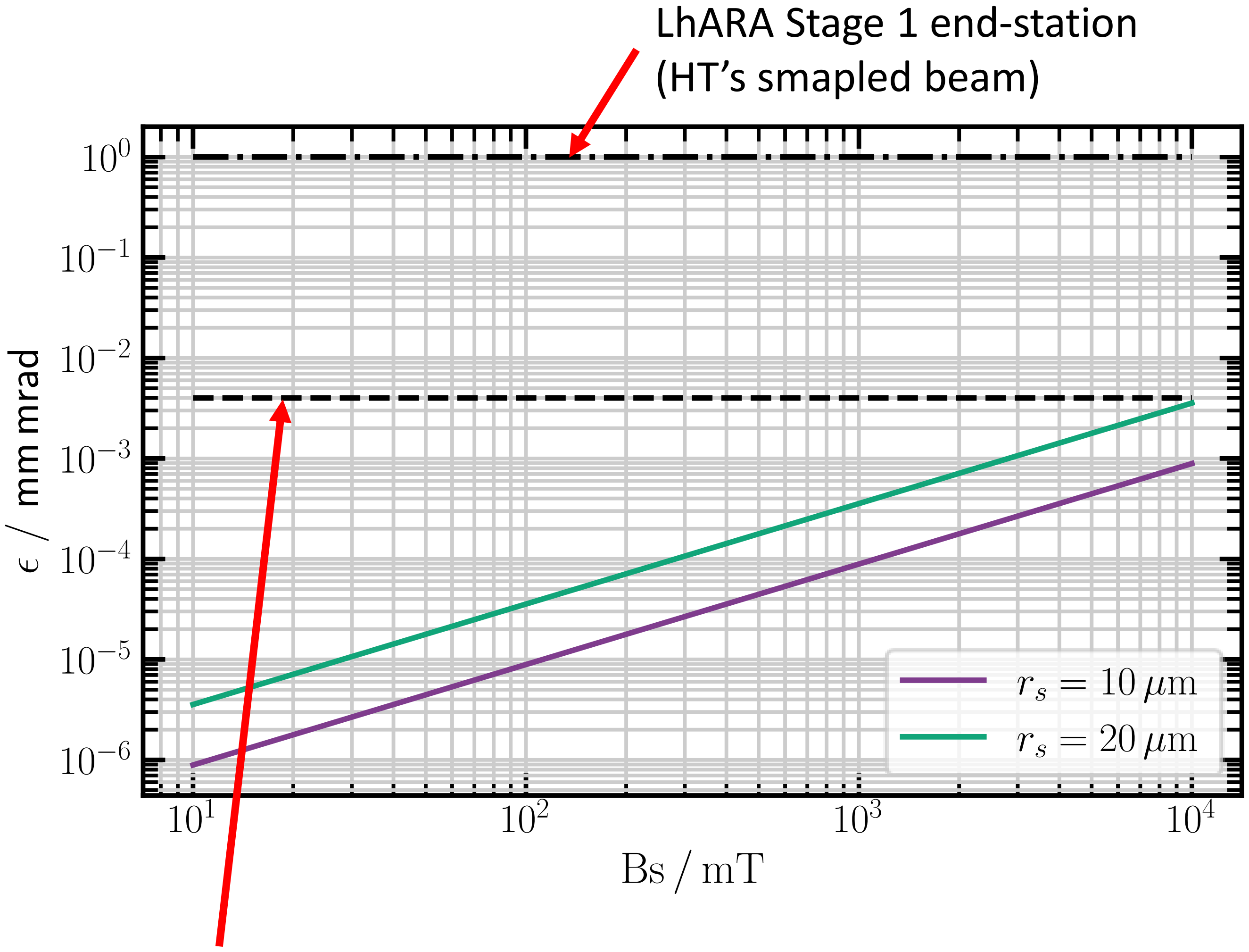
Magnetisation emittance

A non-zero magnetic field at the proton source
$\Longrightarrow$ protons remain with angular momentum after they leave the field region (unequal “kick” from the fringe fields)
$\Longrightarrow$ the beam evolves as if it has an equivalent emittance

$$\epsilon = \frac{eB_s r_s^2}{2\gamma\beta m_p c},$$



The laminarity of high-current multi-MeV proton beams produced by irradiating thin metallic foils with ultraintense lasers has been measured. For proton energies $> 10\ \mathrm{MeV}$, the transverse and longitudinal emittance are, respectively, $< 0.004\ \mathrm{mm\ mrad}$ and $< 10^{-4}\ \mathrm{eV\ s}$, i.e., at least 100-fold and may be as much as 10^4-fold better than conventional accelerator beams. The fast acceleration being electrostatic from an initially cold surface, only collisions with the accelerating fast electrons appear to limit the beam laminarity. The ion beam source size is measured to be $< 15\ \mu\mathrm{m}$ (FWHM) for proton energies $> 10\ \mathrm{MeV}$.

