

Mikhail Fedurin

Experiments in period of 2012-2014 presented on PIs behalf

Finished experiments in 2012-2014 presented on behalf of PIs

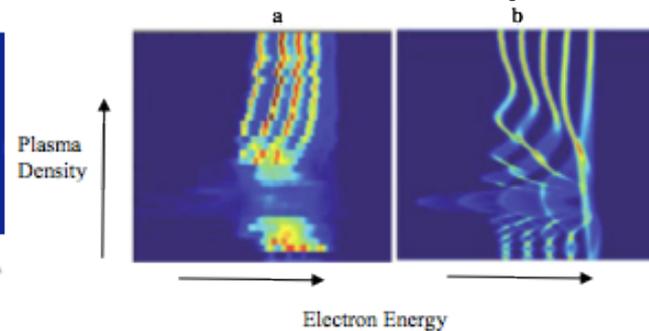
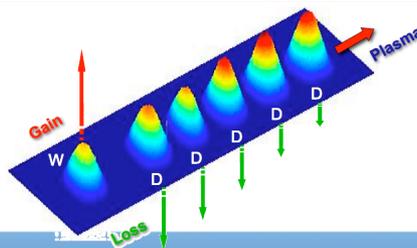
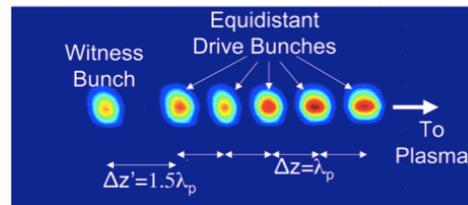
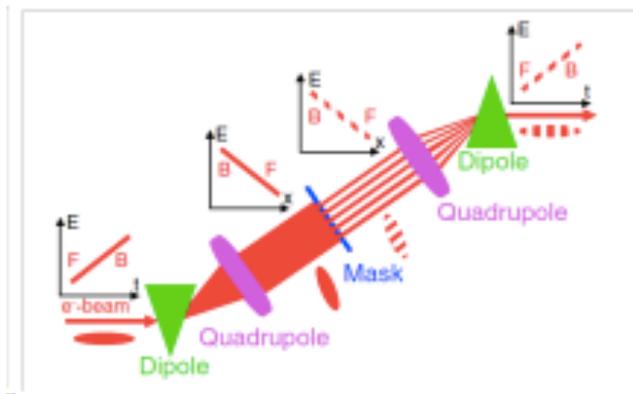
- AE31 – *“Multi-bunch PWFA”* by Patric Muggli (2006-2014), 16 papers, 2 thesis works
- AE48 – *“Current noise suppression”* by Avi Gover (2011-2012), paper in Nature Physics, 1 thesis work
- AE49 – *“Measurement of coherent terahertz radiation using a real-time interferometer”* (withdrawn in 2013)

