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# Radiative transitions in quasi-molecules Hg($6\,^3P_1 - 6\,^1S_0$) + Xe. The influence of buffer gas atom density on spectral line shape

**A Z Devdariani[1,2], G M Grigorian[1], N A Kryukov[1], M G Lednev[3] and A L Zagrebin[3]**

[1]St. Petersburg State University, Peterhof, Ul'janovskaya St. 3, 198504, St. Petersburg, Russia
[2]The Herzen State Pedagogical University of Russia, nab. rekiMoiki, 48, 191186, St. Petersburg, Russia
[3]Baltic State Technical University "VOENMEH" named after D.F. Ustinov, Krasnoarmeyskaya St. 1, 190005, St. Petersburg, Russia

E-mail: snbrn2@yandex.ru

**Abstract**. This study is aimed at the explanation of discrepancies in emission spectral profiles obtained by different authors for the excimer band HgXe($A^30^+$) – HgXe($X^10^+$). The calculations of the spectral profiles have been fulfilled for two limiting cases: for the high density and low density of buffer gas atoms. The results obtained let us to conclude that the discrepancies can be mainly caused by the recombination and relaxation processes leading to the population ro-vibrational states of the HgXe($A^30^+$) excimer.

## 1. Introduction

The present work is devoted to the explanation of discrepancies in emission spectral profiles obtained in [1-3] for the excimer band HgXe($A^30^+$) – HgXe($X^10^+$) at the temperature $T$ = 300 K. We suggest that the discrepancies are mainly caused by the recombination and relaxation processes leading to the population ro-vibrational states of the HgXe($A^30^+$) excimer. This suggestion has been backing up by the calculations of the profiles in two limiting cases: for the high and low densities of buffer gas atoms.

The calculations are based on the experimental potential curves presented in [4, 5]. For the case of high density of buffer gas atoms the calculations have been perfomed in the framework of quasi-static approach [6]. For the case of low density the approach proposed in [7] has been used.

## 2. Interaction potential curves

The interaction potential curves obtained experimentally in [4, 5] for the excited and ground states and the corresponding difference potentials are presented on figure 1 and figure 2 respectivelly.

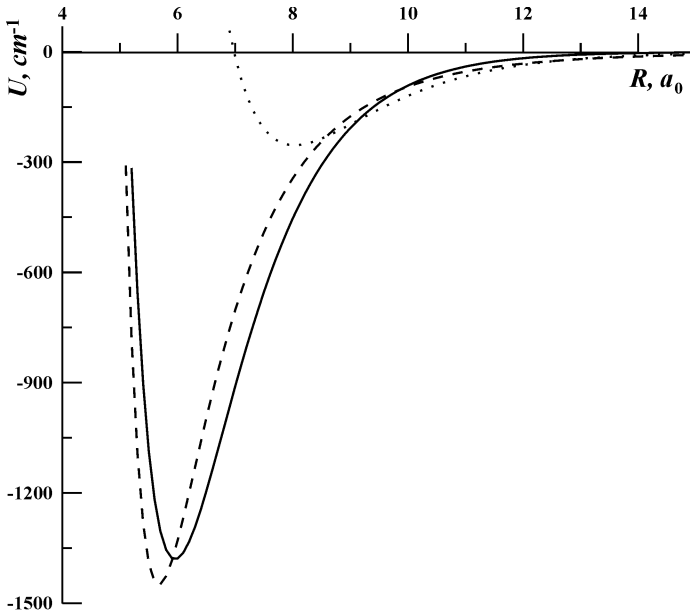


**Figure 1.** Interaction potential curves for the excited state $A^30^+$ obtained in [4] (dashed line) and [5] (solid line) and for the ground state $X^10^+$ obtained in [5] (dotted line).

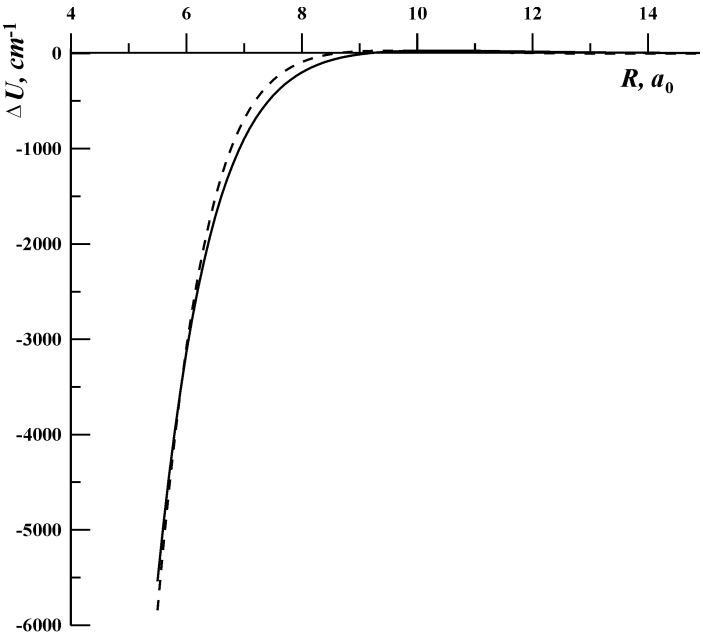


**Figure 2.** The difference potentials $\Delta U = U(A^30^+) - U(X^10^+)$ (dashed line – [4,5], solid line – [5,5]).

## 3. Emission spectra

The experimental and calculated emission spectra are presented on figure 3. The experimental spectra were obtained for different values $N_{Xe}$ of the concentrations of xenon atoms. The calculated spectra are presented for the cases of high and low densities of xenon atoms.

