

Laser Wakefield Acceleration in the Netherlands: External Injection of Electrons

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Where innovation starts

- Motivation and objectives
- Acceleration goals
- Application goals
- Possibilities for open access
- Expectations for network

Laser Wakefield Acceleration in The Netherlands



Twente
nonlinear regime:
3 MeV injection
10-30 TW laser

Eindhoven
linear regime:
6 MeV injection
< 5 TW laser

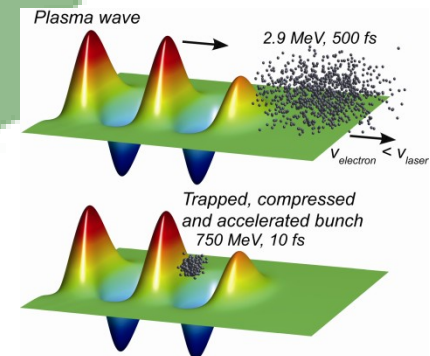
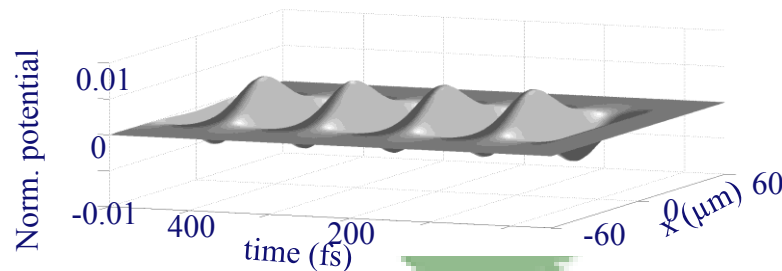


Fig. 1 : External electron bunch injection in front of the laser pulse



Potential of linear wakefield

External Injection of Electrons

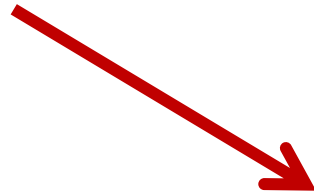
- Stability



Control injection point: Energy
Control bunch charge
Avoid/control nonlinearities:

- laser pulse compression
- wavebreaking
- beamloading

- Tunability



Increase parameter range
Decouple parameters: laser/plasma/e-bunch

- Physics

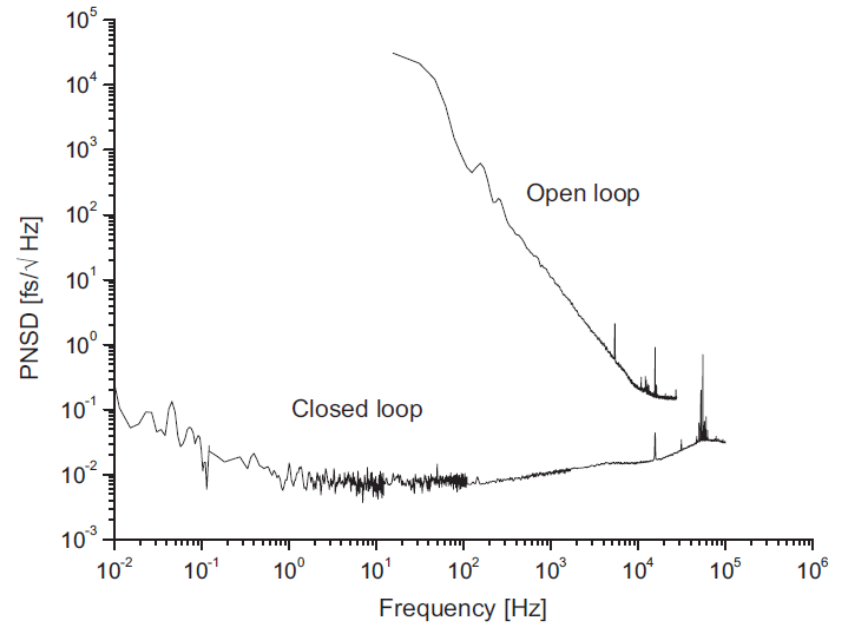
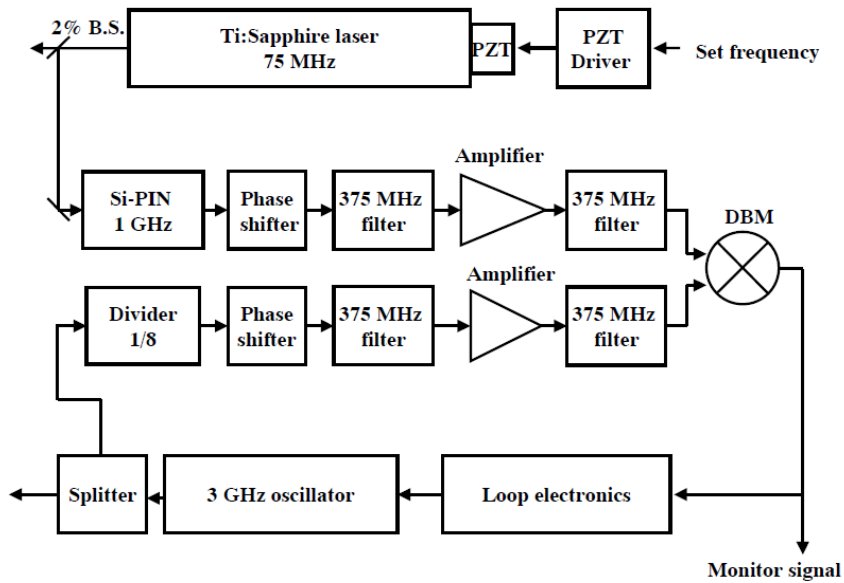


