

Sources Subgroup Summary

IDT-WG2, Dec.13. 2022, K. Yokoya

➤ Dec.12 34th Regular meeting

- ✓ Joe Grames, Sabine Riemann, Hitoshi Hayano, Andriy Ushakov, Sami Habet, Andy Lankford, Tsunehiko Omori, Yoshinori Enomoto, Masao Kuriki, Steffen Doebert, Gudi Moortgat, Peter Sievers, Carlos Hernandez-Garcia, Hofler, Reza Kazimi, Manuel Formela, Niclas Hamann, Kaoru Yokoya
- ✓ Indico <https://agenda.linearcollider.org/event/9902/>

➤ Talk

- ✓ “Plasma lens prototype as an optical matching device for the undulator-based e+ source”
 - Niclas Hamann (University of Hamburg)
 - File uploaded as Group Source Meeting Niclas Hamann.pptx

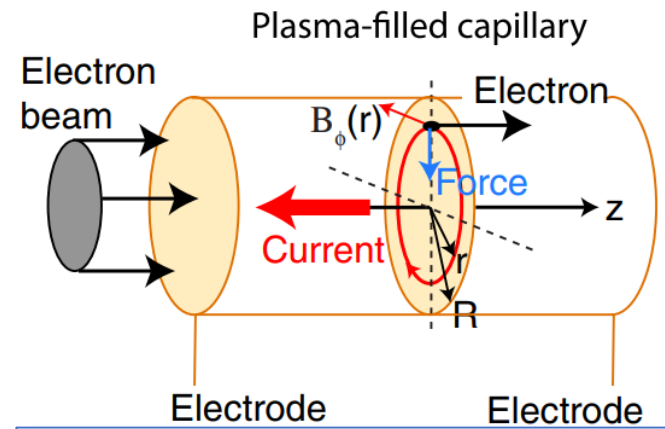
➤ Next meeting

- ✓ No more meeting this year

Plasma lens prototype as an optical matching device for the undulator-based e+ source

Niclas Hamann, Gregor Loisch, Manuel Formela, Gudrid Moortgat-Pick, Klaus Flöttmann (University of Hamburg/DESY)

- Used to focus proton beam from cyclotron (1999)
- Can be used for ILC positron
- 5Hz, 1312 bunches, 554ns bunch interval
- → repetition rate of plasma lens = 2 MHz

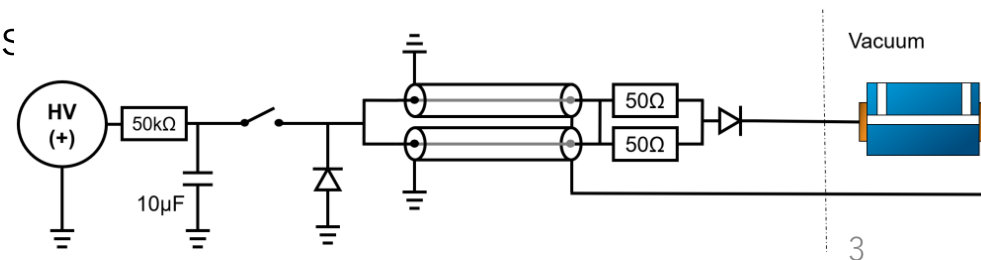
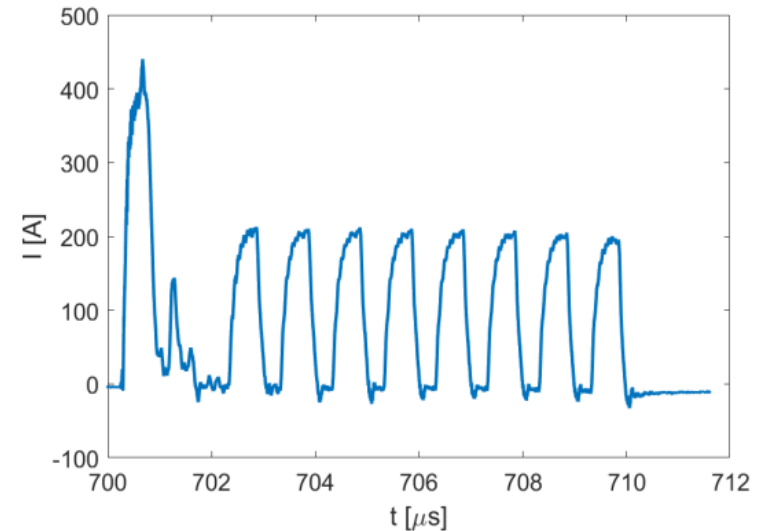


