

Characterization of the microdroplet target at the ESR

Eisenach, 28.06.2010

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H₂ - Microdroplets

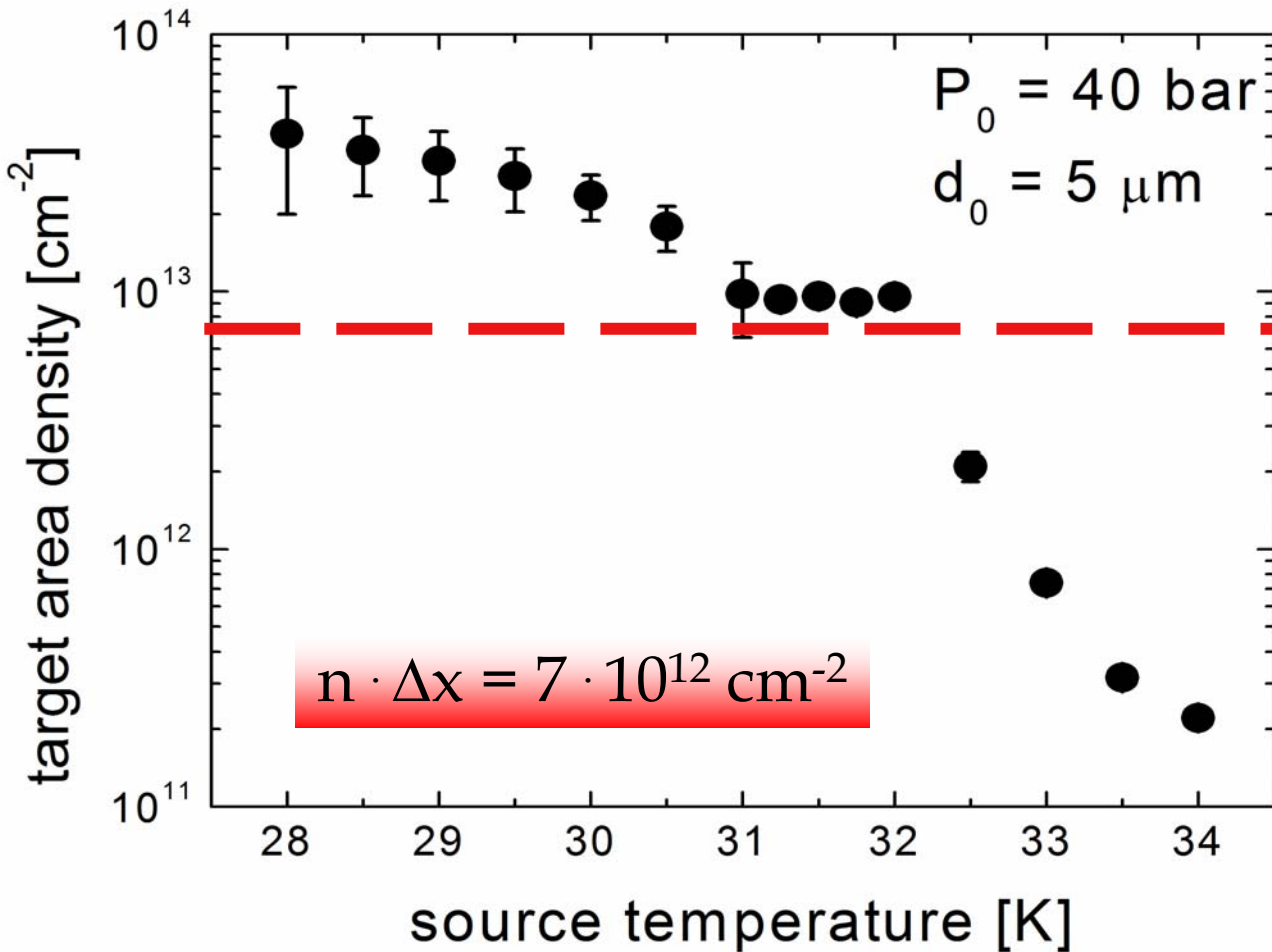
H₂ at P₀ = 40 bar and T₀ = 28 K

A grayscale micrograph showing a horizontal spray of hydrogen microdroplets. The droplets are concentrated in a narrow band below a dashed white horizontal line. The background is dark, and the droplets appear as small, bright, irregular spots.

