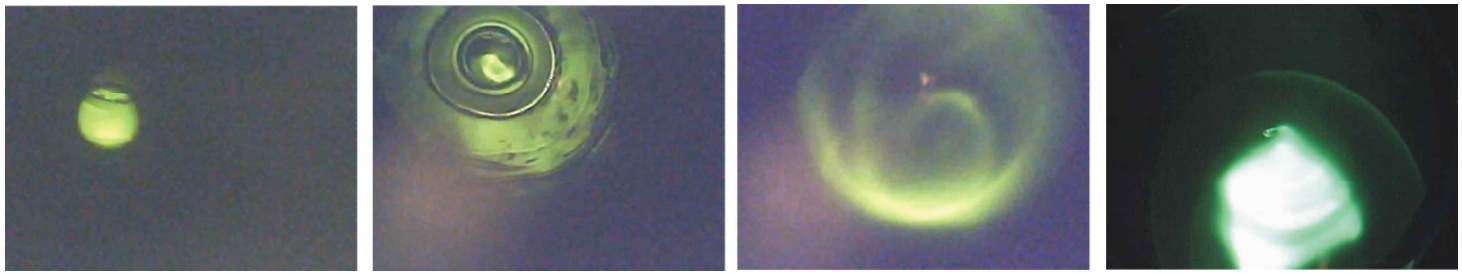
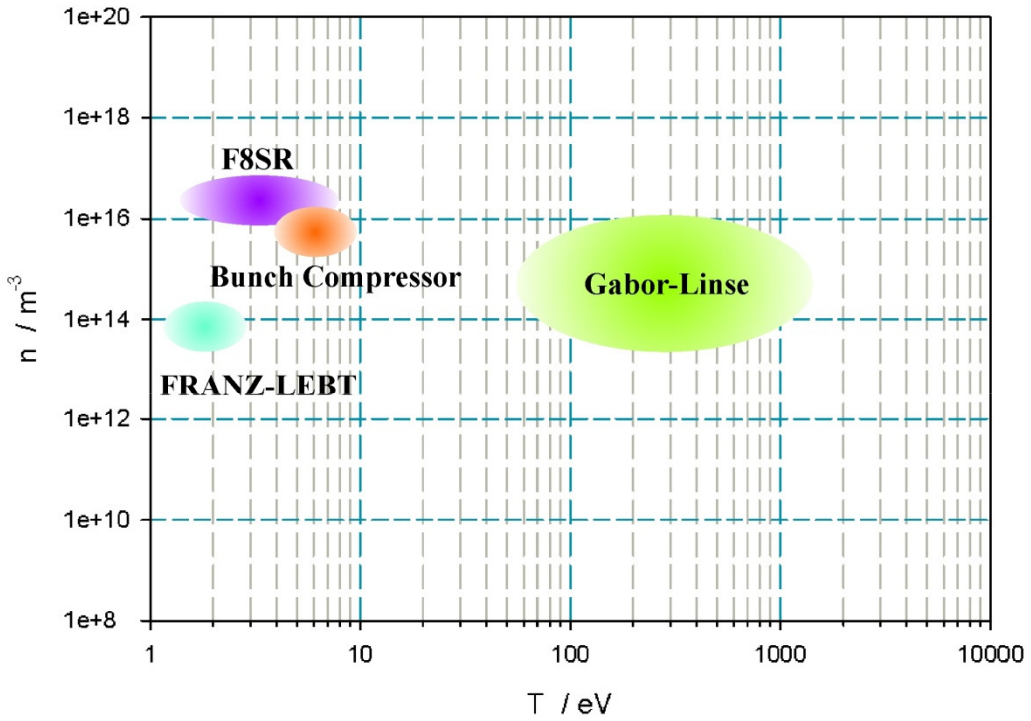
Non-Neutral Plasma and Ion Beams

M. Droba



Motivations



- Space charge lenses
- Intense ion beams (transport, focusing, chopper-systems, acceleration, accumulation)

Neutral Plasma

Number of particles in Debye sphere

$n\lambda_D^3 >> 1$

Debye length smaller than size of plasma

$\lambda_D < L$

Observed time scale longer than

$T > 2\pi/\omega_p$

Neutrality -> +=- (quasineutrality)

Non-Neutral Plasma

Number of particles in Debye sphere

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Debye length smaller than size of plasma

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$T > 2\pi/\omega_p$

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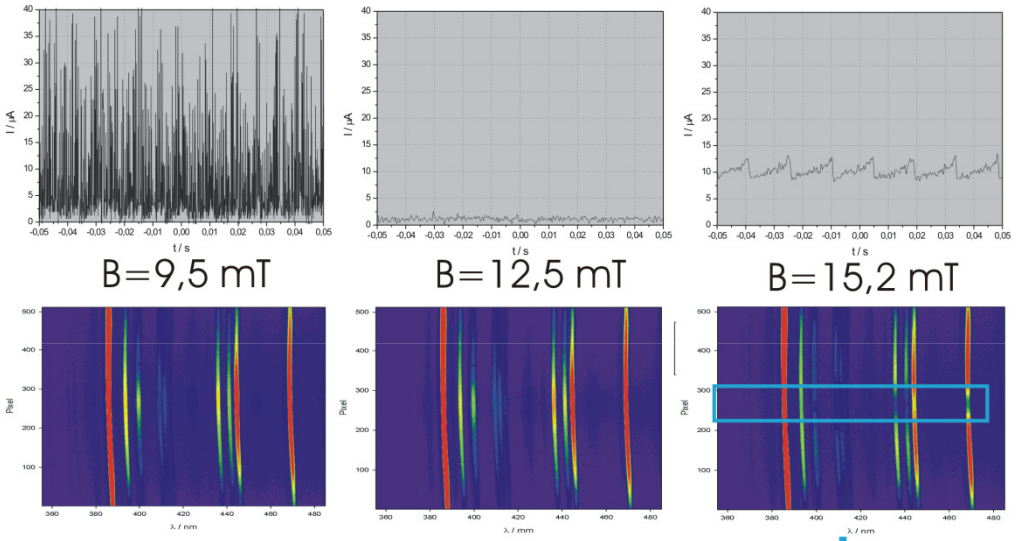
NNP

