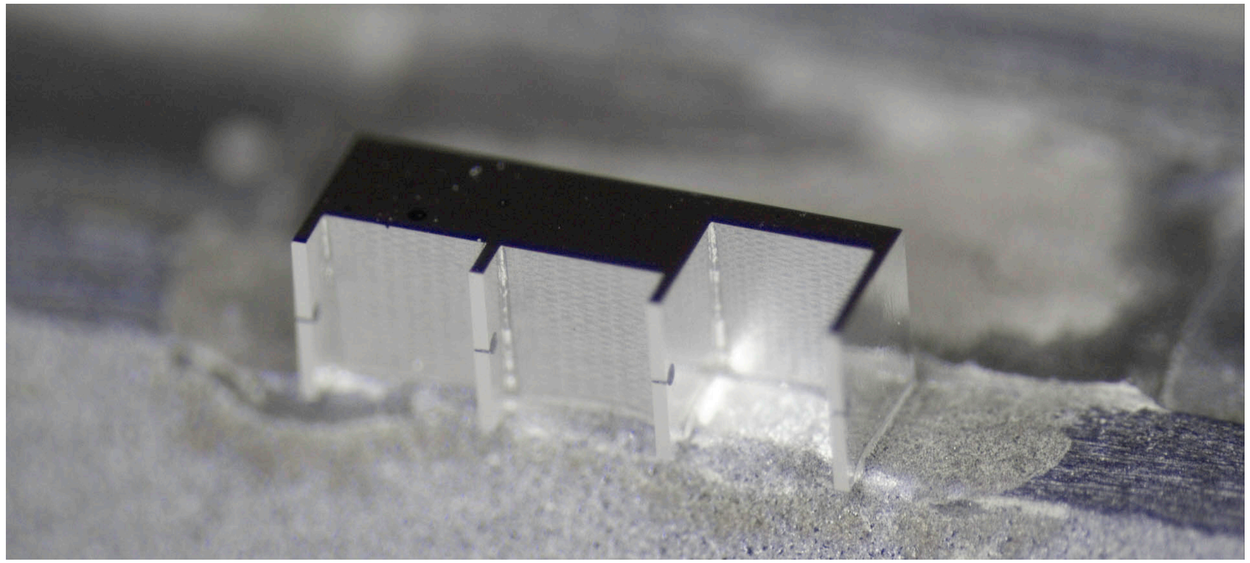
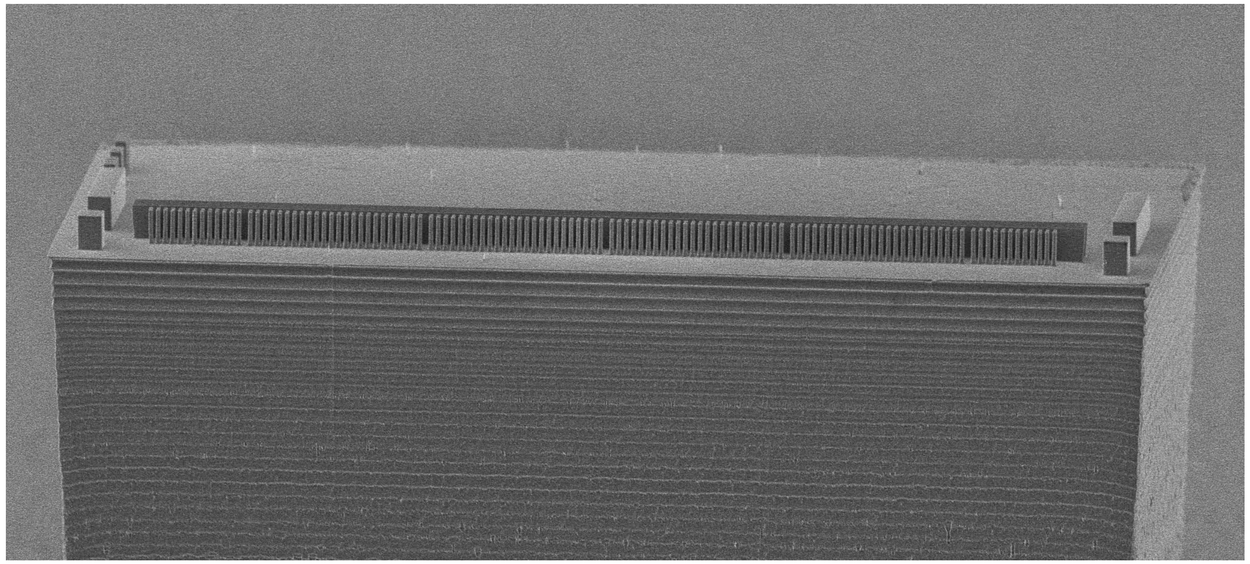
Rasmus Ischebeck

STRUCTURE-BASED NOVEL ACCELERATORS

FROM RADIO FREQUENCIES TO INFRARED LIGHT





LASER-BASED ACCELERATORS 61 YEARS AGO

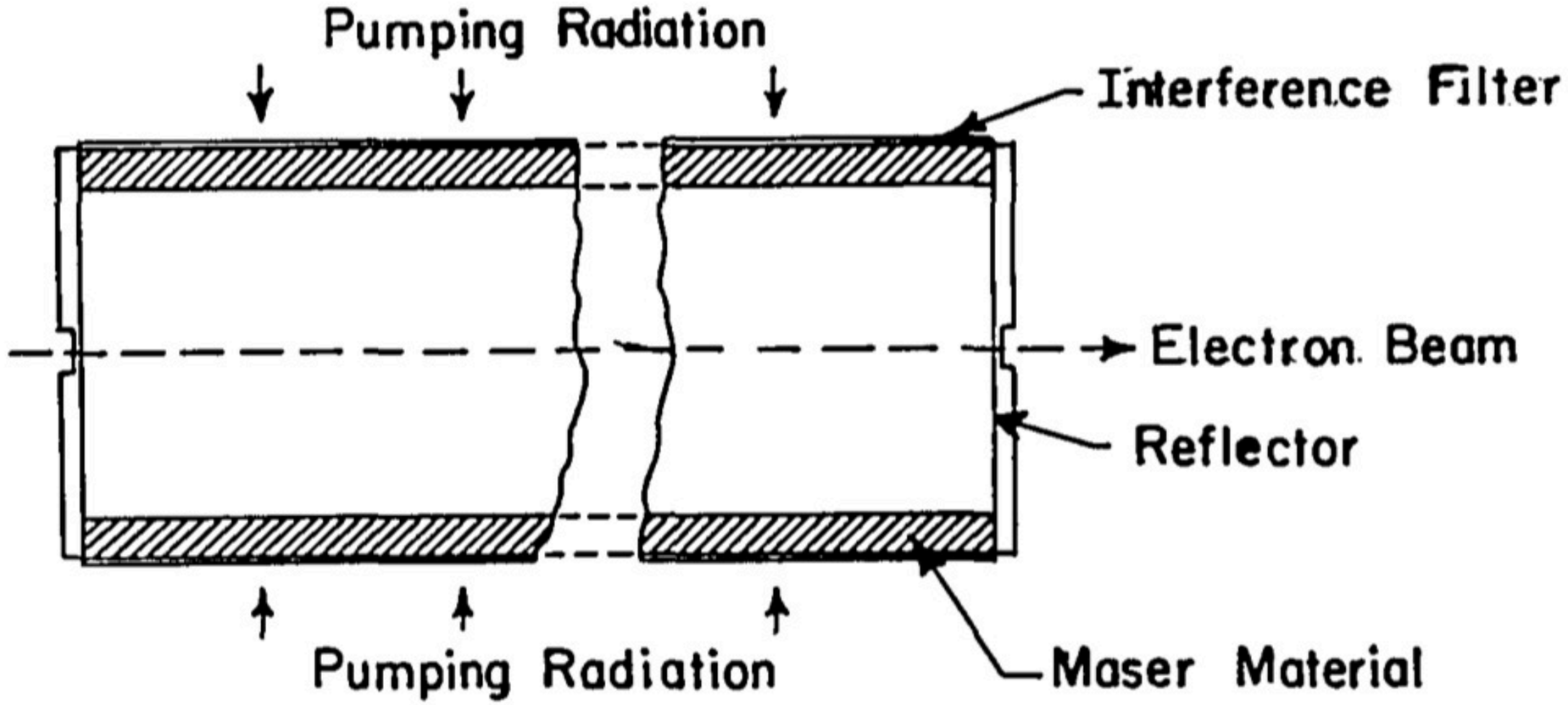
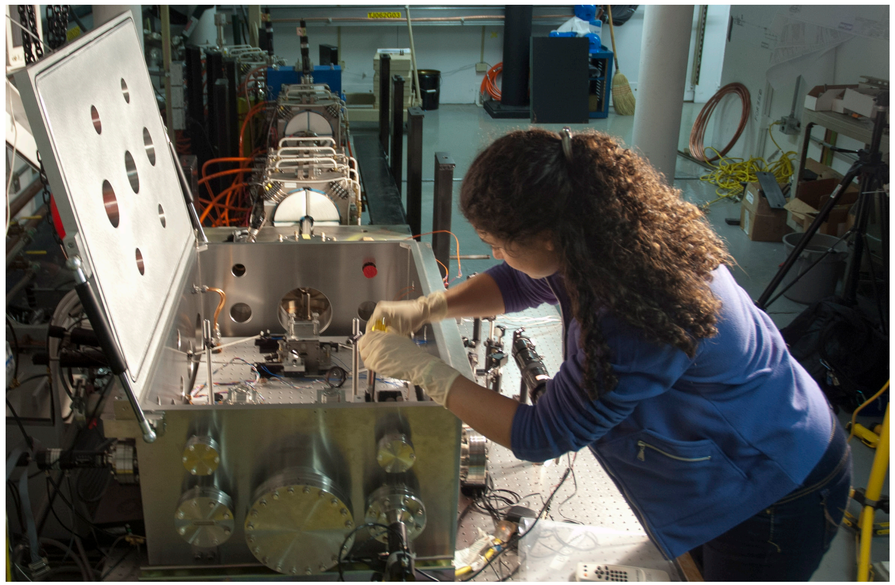
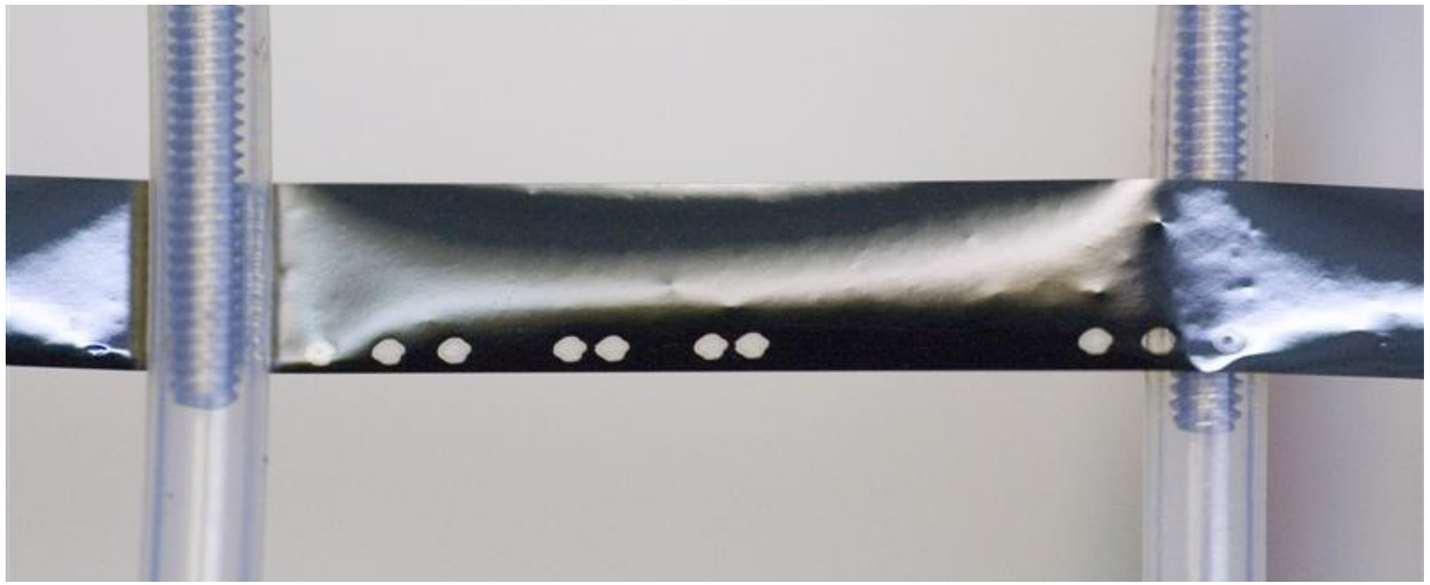