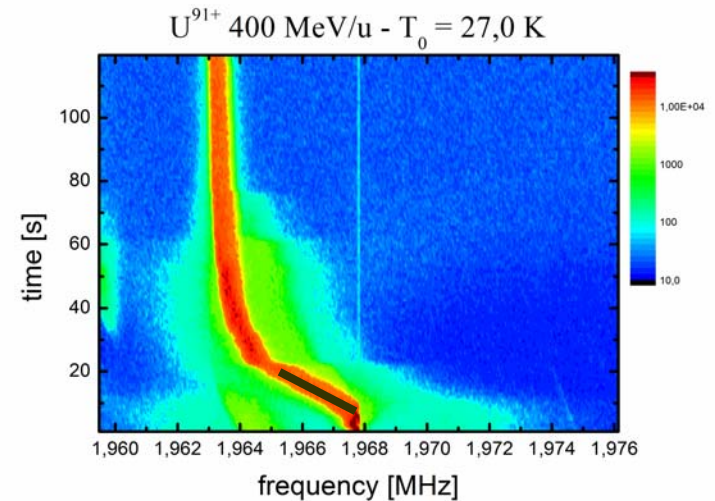
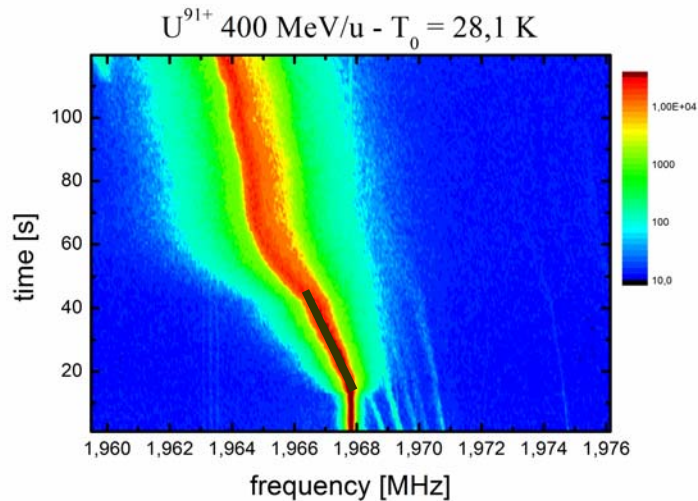
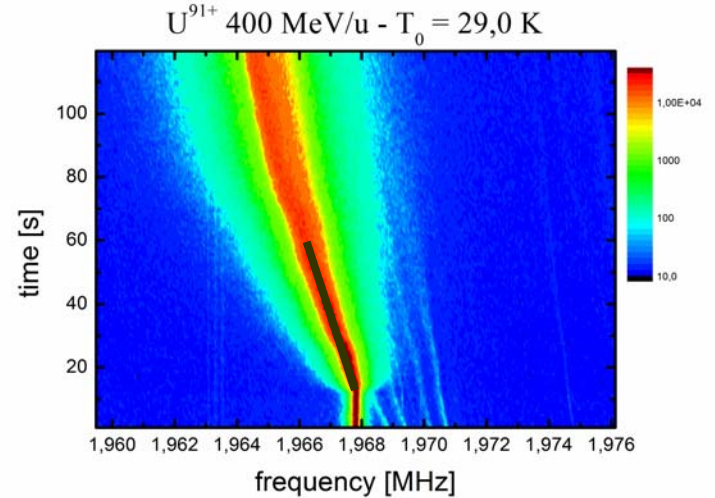
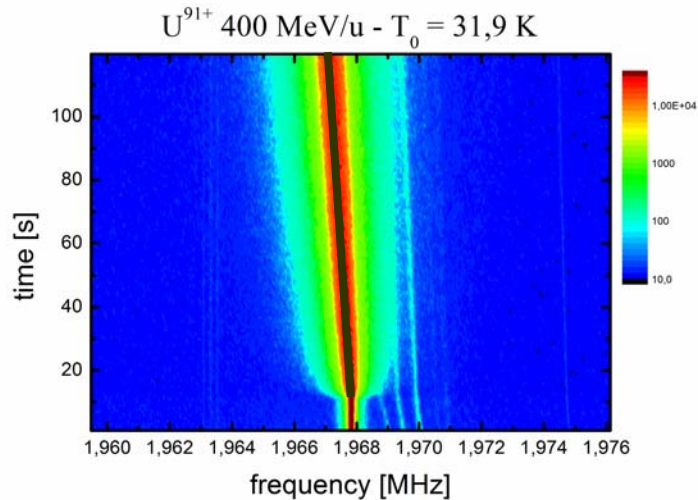
H₂ at P₀ = 40 bar and T₀ = 26 K