Principle of an active plasma lens

- Simulation has been done (no space charge, homogeneous current density, no edge effects)
- Capture rate 44.35 %
 - ✓ Used photon spectrum from the undulators
 - ✓ Current limited to $\sim 9\text{kA}$ due to electron erosion

MHz Pulse Modulator

- ADVANCE laboratory at DESY
- kA/MHz modulator already exists (for high-current induction accelerators)
 - ✓ 45 kA, 4.8 kA, 2 MHz
 - ✓ This is too much Time-consuming and expensive for now
 - ✓ Future funding?
- Behlke SiC switching unit
- Main parameters:
 - ✓ Voltage: 1 – 8 kV
 - ✓ Peak current: 50 – 400 A
 - ✓ Pulse length: 150 – 5000 ns
 - ✓ Pulse rep. Rate: 0.1 – 1 MHz
 - ✓ Burst rep. rate: 10 Hz
 - ✓ Max. burst number: 100 puls



Gas Flow Simulations

➤ Goal: Pressure distribution as uniform as possible

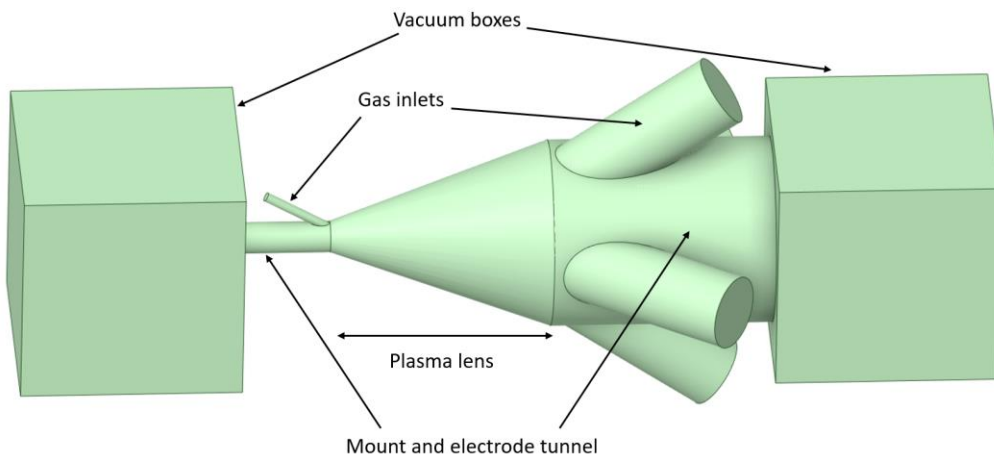
➤ Results

✓ Asymmetric design

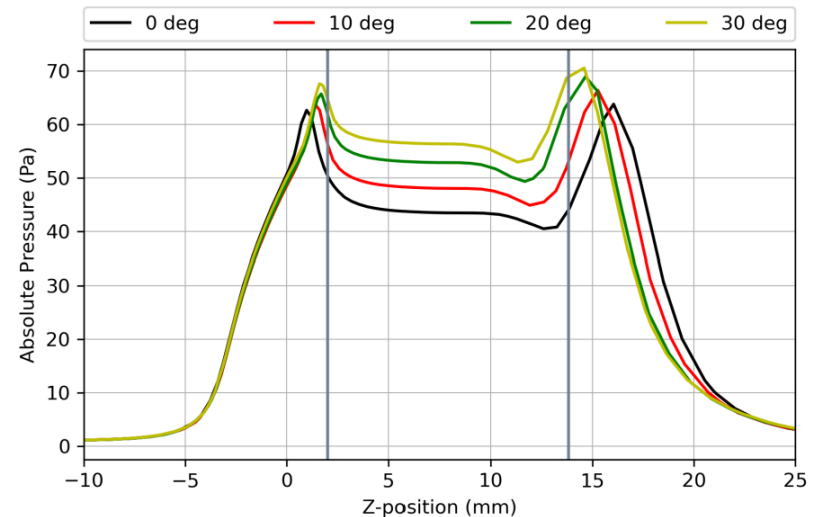
- No inlets at plasma lens entry and two at the plasma lens exit

✓ Inlets have to be angled

- results in higher pressure inside the plasma lens



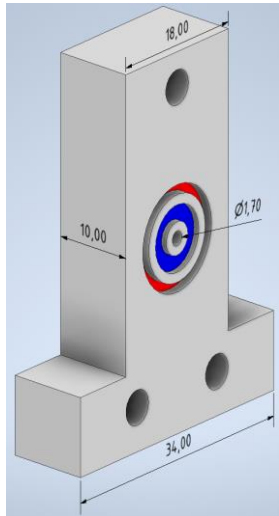
Example of a fluid volume



Pressure distribution along the z-axis
Vertical grey lines indicate the plasma lens