AE31 - Multi-bunch PWFA . Publications

- 2007
 - 1) **P. Muggli**, W. D. Kimura, E. Kallos, T. C. Katsouleas, K. P. Kusche, I. V. Pavlishin, D. Stolyarov, and V. E. Yakimenko "Plasma Wakefield Acceleration Experiments using Two Subpicosecond Electron Bunches" *PAC07 Conf.Proc.* 3073p
 - 2) **P. Muggli** , E. Kallos, V. E. Yakimenko, M. Babzien, K. P. Kusche, and W. D. Kimura, "Generation and Characterization of the Microbunched Beams with a Wire Mesh Mask" *PAC07 Conf.Proc.* 3079p
- 2008
 - 3) **Efthymios Kallos**, Tom Katsouleas, Wayne D. Kimura, Karl Kusche, Patric Muggli, Igor Pavlishin, Igor Pogorelsky, Daniil Stolyarov and Vitaly Yakimenko High-Gradient Plasma-Wakefield Acceleration with Two Subpicosecond Electron Bunches *Phys. Rev. Lett.* **100** 074802
 - 4) **Efthymios Kallos** , Patric Muggli, Thomas C. Katsouleas, Vitaly Yakimenko and Jangho Park "Simulations of a high-transformer-ratio plasma wakefield accelerator using multiple electron bunches" *AIP Conf.Proc.* 1086:580-585
 - 5) **E. Kallos** , T. C. Katsouleas, P. Muggli W. D. Kimura K. Kusche, J. H. Park, I. Pogorelsky, D. Stolyarov, V. Yakimenko "Experimental Results of a Plasma Wakefield Accelerator Using Multiple Electron Bunches" *EPAC08 Conf.Proc.* 1912p
 - 6) **P. Muggli**, E. Kallos M. Babzien, K. Kusche, V. Yakimenko "Generation of Electron Microbunches Trains with Adjustable Sub-picosecond Spacing for PWFA and FEL applications" *EPAC08 Conf.Proc.* 2830p
- 2011
 - 7) **Patric Muggli et al.** "Resonant Excitation of Plasma Wakefields in the Linear and Nonlinear Regime"(Talk)
 - 8) **P. Muggli et al.**, "Witness Bunch Acceleration in Multi-bunch PWFA"
 - 9) **Brian Allen et al.** "Progress in Experimental Study of Current Filamentation Instability"
- 2012
 - 10) B. Allen, V. Yakimenko, M. Babzien, M. Fedurin, K. Kusche, and P. Muggli "Experimental Study of Current Filamentation Instability ", *Phys. Rev. Lett.* 109, 185007
 - 11) B. Allen et al." Seeding of the current filamentation instability for an accelerator beam in a capillary plasma"
 - 12) P. Muggli et al."Three regimes of relativistic beam - plasma interaction"
 - 13) B. Allen et al. "Experimental Progress: Current Filamentation Instability Study"
 - 14) Y. Fang et al. "Numerical Study of Self Modulation Instability of ATF Electron Beam."
 - 15) P. Muggli et al. "Excitatuion of Plasma Wakefields with Designer Bunch Trains"
- 2014
 - 16) Y. Fang, V. E. Yakimenko, M. Babzien, M. Fedurin, K. P. Kusche, R. Malone, J. Vieira, W. B. Mori, and P. Muggli, "Seeding of Self-Modulation Instability of a Long Electron Bunch in a Plasma", *PhysRevLett.* 112.045001

AE31 - Multi-bunch PWFA. Facility improvements

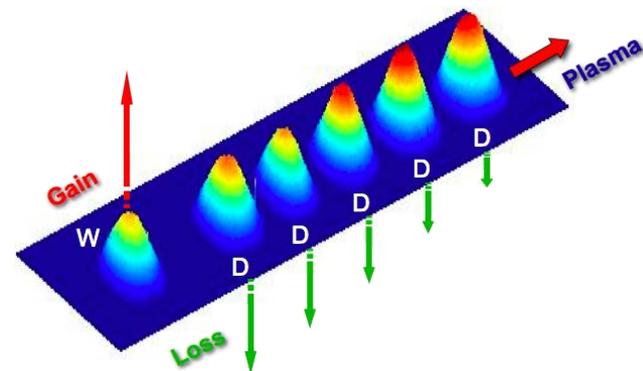
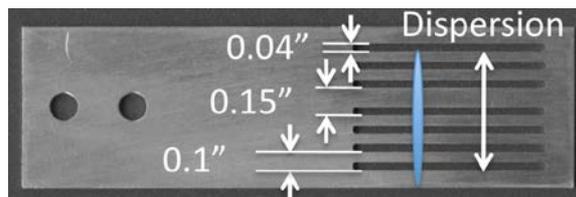
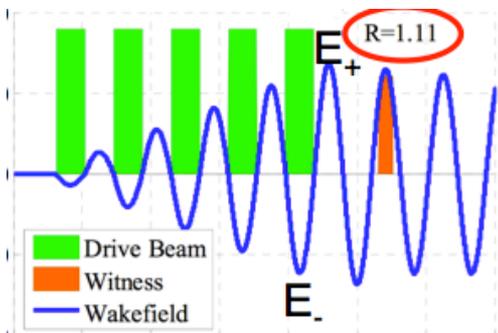
- Mask technique
- Capillary development and plasma density calibrations
- Driver-witness diagnostics (timing, spectroscopy, bunch length measurements)



AE31 - Multi-bunch PWFA . Students.