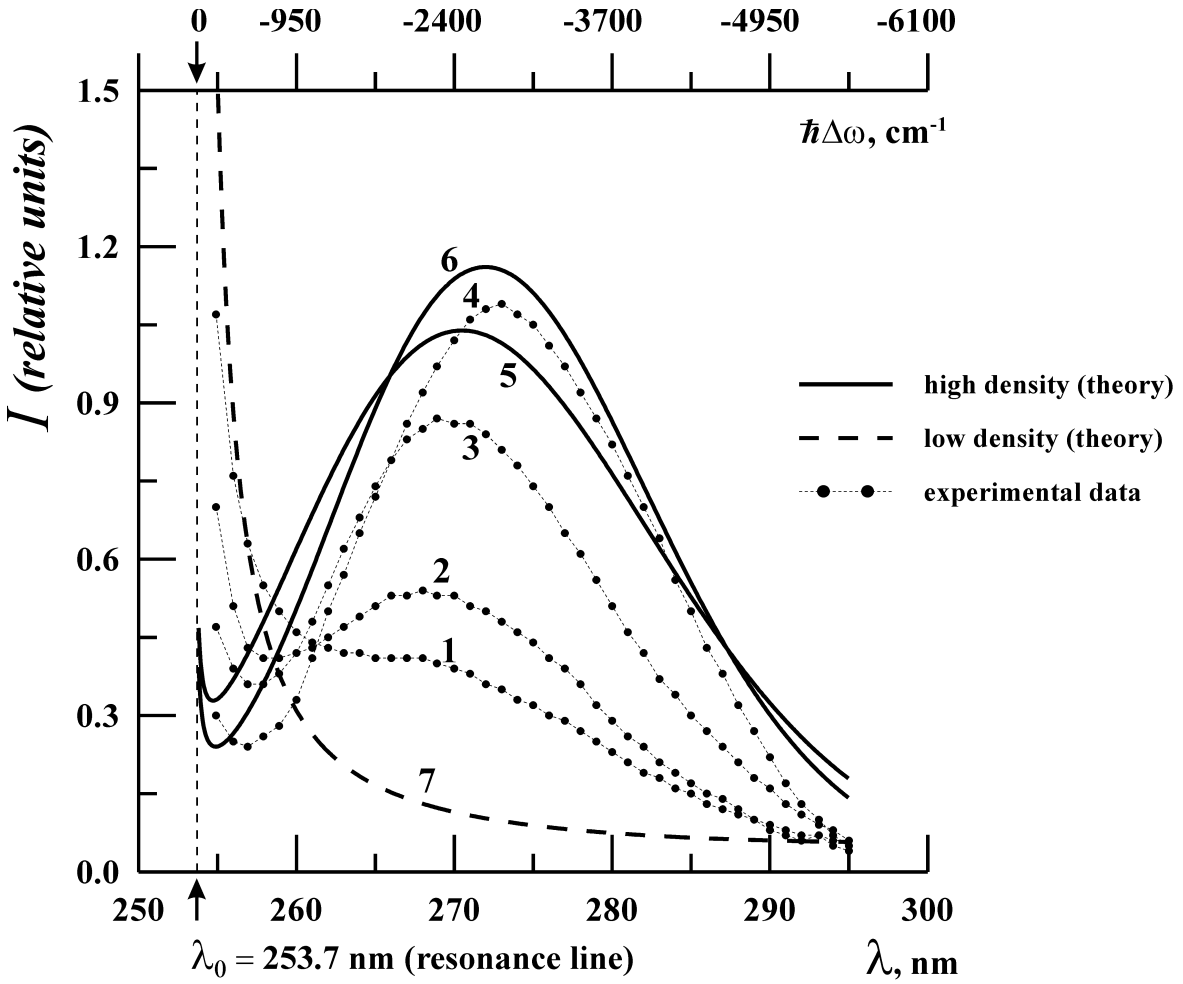


**Figure 3.** Experimental (lines 1 – 4) and calculated (lines 5 – 7) emission spectral profiles. Line 1 corresponds to $N_{Xe} = 3 \cdot 10^{17}$ cm$^{-3}$ [1], line 2 – $N_{Xe} = 10.1 \cdot 10^{17}$ cm$^{-3}$ [1], line 3 – $N_{Xe} \approx 10^{19}$ cm$^{-3}$ [2], line 4 – $N_{Xe} \approx 1.1 \cdot 10^{20}$ cm$^{-3}$ [3]. Lines 5 (on data [4] for $A^3 0^+$ and [5] for $X^1 0^+$) and 6 (on data [5] for $A^3 0^+$ and [5] for $X^1 0^+$) correspond to calculations for high density of Xe atoms. Line 7 (on data [4] for $A^3 0^+$ and [5] for $X^1 0^+$) corresponds to calculations for low density of Xe atoms.

The comparison leads to the conclusion that the experimental data obtained in [1] can be attributed to the case of the intermediate densities. The conditions of experiments [2, 3] are fairly close to the high density limit.

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