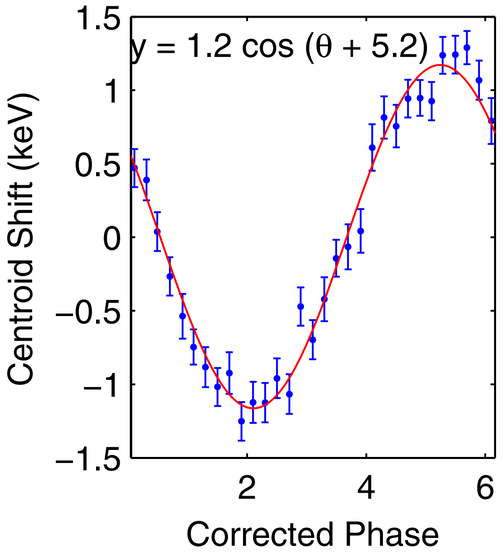
Fig. 1. Schematic diagram of an electron linear accelerator by optical maser.

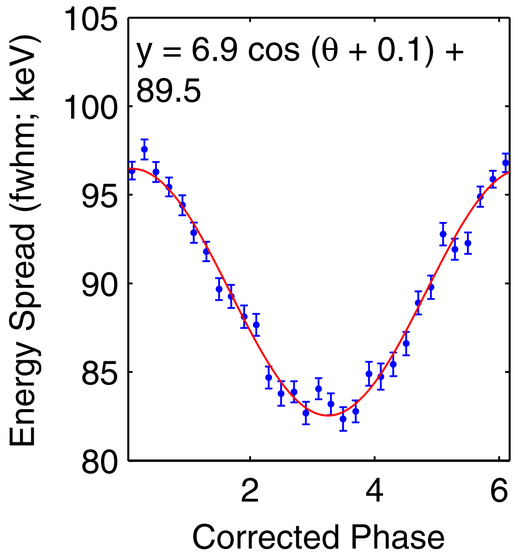
Shimoda, Appl. Opt. **1 (1)**, 33 (1961)

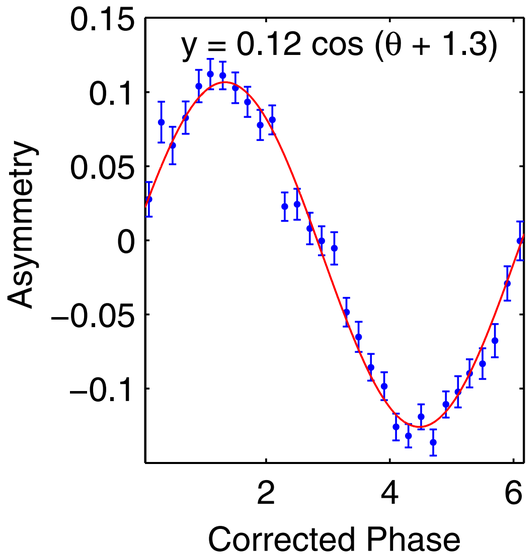
DIELECTRIC LASER ACCELERATION 14 YEARS AGO