Radiation from Plasma & Electron bunches
Emittance: Injection vs Acceleration
e-bunch compression

Combine Laser Wakefield Acceleration with RF Accelerator Technology

- Synchronization
- Transport
- Stability

Synchronization



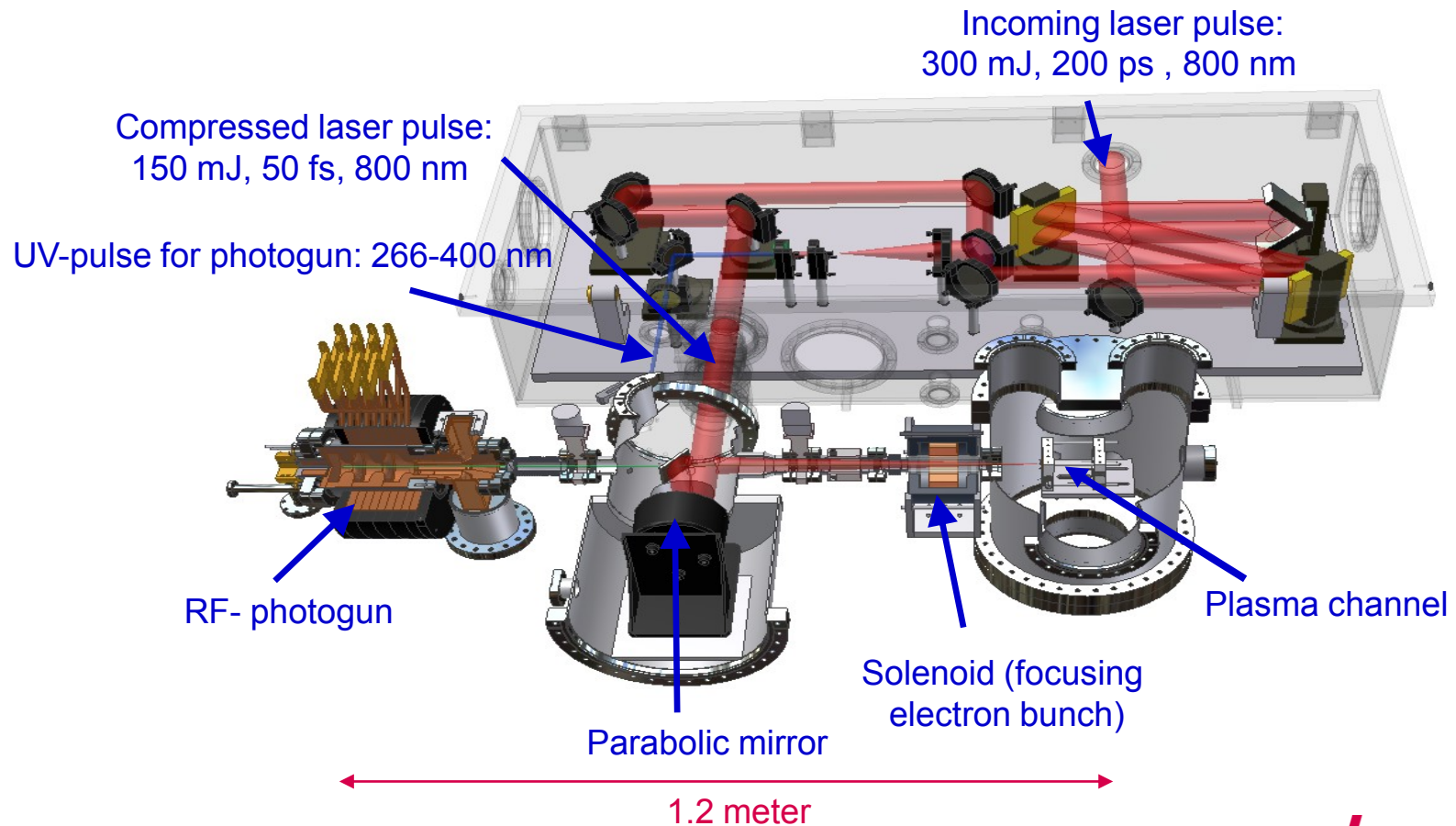
20 fs



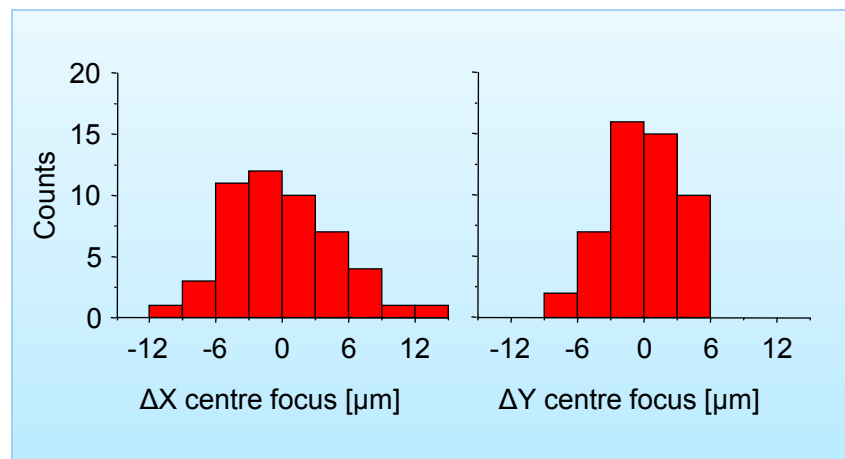
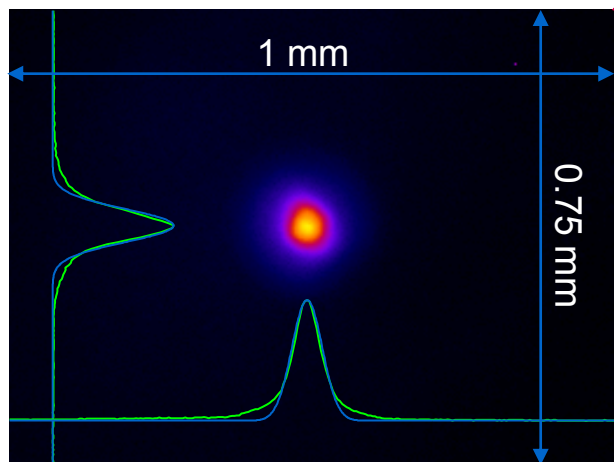
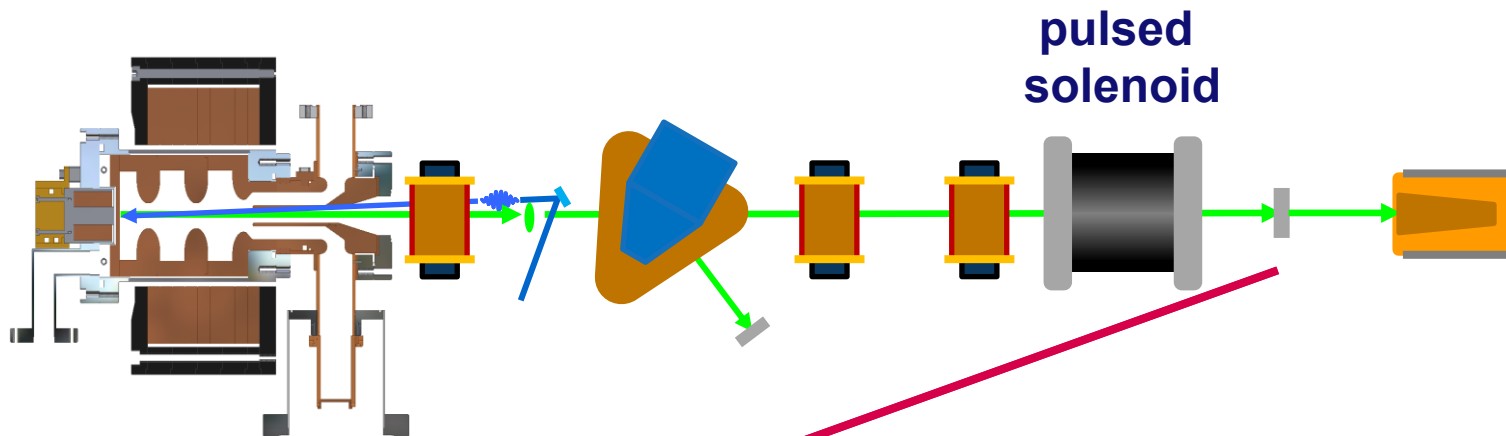
120 fs after
Klystron & Accelerator

