STUDY OF ELECTRON CAPTURE IN THE N^{5+}-He, H_2 COLLISIONS BY UV SPECTROSCOPY

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The physics of multicharged ions has considerably developped during the last few years. Aside from its fundamental interest and its motivation for fusion research with Tokamak devices where charge exchange involving highly charged impurities are important, this new effort in this direction is due to the development of new sources of highly charged ions.

We report results concerning spectroscopic study of radiative transitions observed during the collision between multicharged N^{5+} ions with a helium or molecular hydrogen target. N^{X+} ions are produced with the E.C.R. ion source in Grenoble (Geller and Jacquot 1981). The N^{5+} ions are then selected with two 168° bending magnets and finally sent into the target chamber where they collide either with He or H_2 gas. Spectra are observed with a grazing incidence (82°) spectrometer equipped with photon detection.

NV SPECTRA

With a He target, the NV spectra shows a nearly selective capture into the n=3 levels from which decay via the 2s-3p (209Å), 2p-3d (247Å) and 2p-3s (266Å) transitions are recorded. Transitions from the n=4 levels are very weak, apart from 3d-4f.

With H_2 as a target, the n=3 to 2 transitions are always intense but the 3-4 and 2-4 transitions are present in the spectrum, and the 3-5, 4f-6g and 4d-6f transitions are also identified. The electron capture is in this case predominantly into the n=3,4 levels.

Part of the spectra are displayed in figures 1(He) and 2(H_2).

The relative intensity measurement of the 2s-2p transition between He and H_2 is compatible with the total cross section ratio value deduce from Crandall *et al.* 1977. So far we have based cross section calibration on the total charge exchange cross section measurement of Crandall *et al.* 1977. The results for a 50 keV N^{5+} beam are reported in table I.

TABLE I

NV level cross section measurements (in 10^{-16} cm^2) at 50 keV

	σ_{3s}	σ_{3p}	σ_{3d}	σ_{4s}	σ_{4p}	σ_{4d}	σ_{4f}
He target	5	2.5	2.5	-	-	-	0.1
H_2 target	3	8	7	0.6	0.9	1.3	1.9

$\sigma_{n=5}$ estimated (with H_2) : 0.3
$\sigma_{n=6}$ estimated (with He) : 0.15 .

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Cross section variation with energy has also been measured with a helium gas target. Results are displayed in figure 3.

TWO ELECTRON CHARGE EXCHANGE: N IV SPECTRA

Some line of N IV appear in the spectra. Two processes may be considered: $N^{5+} \rightarrow N^{4+} \rightarrow N^{3+}$

$N^{5+} \rightarrow N^{3+}$.

The first mechanism may be called a double collision process, and the second, a double capture process. The intensity variation with pressure of these N IV lines shows a nearly quadratic dependence with the H_2 target characteristic of the first mechanism and a linear variation with He characteristic of the second one.

The double electron capture is well established during the N^{5+}+He collision and shown with the very strong $2s^2\ ^1S$-$2s2p\ ^1P$ N III-transition (figure 1).

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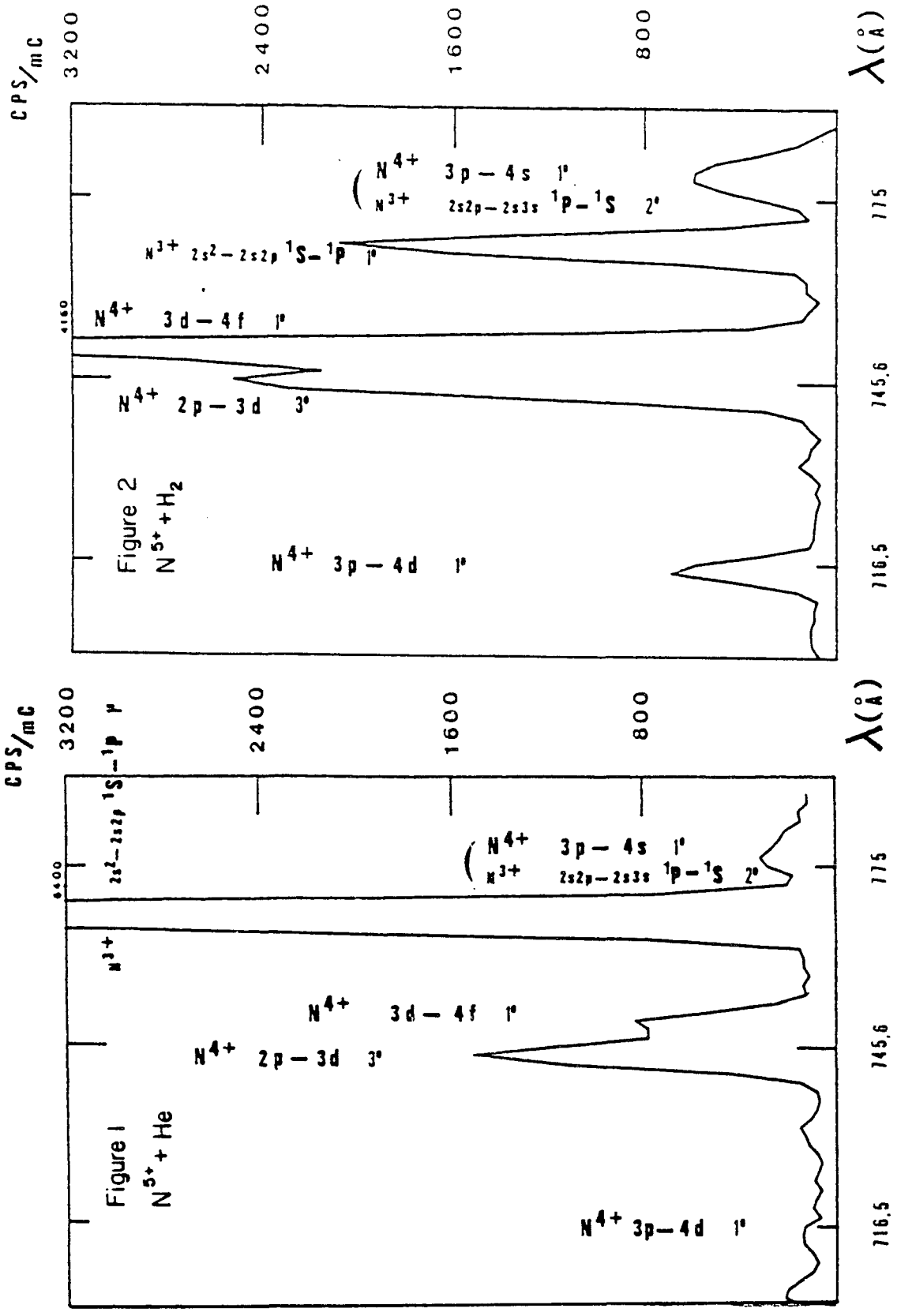