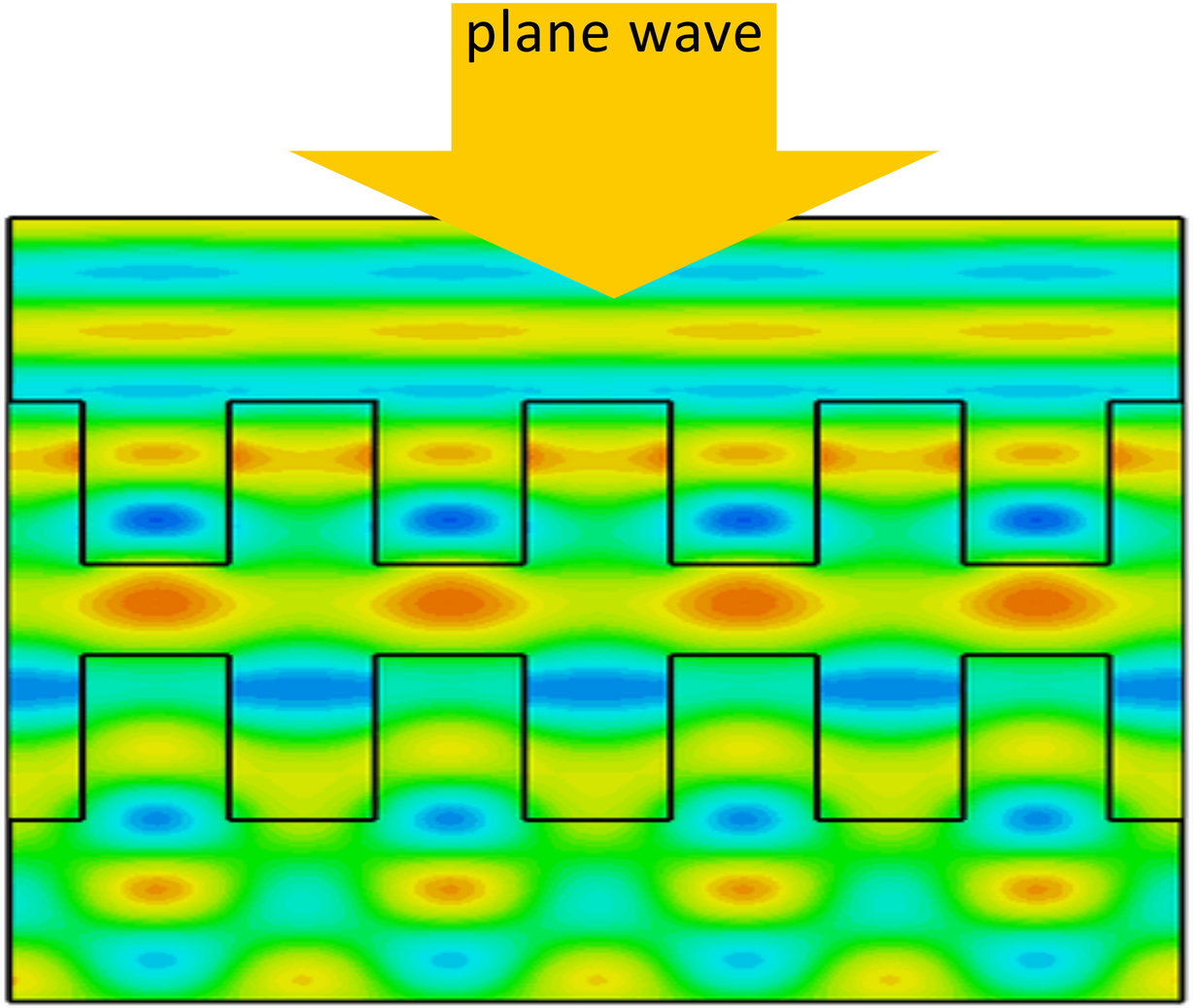




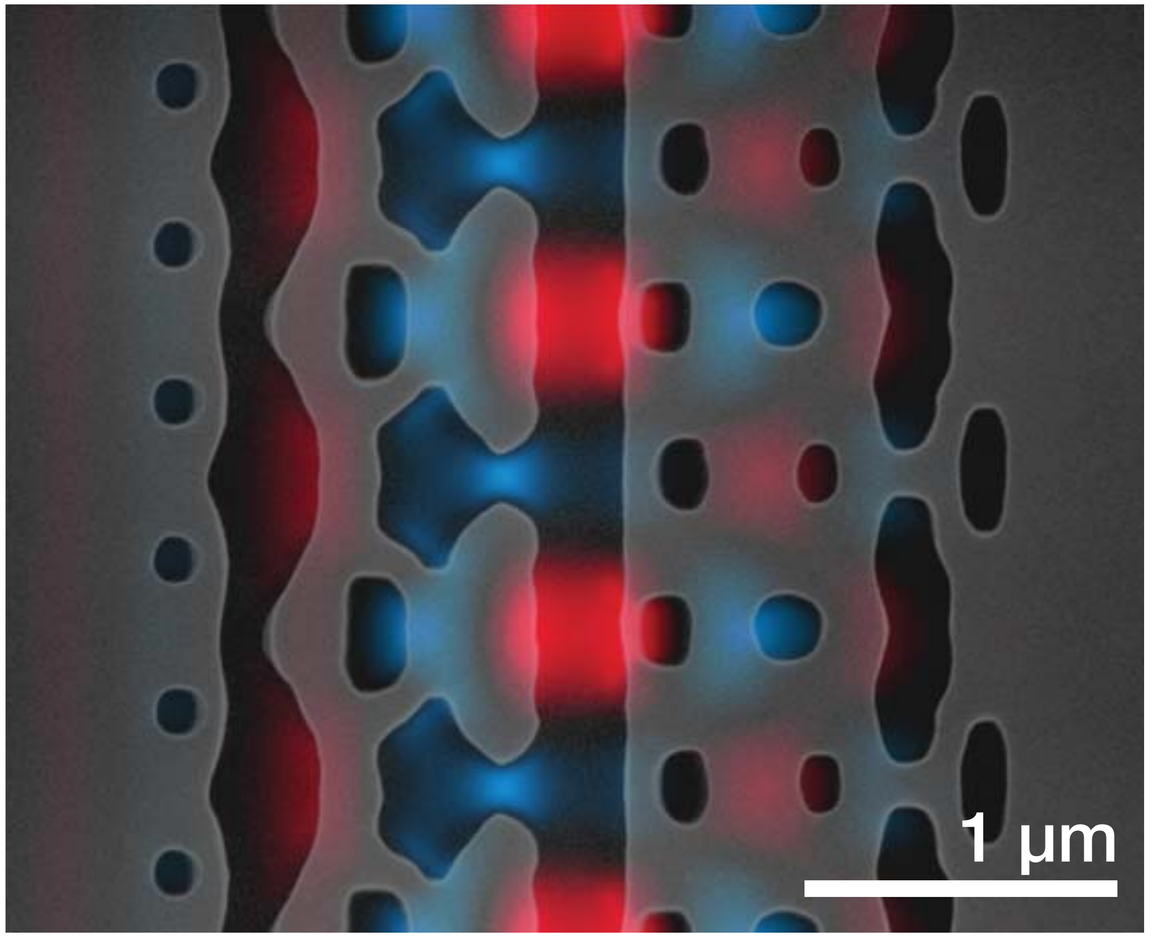


Sears et al., PRST-AB **11**, 101301 (2008)

MODELING OF THE ACCELERATING FIELDS

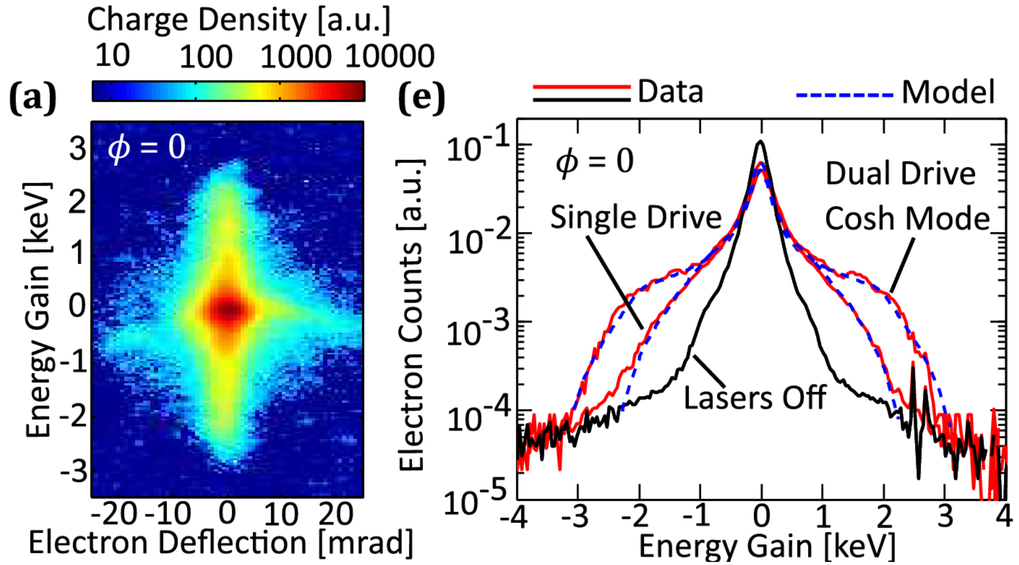


Yelong Wei

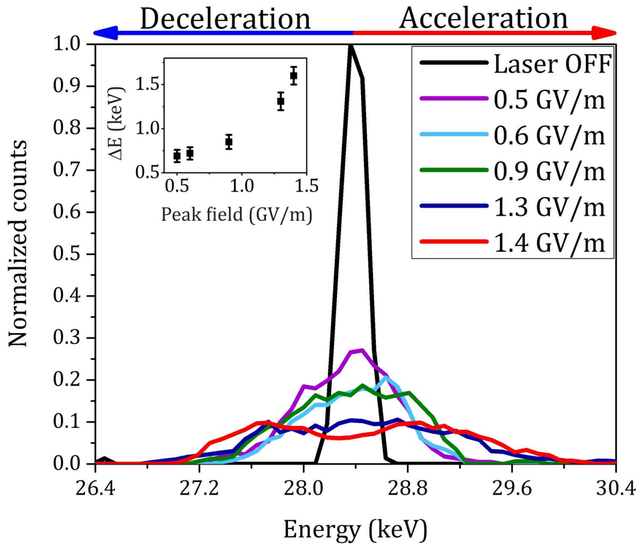


Sapra et al., Science 367, 79–83 (2020)

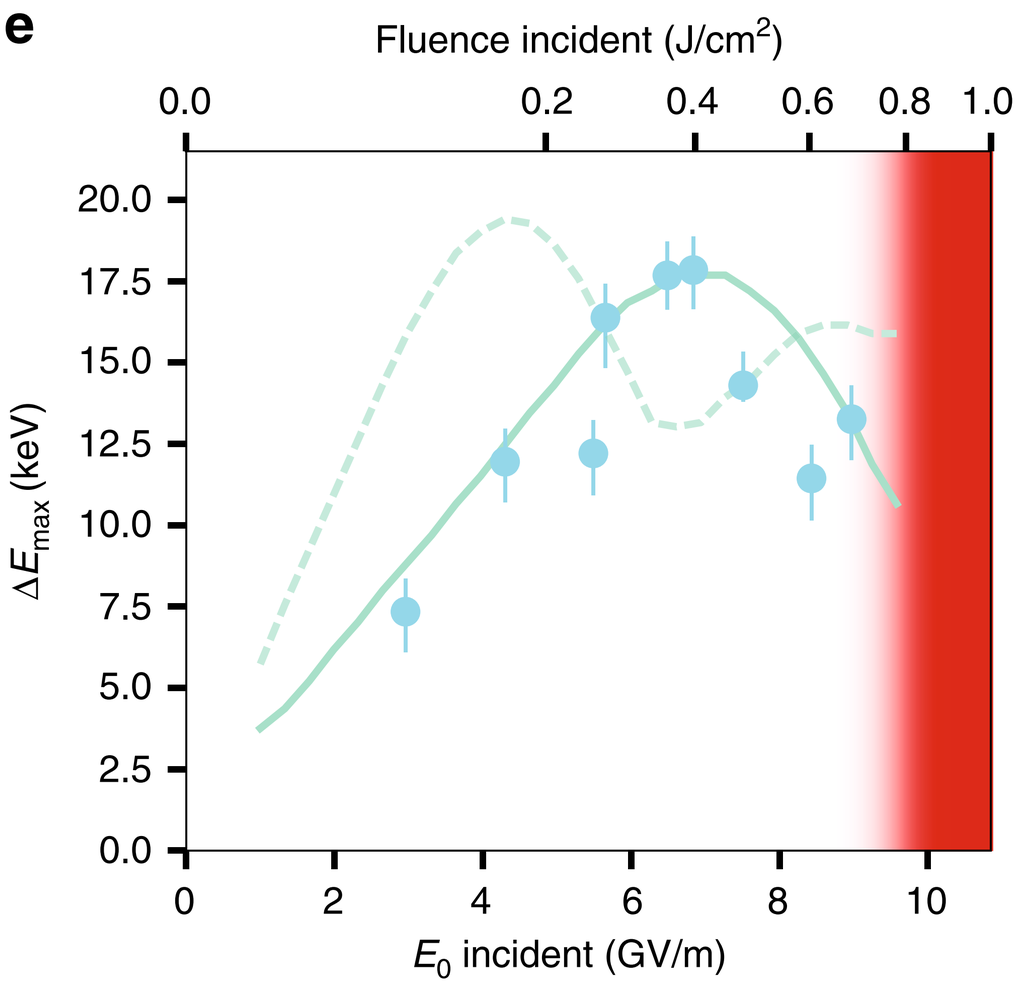
EXPERIMENTAL WORK



Leedle et al., Optics Letters 43, 9, 2181(2018)