Technological Challenge

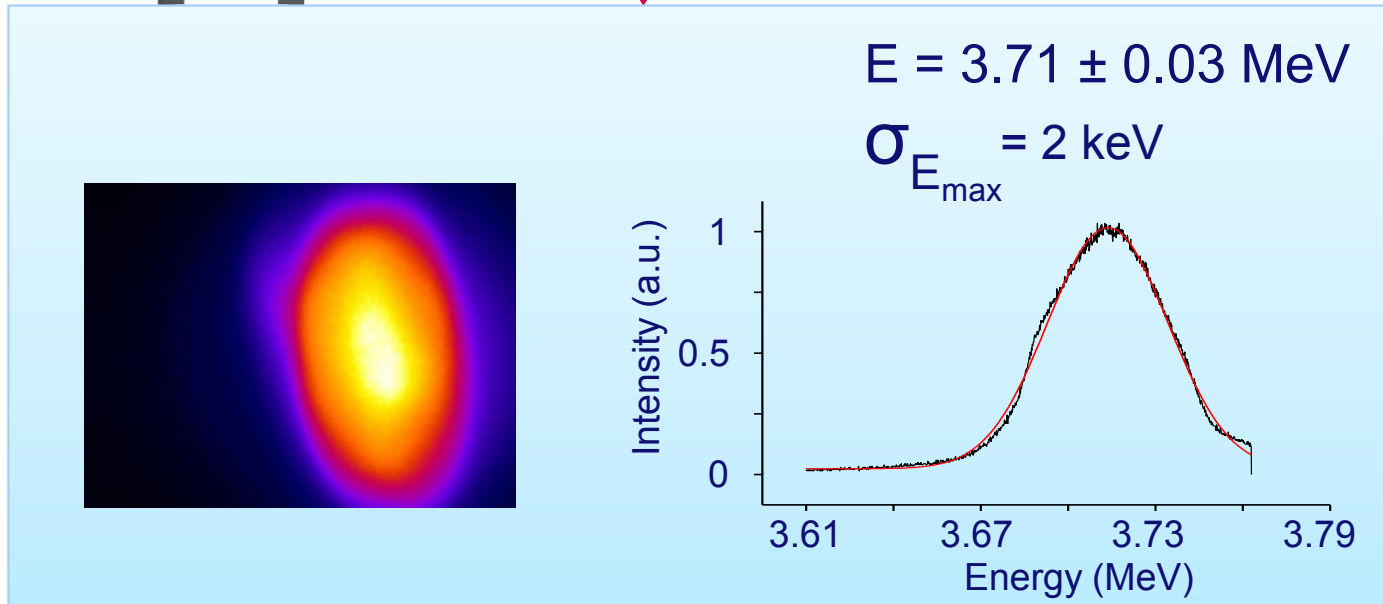
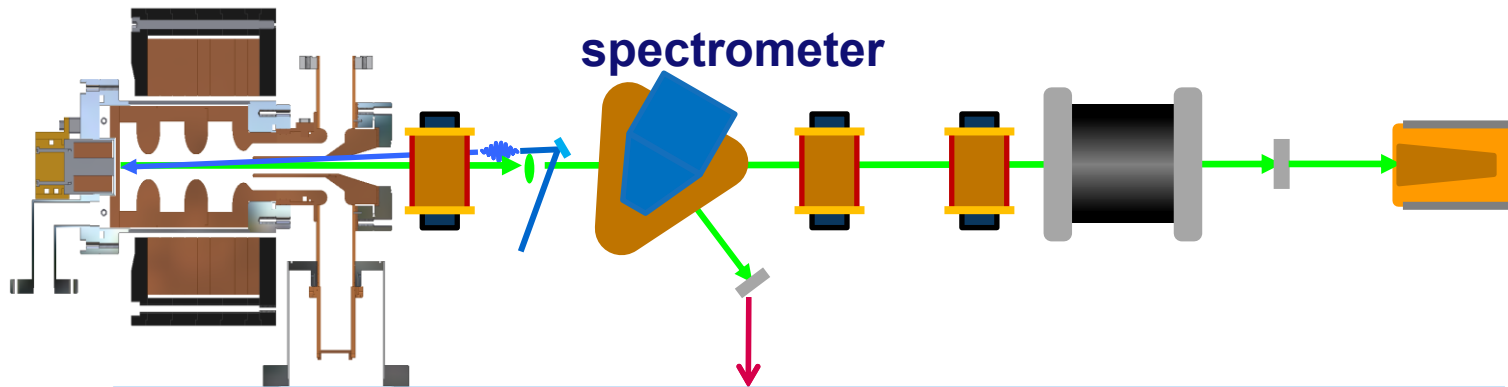
Combine Laser Wakefield with RF Accelerator Technology