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Some updates from IPAC22

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INVESTIGATION, SIMULATION AND FIRST MEASUREMENTS OF A 2M LONG ELECTRON COLUMN TRAPPED IN A GABOR LENS DEVICE

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https://accelconf.web.cern.ch/ipac2022/papers/wepotk002.pdf

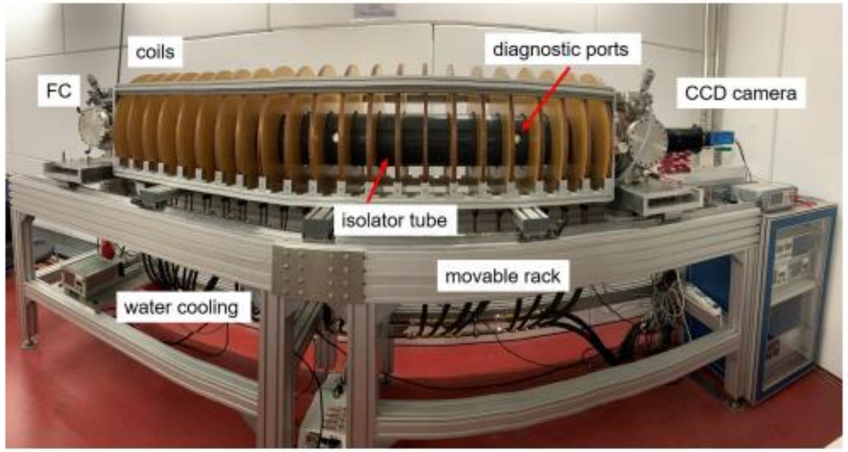

Figure 1: Setup of the experiment GL2000 in a concrete shielding.

“The first operational tests show that it is possible to confine a two-meter-long electron column.”

- Plan to measure the electron density as a function of the confinement strength (up to **30 kV, 0.5 T)**

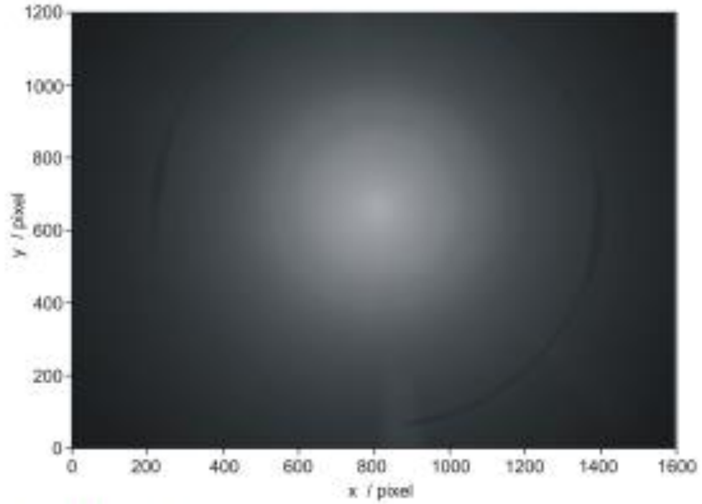

Figure 4: Residual-gas luminescence of argon during electron cloud confinement with GL settings: $\Phi_A = 6\,kV$, $B_z = 18\,mT$.

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BEAM TRANSPORT SIMULATIONS THROUGH FINAL FOCUS HIGH ENERGY TRANSPORT LINES WITH IMPLEMENTED GABOR LENSES

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https://accelconf.web.cern.ch/ipac2022/papers/mopoms017.pdf

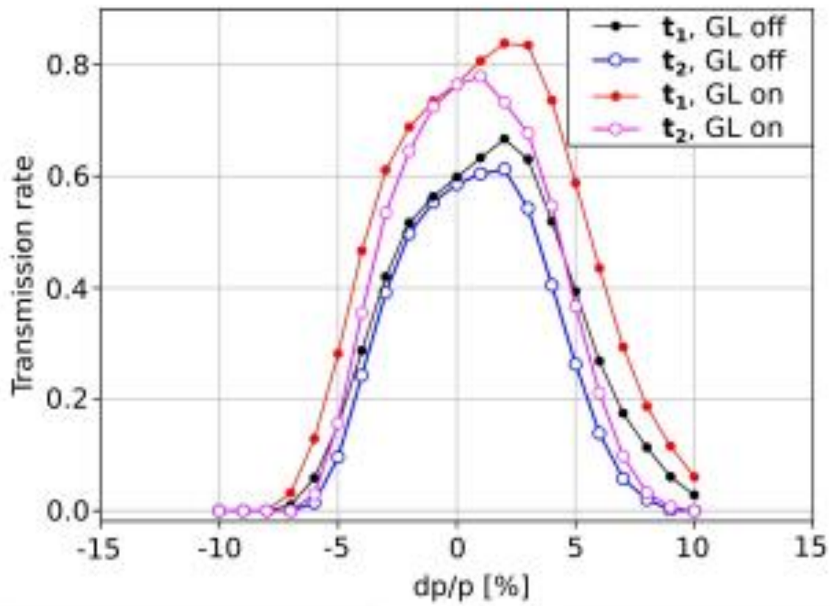

Figure 6: Transmission rate at t_1 and t_2 as a function of dp/p.

- Gabor lenses as part of very low energy (VLE) beamline of NA61/SHINE at CERN
  - Focus protons, pions, kaons with 1<p<13 GeV/c
  - Two 2m long lenses

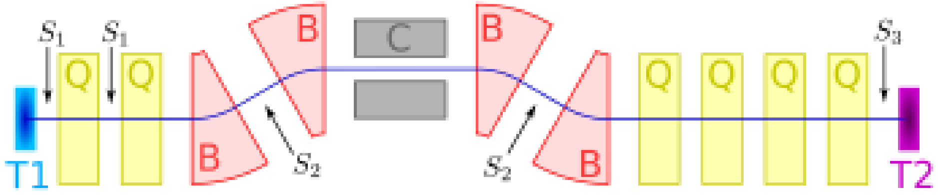

Figure 1: Conceptual design of the H2-VLE-beamline (CERN) from primary (T1) to secondary target (T2) including focusing and momentum selection devices and three possible positions for the implementation of Gabor Lenses.

Table 1: Accumulated transmission of initial 5×10^5 protons over all momentum deviation of ±10% on t_2

p [GeV/c]	Particles, GL off	Increase, GL on
1	13938	+36%
2	13156	+15%
3	13421	+6%
4	11975	+4%