Experimental demonstration of wakefield effects in a THz planar diamond accelerating structure

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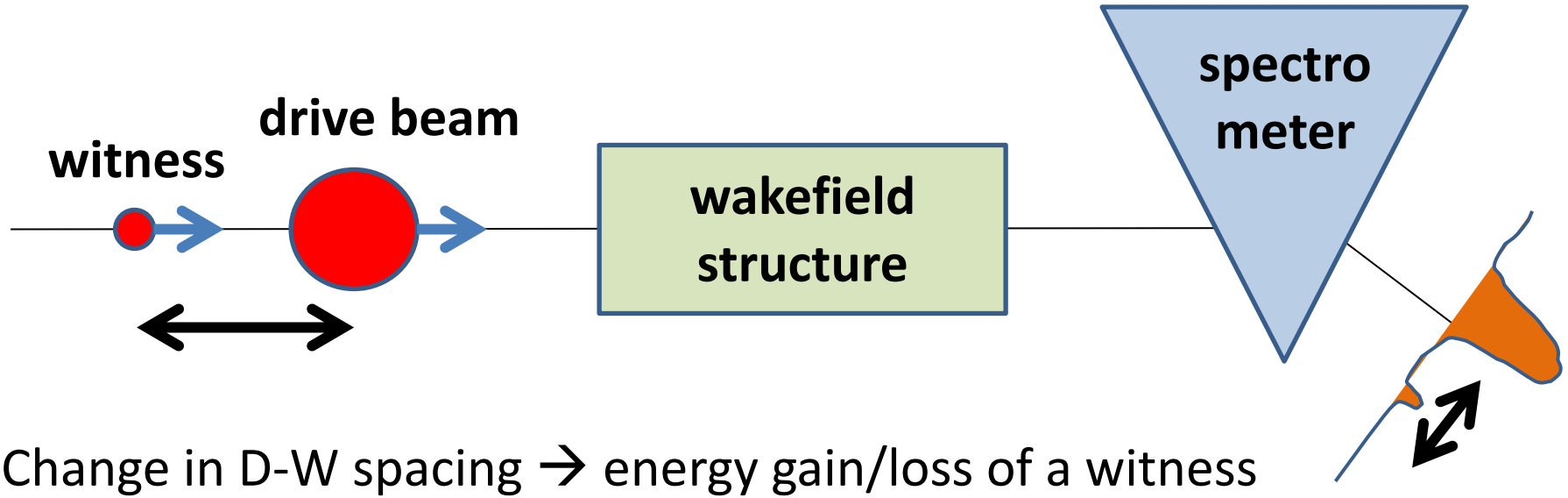
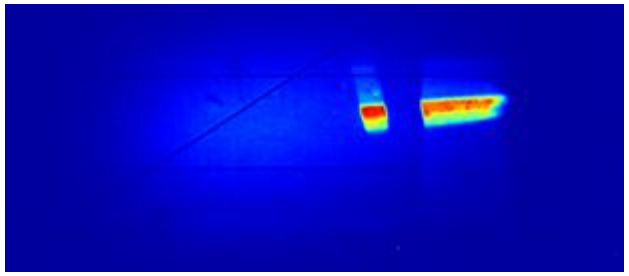
Euclid Techlabs

ATF Program Advisory Committee and
the ATF Users' Meetings, April 26 - 27, 2012

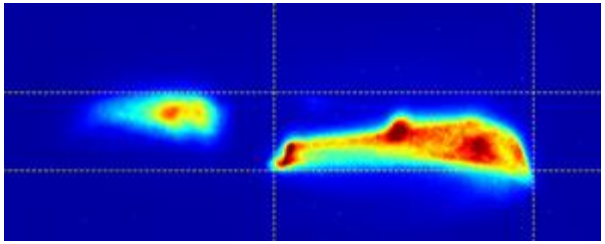
Wakefield Mapping



Change in D-W spacing → energy gain/loss of a witness



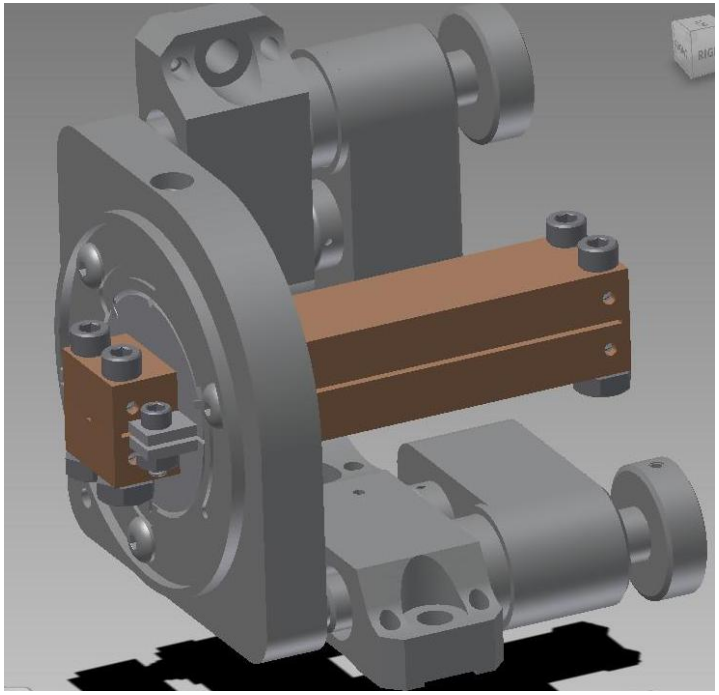
Experimental drive + witness visualization

