



HAL
open science

Electron- and proton-impact excitation of He-like uranium

A Gumberidze, D B Thorn, C J Fontes, B Najjari, H L Zhang, A Surzhykov, A Voitkiv, S Fritzsche, D Banaś, H Beyer, et al.

► **To cite this version:**

A Gumberidze, D B Thorn, C J Fontes, B Najjari, H L Zhang, et al.. Electron- and proton-impact excitation of He-like uranium. XXIX International Conference on Photonic, Electronic, and Atomic Collisions (ICPEAC2015), Jul 2015, Toledo, Spain. pp.022063, 10.1088/1742-6596/635/2/022063 . hal-01266746

HAL Id: hal-01266746

<https://hal.sorbonne-universite.fr/hal-01266746>

Submitted on 3 Feb 2016

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution| 4.0 International License

Electron- and proton-impact excitation of He-like uranium

This content has been downloaded from IOPscience. Please scroll down to see the full text.

2015 J. Phys.: Conf. Ser. 635 022063

(<http://iopscience.iop.org/1742-6596/635/2/022063>)

View [the table of contents for this issue](#), or go to the [journal homepage](#) for more

Download details:

IP Address: 134.157.80.136

This content was downloaded on 03/02/2016 at 10:35

Please note that [terms and conditions apply](#).

Electron- and proton-impact excitation of He-like uranium

A. Gumberidze^{a,1}, D.B. Thorn^{b,c}, C.J. Fontes^d, B. Najjari^e, H.L. Zhang^d, A. Surzhykov^f,
A. Voitkiv^g, S. Fritzsche^{f,h}, D. Banaśⁱ, H. Beyer^{a,f}, W. Chen^a, F. Currell^j,
R.D. DuBois^{b,k}, S. Geyer^{a,l}, R. Grisenti^{a,l}, S. Hagmann^{a,l}, M. Hegewald^{a,l},
P. Indelicato^m, C. Kozhuharov^a, R. Martin^{a,f}, N. Petridis^a, R. Schuchⁿ, U. Spillmann^a,
S. Trotsenko^{a,f}, A. Warczak^o, G. Weber^{a,f}, W. Wen^p, D.F.A. Winters^a, N. Winters^a,
Z. Yin^{a,q}, Th. Stöhlker^{a,f,h}

^aGSI Helmholtzzentrum für Schwerionenforschung, 64291 Darmstadt, Germany; ^bExtreMe Matter Institute EMMI and Research Division, GSI Helmholtzzentrum für Schwerionenforschung, 64291 Darmstadt, Germany;

^cFIAS Frankfurt Institute for Advanced Studies, 60438 Frankfurt am Main, Germany; ^dComputational Physics Division, Los Alamos National Laboratory, Los Alamos NM 87545, USA; ^eInstitut Pluridisciplinaire Hubert-Curien, Groupe RaMsEs, 23 rue de Loess - BP 28 F-67037 Strasbourg Cedex 2, France;

^fHelmholtz-Institut Jena, D-07743 Jena, Germany; ^gTheoretische Physik I, Heinrich Heine Universität Düsseldorf, Universitätsstr. 1, 40225, Düsseldorf, Germany; ^hIOQ, Friedrich-Schiller-Universität Jena, 07743 Jena, Germany; ⁱInstitute of Physics, Jan Kochanowski University, PL-25-406 Kielce, Poland; ^jSchool of Mathematics and Physics, Queen's University, Belfast BT7 1NN, United Kingdom; ^kMissouri University of Science and Technology, Rolla, USA; ^lInstitut für Kernphysik, Universität Frankfurt, 60486 Frankfurt am Main, Germany; ^mLaboratoire Kastler Brossel, École Normale Supérieure, CNRS, Sorbonne Universités, UPMC Univ. Paris 06, Case 74; 4, place Jussieu, 75252 Paris CEDEX 05, France; ⁿPhysics Department, Stockholm University, S-106 91 Stockholm, Sweden; ^oInstitute of Physics, Jagiellonian University, PL-30-059 Cracow, Poland ^pInstitute of Modern Physics, 730000 Lanzhou, China; ^qMax-Planck-Institut für Biophysikalische Chemie, DESY, Hamburg, Germany

Synopsis In this contribution, we present an experimental and theoretical study of the proton- and electron-impact excitation effects in helium-like uranium ions in relativistic collisions with different gaseous targets. The experiment was carried out at the experimental storage ring at GSI Darmstadt. Our experimental results are in agreement with predictions of the state-of-the art theory which treats both processes within the relativistic framework.

Electron-impact excitation (EIE) of bound electrons is a fundamental atomic processes which is also responsible for the vast majority of x-ray radiation produced in various kinds of laboratory and astrophysical plasmas.

Up to now, electron beam ion traps (EBITs) have been the preferred tool for studying the EIE [1]. Due to the small electron-impact ionization and excitation cross sections for heavy highly-charged ions, the focus of most of these EBIT studies has been confined to low and mid-Z systems.

In this contribution, we present an extension of our previous study [2] of the effect of electron-impact excitation in heavy highly-charged ions (HCI) undergoing collisions with neutral atoms. Namely, in a measurement carried out at the Experimental Storage Ring (ESR) we looked for electron- and proton (nucleus)-impact excitation (PIE) in relativistic collisions between Helium-like uranium ions and hydrogen and argon targets. Here, electron-electron correlation and relativistic effects can be addressed which are pre-

dicted to influence these processes significantly. By performing measurements with different targets as well as at different collision energies, we were able to gain access to both; PIE and EIE processes of the ground state in He-like uranium ions in the relativistic collisions. Combined calculations which treat both processes within the relativistic framework, provide a good agreement with the experimental data. Moreover, our experimental results clearly demonstrate the importance of including the effect of the generalized Breit interaction (GBI) in the EIE calculations [3].

References

- [1] H. Chen and P. Beiersdorfer 2008 *Can. J. Phys.* **86** 55
- [2] A. Gumberidze *et al.* 2013 *Phys. Rev. Lett.* **110**, 213201
- [3] C. J. Fontes, D. H. Sampson, H. L. Zhang 1995 *Physical Review A* **51** R12

¹E-mail: a.gumberidze@gsi.de