- Production – Extraction from NP, External production, Beam induced (ionisation and secondaries),

- Confinement - Traps
  - Beam potential – focal points (in kV range)
  - External fields
    - magnetic (bottle and cusp configurations)
    - electric (potential well)
    - combination of both

Gabor lens – different states



Detected ion current – Faraday cup measurement

Optical spectra Background gas

Diocotron “slipping-stream” instabillity

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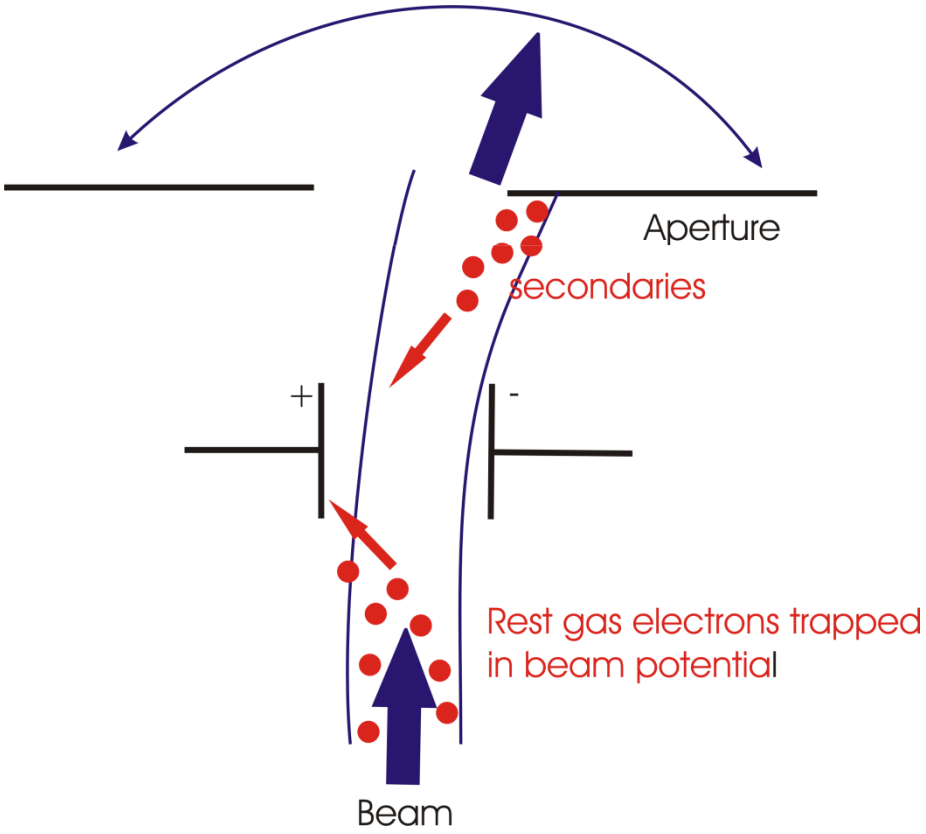
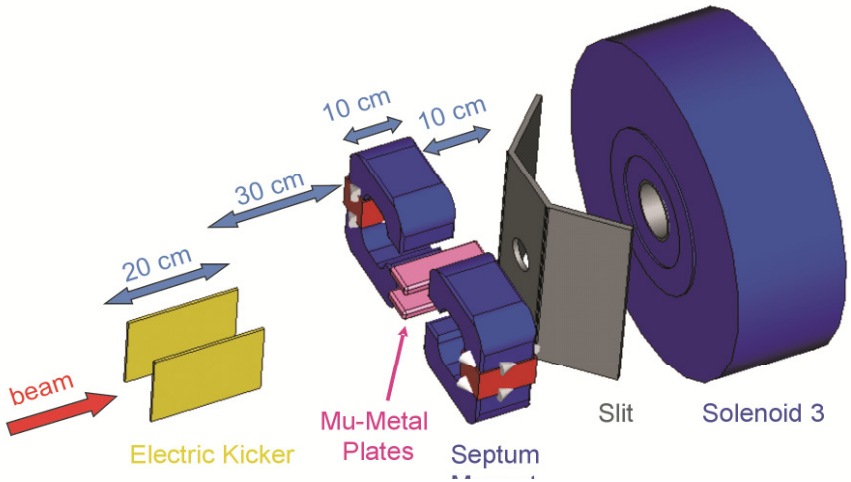
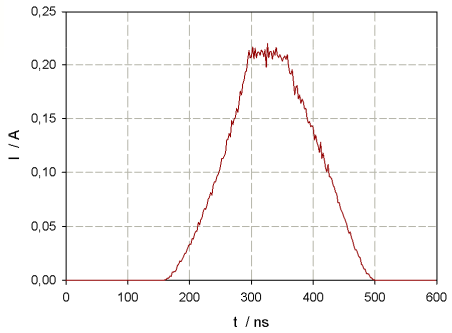
Electron clouds