A grayscale micrograph showing a horizontal spray of hydrogen microdroplets. The droplets are concentrated in a narrow band below a dashed white horizontal line. The background is dark, and the droplets appear as small, bright, irregular spots.

Results - H₂ density



Energyloss at 400 MeV/u



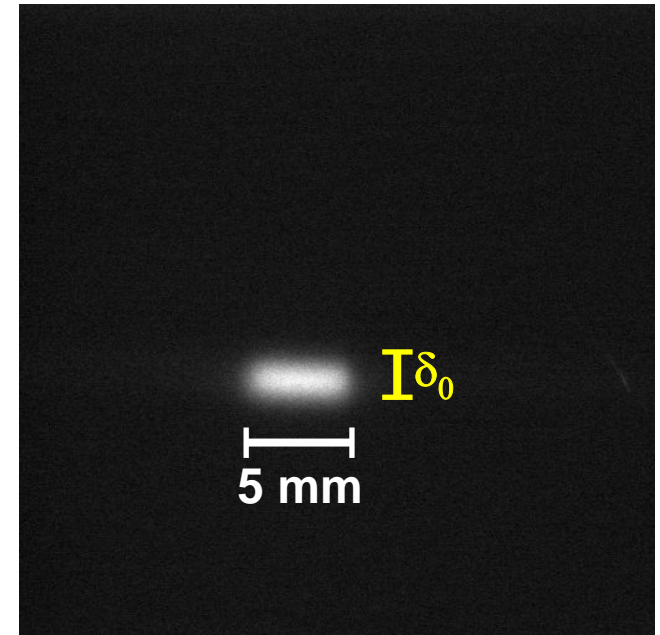
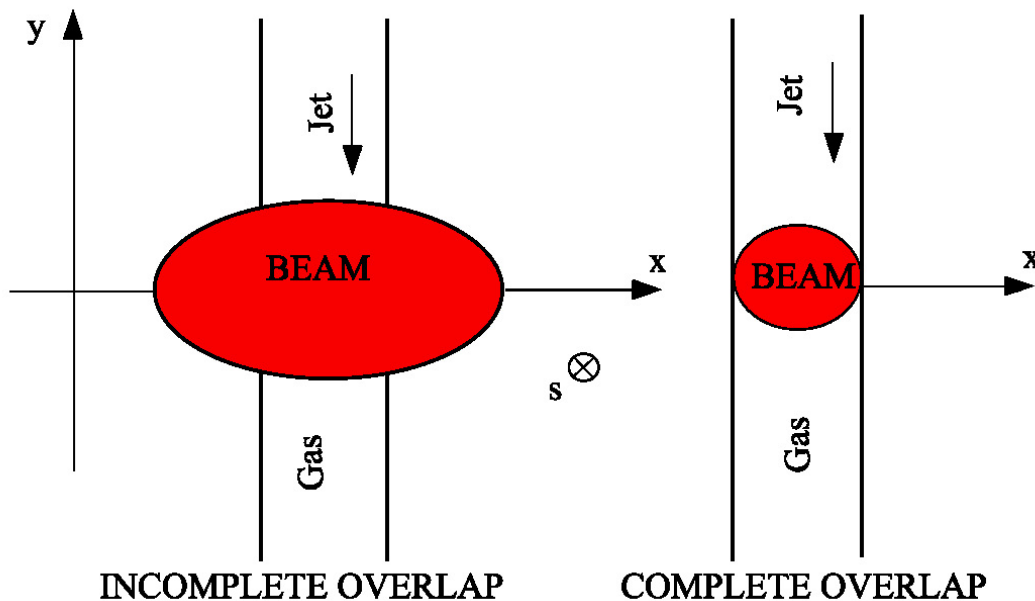
Transversal Beam Scattering