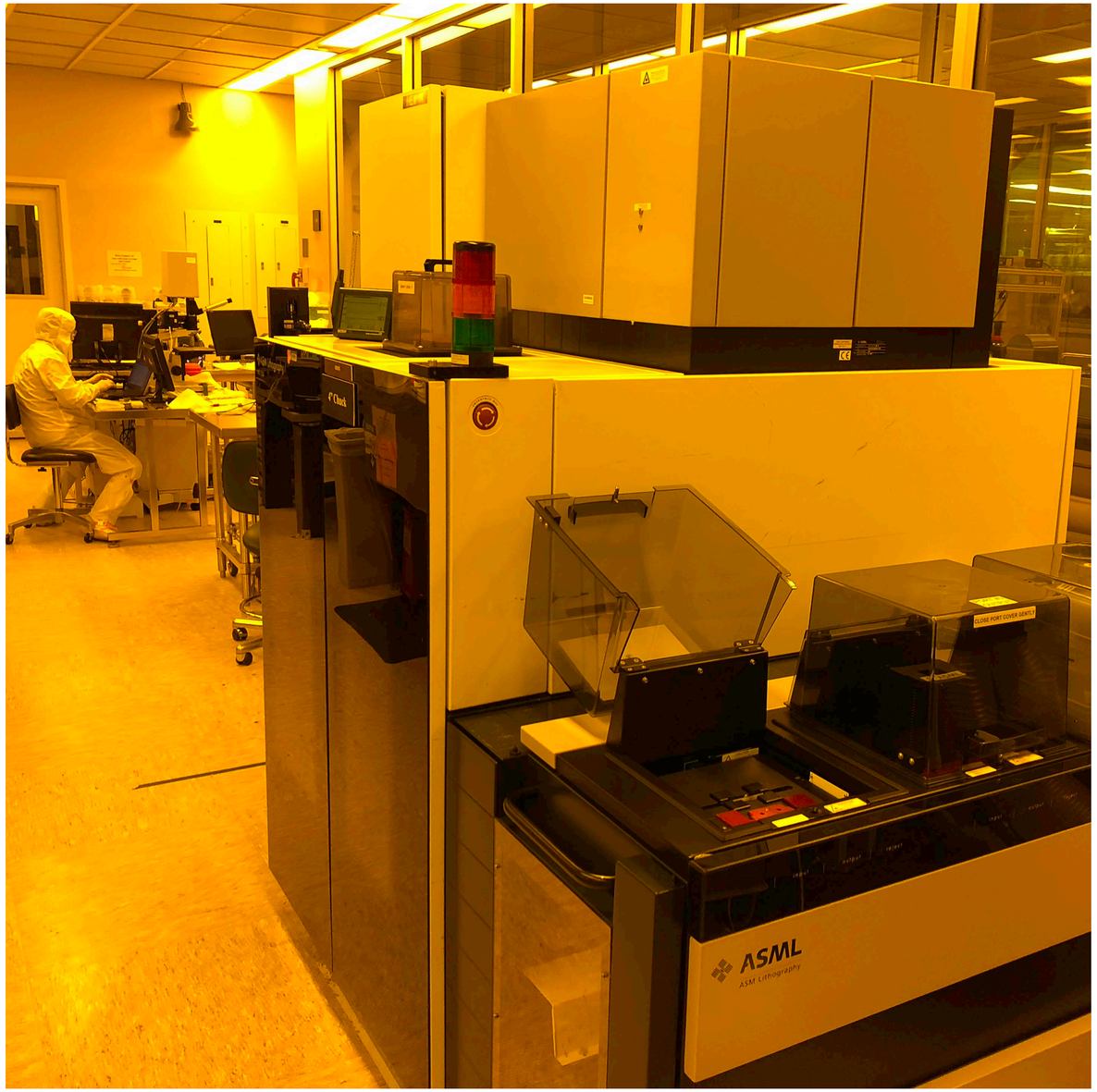


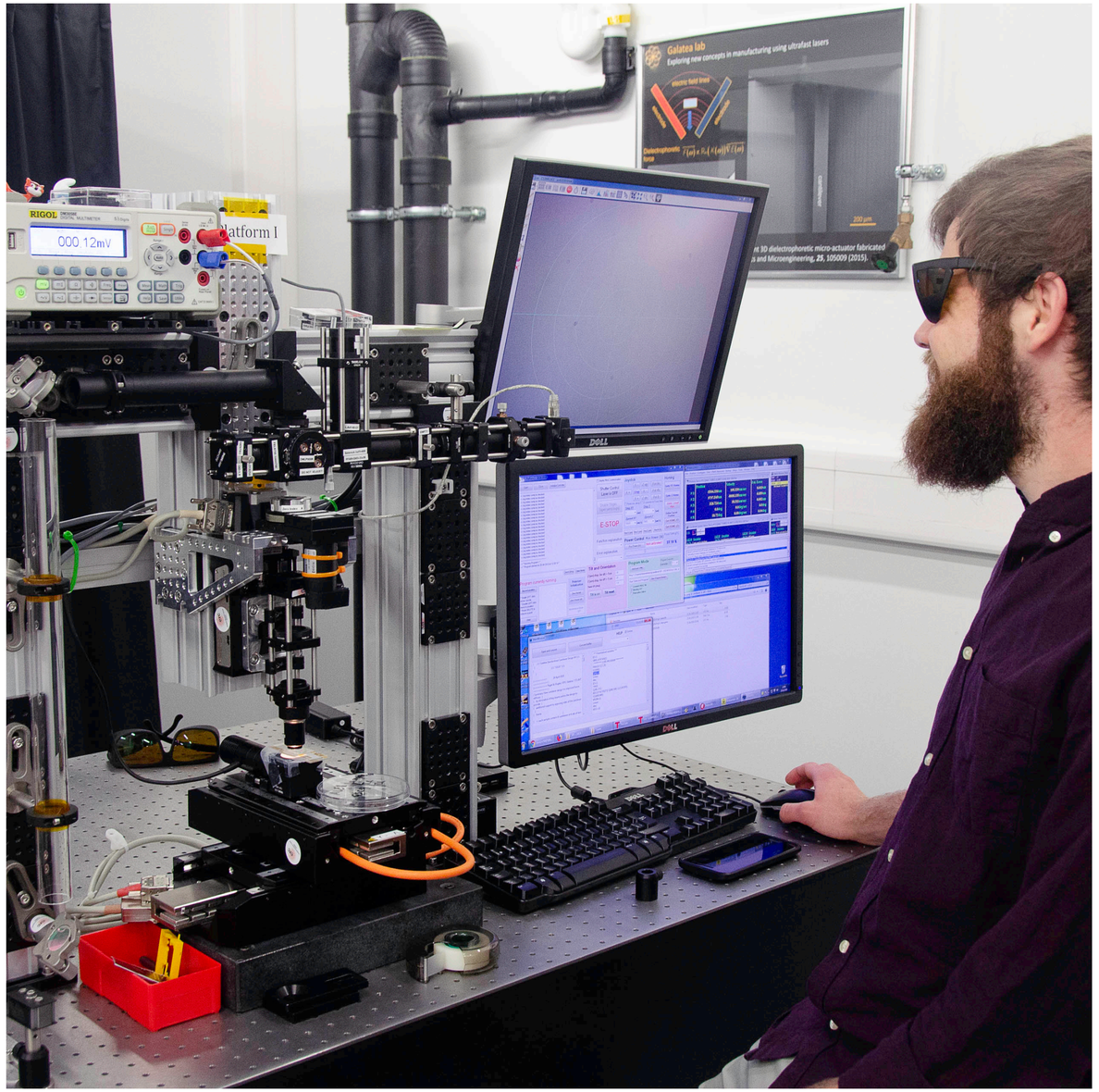
Yousefi et al., Optics Letters 44, 6, 1520-1523 (2019)



Cesar et al., Communications Physics 1, 46 (2018)

MANUFACTURING OF ACCELERATING STRUCTURES





BEYOND ACCELERATION OF SINGLE PARTICLES

- Particle sources
- Bunching and net acceleration
- Staging of dielectric structures
- Focusing and beam containment
- Instrumentation
- Direct measurement of accelerating fields