Example – electric chopper







150keV p, 200mA
ϕmax30 kV, 250kHz
Red electrons
Blue protons

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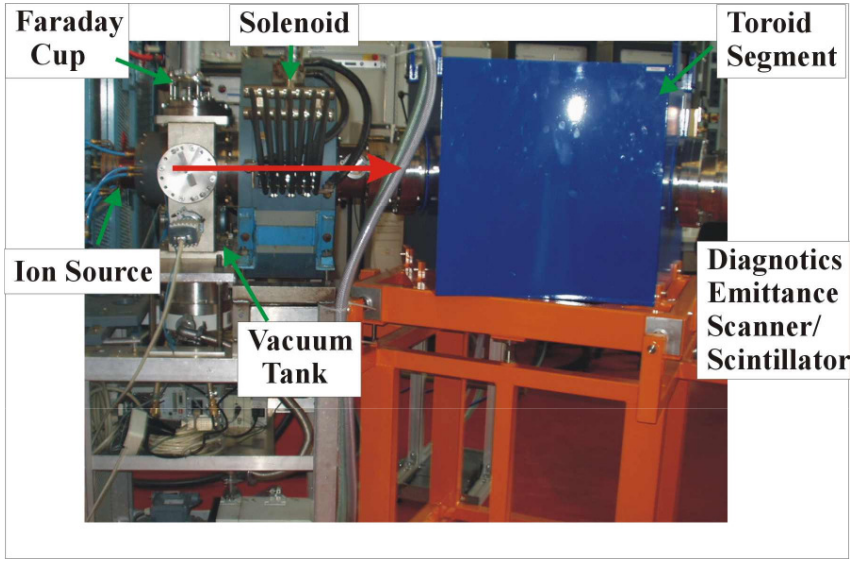
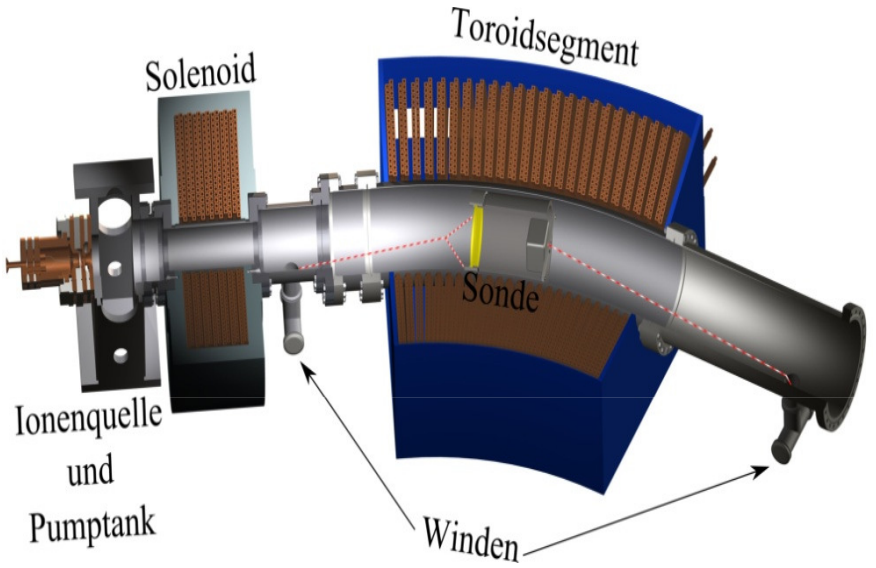
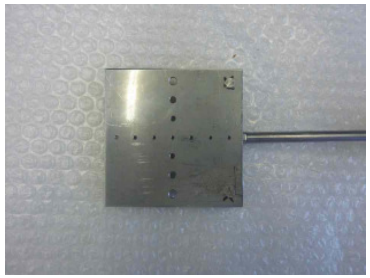
Beam Transport Experiments



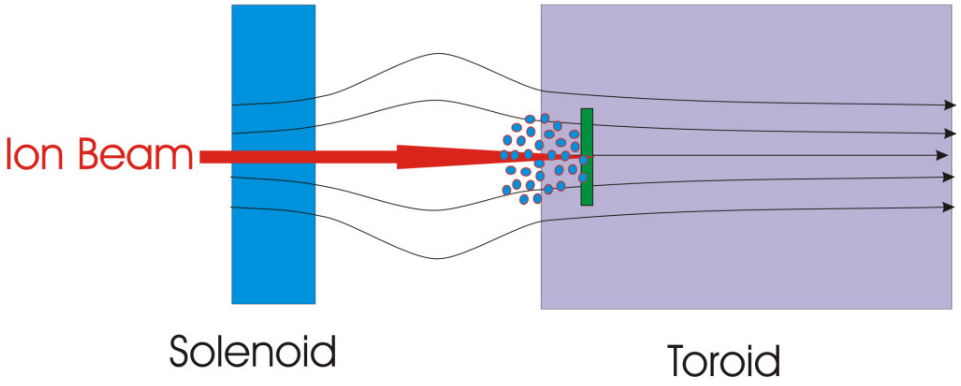


No. of winding	33×24
Maximum Magnetic field on axis	$0.6\ T$
Maximum Voltage and Current	$140\ V, 480\ A$
Major Radius R_0	$1300\ mm$
Arc angle	$30°$
Arc length	$680\ mm$
Diameter of aperture	$200\ mm$
Magnetic Shielding	absent
Cooling water	$70\ l/min$
Weight	$1050\ kg$

