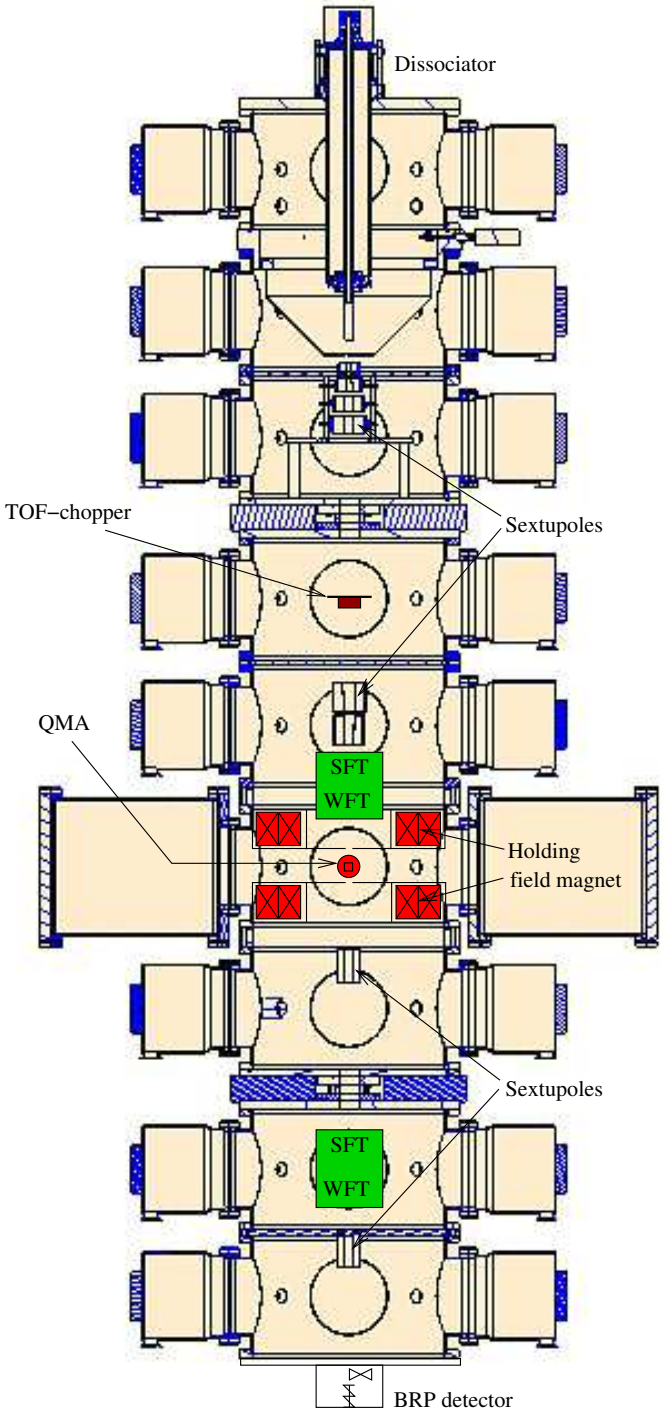
Update on the H-Jet

1. TOF measurements

2. First setup to measure the degree of dissociation using an electron gun (JET beam analyzer)



Alexander Nass, Brookhaven National Laboratory September 2nd 2004

TOF Measurement

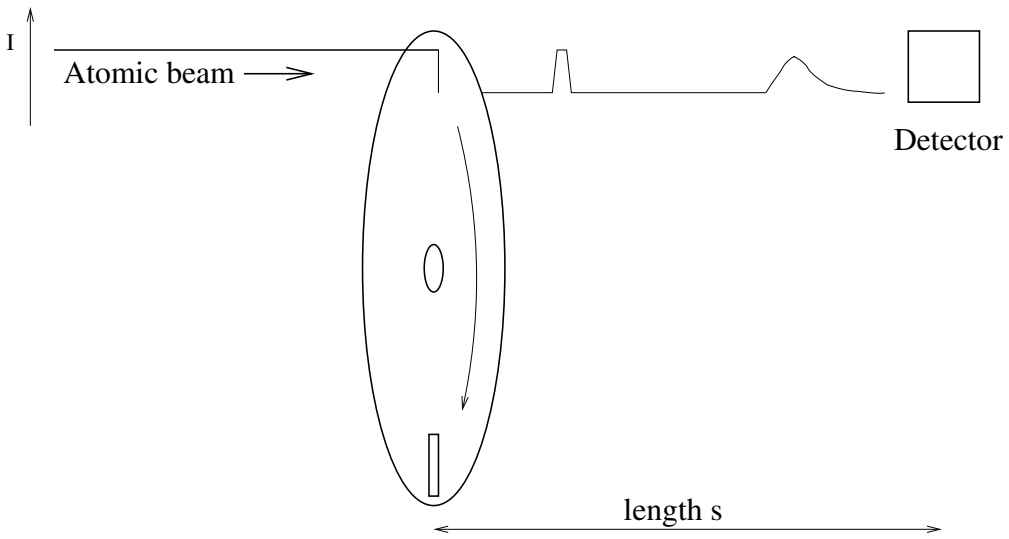
- TOF measurements done using a high frequency transition and BRP.