Spot Size & Stability



Bunch Energy



Acceleration Goals

Ultra-short bunches: < 10 fs
“Low” Energy: < 100 MeV
Current: > 100 A

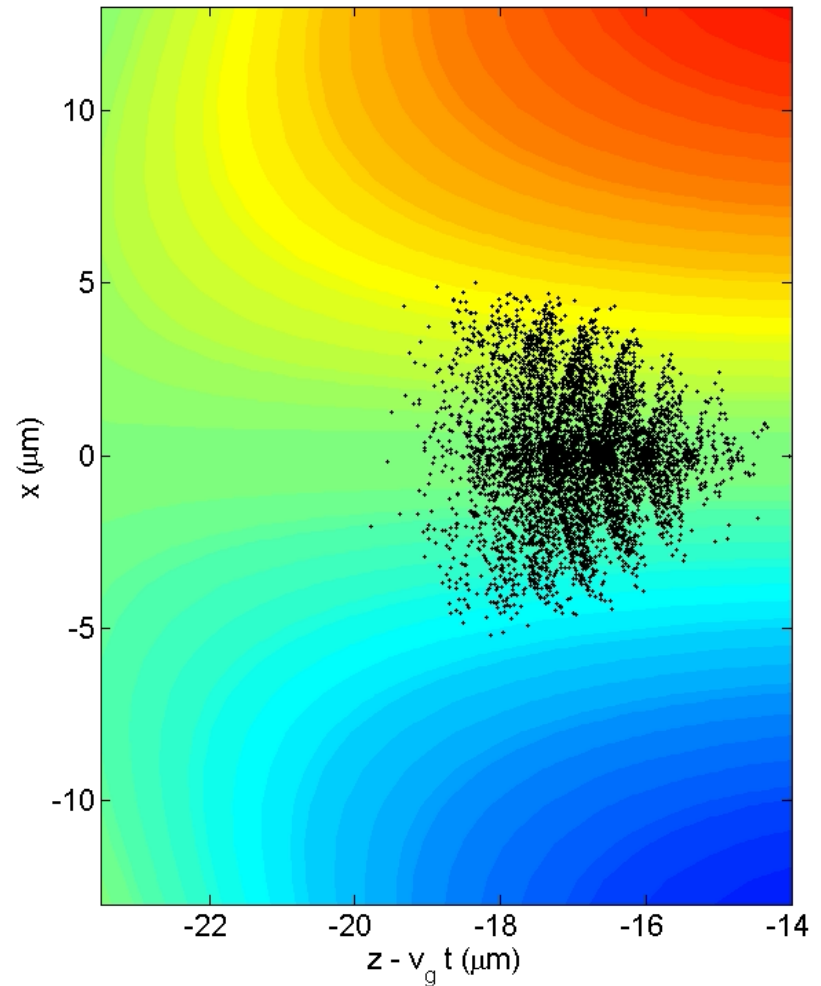
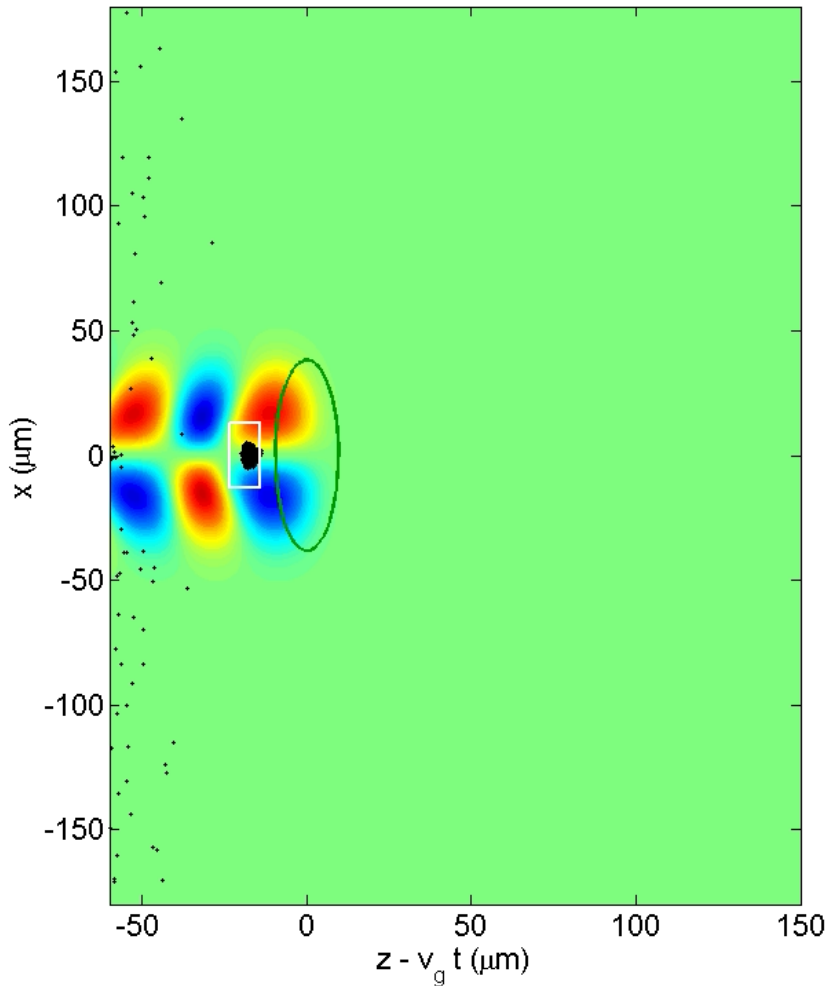
Application Goals