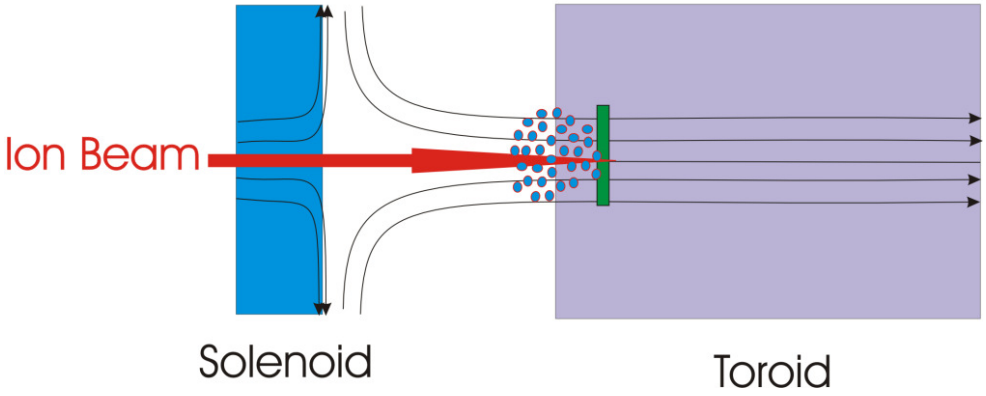


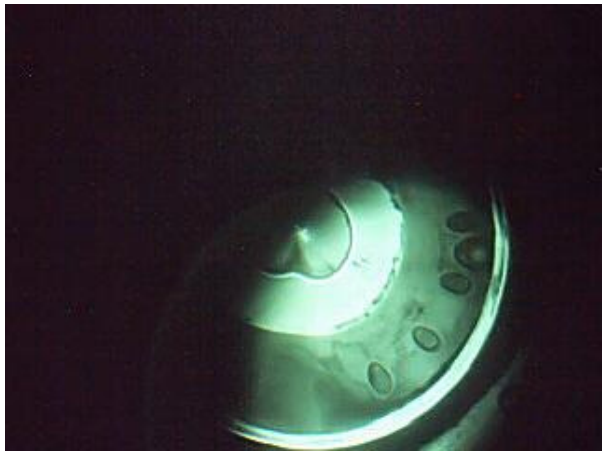
- Filter installed before solenoid
- Holes about 2mm horizontal direction and 3mm and 4mm in vertical direction

