and upper atmospheres from space. One of his most appreciated results was the explanation of the long-standing problem of why the mesopause temperatures obtained from the TIMED/SABER observations differed greatly from the in-suite rocket observations. Later, together with Alex Panka, one of Dr Yiğit's former PhD students, the explanation of the strong nighttime CO2 4.3 micron emission was given - the problem that remained unsolved for more than 40 years.