High-power laser filamentation dynamics in high-pressure nitrogen

Apeksimov D.V.[1,@], **Babushkin P.A.**[1], **Geints Yu.E.**[1], **Kabanov A.M.**[1], **Minina O.V.**[1], **Oshlakov V.K.**[1], **Petrov A.V.**[1], **Udalov A.A.**[1] **and Khoroshaeva E.E.**[1]

[1] V.E. Zuev Institute of Atmospheric Optics of Siberian Branch of the Russian Academy of Science, 1, Academician Zuev square, Tomsk, 634055, Russia

[@] mov@iao.ru

Modern trends in atmospheric-optical research are closely related to nonlinear femtosecond laser physics. Their practical focus is remote atmospheric diagnostics, efficient energy delivery over long paths, plasma formation. The main prospects in these cases are associated with the phenomena of self-focusing [1] and filamentation [2] of high-power laser pulses. In particular, in recent years [3], [4], pulses propagation have been actively developed. The interest is also related to the possibilities of scaling the results obtained in laboratory conditions to the real long-range atmospheric paths [5].
In this work, the influence of the gas pressure in the optical cuvette on the characteristics of the titanium-sapphire laser radiation propagating in the self-focusing and filamentation mode was experimentally and theoretically studied. The cuvette gas under the pressure of 1 to 11 atmospheres was nitrogen. In general, with increasing gas pressure in the optical cuvette, the average diameter of postfilaments decreases, and their number increases (with a tendency to saturation).
This study is supported by the Russian Science Foundation (Agreement No 24-12-00056).

[1] Boyd R W, Lukishova S G and R S Y 2009 *Self-focusing: Past and Present. Fundamentals and Prospects* (Berlin: Springeräuser)
[2] Couairon A and Mysyrowicz A 2007 *Physics Reports* **441** 47–189
[3] Kompanets V O, Shipilo D E, Nikolaeva I A, Panov N A, Kosareva O G and Chekalin S 2020 *JETP LETT* **111** 31–35
[4] Li S, Yu M, Cai X, Zhang H, Jin M and Wu J 2023 *Optoelectron. Lett.* **19**(10) 605–613
[5] Geints Y E 2024 *Optics Communications* **573** 131007–1–131007–8