pump-probe type

- Electron Diffraction
 - Pulse radiolysis
 - Radiation
- In combination with:
- single-shot (sub-relativistic) electron diffraction
 - Ultra-cold Ion Beams

FINE-STRUCTURE FORMATION

$t = 127 \text{ ps} - z = 38 \text{ mm}$



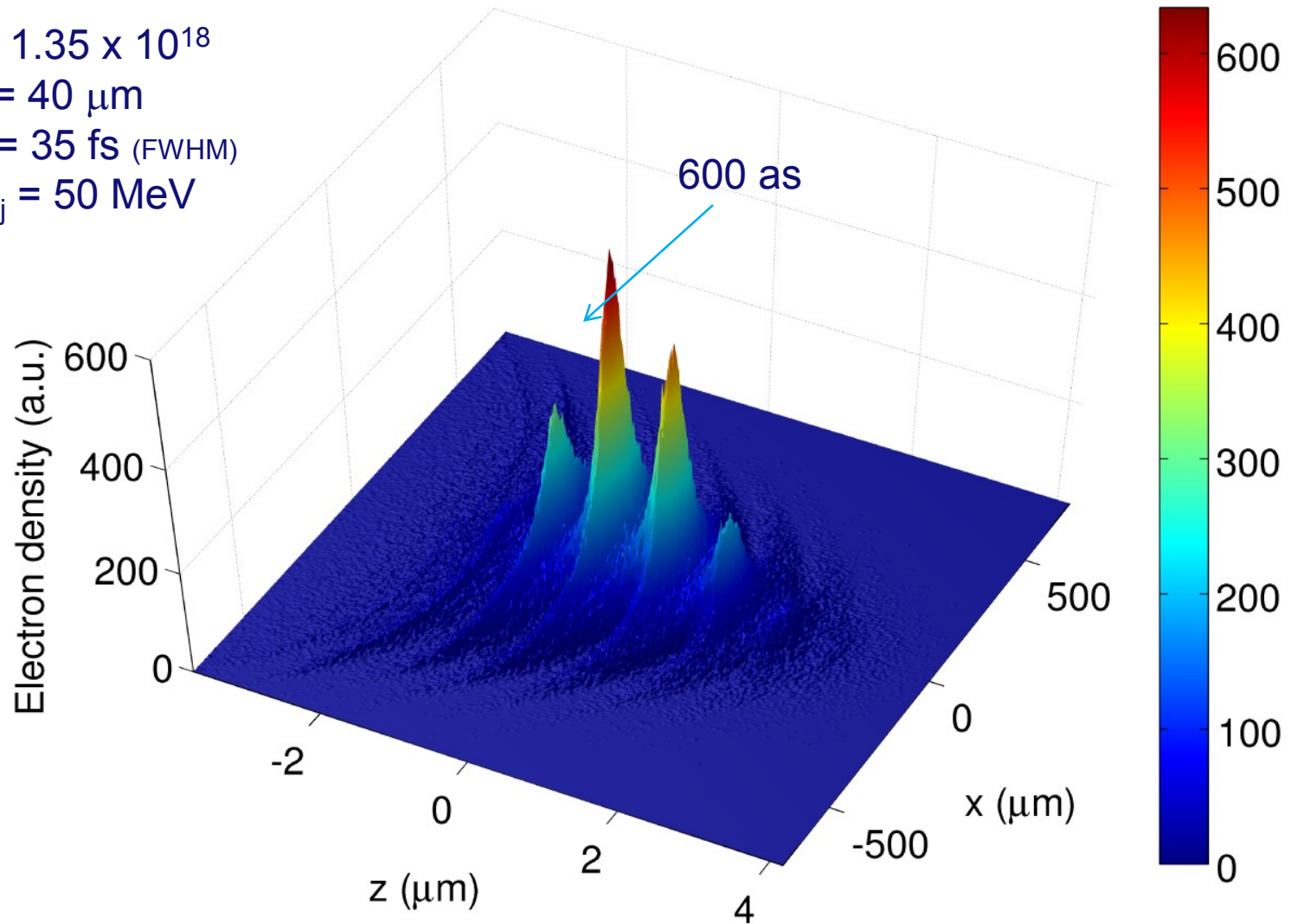
