MEASUREMENT OF THE LEVEL LIFETIMES FOR $2s^2 2p^2\ ^1S_o$ M1 TRANSITION OF O^{2+} AT 232 nm

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Measurements have been made of the lifetimes of metastable levels of singly- and multiply-charged ions (MCI). These contribute to the optical absorption, emission and energy balance in the ISM, stellar and solar atmospheres, etc. The experimental lifetime measurements were carried out using the 14.0 GHz electron cyclotron resonance ion source at the JPL HCI Facility.[1,2] The ECR ion source provides microampere currents of ions such as $O^{(1-6)+}$ and $Mg^{(1-6)+}$. The O^{2+} beam was produced from CO feed gas and extracted at 2x7 keV from the ECR. The metastable fraction of the ion beam can be determined by the gas attenuation technique and typically measures 25% of the ground state ion, depending on ECR operating parameters such as microwave power and ECR pressure.

Ions are injected into a Kingdon ion trap and stored for times longer than the metastable lifetimes (0.001 -1 sec.) Decay channels include intercombination, E2,M1 and 2E transitions. The UV photons are filtered by an interference filter (232 nm) and detected by a UV grade photomultiplier tube using a UV grade optical system. For wavelengths less than 180 nm, a cesium-iodide coated microchannel plate enhanced for UV performance is used. The Kingdon trap was constructed in collaboration with Texas A & M.[3] We have previously reported lifetimes for the $^2P^o$-^4P intercombination transitions of C^+.[1]

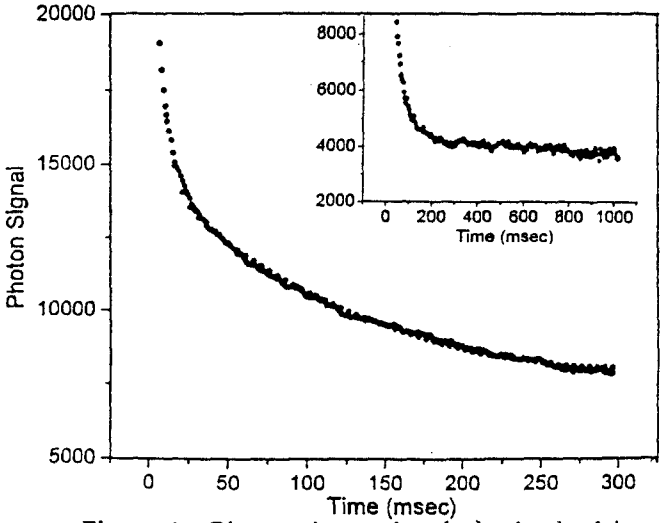

Figure 1. Photon-decay signal obtained with O^{2+} ions showing the M1 232nm decay to the $2s^2 2p^2\ ^3P_1$ level.

The O^{2+} ground configuration consists of 5 levels ($2s^2\ 2p^2\ ^3P_{0,1,2,3}$, $^1D_2$ and ^1S_o). M1 transitions occur between the $2s^2 2p^2\ ^1S_o$ and ^3P levels at 232.2 nm. They were observed using a 232 nm uv filter with a 12 nm bandwidth. The ^1S_o - $^1D_2$ E1 436.5 nm optical decay signal and the UV decay signal from $^5S_0$ -^3P E1 transitions at 166.1 nm were rejected by the filter. Also the fact that the UV photomultiplier tube is held at atmosphere aided in rejection of the shorter 166.1 nm emission. Base vacuum is 4 x 10^{-10} Torr.

The preliminary measured lifetime for the 232 nm line seen in Fig. 1 was 541 ±40 ms. This compares favorably with the value of 530 ±25 ms obtained from experiment[4] and it is in good agreement with the results of several calculations.[5] Additional metastable lifetimes have been measured for Fe^{9+} and Fe^{13+} and will be reported in the near future.

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