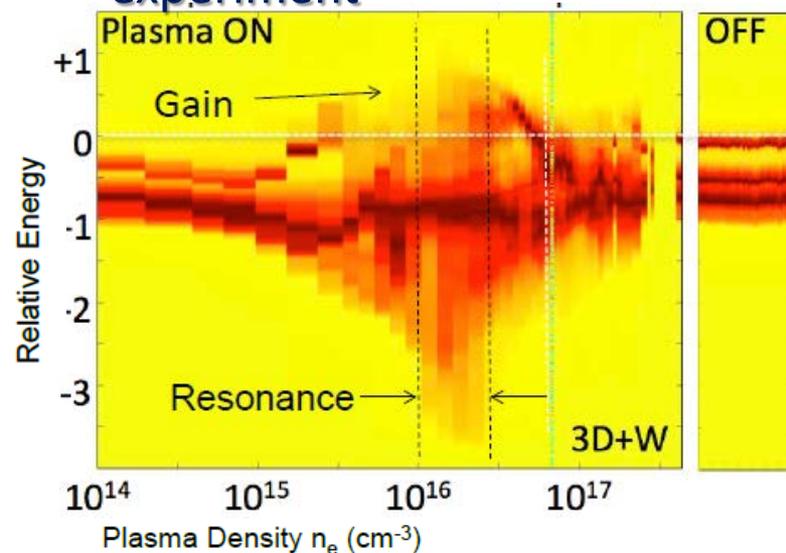
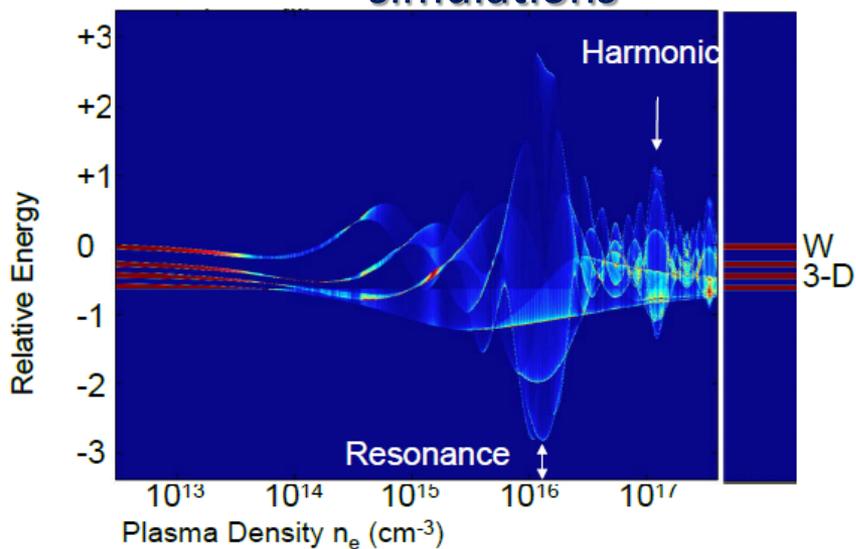
- **Efthymios Kallos**, 2008. Thesis title: *“Plasma Wakefield Accelerators using Multiple Electron Bunches”* (Adv. Tom Katsouleas), this work received IEEE student award
- **Brian Allen**, 2012. Thesis title: *“Experimental study of the current filamentation instability”* (Adv. Patric Muggli)
- **Yun Fung**, PhD student, last paper: *“Seeding of Self-Modulation Instability of a Long Electron Bunch in a Plasma”*, PhysRevLett.112.045001

AE31 - Multi-bunch PWFA. Science details



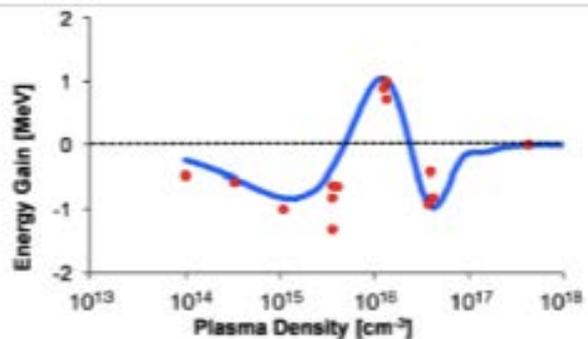
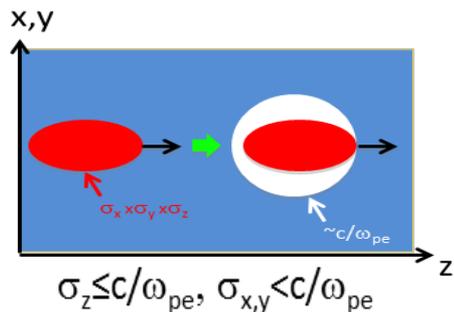
simulations

