

AUTOIONIZATION SPECTRA OF He EXCITED BY FAST (MeV)  
 $H^+$ ,  $He^+$ , AND  $Li^{n+}$  ( $N = 1, 2, 3$ ) IONS

CONF-830449--4

DE83 017956

D. Schneider, P. Arcuni, P. Bruch,\* W. Stöffler  
Argonne National Laboratory, Argonne, IL 60439

Autoionization spectra of He following excitation by 1 to 3 MeV  $H^+$ ,  $He^+$ , and  $Li^{n+}$  ( $n = 1, 2, 3$ ) have been measured as a function of observation angle. The  $(2p^2)^1D$  and  $(2s2p)^1P$  resonances have been examined and a strong dependence on projectile velocities, charge state and observation angle was found. Similar studies have been performed at lower projectile velocities recently.<sup>1,2</sup>

The measurements were performed in a crossed-beam scattering chamber as described previously in more detail.<sup>3</sup> The target-gas pressure was in the order of  $10^{-4}$  Torr. The secondary electrons have been energy analyzed by a  $45^\circ$  parallel-plate analyzer. The resolution was typically 0.2 eV FWHM (obtained by applying deceleration mode). The observation angle of the spectrometer could be varied from  $20^\circ$  to  $160^\circ$  (w.r.t beam-axis).

Fig. 1 shows spectra measured at various observation angles for different charge states of  $Li^-$  projectiles. The asymmetries in the observed lines reflect the interference of the transition amplitudes for autoionization and direct ionization. The line shapes show, in general, strong asymmetries at forward angles which disappear towards backward angles. The interference is particularly strong if the transition amplitudes are comparable; the interference pattern disappears at backward angles where the direct ionization cross section is small.<sup>4</sup> A preliminary analysis indicates that the phase between the transition amplitudes depends sensitively on the projectile parameter (velocity,  $Z$ , charge state) and the observation angle. In the  $Li^+$  case the asymmetry in the  $^1D$  seems to decrease with increasing angle, however, the  $^1P$  shows the opposite behavior. In the  $Li^{2+}$  case the asymmetry seems to show up only on the  $^1D$ ; it decreases with increasing angle. The  $Li^{3+}$  induced spectra show a "dip" at forward angle and no asymmetry at backward angles. Measurements at different beam energies of the  $Li^{n+}$  ions show a strong velocity dependence of the asymmetry (Fig. 2).

MASTER

## **DISCLAIMER**

**This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.**

## **DISCLAIMER**

**Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.**

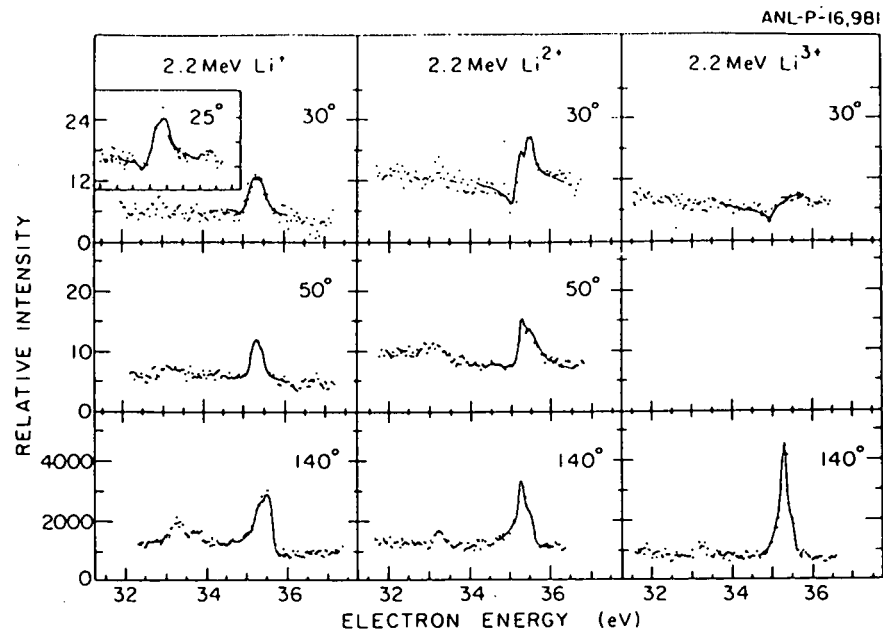


Fig. 1 He-autoionization spectra produced by a 2.2 MeV Li<sup>n+</sup> (n = 1,2,3) beam and measured as a function of observation angles.

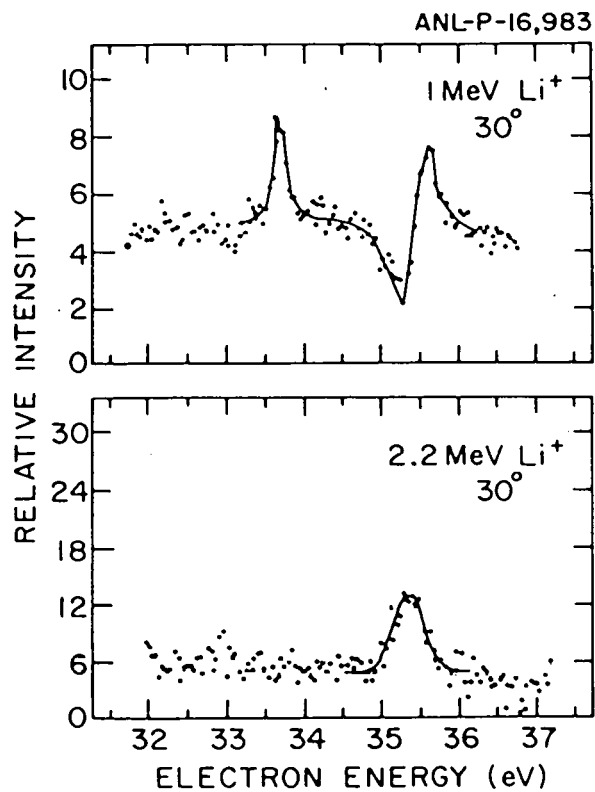


Fig. 2 Velocity dependence of line-shapes in the autoionization spectra.

### Acknowledgement

The work was supported by the U. S. Department of Energy, Office of Basic Energy Sciences, under Contract W-31-109-Eng-38.

### References

- \*. Permanent address, Fakultät für Physik der Universität Freiburg, Freiburg, West Germany.
- 1. N. Stolterfoht, D. Ridder, and P. Ziem, Phys. Lett. 42A, 240 (1972).
- 2. A. Bordenave-Montesquieu, A. Gleizes, M. Rodiere, and P. Benoit-Cattin, J. Phys. B: 6, 1997 (1973).
- 3. N. Stolterfoht, Z. Phys. 248, 81 (1971).
- 4. M. Prost, Ph.D. Thesis (Hahn-Meitner-Institut, Berlin) unpublished.

### DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.