Magnetic bottle

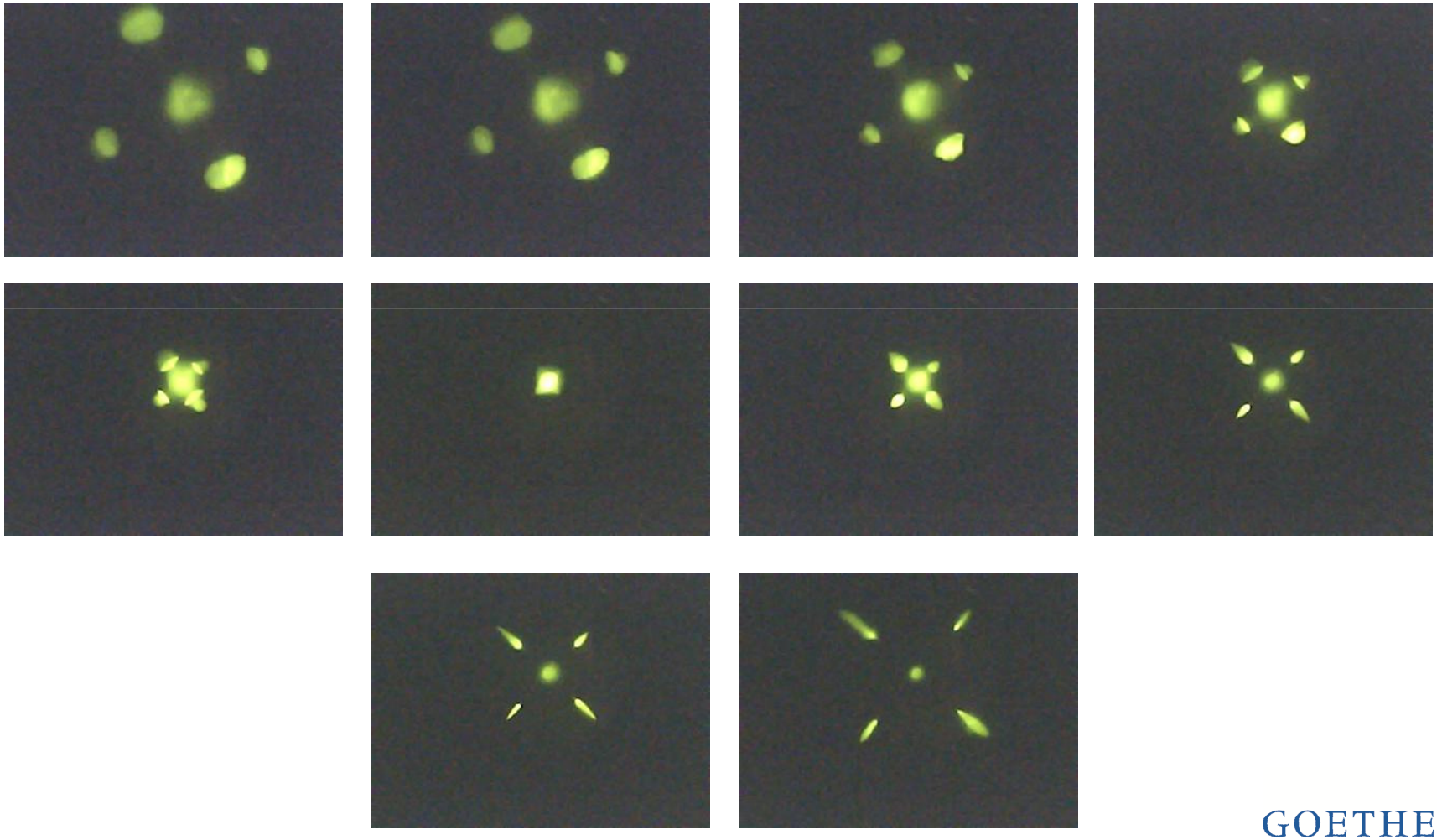


Cusp





- He – beam 8 keV
- Solenoid field varied from 0.4T – 0.52T



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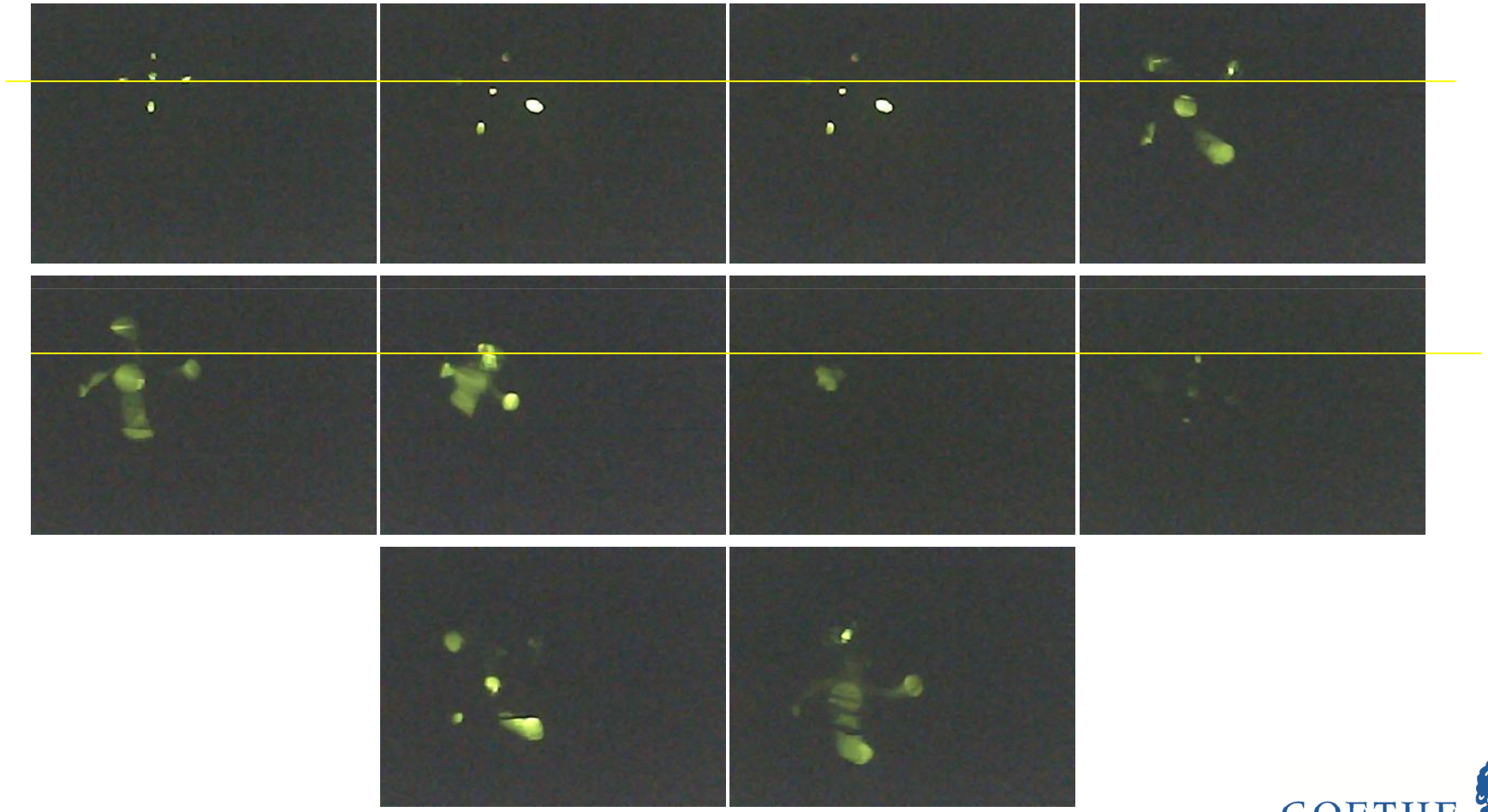
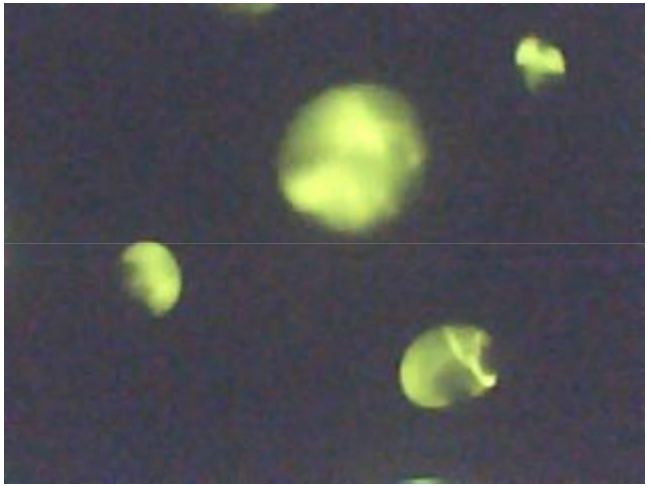
- He – beam 8 keV, Solenoid field=0.26T , Toroid field=0.53T
- Probe moved longitudinally position1- position10