  But: Velocity distribution was altered by the sextupole system of the BRP.
  $\Rightarrow$ No clear information about velocity at IP.

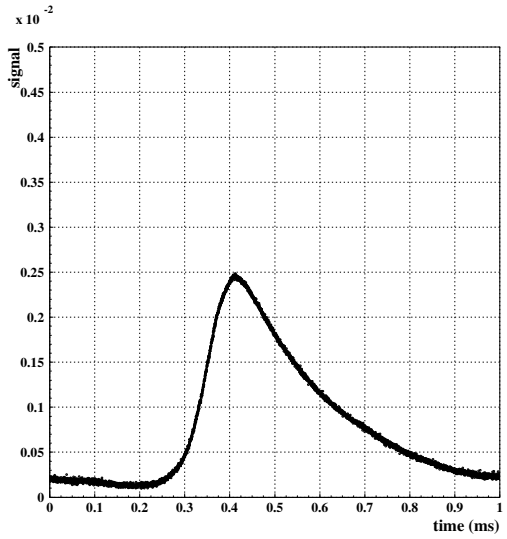
- New setup includes insertion of a fast chopper (up to 300 Hz) in chamber #4 and measurement of the TOF distribution at the IP.

  $\Rightarrow$ Direct measurement of the velocity distribution at the IP.

  $\Rightarrow$ Exact determination of the target density.



TOF Measurement



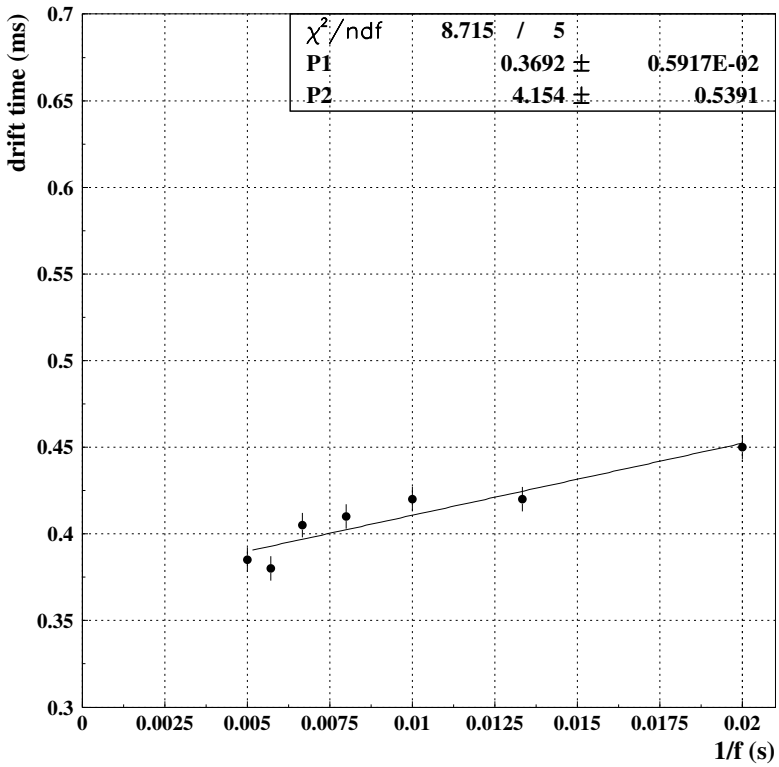
- Light break on the chopper gives reference time
- Time measured until atoms arrive at the QMA
- Signal is a convolution of the velocity distribution of the atoms and the so-called opening function of the chopper window

$\Rightarrow$ Deconvolution necessary

TOF Measurement

- Parametrization of the TOF signal necessary for deconvolution, but difficult due to non-Maxwellian distribution.
- Influence of the opening function is decreasing as the speed of the chopper increases.

