Determination of the $^4P^o/^2P$ ratio in single electron capture of C^{4+} ($1s^2$, $1s2s\ ^3S$) mixed state ion beams in 6-18 MeV collisions with H_2, He, Ne and Ar targets*

I. Madesis[1,2]♦, A. Laoutaris[1,2], E. P. Benis[3], T. Kirchner[4], T. J. M. Zouros[1,2]

[1]Department of Physics, University of Crete, P.O Box 2208, Herakleion GR-71003 , Greece
[2]Tandem Laboratory, INPP, NCSR Demokritos, P.O Box 60228, Aghia Paraskevi GR-15310 , Greece
[3]Department of Physics, University of Ioannina, P.O Box 1186, Ioannina GR-45110, Greece
[4]Department of Physics and Astronomy, York University, Toronto, Ontario M3J 1P3, Canada

Synopsis

Zero-degree Auger projectile electron spectroscopy of pre-excited He-like ions colliding with various gas targets is used with a new experimental technique which relies on the combination of gas and foil strippers to vary the metastable fraction sufficiently to allow for the determination of the ratio $^4P^o/^2P$ of recent interest. Results to date for C^{4+} ions are presented.

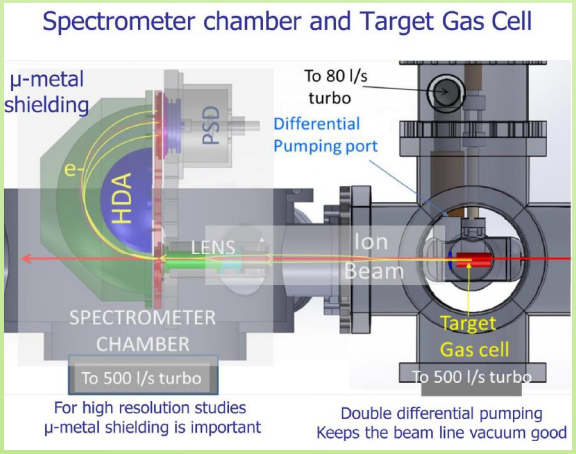

Fig.1: Schematic of the experimental apparatus. The ion beam collides with a gas target. The generated doubly excited states decay through Auger emission. Forward emitted electrons are analyzed by the Hemispherical Deflector Analyzer (HDA), and detected by the Position Sensitive Detector (PSD).

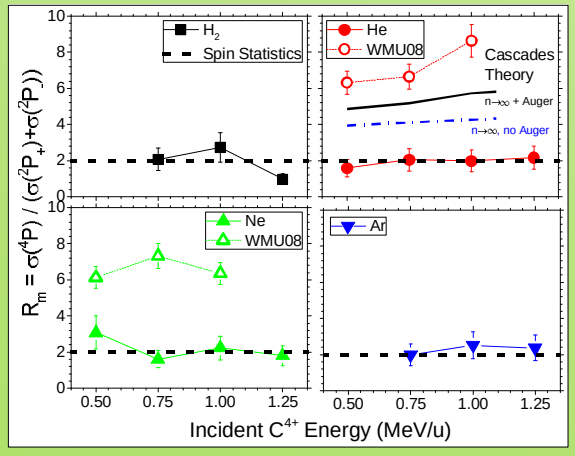

Fig. 4: R_m capture to the **m**etastable ($1s2s$) ^3S ratios measured for different gas targets. Our results are seen to be in good agreement with the spin statistics value of R_m=2. Values of R_m>2 may indicate possible cascade feeding [2-4] as shown for He (lines), that can selectively enhance the ^4P doubly excited state population. Older results (WMU08 [3]) are seen to be much larger than 2 in clear disagreement with our newly measured results.

♦corresponding author: imadesis@physics.uoc.gr

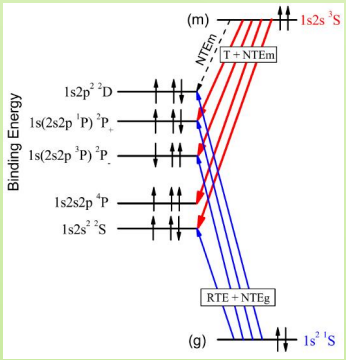

Fig. 2: Production mechanisms for the doubly excited states. Although ^2S, $^2P_-$, and $^2P_+$ are generated from both ground and metastable states, the ^4P is generated solely from the ($1s2s$) ^3S metastable state (m), while the ^2D only from the $1s^2$ ^1S ground state (g) [1]. The processes are:
Transfer (T), Resonant Transfer and Excitation (RTE), Non-Resonant Transfer and Excitation (NTE), with
NTEg: NTE from gs ($1s$-$2l$ excitation+$2l'$ transfer)
NTEm: NTE from ms ($2s$-$2p$ excitation+$2s$ transfer)

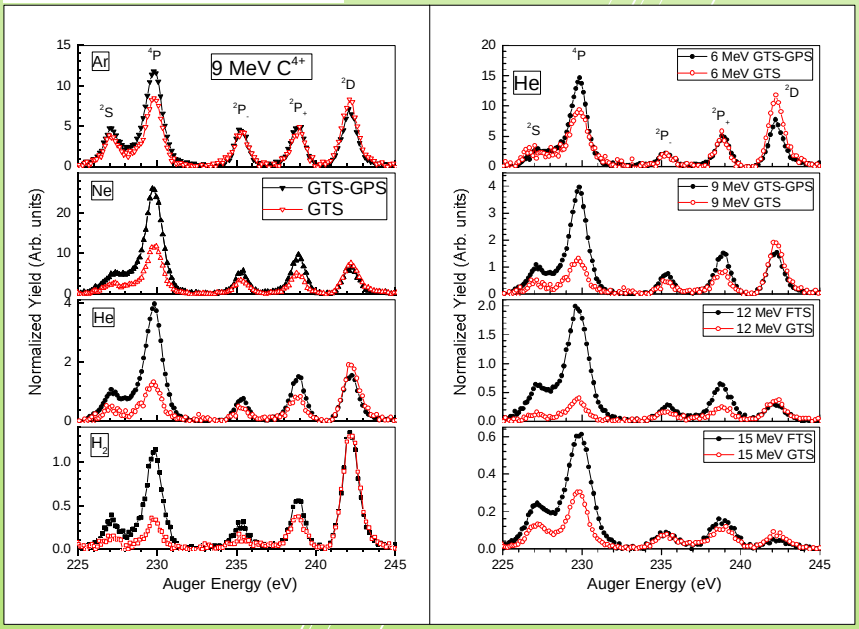

Fig. 3: (Left) Electron spectra from 9 MeV C^{4+} ions in collisions with various gas targets. (Right) Spectra from 9-15 MeV C^{4+} ions in collisions with He gas target. (Both) Depending on the ion production method, different metastable fractions are produced. After normalization to target pressure and ion count, relative counts of each measurement are compared.

Conclusions – Future projects

- An investigation of projectile K-Auger electrons emitted from pre-excited C^{4+} ions in collisions with dilute gas targets has been presented together with new results regarding the R_m capture ratio.
- Future plans include a systematic isoelectronic study starting with O^{6+}.

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Acknowledgement
* Co-financed by the European Union (European Social Fund—ESF) and Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) — Research Funding Program: THALES. Investing in knowledge society through the European Social Fund (Grant No. MIS 377289).