NNP and Intense Ion Beams

- Diagnostic
- Simulations
- Theory
- Experiments

- p – beam 8 keV (other components H_2^+, H_3^+)
- Solenoid field varied



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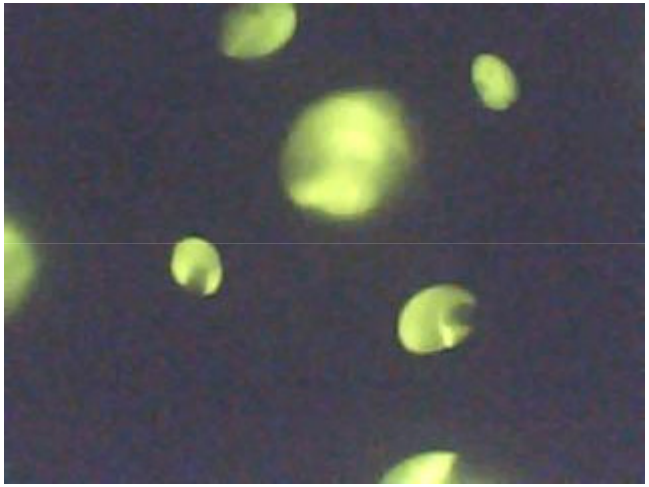

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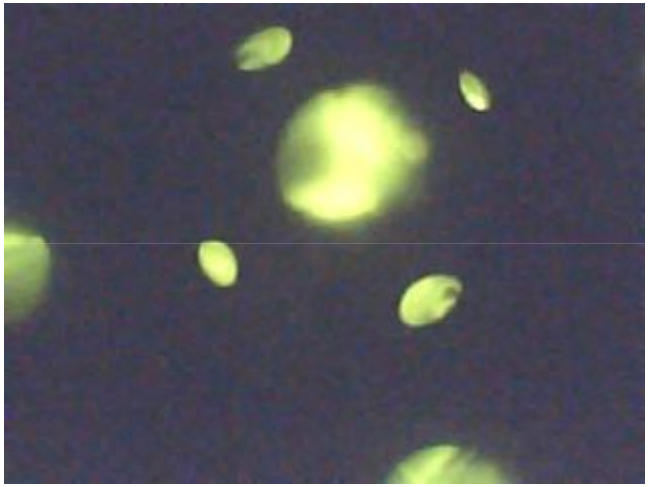

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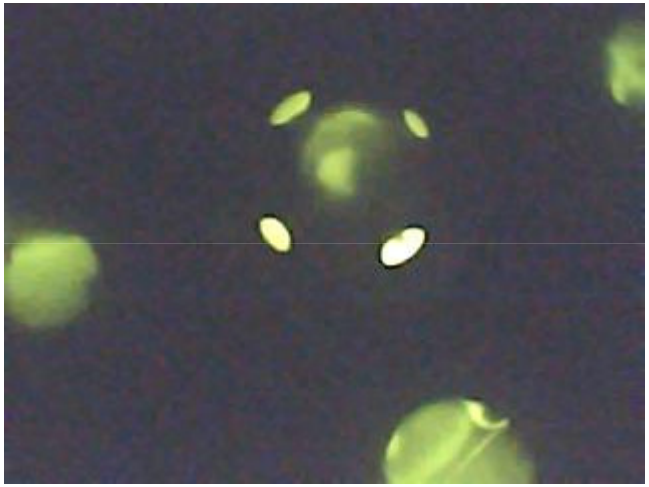

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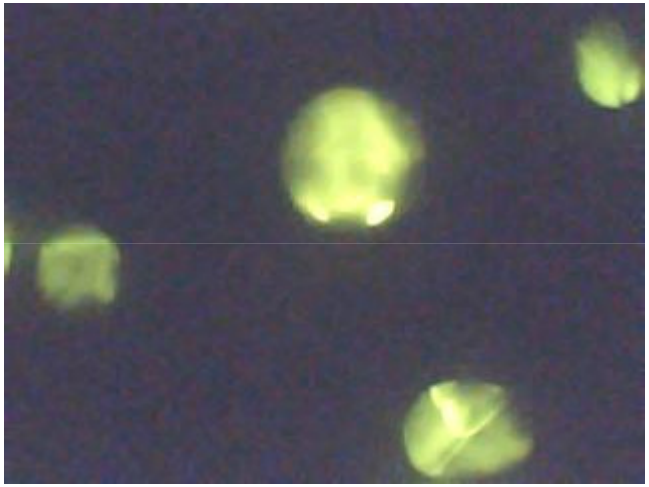

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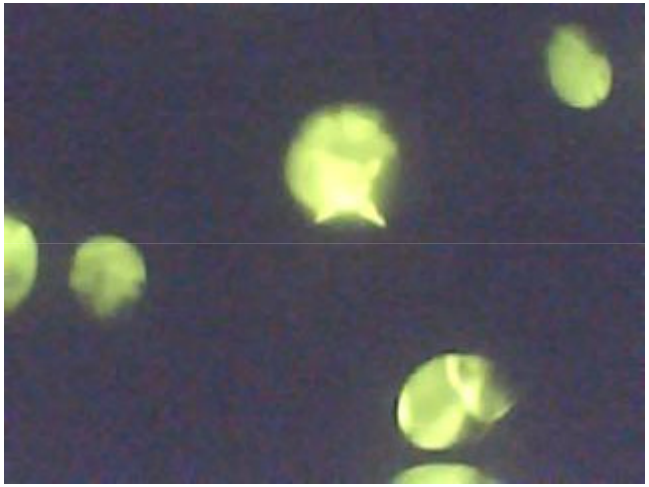