experiment



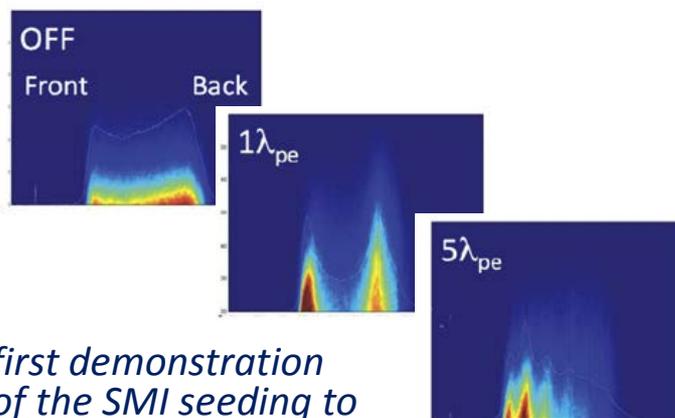
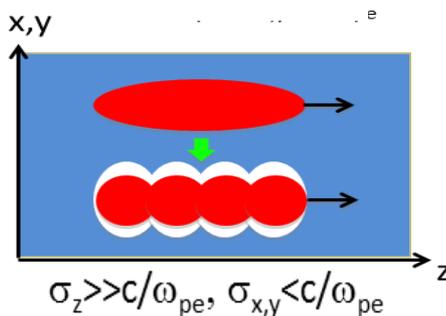
AE31 - Multi-bunch PWFA. Science details

PWFA



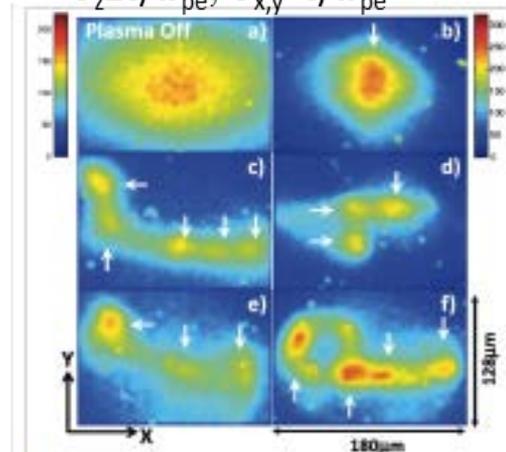
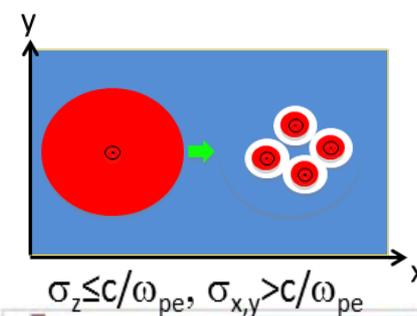
acceleration of a short electron bunch trailing a driver electron bunch in high-density plasma.

Self-Modulation



first demonstration of the SMI seeding to be used in experiments in the planning phase at FACET and CERN.