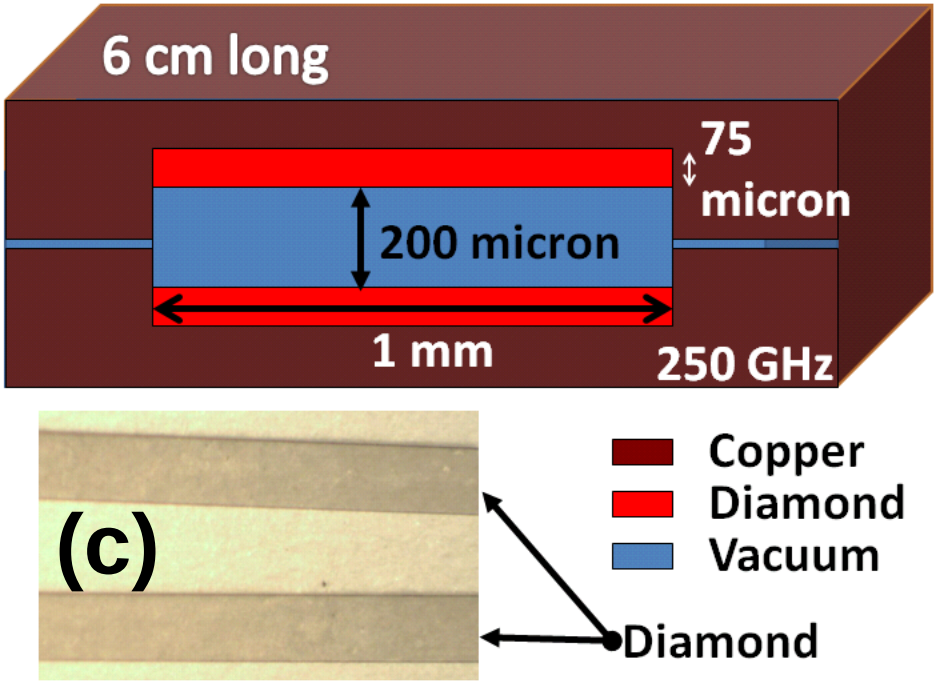


Spectrometer measurement

AATF / ANL: Phys. Rev. Lett. 61, 2756–2758 (1988)