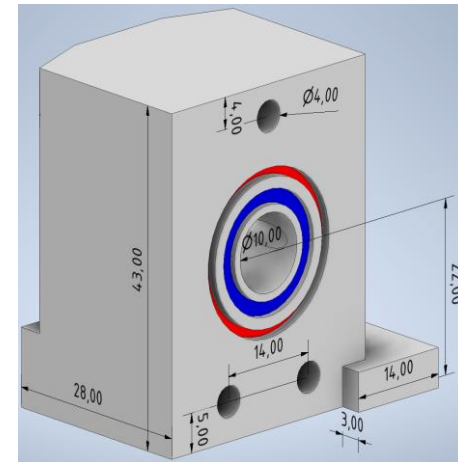
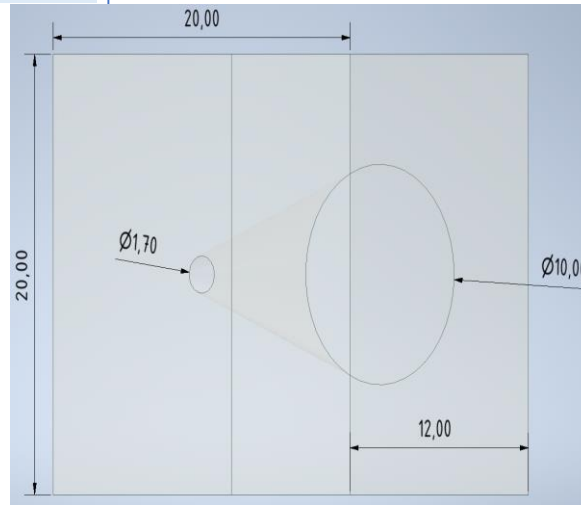
Technical design

no gas inlets

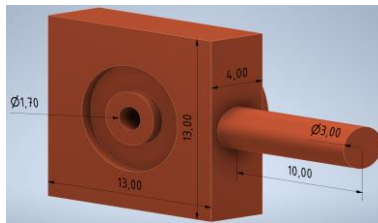


Mount at the entry

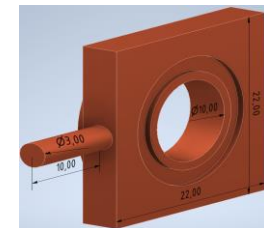
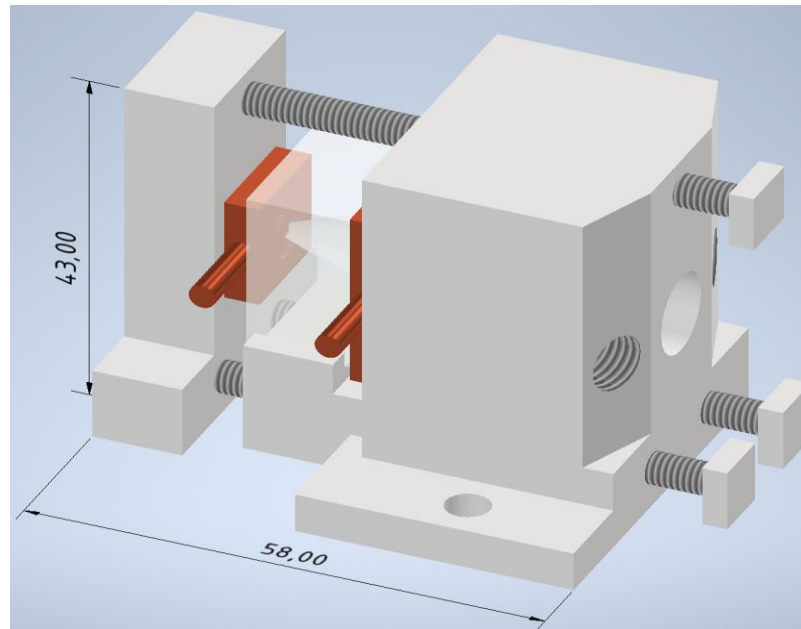
Lens:
20mmx20mm
x12mm
sapphire
block



Mount at the exit with
gas inlets



Electrode (copper)
entry side (1.7mm ϕ)



Electrode (copper) exit
side (10mm ϕ)

Outlook

- Next step: Production of the down-scaled prototype in the workshop and assembly
- Future: Diagnostics of plasma lens
 - ✓ Measurement of plasma-, current density and magnetic fields
- Comparing measurements with simulated results (Magnetohydrodynamics sim.)
 - ✓ Freshly started by M. Formela
- Fullscale prototype (incl. kA/MHz pulse modulator)
 - ✓ Next funding period?