Emittance growth:

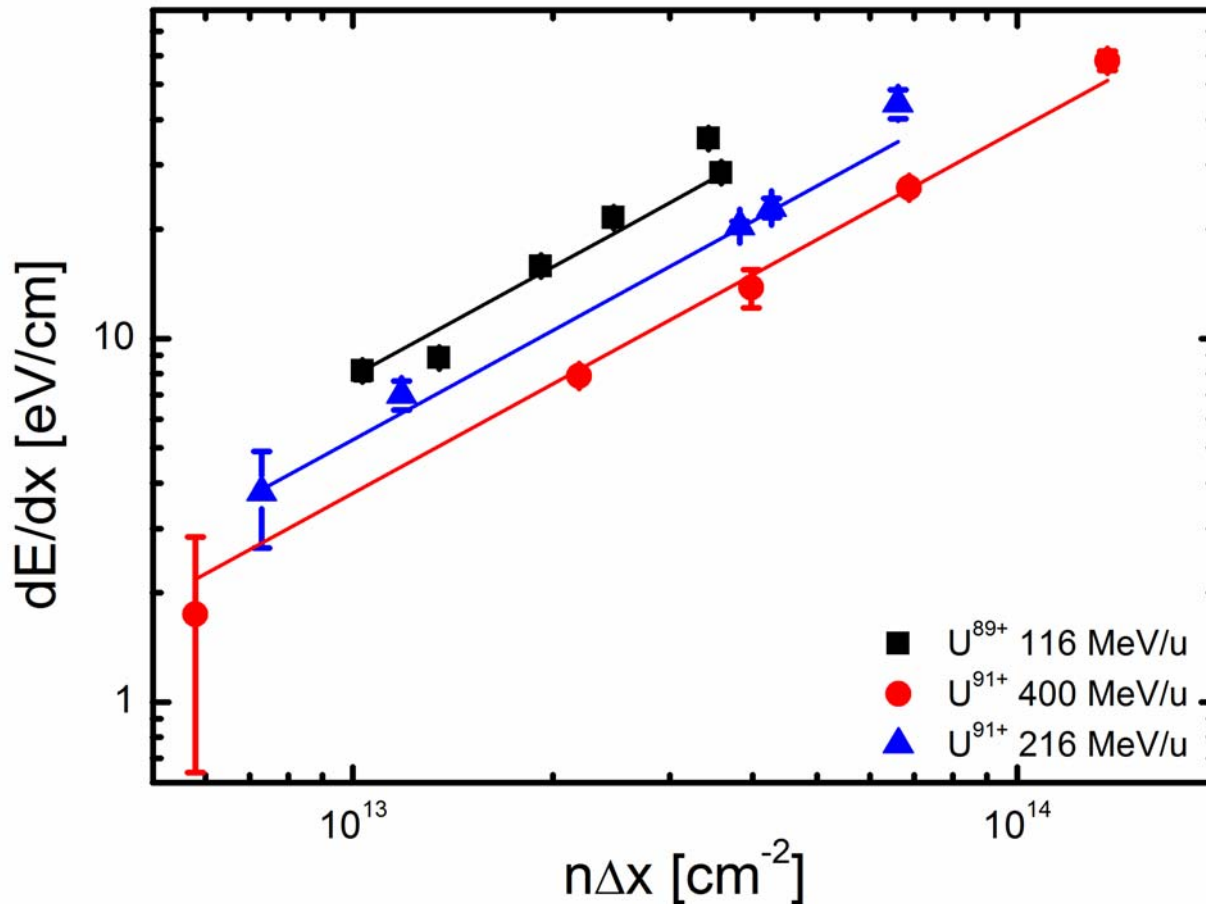
$$\varepsilon = \varepsilon_0 + \frac{1}{2} N \beta \theta_{rms}^2$$