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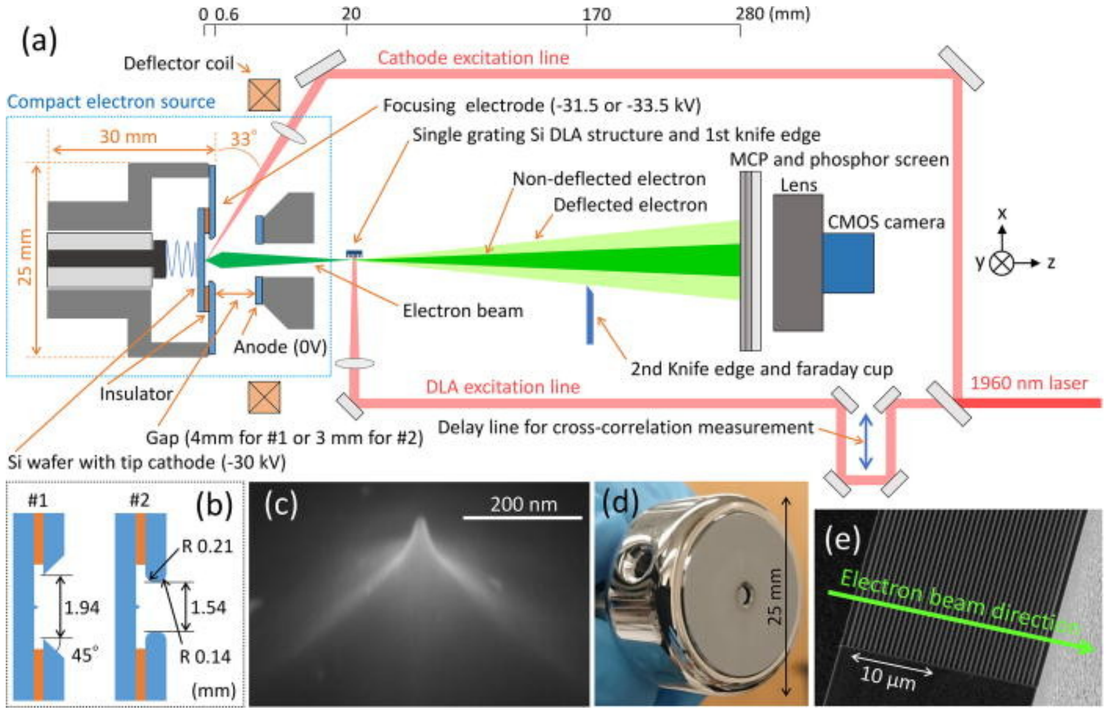

Hirano et al., Appl. Phys. Lett. 116, 161106 (2020)

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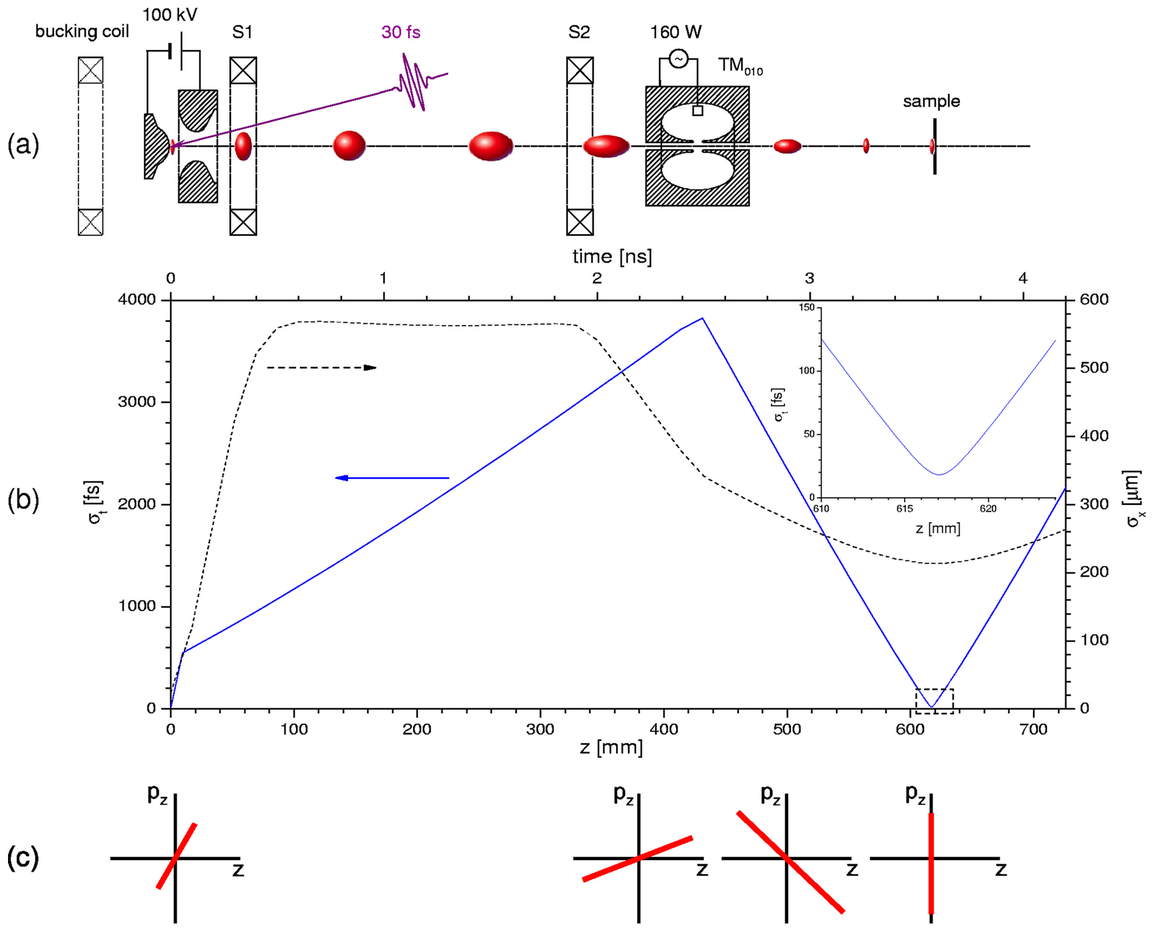

Oudheusden et al., Journal of Applied Physics 102, 093501 (2007)

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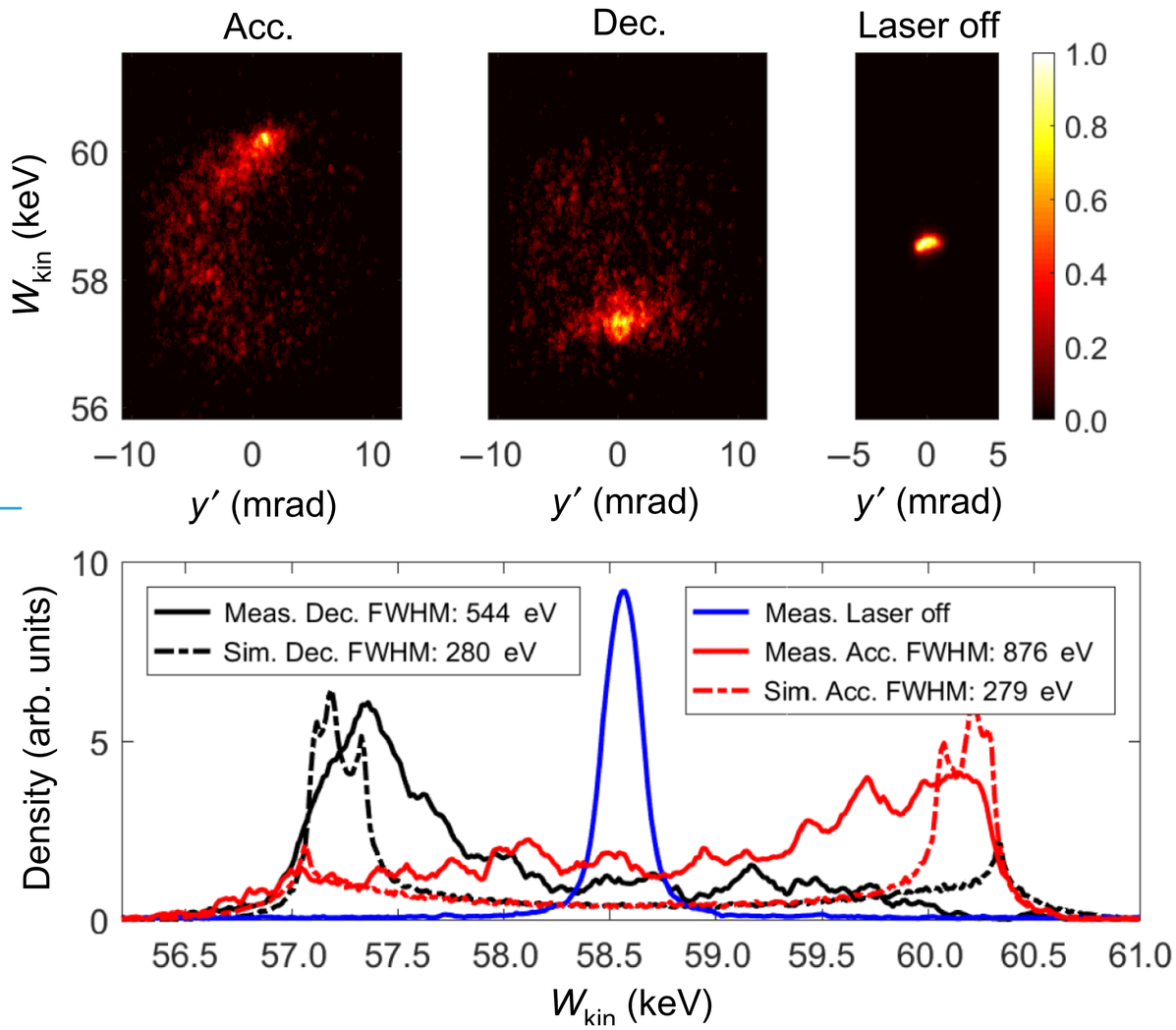