ELECTRON DENSITY DISTRIBUTION AFTER PROPAGATING 10 CM IN VACUUM

$$I = 1.35 \times 10^{18}$$

$$w = 40 \mu\text{m}$$

$$\tau_L = 35 \text{ fs (FWHM)}$$

$$E_{\text{inj}} = 50 \text{ MeV}$$



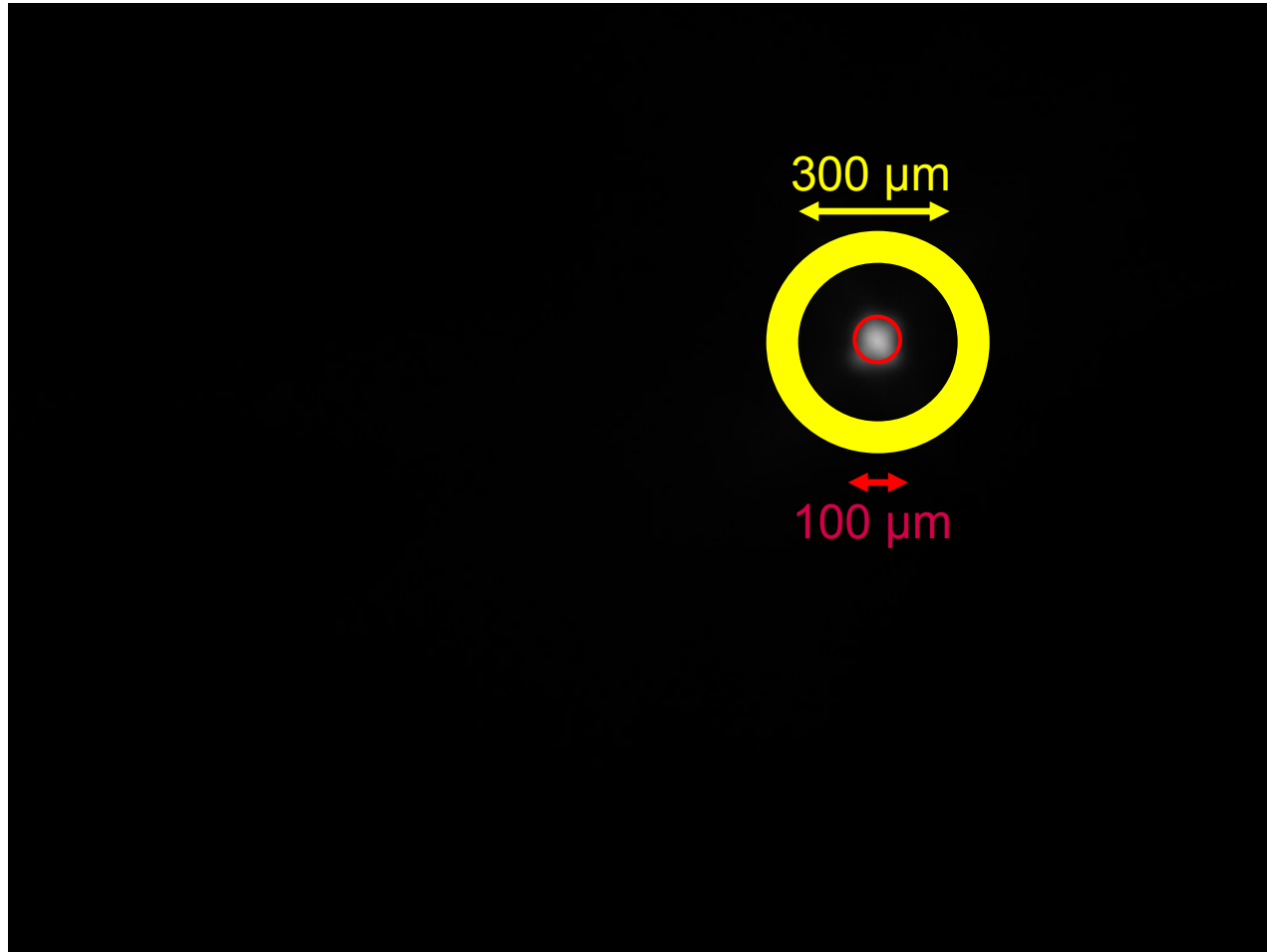
Not a user-facility type of setup

No Restrictions for collaboration

Demonstrate External Injection