Wakefield structure

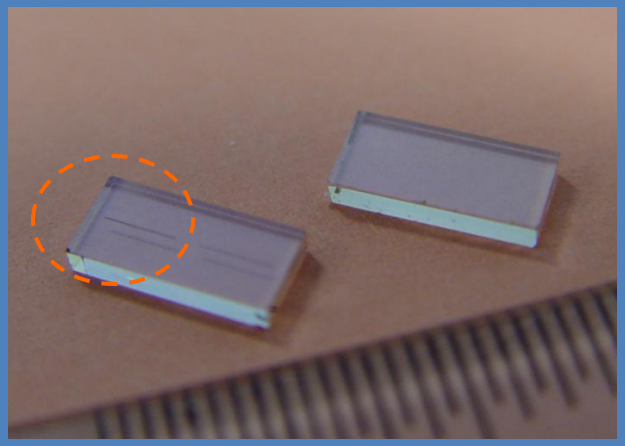


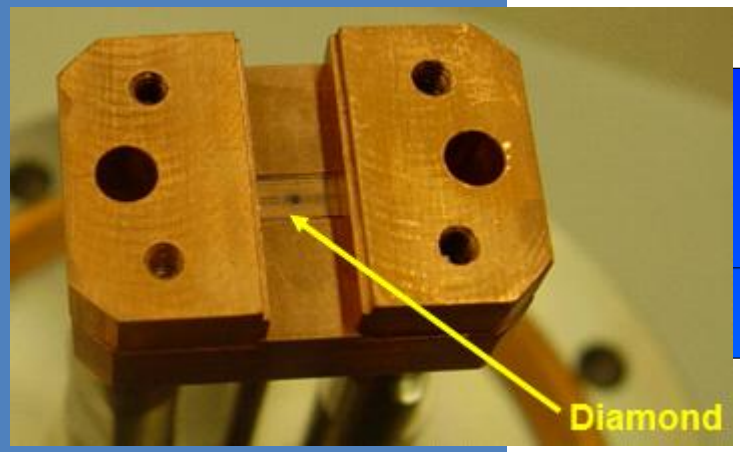


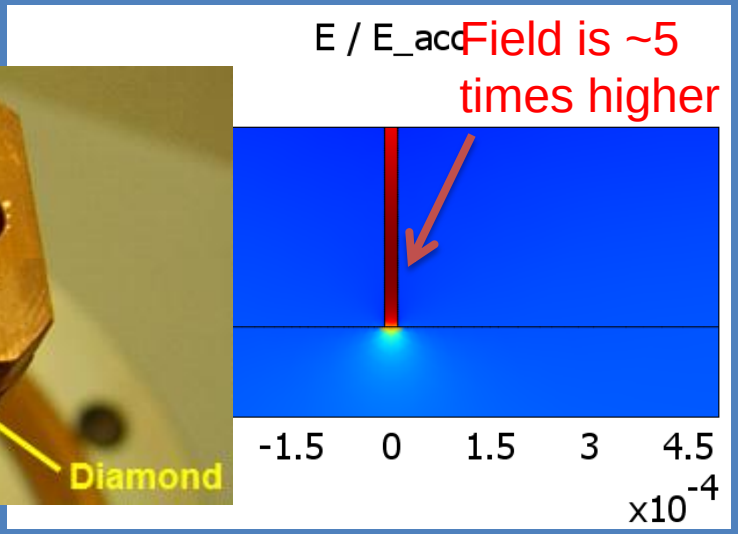
- Polycrystalline diamond, 75um thick
- 250 GHz slab-symmetrical structure

Why Diamond

Breakdown test at the AWA: 72nC goes through a standing wave diamond based structure (~70 MV/m, 35ns long) + scratch on a diamond → field enhancement ~ ε times (300 MV/m field in the scratch)







Preliminary examination shows no evidence of breakdowns. Additional test will be carried out.

We are currently working on CVD diamond technology for THz DLA applications: ~200um aperture, 1-2 inches long high quality diamond

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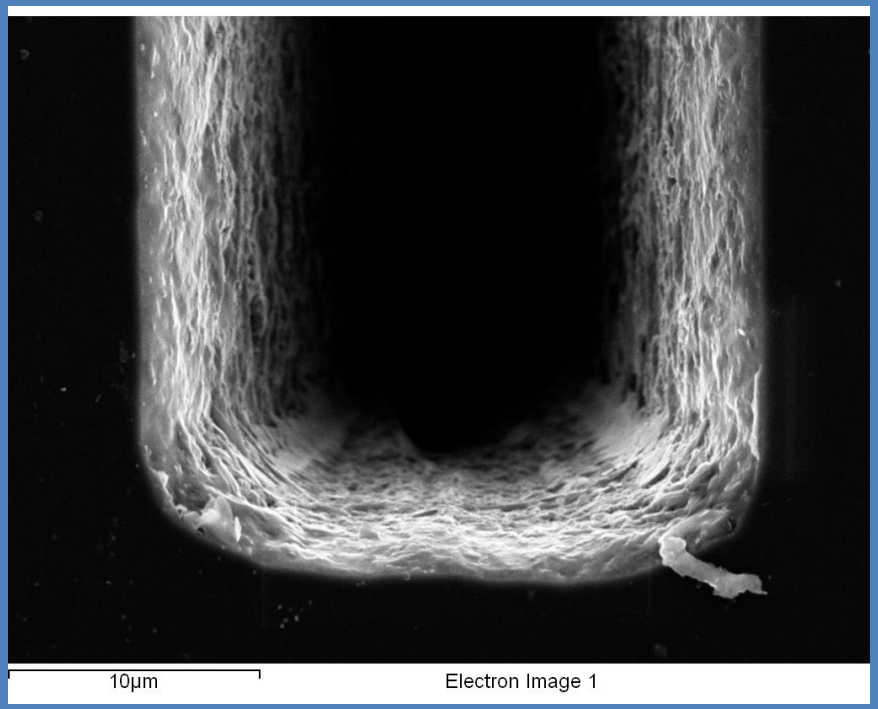
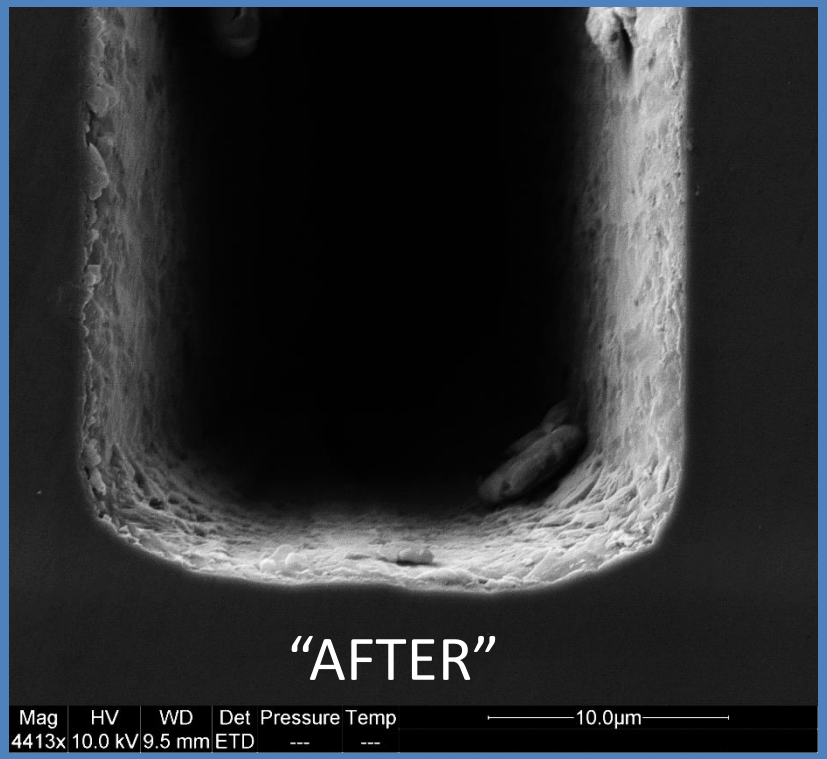
"BEFORE"





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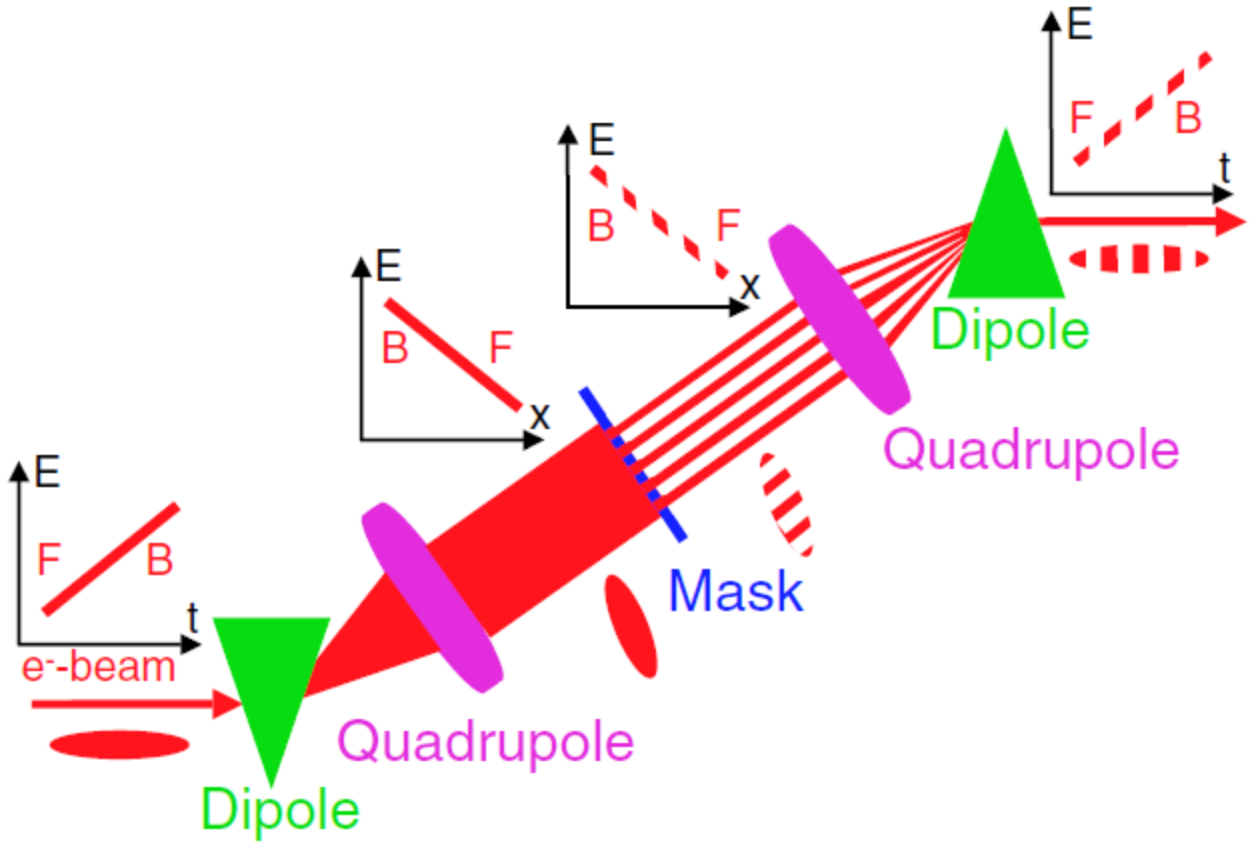
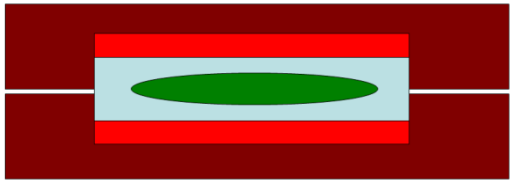
ATF beam masking



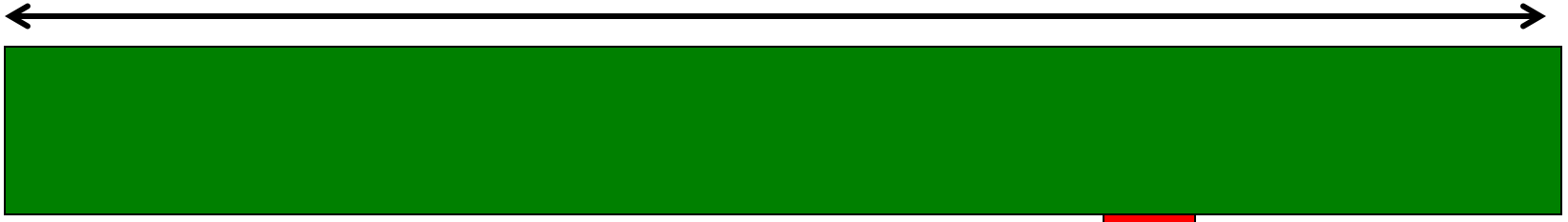
P. Muggli et al. Phys. Rev. Lett. 101, 054801 (2008)

ATF beam masking

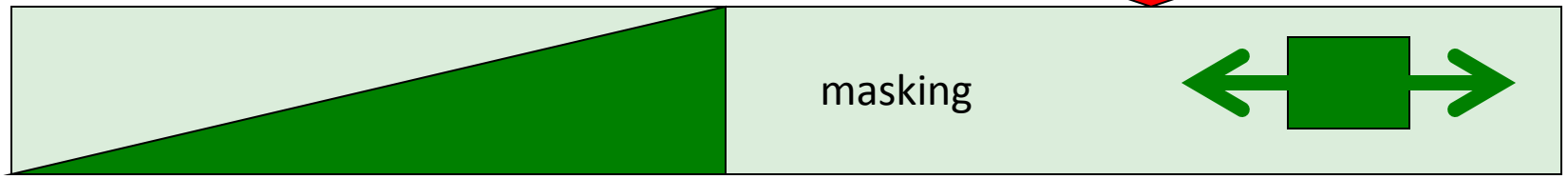
Transversely, flat beam is preferred, with max possible charge:



Longitudinally: 800 pC in 2.4 mm length [100 A]



Longitudinal → Transverse with **Energy spread**

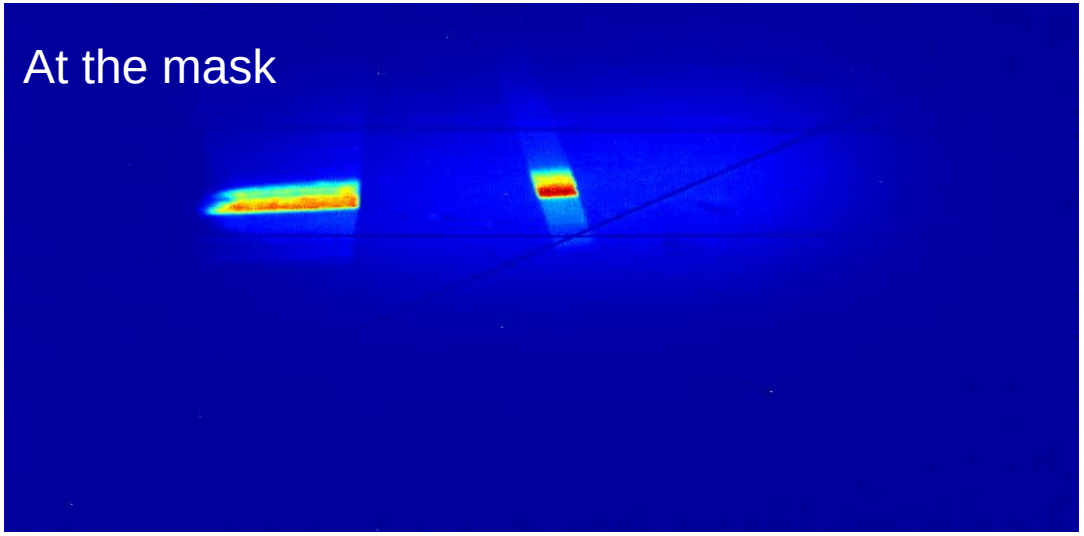


1 – 1.5 mm

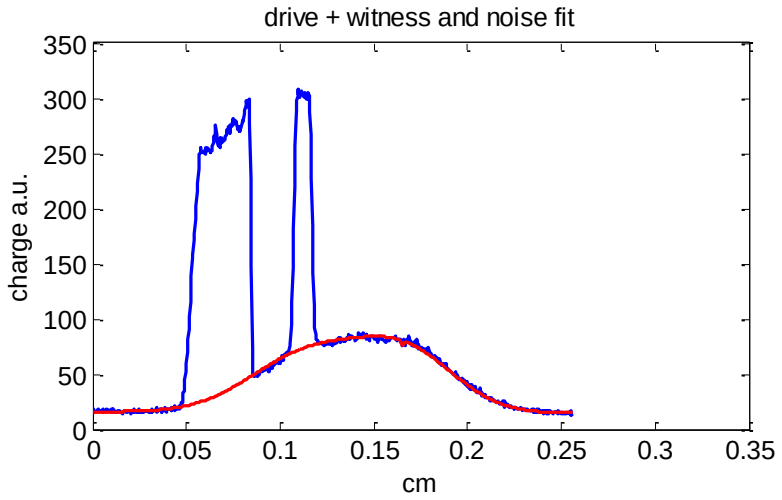
Possibility of movable mask to sweep the position of the witness beam?