Mean diameter of the beam:

$$\delta_0 = \sqrt{2\varepsilon_0\beta}$$



Results of Energyloss Measurements



Relative overlap correction factors:

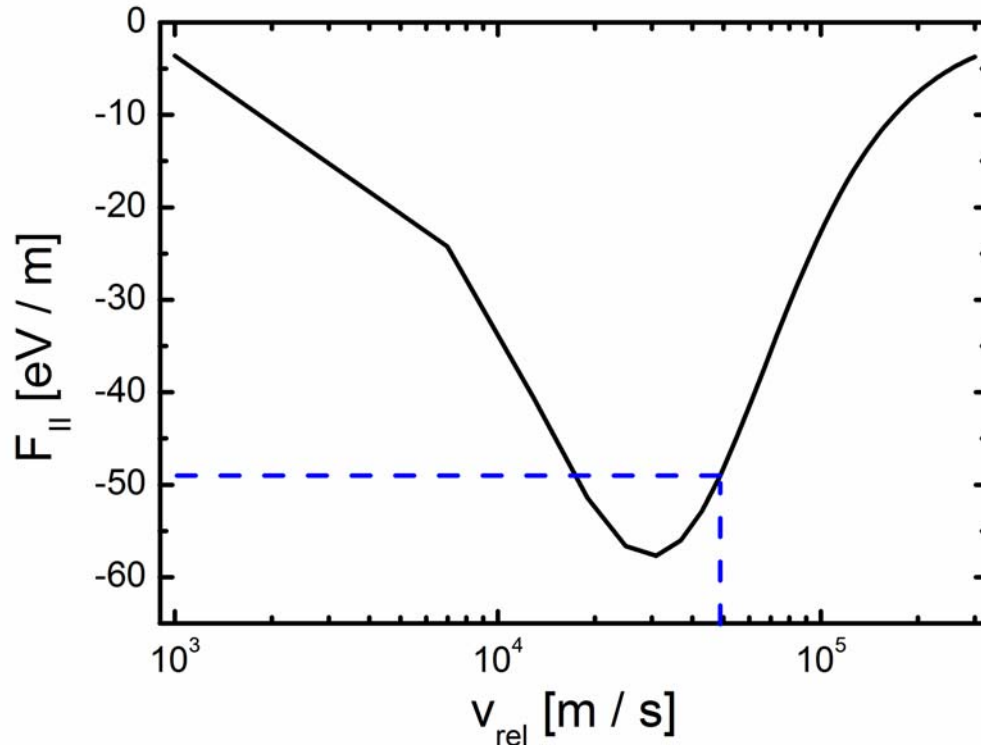
$$a_{corr} = \frac{\mathcal{E}_{116MeV}}{\mathcal{E}_{400MeV}}$$

$$b_{corr} = \frac{\mathcal{E}_{216MeV}}{\mathcal{E}_{400MeV}}$$

Calculated Cooling Force

$$\vec{F}_{cool} = -4\pi\vec{v}_i \frac{Z_i^2 e^4 L_p}{m_e} \frac{1}{(v_i^2 + v_{eff}^2)^{3/2}}$$