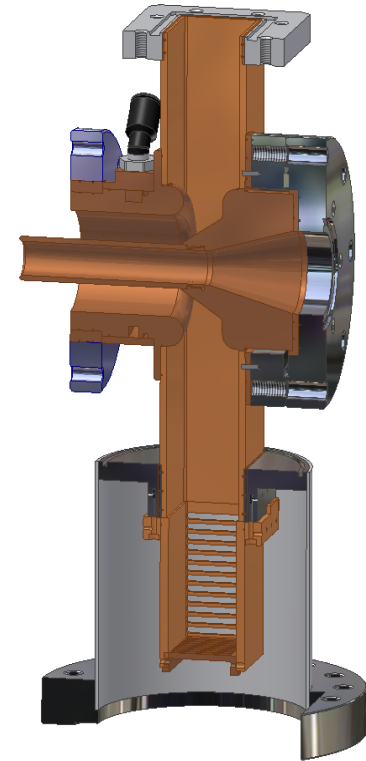
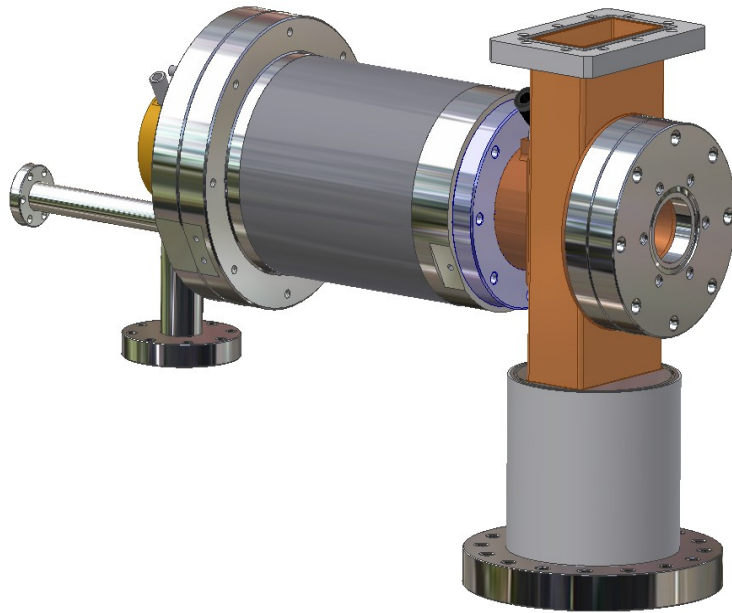
**Transfer Technology
to Facility with more laser- and manpower**

Focus Stability



RF Photogun

Coaxial S-band input coupler:
scaled down version L-band design DESY



RF Photogun

Cavity mounted inside main magnet:

