Radiative cooling of C_5^-

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The recent detection of carbon chain anions [1] and other carbon containing molecules in interstellar space has provoked a lot of effort into mapping out the spectroscopic properties of these and other molecular candidates that can potentially be present in space.

We have measured spontaneous and laser induced decay of C_5^- in an electrostatic storage ring. The ions were produced in a laser ablation source, accelerated to 15 keV and injected into the ring. The neutral counts were measured after one of the straight sections. The spontaneous decay is fast and non-exponential and after about 4 ms of storage time we see only collision induced dissociation. Any change in the energy distribution after this time is exclusively due to radiative cooling.

To study this cooling the ions are reheated with a ns laser pulse of various photon energies after a storage time of 1-90 ms. The increase of the neutral signal due to the photon absorption is measured at 1/2, 3/2, 5/2 etc turns in the ring after the laser is fired. The figure shows an example of the enhanced neutral signal for two different laser wavelengths (495 and 610 nm) at varying storage times in the ring. These experiments give information about the energy distribution of the ions and how it is changed with time which can be used to deduce a radiative cooling rate. We find that the emitted power varies by temperature as $P = \alpha T^4$ and the emissivity is $1.1*10^{-4}$.

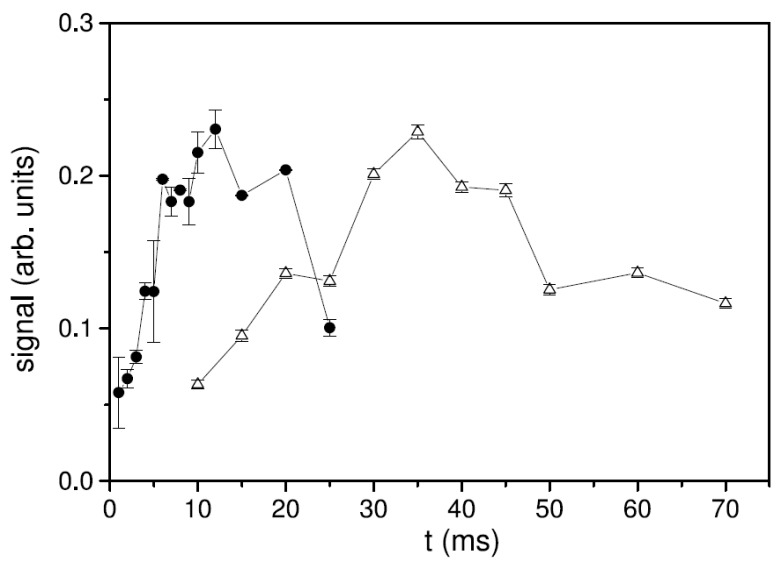

Figure 1. The enhancement of the neutral signal vs. laser firing time for 495 nm (open triangles) and 610 nm light (filled circles).

References

[1] M. C. McCarthy, *et al*., ApJ. **652**, L141-L144 (2006).

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