

## Recent progresses of laser plasma based electron acceleration and radiation at Shanghai Jiao Tong university

Min Chen<sup>1,2</sup>, Xinzhe Zhu<sup>1,2</sup>, Boyuan Li<sup>1,2</sup>, Feng Liu<sup>1,2</sup>, Jianlong Li<sup>1,2</sup>, Zewu Bi<sup>1,2</sup>, Xulei Ge<sup>1,2</sup>, Lin Lu<sup>1,2</sup>, Wenchao Yan<sup>1,2</sup>, Xiaohui Yuan<sup>1,2</sup>, Liming Chen<sup>1,2</sup>, Zhengming Sheng<sup>1,2</sup>, and Jie Zhang<sup>1,2</sup>

<sup>1</sup> Key Laboratory for Laser Plasmas (Ministry of Education), School of Physics and Astronomy, Shanghai Jiao Tong University, <sup>2</sup> Collaborative Innovation Center of IFSA (CICIFSA), Shanghai Jiao Tong University

e-mail (Min Chen): minchen@sjtu.edu.cn

Laser plasma based electron acceleration and radiation have many applications. Aiming to the high energy electron acceleration and intense harmonics generation, we have performed both theoretical and experimental studies.

For the high energy acceleration, a curved plasma channel has been proposed to guide intense lasers for multistage laser wakefield acceleration [1]. We then use the femtosecond laser fabrication to construct such a curved plasma channel with low surface roughness and high circularity. These channels are used for later staging experiments [2,3]. We successfully made a discharged curved capillary and the plasma distribution and evolution are measured [4]. The dependence of plasma properties on discharging parameters were carefully studied. In the experiment with relativistic laser pulse, we found that when the channel curvature radius is gradually increased and the laser incidence offset is optimized, the stable laser guiding is possible and wakefields can be excited in the curved channel. Electrons with maximum energy of 0.7GeV have been observed [5]. Our results show that such a channel exhibits good potential for seamless multi-stage laser wakefield acceleration.

For high harmonics generation in laser solid interaction, we proposed multi laser beam controlled harmonics generation [6]. In this scheme, different orders of harmonics emit at different angles, which makes single color radiation possible.

A 200+300TW two-laser system platform have been installed in SJTU. The research plans, such as staged

wakefield acceleration, Thomson scattering and plasma optics studies on this platform, will be introduced.

### References

- [1] J. Luo, M. Chen, W.Y. Wu, S.M. Weng, Z.M. Sheng+, C.B. Schroeder, D.A. Jaroszynski, E. Esarey, W.P. Leemans, W.B. Mori, and J. Zhang, *Phys. Rev. Lett.*, 120,154801 (2018)
- [2] Hongyang Deng, Ziyang Zhang, Min Chen, Jianlong Li, Qiang Cao, and Xuejiao Hu, *Materials*, 16, 3278 (2023)
- [3] Ziyang Zhang, Qiang Cao, Hongyang Deng, Jianlong Li, Xinzhe Zhu, Boyuan Li, Feng Liu, Sheng Peng, Junjie Zou, Min Chen, *Optics & Laser Technology*, 177, 111206 (2024)
- [4] Jian-Long Li, Bo-Yuan Li, Xin-Zhe Zhu, Ze-Wu Bi, Xin-Hui Wen, Lin Lu, Xiao-Hui Yuan, Feng Liu, and Min Chen, "Generation of a curved plasma channel from a discharged capillary for intense laser guiding", *High Power Laser Sci. Eng.*, 11, e58 (2023)
- [5] Xinzhe Zhu, Boyuan Li, Feng Liu, Jianlong Li, Zewu Bi, Xulei Ge, Hongyang Deng, Ziyang Zhang, Peilin Cui, Lin Lu, Wenchao Yan, Xiaohui Yuan, Liming Chen, Qiang Cao, Zhenyu Liu, Zhengming Sheng, Min Chen, and Jie Zhang, "Experimental Demonstration of Laser Guiding and Wakefield Acceleration in a Curved Plasma Channel", *Phys. Rev. Lett.*, 130, 215001 (2023)
- [6] Yili Xia, Boyuan Li, Min Chen, Feng Liu, Xiaohui Yuan, Zhengming Sheng, and Jie Zhang, *Phys. Plasmas*, 30, 123108, (2023)