Filamentation



first demonstration of filamentation instability when transverse beam size is bigger than plasma wavelength

AE48 – Current noise suppression

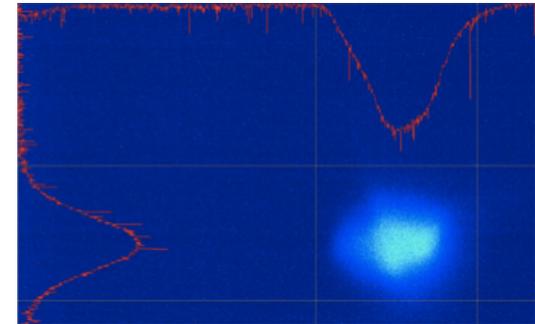
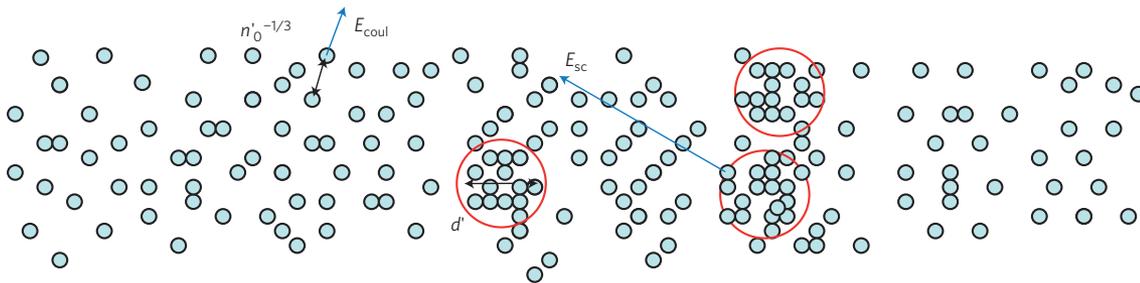
- Most time/results efficient experiment: 2 weeks of beam time in 2011, 1 week in 2012
- Results published in Nature Physics
- **Ariel Nause** thesis work at TAU in 2013, Title: *“Beating the Shot-Noise Limit: Collective Interaction Optical Noise Suppression in Charged Particle Beam”* (Adv. Avi Gover)
- Awards for best thesis work from BNL and APS



Beating the shot-noise limit

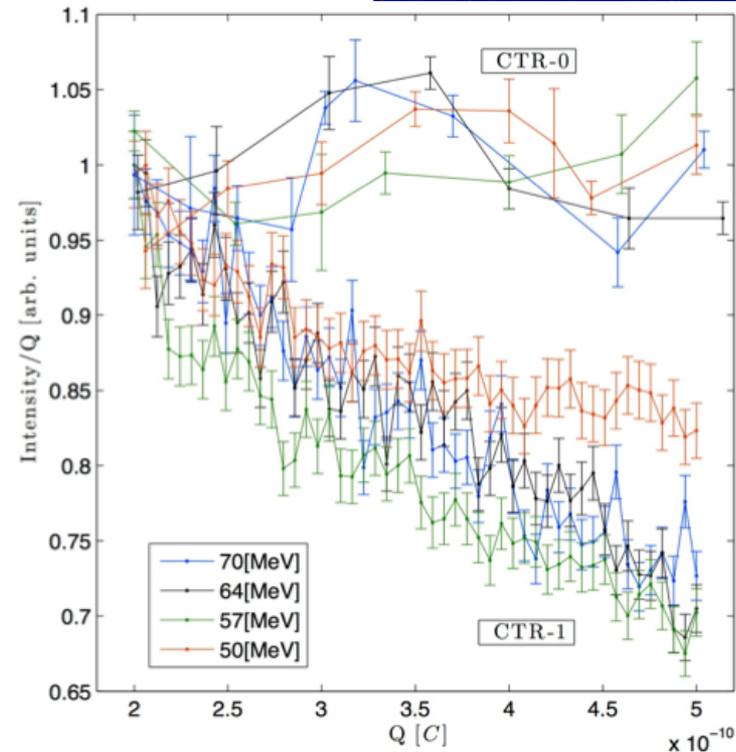
Avraham Gover^{1*}, Ariel Nause¹, Egor Dyunin¹ and Mikhail Fedurin²

AE48 – Current Noise suppression. Science details



$$\frac{\epsilon_{sc}}{\epsilon_{Coul}} = \left(\frac{2\pi}{3} \frac{d'}{n'_0{}^{-1/3}} \right)^{1/2} > 1$$

$$\omega'_{p0} = (e^2 n'_0 / m \epsilon_0)^{1/2}$$



AE49 - Measurement of coherent terahertz radiation using a real-time interferometer

- No beam request from users
- Experiment was withdrawn by users in 2013