Niedermayer et al., Phys. Rev. Applied 15, L021002 (2021)

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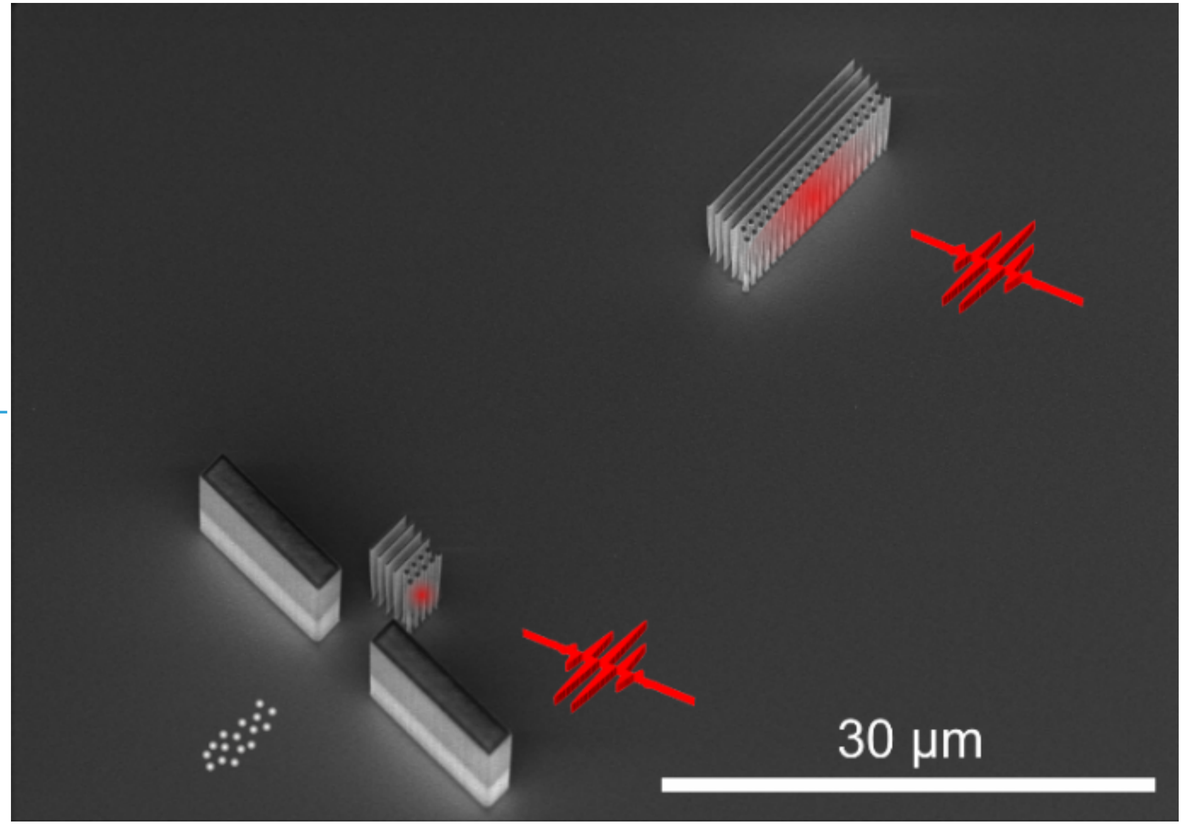

McNeur et al. arXiv:1604.07684
Niedermayer J. Phys. A Conf. Ser. 874 012041

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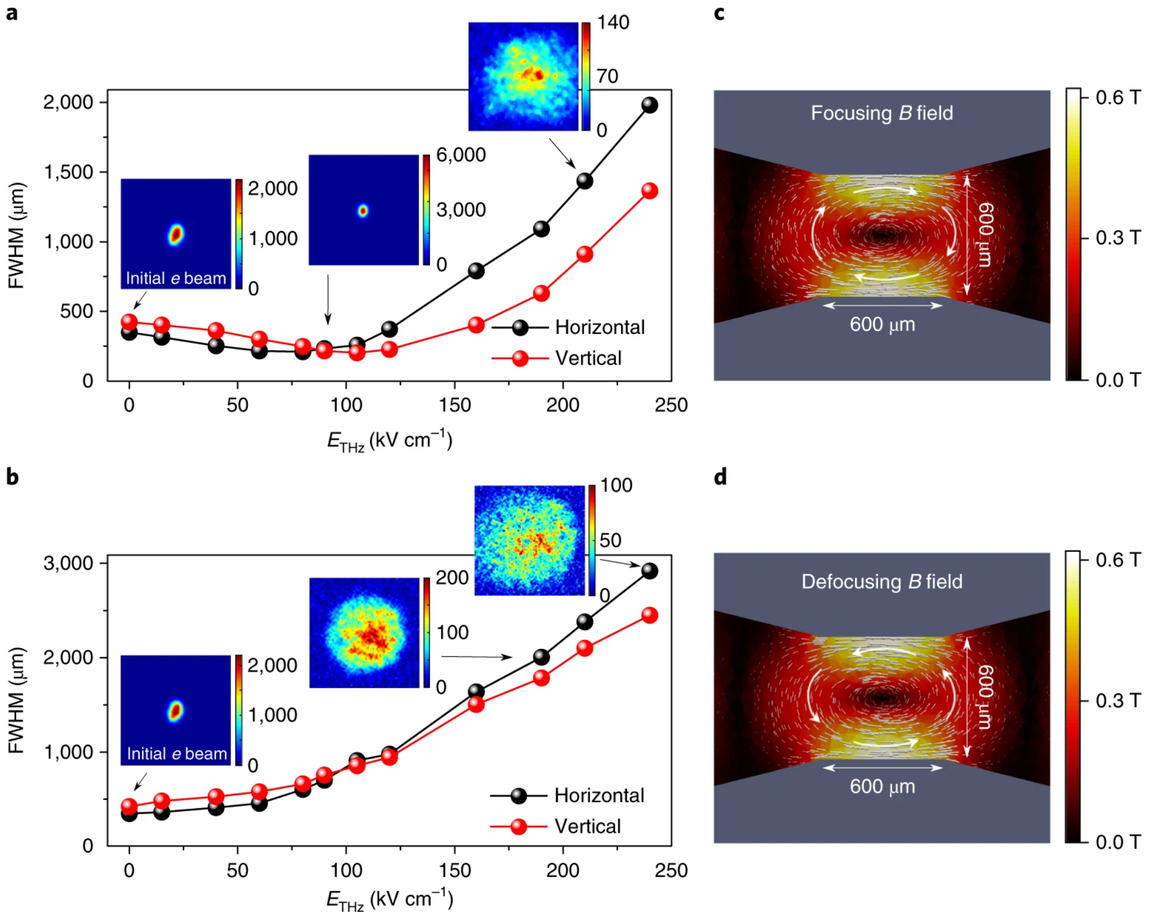

Zhang et al., Nature Photonics 12, 336 (2018)

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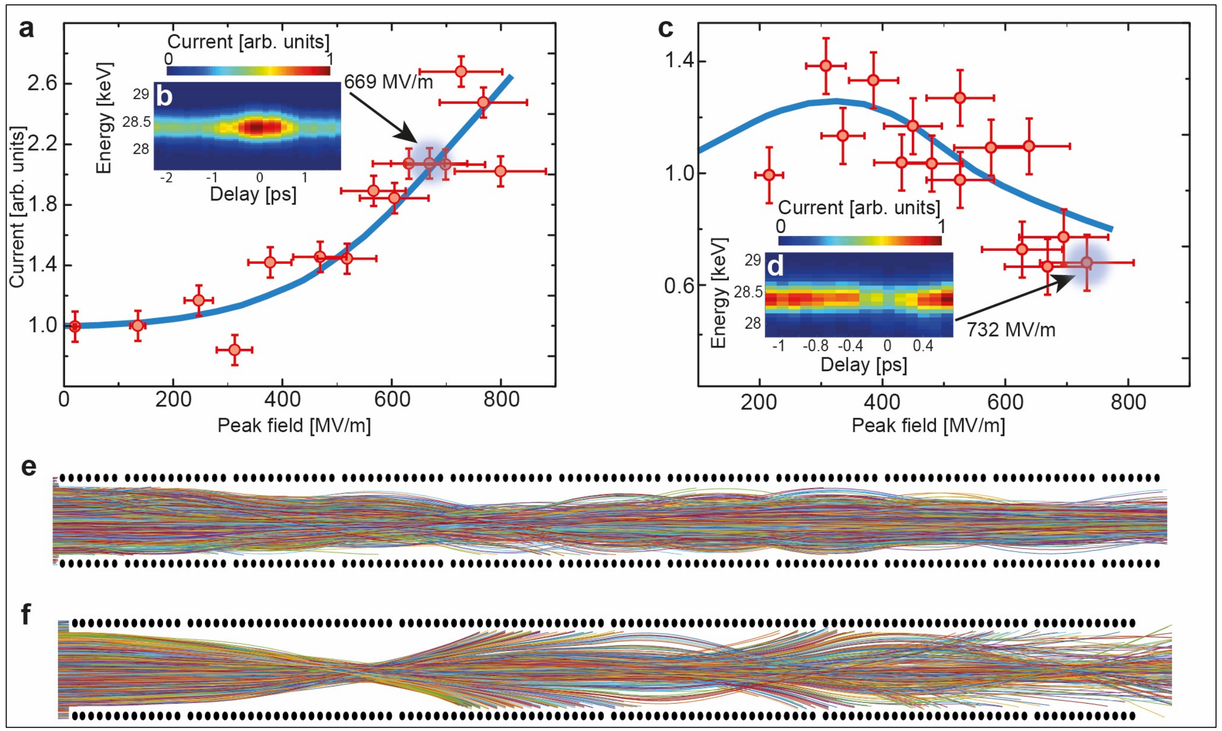