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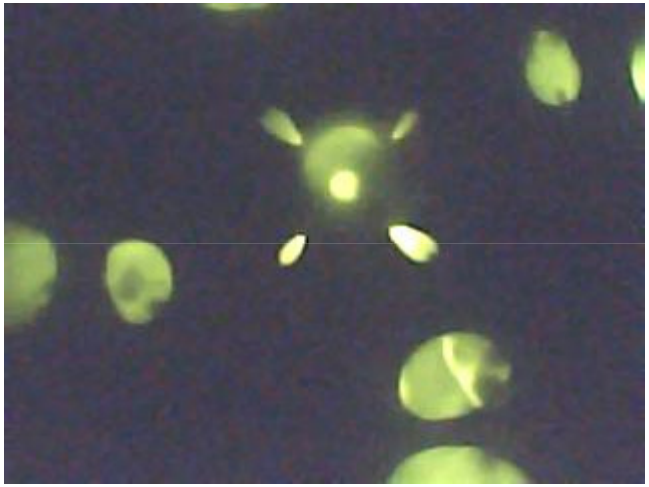

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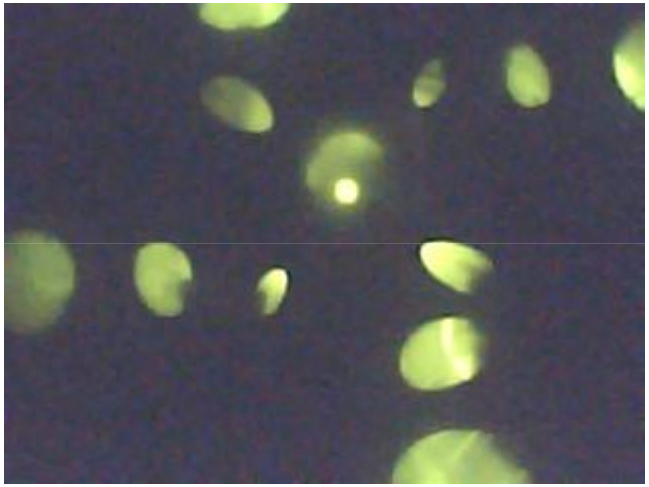

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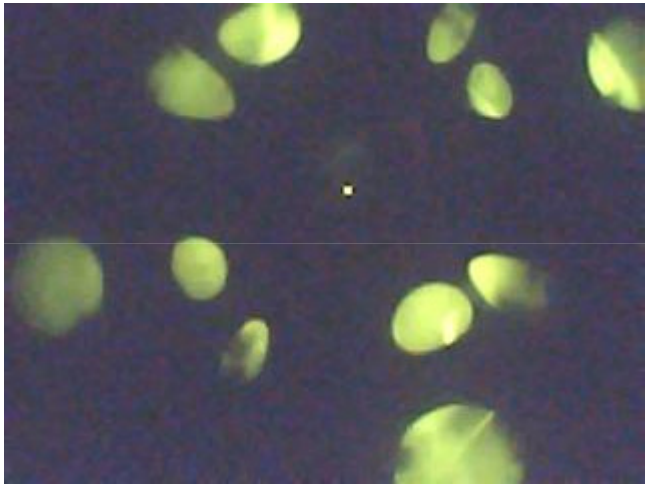

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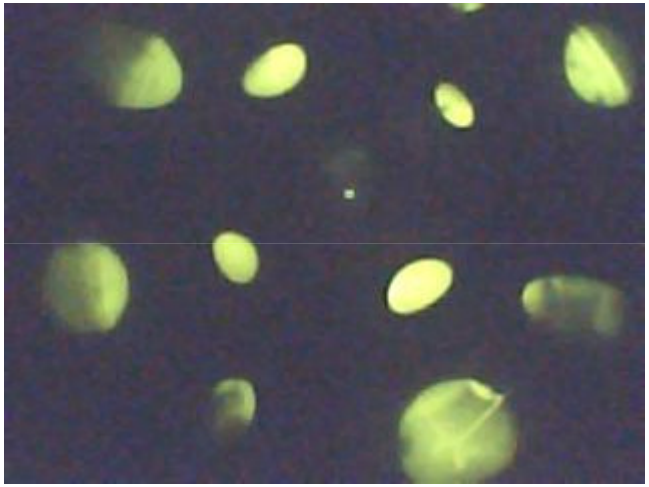

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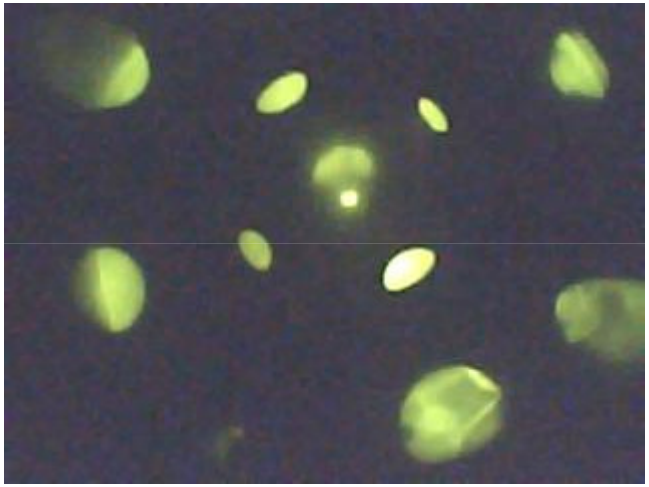