  $\Rightarrow$ Measurements at different speeds and extrapolation.



$\Rightarrow$ Result: v = 0.65m/0.369ms = 1760$\pm$20 m/s

Variations in dissociator parameters (H_2 flux, T_{nozzle}, P_{RF}) changed this value by 50 m/s maximum since the velocity is almost fixed by the transmission function of the sextupole magnets.

Areal density of the JET

- FWHM of the JET (measured): 5.5 mm
- Measured intensity of full beam: $12.5 \cdot 10^{16}$ atoms/s
- Using measured velocity: $\rho_z = 7.35 \cdot 10^{10}$ atoms/mm
- Assuming Gaussian distribution:

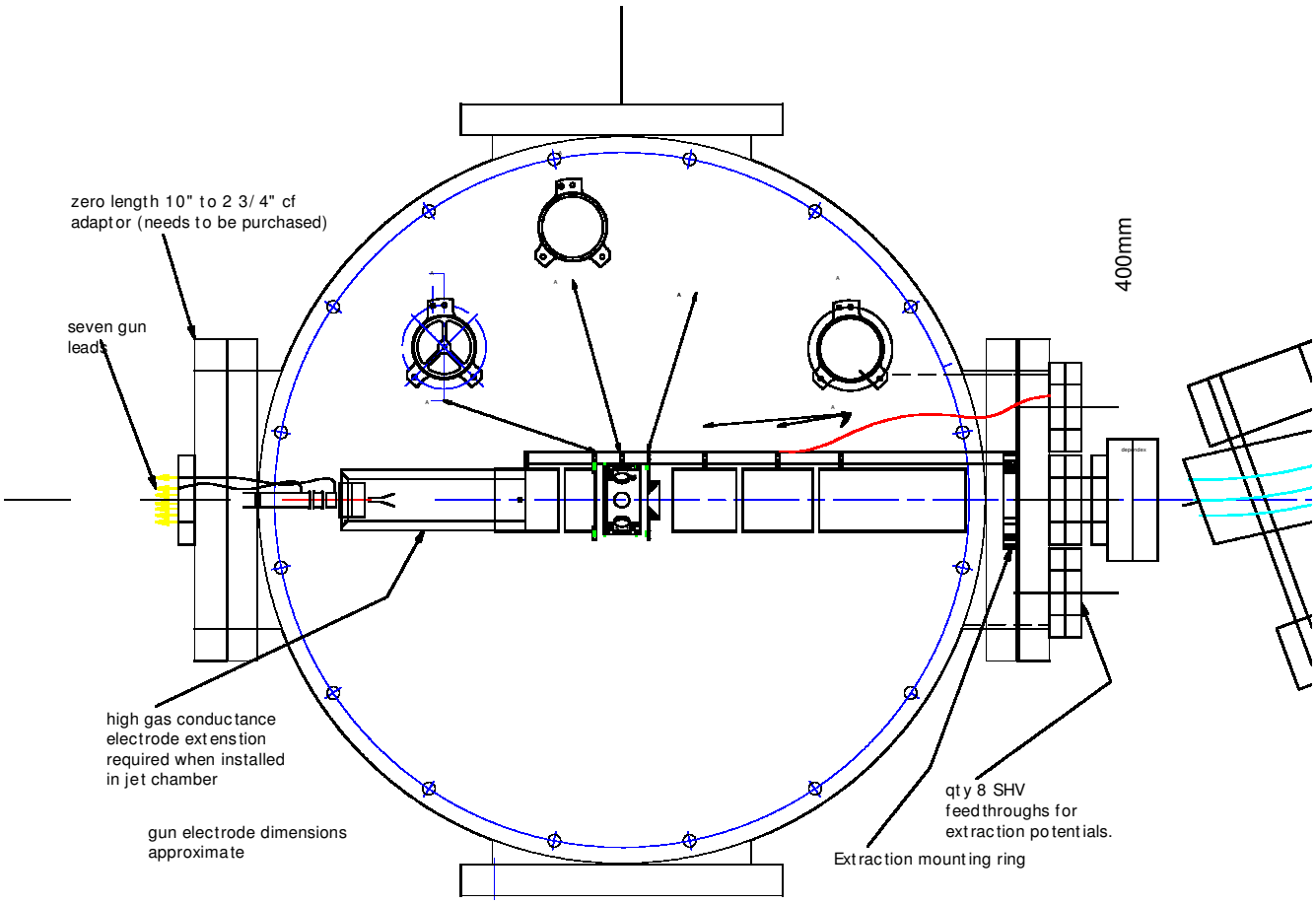
$$f(x,y) = \frac{\rho_z}{2\pi\sigma^2} \exp \frac{-(x^2+y^2)}{2\sigma^2} \qquad (1)$$