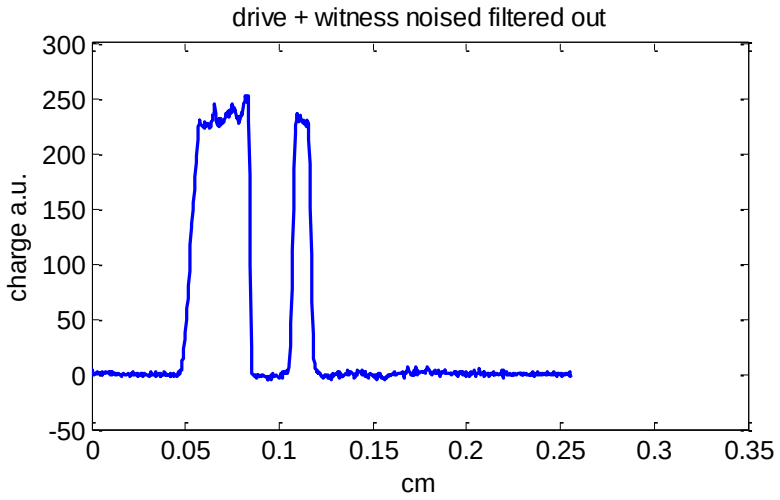
Triangle drive bunch (max charge ~ 200pC) and small witness bunch (min possible)