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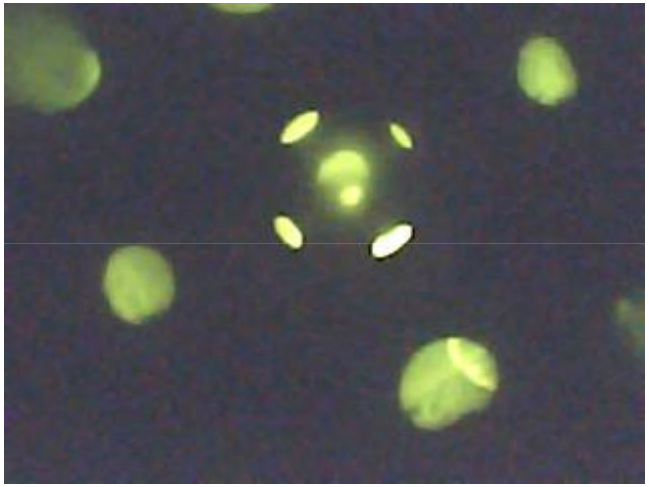

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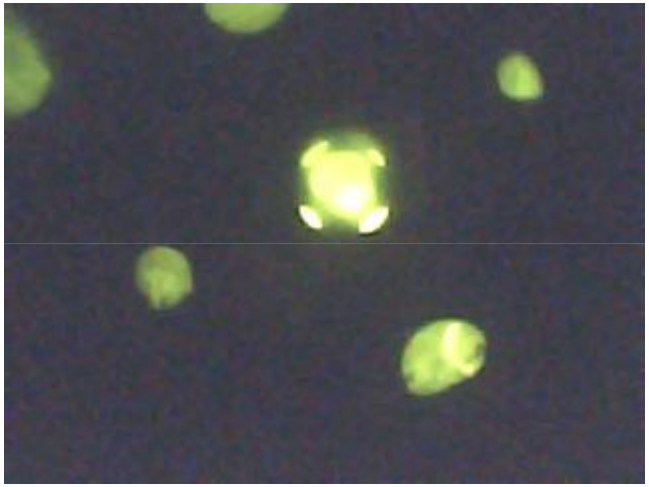

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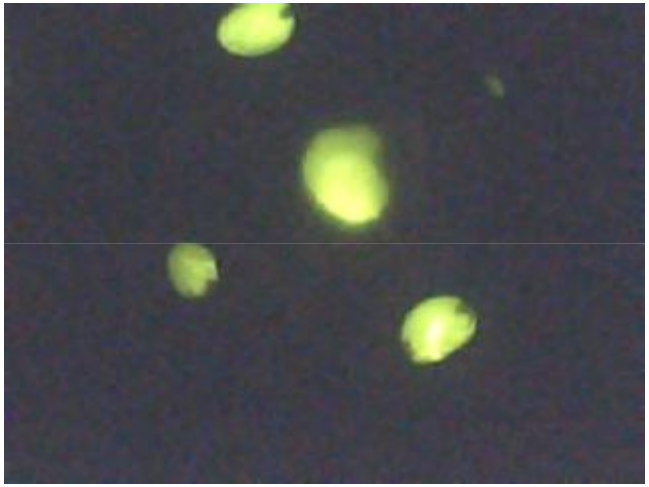

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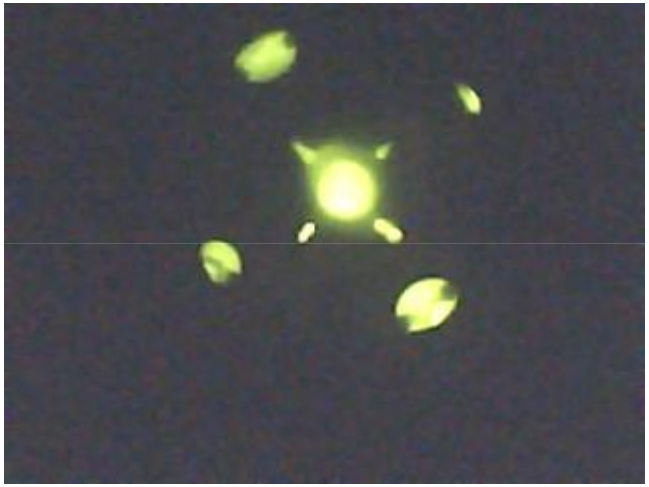

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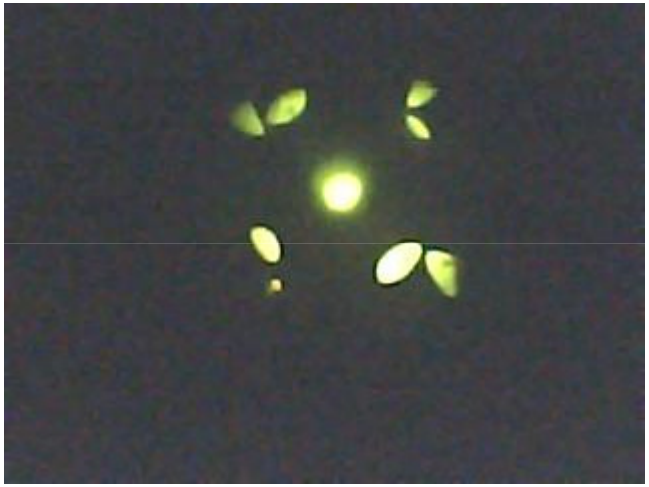

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