

Abstract Submitted  
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**The natural line widths, asymmetric indices, and CK transitions in Ca to Ge**<sup>1</sup> Y. ITO, Kyoto Univ., T. TOCHIO, Kobe Univ., H. OHASHI, Japan Accuray Co Ltd., M. YAMASHITA, Hyogo Prefecture Institute of Technology, S. FUKUSHIMA, National Institute of Materials Science, M. POLASIK, K. SLABKOWSKA, L. SYROCKI, E. SZYMANSKA, Nicolaus Copernicus Univ., J. RZADKIEWICZ, National Centre for Nuclear Studies, P. INDELICATO, UPMC-Sorbonne Univ, J. MARQUES, M. MARTINS, J. SANTOS, F. PARENTE, Faculdade de Ciencias da Univ., de Lisboa — We have investigated systematically the  $K\alpha_{1,2}$  spectra in elements Ca to Ge using a high-resolution anti-parallel double-crystal X-ray spectrometer in order to elucidate the physical meaning of the asymmetry in the spectral profile. Lowe *et al.* [PRA83, 060501] reported that the  $[1s3d]$  shake-off probability for Sc at 42 %, which is the highest reported value. Chantler *et al.* [J. Phys. B46, 015002] concluded that the symmetric profile of the observed Ti  $K\alpha_1$  emission line is different from the results of the Cu  $K\alpha_{1,2}$  obtained by Deutsch *et al.* [PRA51, 283]. To shed some light on this issue, we focused on the implications of the inclusion of the main  $[1s3d]$  shake processes, asymmetric index, and natural line widths in 3d elements. Our experimental results yielded the  $[1s3p, 3d]$  shake probability for the 3d elements. For the  $[1s3p, 3d]$  shake probability on Sc, we have obtained experimentally and theoretically (MCDF and the sudden approximation) the values  $\sim 25\%$  and  $10\%$ , respectively. In both approaches, it is found that the shake-off related peaks appear between the  $K\alpha_1$  and  $K\alpha_2$  lines. Moreover, the observed Sc  $K\alpha_1$  line approaches a symmetric profile, unlike the another 3d's  $K\alpha_1$  line profile. The asymmetry index of  $K\alpha_1$  in 3d elements from Sc to Zn is ascribed to the 3d spectator hole.

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