Niedermayer et al., Phys. Rev. Lett. 125, 164801 (2020)

Shiloh et al., Nature 597, 498–502 (2021)

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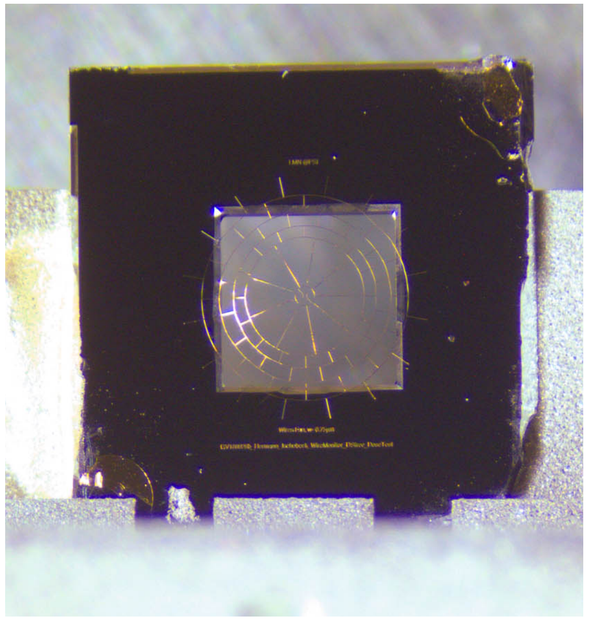

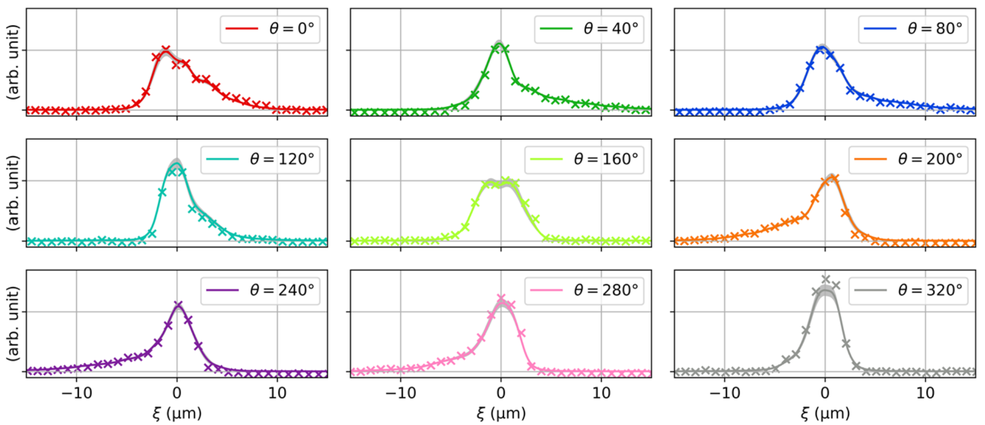

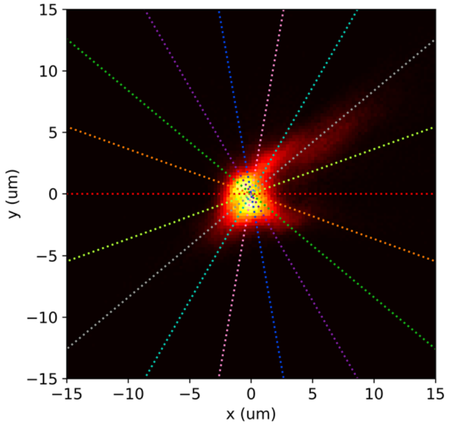

Hermann et al., Phys. Rev. Accel. Beams 24, 022802 (2021)

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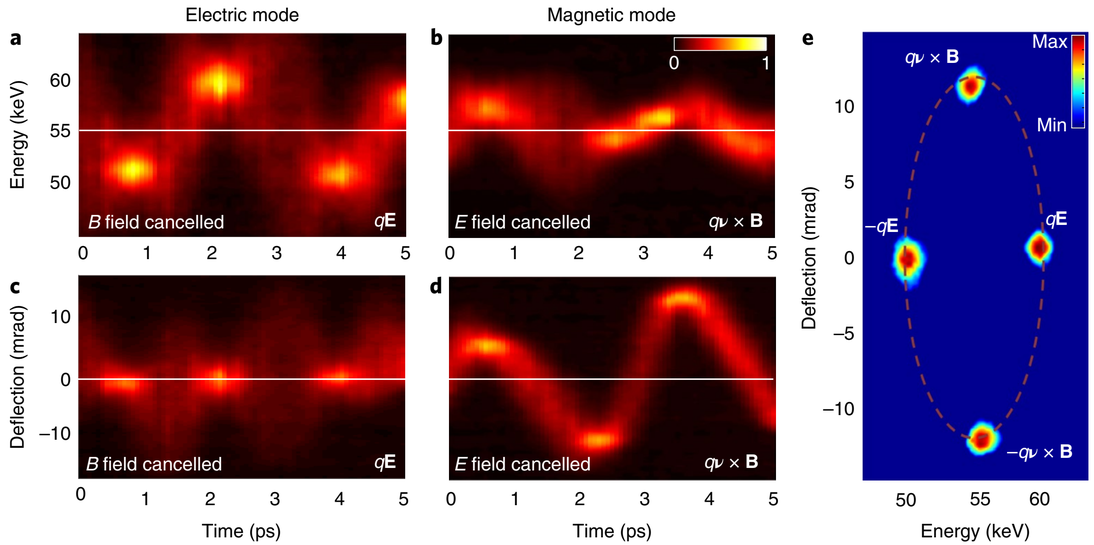

Zhang et al., Nature Photonics 12, 336–342 (2018)

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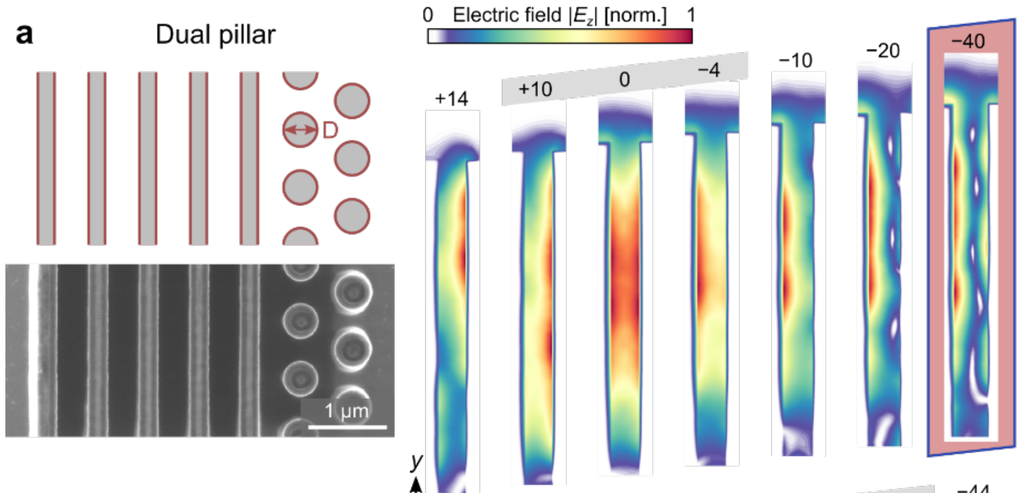

POSSIBLE APPLICATIONS

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- Electron diffraction and imaging
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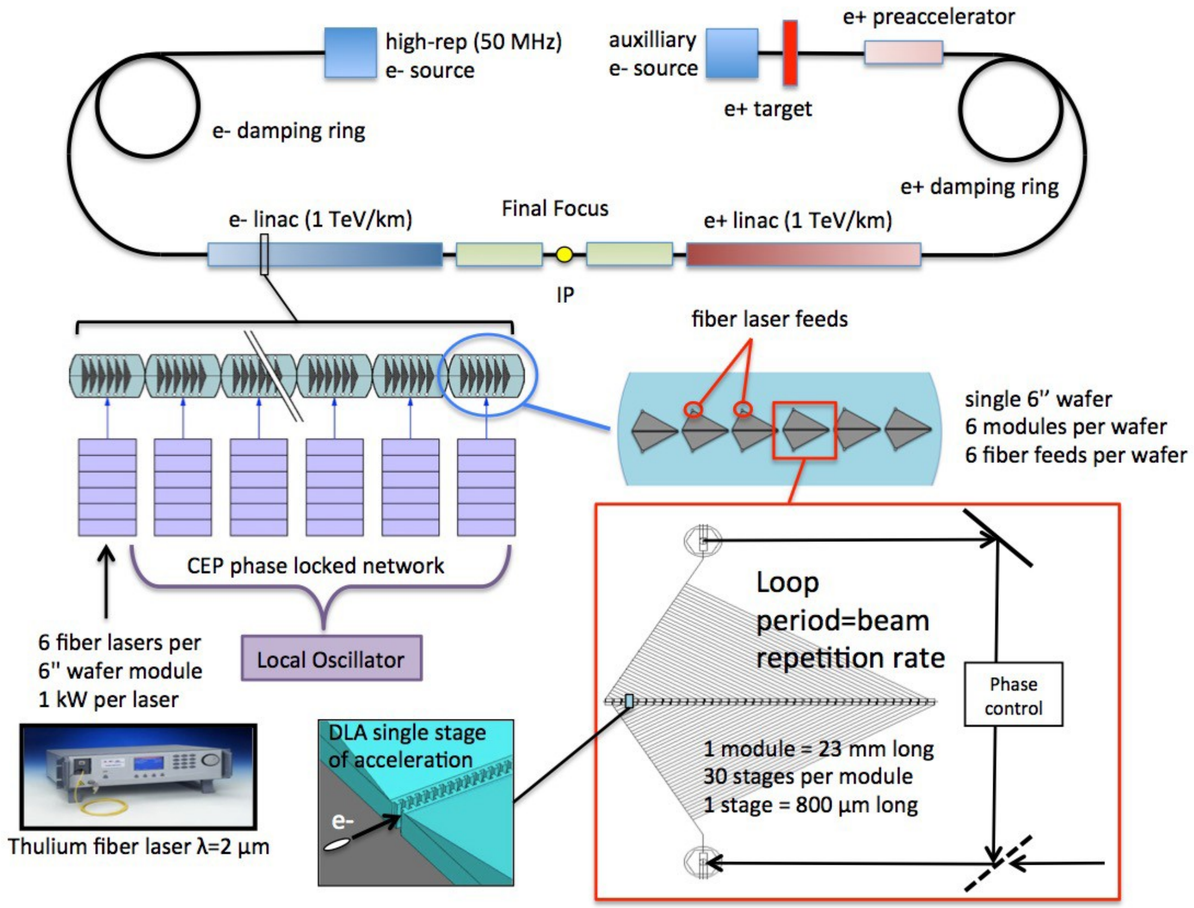