- Density for RHIC interaction (square of 1mm x 1mm):

$$\begin{aligned}
\rho_{\mathrm{RHIC}} &= \int_{-0.5}^{0.5}\int_{-0.5}^{0.5}\int_{-\infty}^{\infty} f(x,y)dxdydz \\
&= 1.19 \cdot 10^{12} atoms/cm^2 \quad \text{(centered beam)} \\
&= 1.09 \cdot 10^{12} atoms/cm^2 \quad \text{(1mm off center)} \\
&= 0.84 \cdot 10^{12} atoms/cm^2 \quad \text{(2mm off center)}
\end{aligned}$$

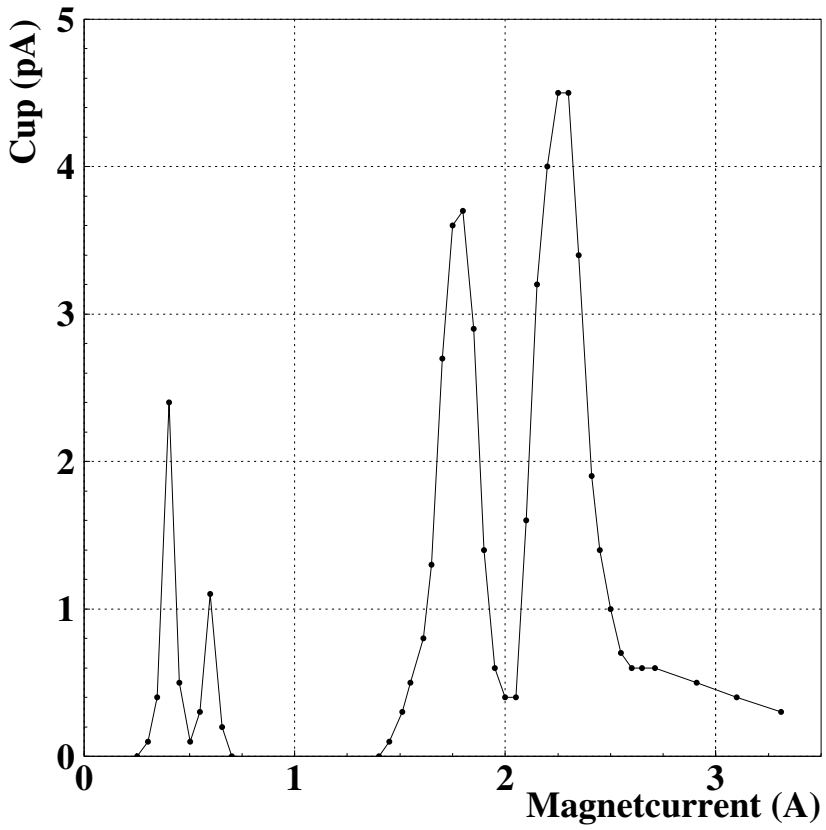
$\Rightarrow$ Centering very important

JET beam analyzer setup (Wisconsin)



Electrons have same path as RHIC protons $\Rightarrow$ measurement independent of beam profile

JET beam analyzer setup (Wisconsin)



- Resolution of mass 1, 2, (14+16+18), (28+32) achieved
- Next tasks:
  - Improve resolution (separate mass 14,16,18,28,32)
  - Verify that the peak heights and/or peak integrals reflect the gas composition. Will be done with water vapor whose cracking ratio at our e- energy of 600V is known to 2%.