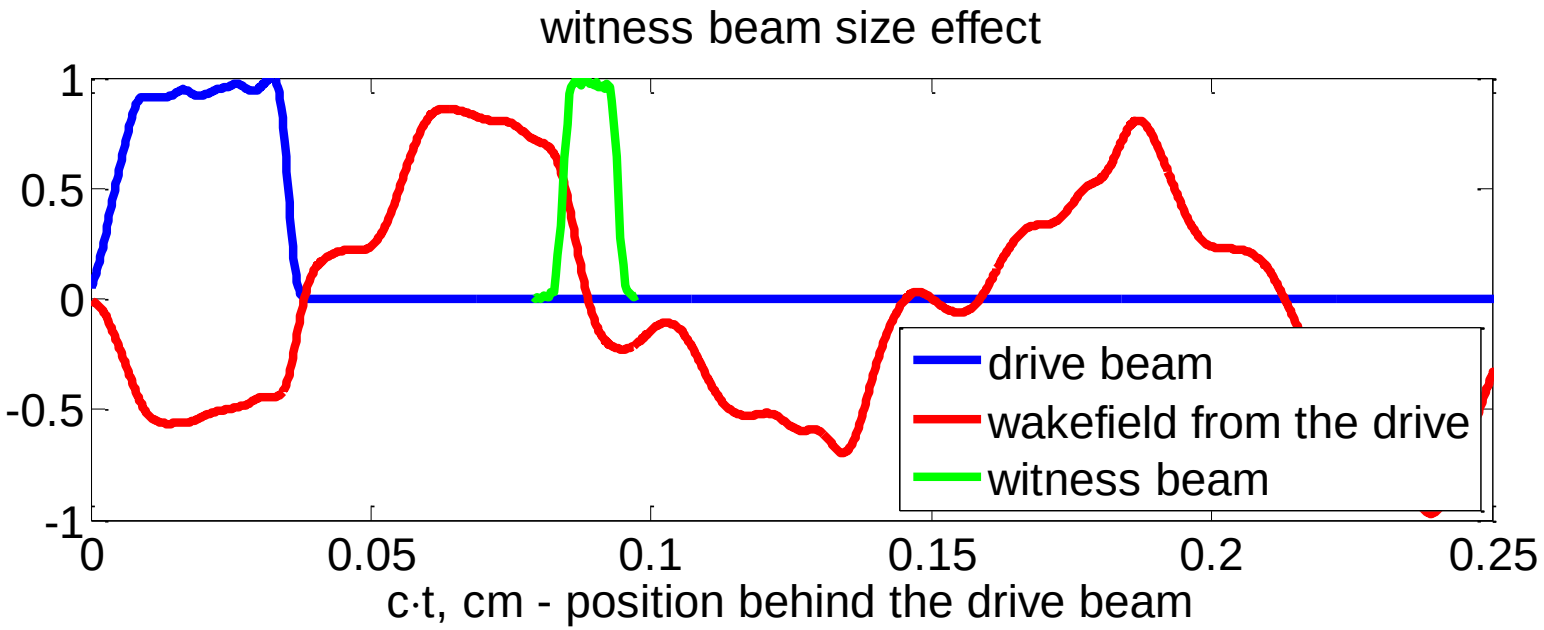
Drive and Witness

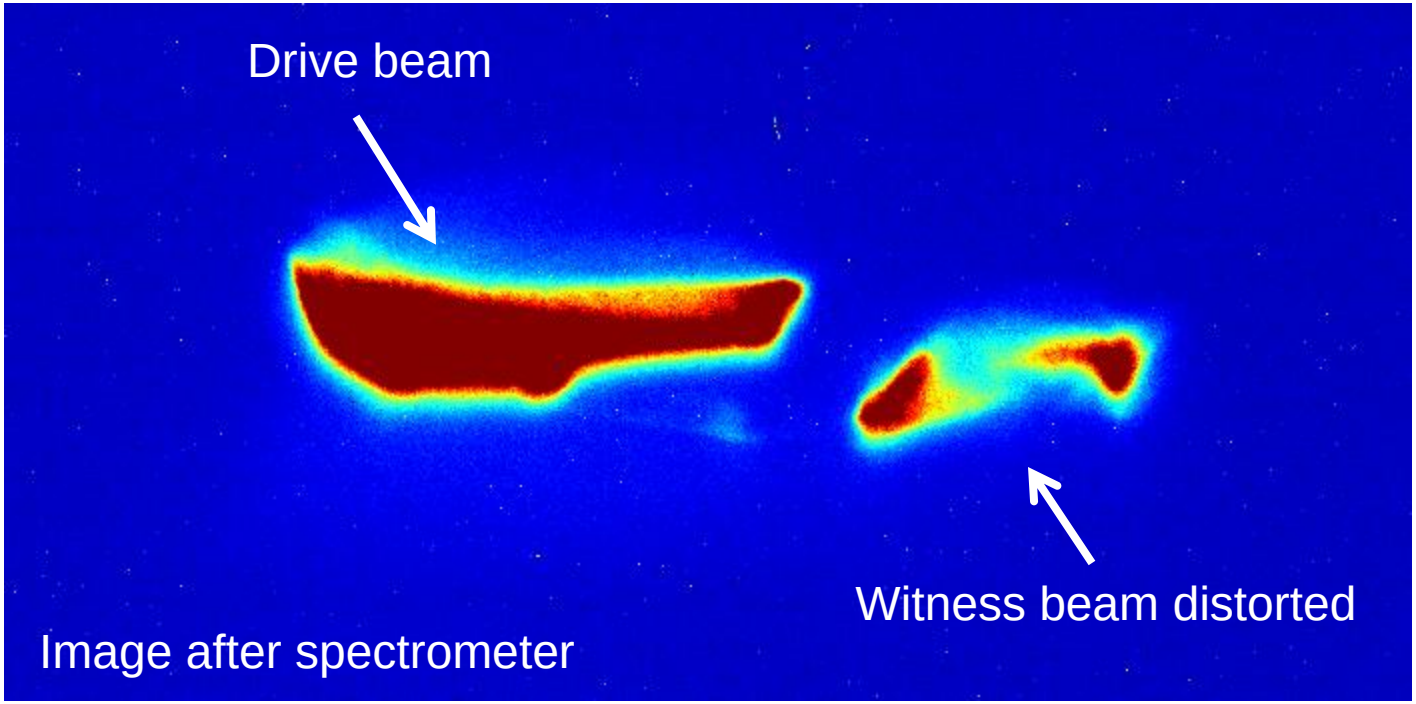


IPOP3 image
(right after the mask)
CTR interferometry is used to calibrate the IPOP3 image to the longitudinal current distribution

