AAPPS-DPP 2018 Plenary speaker Name: Prof. Chao Chang

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Rationale: Prof. Chang received Bachelor and Ph.D. from Tsinghua University, and Postdoctorial from Stanford University. He is full Professor of Xian Jiaotong University, and adjunct Professor of Tianjing University. As the 1st and correspondence author, he has published more than 42 peer-reviewd papers, including 2 PRL,7 APL, and authorized 20 invention patents of China.

[1] C. Chang; G. Z. Liu; C. X. Tang, et al. POP, 18, 055702, 2011. (Invited Paper). [2] C. Chang, M. Zhu, J. Verboncoeur, et al. APL, 104,253504, 2014. [3] C. Chang , J. Verboncoeur, M. N. Guo, et al. PRE, 90,063107,2014. [4] C. Chang, G. Liu, C. Tang, et al., APL 96, 111502, 2010. [5] C. Chang, J. Fang, Z. Zhang, et al., APL, 97, 141501, 2010. [6] C. Chang, Y. S. Liu, X. P. Ouyang, et al. APEx, 7, 097301, 2014. [7] C. Jing, C. Chang, S. Gold, et al. APL, 103 (213503), 2013. [8] C. Chang, Y. Liu, J. Verboncoeur, et al. APL, 106, 014102, 2015. [9] Z. Fan, C. Chang, J. Sun et al., APL 111, 123503, 2017. [10] C. Chang, C. Tang, J. Wu, PRL, 110, 064802, 2013. [11] C. Chang, J. Y. Liang, D. W. Hei, et al. OpEx, 21, 32013, 2013. [12] C. Chang, M. Shumail, S. Tantawi, et al., APL,101, 161102, 2012. [13] S. Tantawi, M. Shumail, J. Neilson, G. Bowden, C. Chang, PRL, 112, 164802, 2014.

Talk Title: Nanosecond Intense Microwave Plasma and Electromagnetic Undulator for FEL

Short abstract: The nanosecond microwave-driven breakdowns at window and in microwave devices limit the maximum power capacity of microwave system, becoming the bottle neck of the technology development and international technical challenges. To understand the breakdown mechanism at window, we establish several multipactor dynamic models, especially involving electron-neutral collision and ionization in the desorbed gas layer, analytically obtaining the influence of desorption gas on multipactor saturation, and space charge field and potential distribution above dielectric surface formed by multipactor and plasma [1]. By diagnosing the time- and space-evolution optical emissions, we revealed the mechanisms of nano-second microwave-driven discharges near the dielectric/vacuum and dielectric/air interface [2]. For breakdown at the dielectric/vacuum interface, multipactor and plasma developing in a thin layer of several millimeters above interface, revealing intense ionization concentrated in a desorbed high-pressure layer. For breakdown at the dielectric/air interface, nonlinear positive feedback of formation of a space-charge microwave sheath near the dielectric surface, accelerated by the normal components of the microwave field, significantly enhances the local-field amplitude and hence ionization near the dielectric surface in APL [3]. We theoretically propose and experimental demonstrate the mechanism and methods of using magnetic field satisfying specific amplitude and direction perpendicular to Erf x Edc to suppress microwave multipactor in APL [4-5]. The methods of the external resonant magnetic field have been demonstrated by proof-of principle S-band large power experiments to significantly improve the power capacity by 9 times in APL [5]. The Halbach-like magnets to generate the transverse homogeneous B-field in a large scale was designed to suppress multipactor [6], and the window breakdown threshold was significantly enhanced at multi-Giga-watt. The single-surface resonant multipactor problem reported in DLA [J. G. Power et al., Phys. Rev. Lett. 92, 164801 (2004)] results in serious power absorption. We presented the mechanism of using external magnetic field satisfying special amplitudes and direction to suppress the resonant multipactor. The method of improving the power capacity of DLA is experimentally demonstrated in APL [7].

We theoretically proposed and experimentally demonstrated the methods of periodic surface profiles on suppressing microwave multipactor [1,8,9]. The three-dimensional periodic ripple profile with each unit of rotational symmetric surface is proposed and theoretically and experimentally demonstrated to suppress multipactor for arbitrary electromagnetic mode with any polarization in APL [8]. Free-electron lasers (FELs) are the most powerful X-ray radiation sources to support many frontier researches; however, the large-scale magnetic undulator limits only a few sources existed worldwide. We proposed a novel type of table-top high-gain optical undulator, which may provide the potential to significantly reduce the size and cost of X-ray sources to university-laboratory scale. This high intensity x-ray source is realized first by the pulse front tilt of two lateral fed standing-wave lasers to extend the electron-laser synchronic interaction time by several orders, accomplishing the FEL exponential growth process and coherent emission with highly microbunched electron beam, in PRL and OpEx. [10-11]. Compared to conventional magnetic undulator, RF undulator with the outstanding advanced character of the flexible polarization and short undulating-period can be an insertion device in the future FEL light source. We studied the electron dynamics for a circular polarized standing wave (CPSW) undulator synthesized from a corrugated cavity operating with a very low-loss HE11 mode, found the mechanism of the transverse drift of the CPSW undulator, and use the tapered field ends to effectively suppress the kick, published in APL [12]. A prototype of the CPSW undulator with the characters of short undulating-period 1.4 cm, high field K~1, large aperture ~5 cm, was designed, modeled, and demonstrated by the proof-of-principle experiments to realize the coherent radiation in PRL [13].