

Optical spectra from Beam Induced Fluorescence (BIF) profile monitor*

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The development of non-interceptive beam diagnostics methods is of high relevance for the future FAIR accelerator facilities. One of these methods is based on Beam Induced Fluorescence (BIF), based on photons detection emitted by residual gas molecules, e.g. Nitrogen, excited and ionized by the ion beam. Such monitors are already in operation at GSI's LINAC since a few years [1]. However, further BIF-monitor developments are required for applying this method to high energy beams, as those to be delivered by FAIR's SIS100 synchrotron.

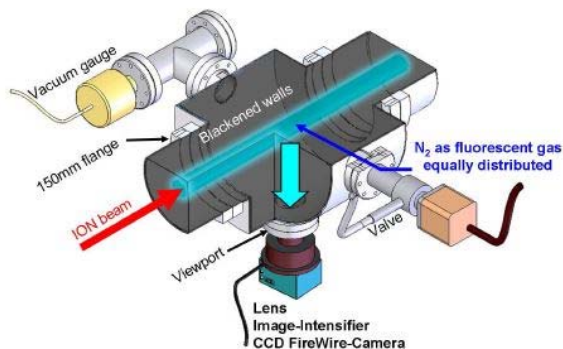


Figure 1: Typical set-up of a BIF profile monitor [2].

For this purpose beam profile and spectroscopic investigations have been performed with different gases in the pressure range from $1 \cdot 10^{-3}$ to 2 mbar. Heavy ion beams at energies between 100 and 900 MeV/u for slow and fast extraction mode could be used.

A typical experimental set-up is shown in Figure 1. The gas chamber is mounted on the beam line and has blackened inner walls to avoid light reflections. The chamber can be filled by different gases through a needle valve regulated by a vacuum gauge. Single photons emitted by the excited gas molecules are detected by image intensified cameras, either by an ICCD equipped with MCPs in Chevron geometry (Proxivision) or an emCCD (Princeton Instruments ProEM+:512B).

During the experiments performed in 2014 three different set-ups have been used: beam transverse profile set-up with the ICCD camera, beam transverse profile set-up with the emCCD camera and spectroscopy set-up with a CP140-202 spectrograph coupled to the ICCD camera. The grating of the spectrograph operates in the 190-800 nm wavelength range with 50 nm/mm dispersion. The ICCD camera has at least 40% of its peak sensitivity in the 200 to 600 nm wavelength range. To increase the light throughput of the system, the spectrometer's entrance slit has been set to 400 μm which resulted in a

spectral resolution of about 12 nm.

As shown in Figure 2, in the case of nitrogen the measurements reveal no significant differences between the slow and fast extraction mode. Moreover, the spectra are consistent with previous results obtained at low ion energies [3].

The measured spectra obtained with Argon at pressures between 0.1 and 1 mbar showed different spectral compositions for the slow and fast extraction mode. This is shown in Figure 3 for measurements performed at 0.4 ± 0.1 mbar N_2 equivalent. The additional, strong emission at 285 and 310 nm, significant only in the case of slow extraction, may be attributed to OH radicals excited by Ar^* atoms [4].

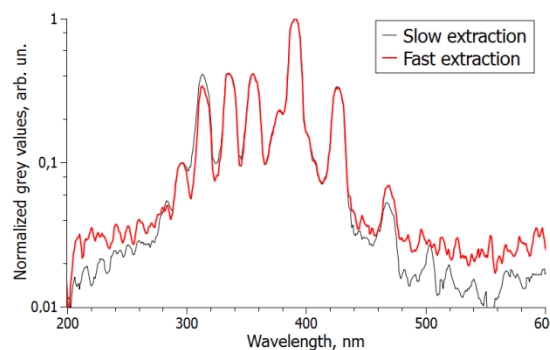


Figure 2: Nitrogen spectra for slow and fast extraction at 0.45 ± 0.02 mbar, U^{73+} 300MeV/u beam.

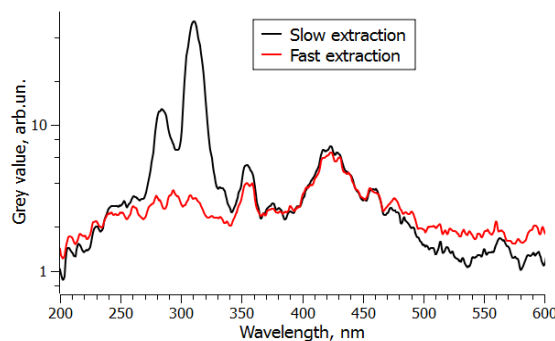


Figure 3: Argon spectra for slow and fast extraction at 0.4 ± 0.1 mbar N_2 equivalent, U^{73+} 300MeV/u beam.

References

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* Work supported by BMBF project No. 05P12RDRBN and Graduate School of Excellence ESE TU- Darmstadt.

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