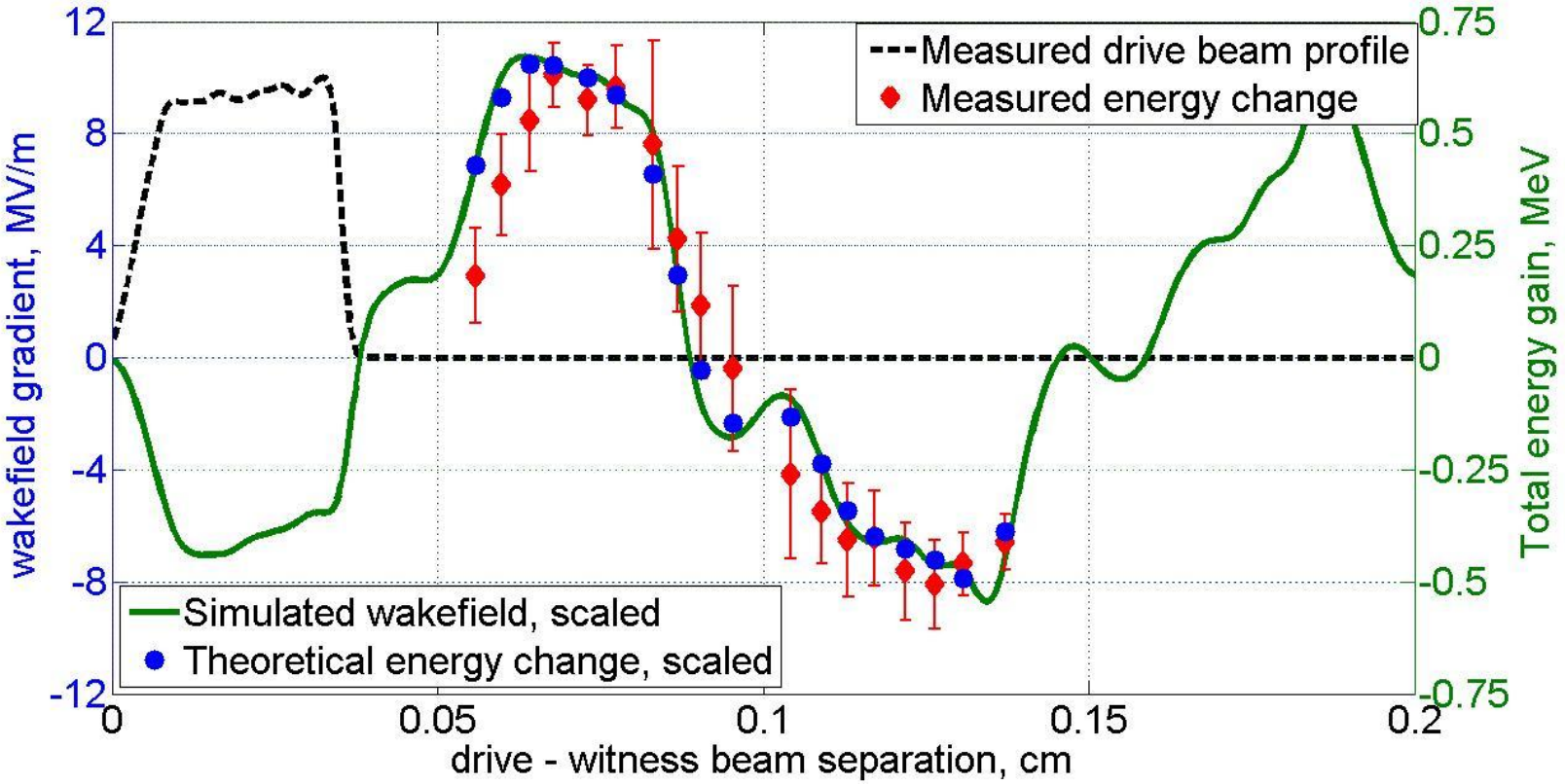




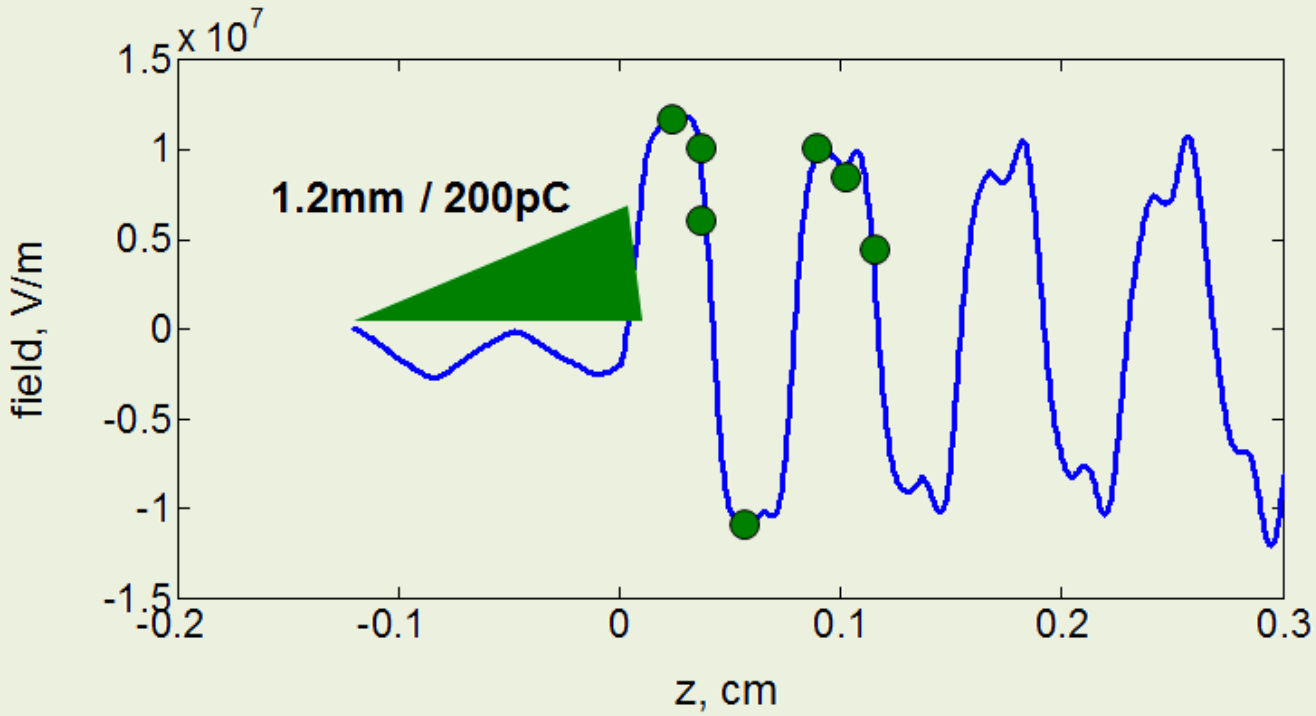

witness beam size effect
1
0.5
0
-0.5
-1
0
0.05
0.1
0.15
0.2
0.25
drive beam
wakefield from the drive
witness beam
c·t, cm - position behind the drive beam


Drive beam
Witness beam distorted
Image after spectrometer

Result: wakefield mapping



- Successful wakefield measurement at 0.25 THz
- Extremely valuable experience



PROPOSED EXPERIMENT: HIGH TRANSFORMER RATIO