Parkhomchuk's Formula

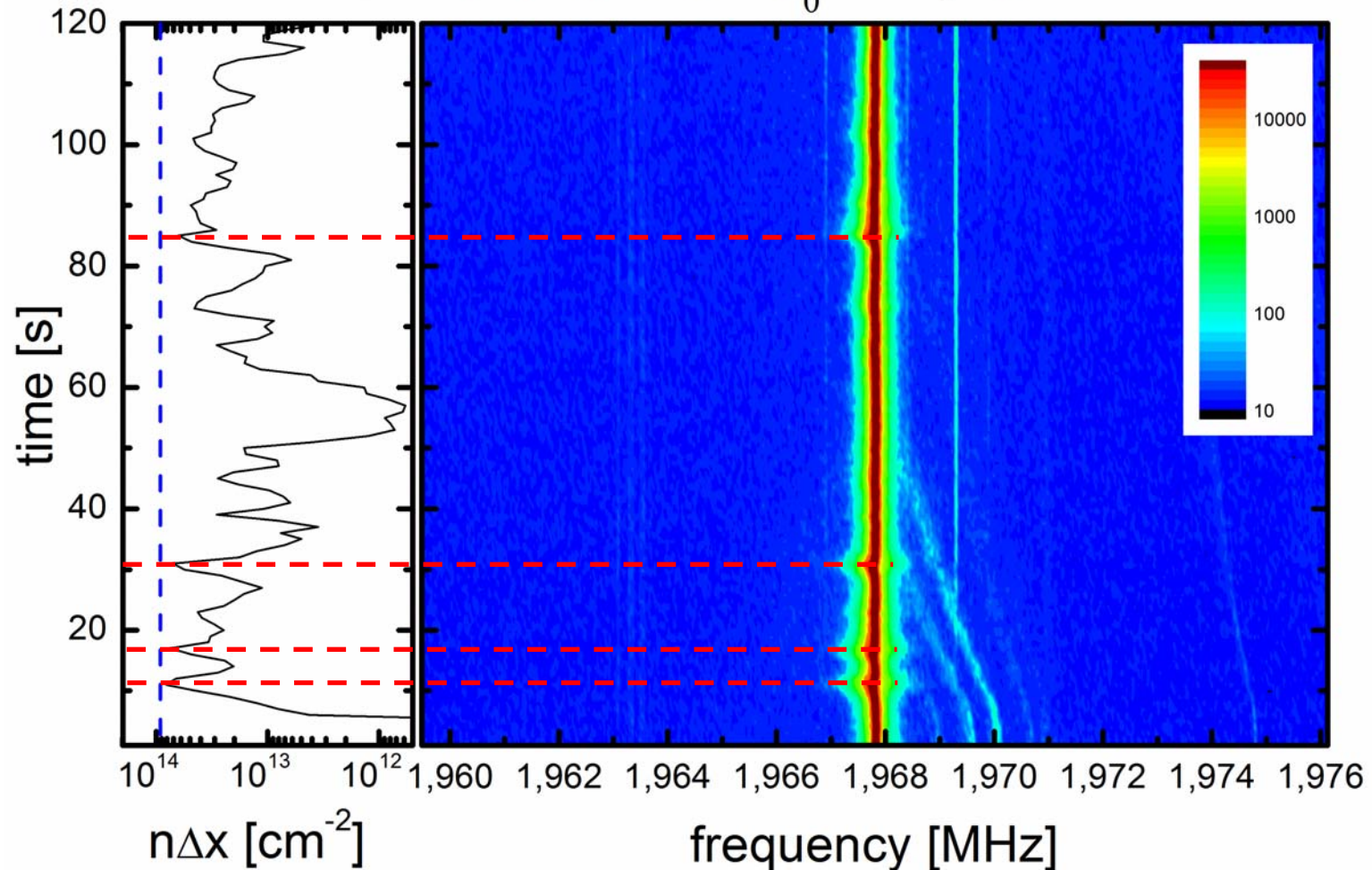


Calculated cooling force
(BETACOOOL-Code) for
 U^{89+} Beam at 116 MeV/u
250 mA electron current
1,8 m electron cooler length

(*Vitaliy Gostishchev*)