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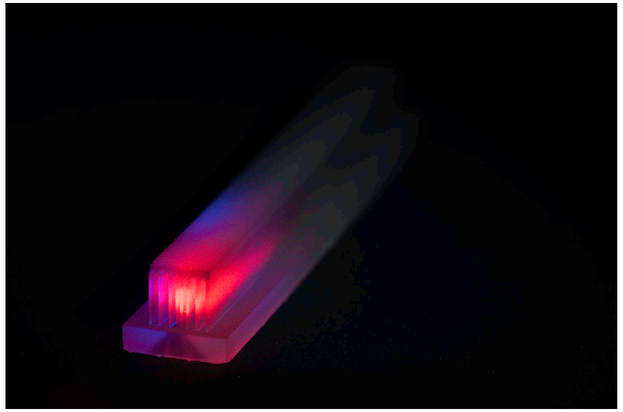

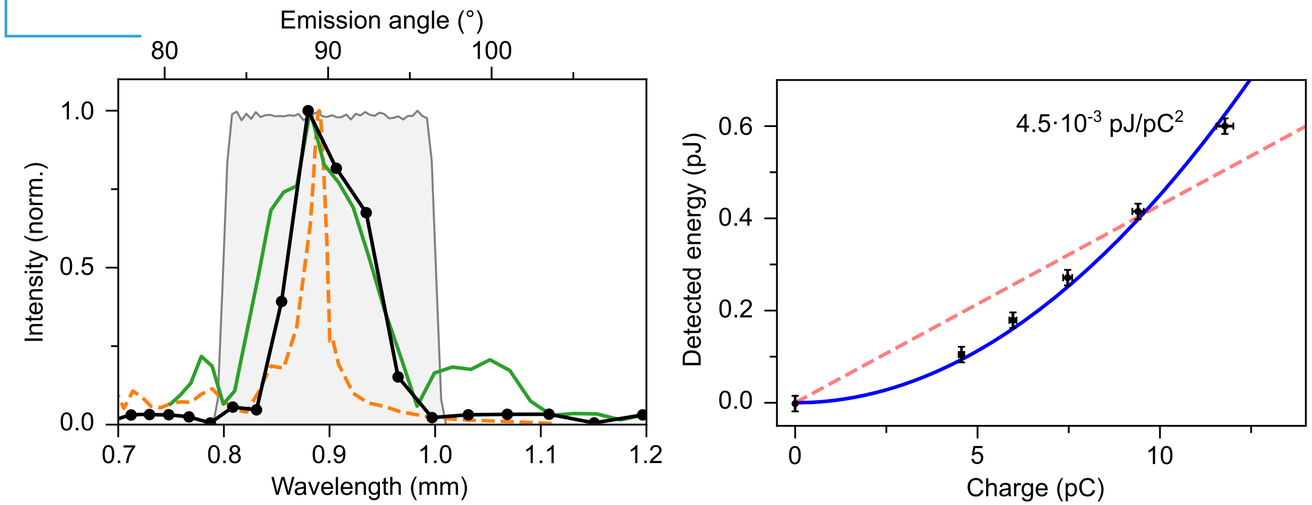

Hermann et al., ACS Photonics 2022, 9, 4, 1143–1149

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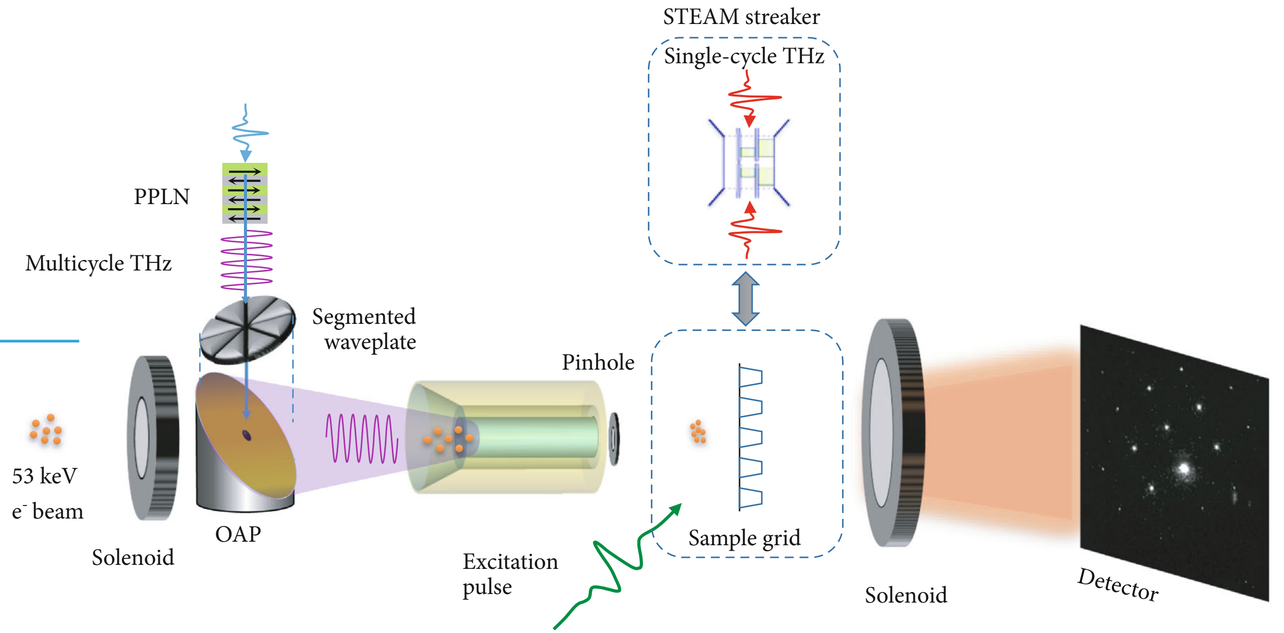

Zhang et al., Ultrafast Science 2021, 9848526

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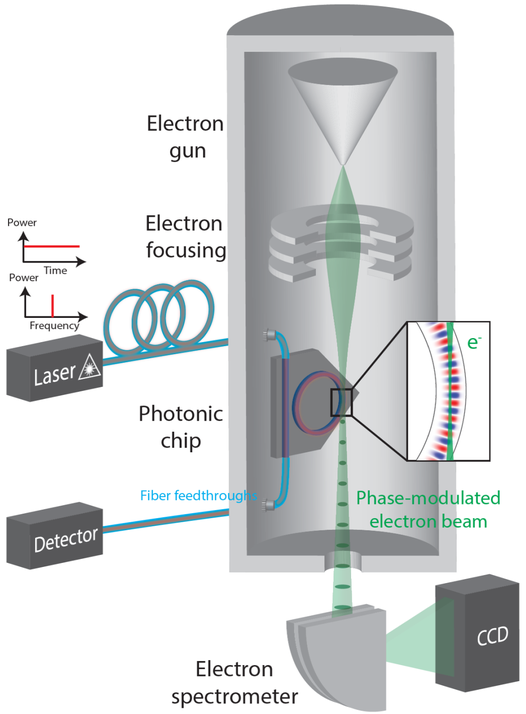

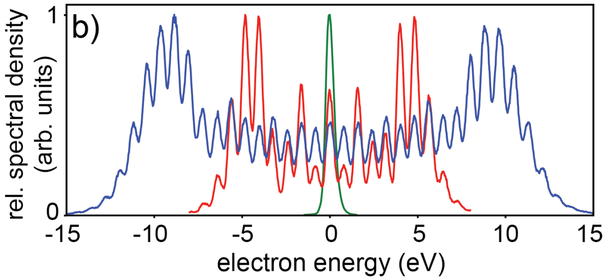

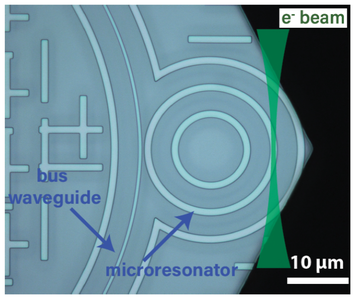

Henke et al., Nature 600, 653–658 (2021)

THANK YOU FOR YOUR ATTENTION!
QUESTIONS?

Nick Veasey