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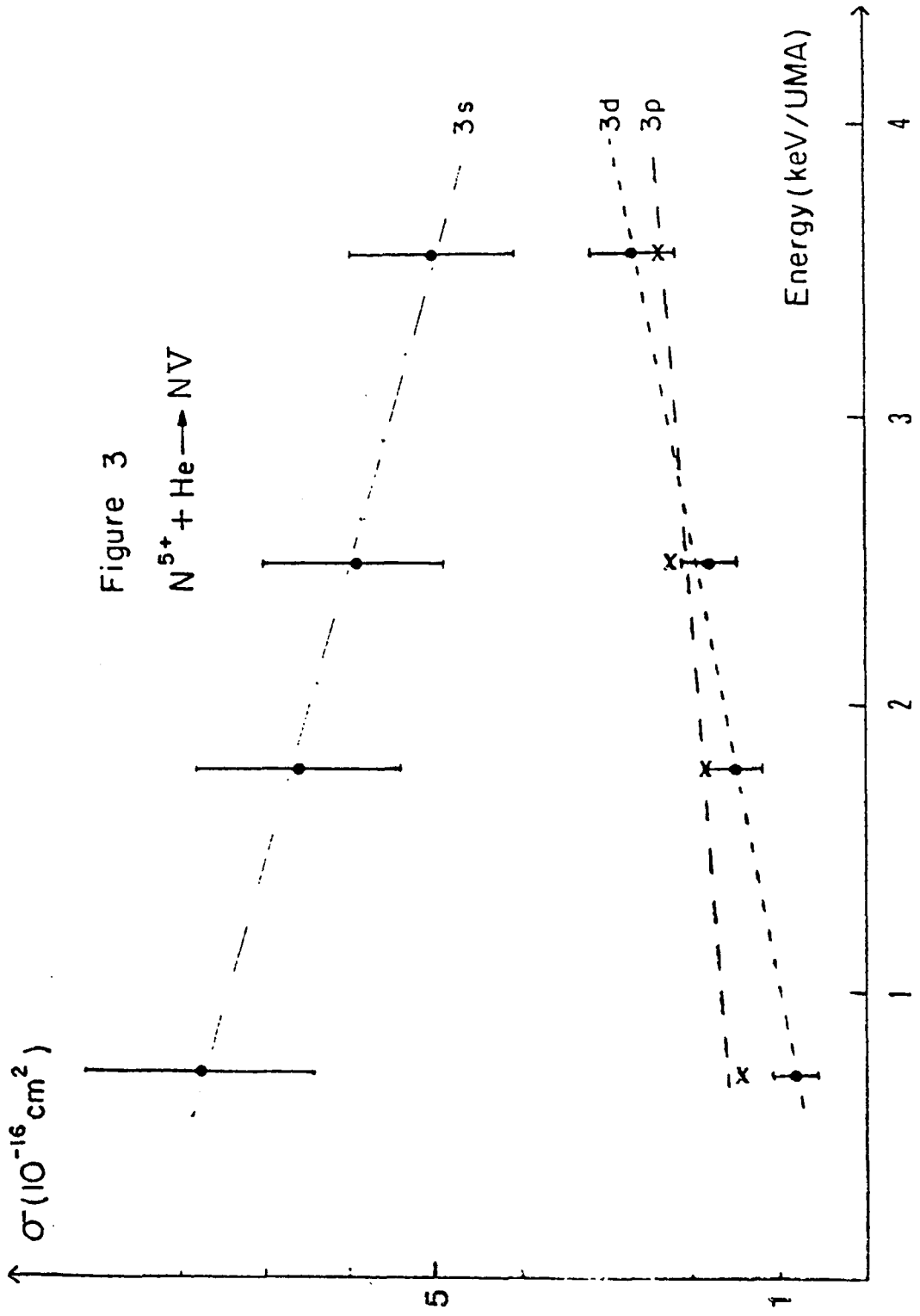

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