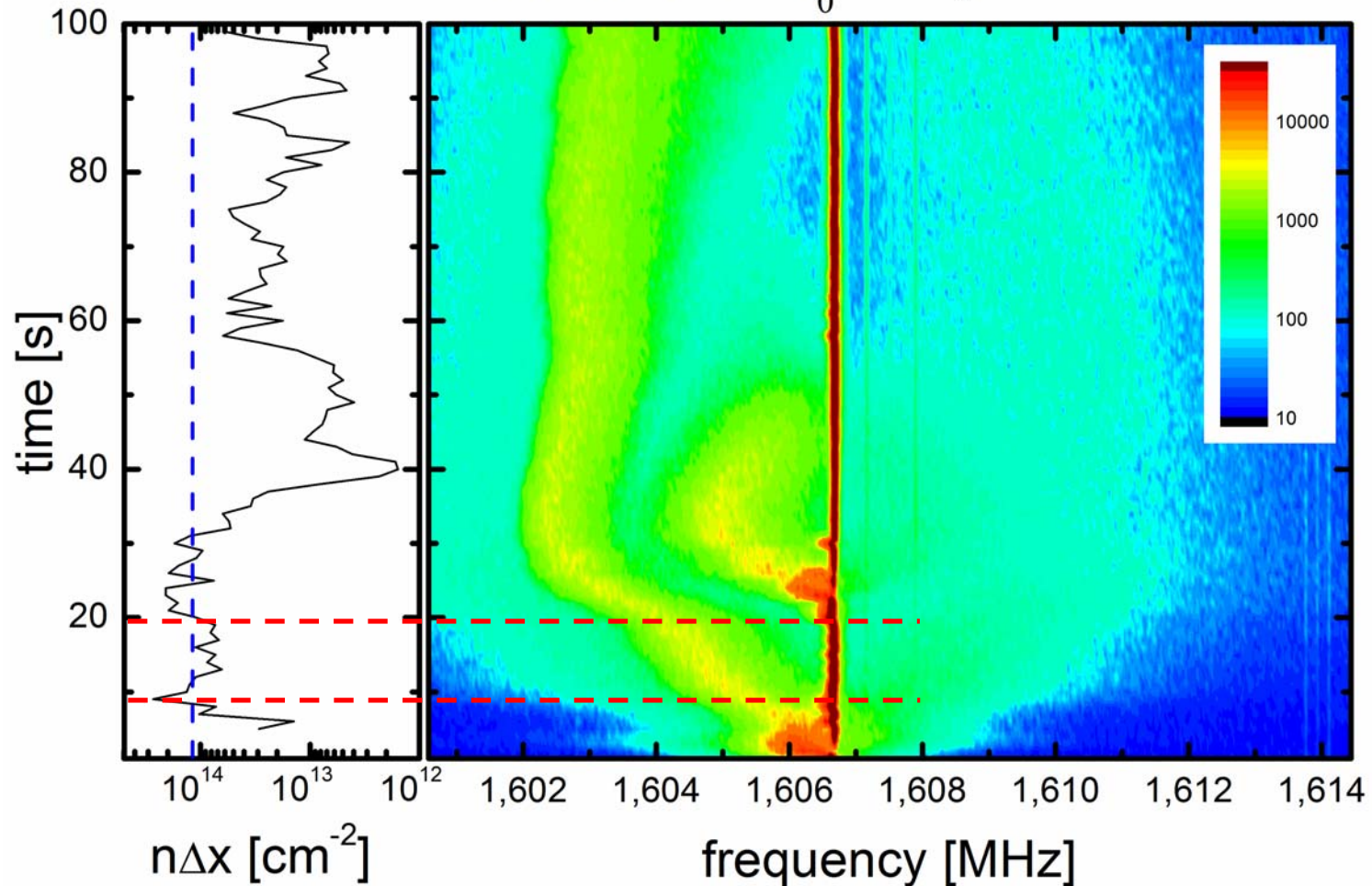
Cooler Performance

U^{91+} 400 MeV/u - $T_0 = 27,1$ K



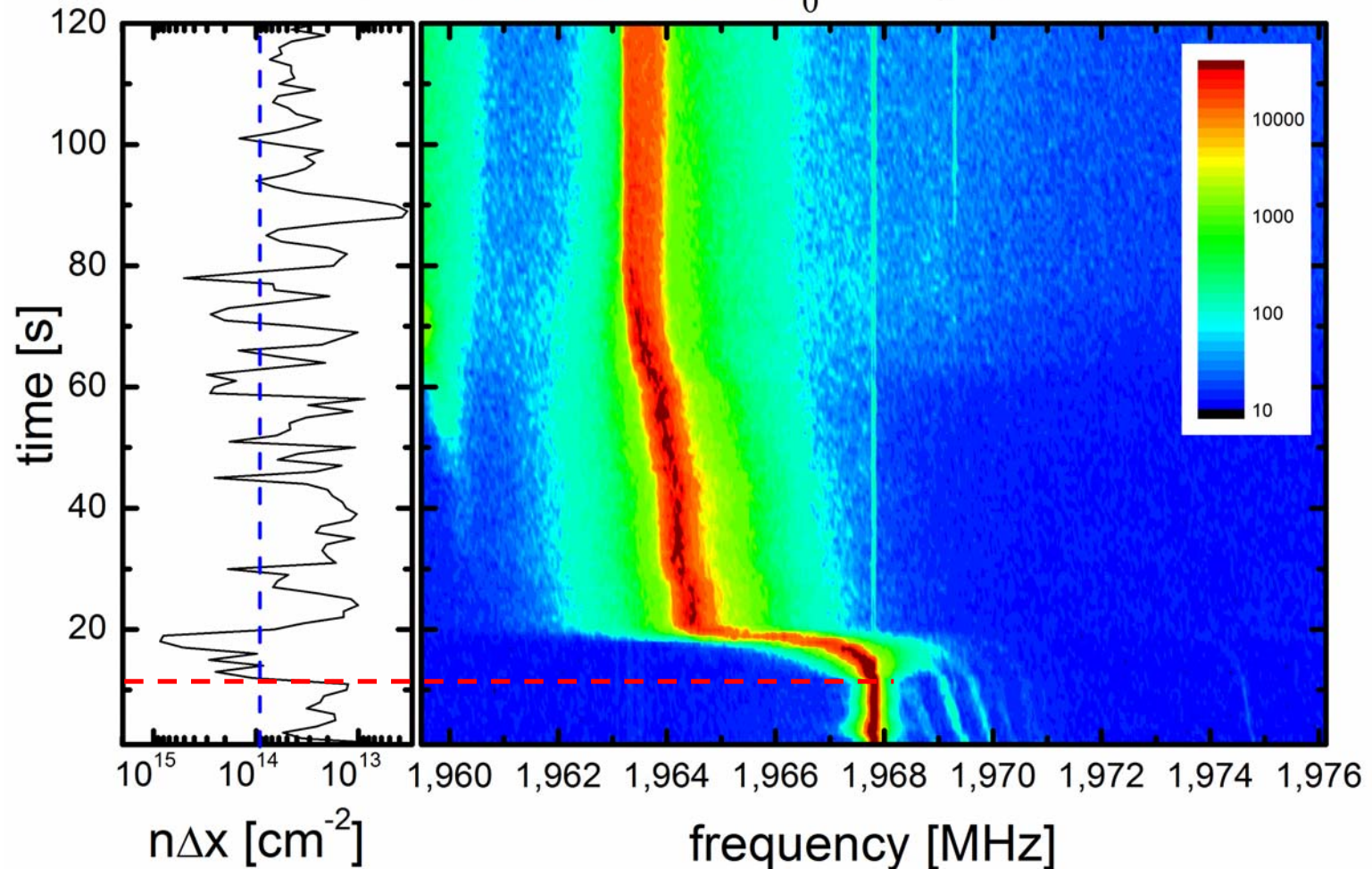
Cooler Performance

U^{91+} 216 MeV/u - $T_0 = 27,1$ K



Cooler Performance

U^{91+} 400 MeV/u - $T_0 = 27,1$ K



Summary

- Good agreement of measurements with theory for energy loss calculations
 - Verified electron cooler performance for **average** target densities (measurements with a time resolution of 1 sec.)
- Microdroplets don't seem to have influence on measured data

Open Questions:

- Maximum electron cooler performance (electron current)

Thanks to...

- AP-Group Thomas Stöhlker
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