

# ATOMIC PHYSICS with ACCELERATORS: PROJECTILE ELECTRON SPECTROSCOPY

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## Abstract

The new research initiative APAPES (<http://apapes.physics.uoc.gr/>) has already established a new experimental station with a beam line dedicated for atomic collisions physics research, at the 5.5MV TANDEM accelerator of the National Research Center "Demokritos" in Athens, Greece. A complete zero-degree Auger projectile spectroscopy (ZAPS) apparatus has been put together to perform high resolution studies of electrons emitted in ion-atom collisions.

A single stage hemispherical spectrometer with a 2-dimensional Position Sensitive Detector (PSD) combined with a doubly-differentially pumped gas target will be used to perform a systematic isoelectronic investigation of K-Auger spectra emitted from collisions of pre-excited and ground state He-like ions with gas targets using novel techniques. Our intention is to provide a more thorough understanding of cascade feeding of the  $1s2s2p$   $^4P$  metastable states produced by electron capture in collisions of He-like ions with gas targets and further elucidate their role in the non-statistical production of excited three-electron  $1s2s2p$  states, recently a field of conflicting interpretations awaiting further resolution<sup>1</sup>.

At the moment, the apparatus is being completed and the spectrometer will soon be fully operational. First beam tests have been accomplished and the first high resolution Auger electron spectra has been recorded and is shown in Fig. 3.

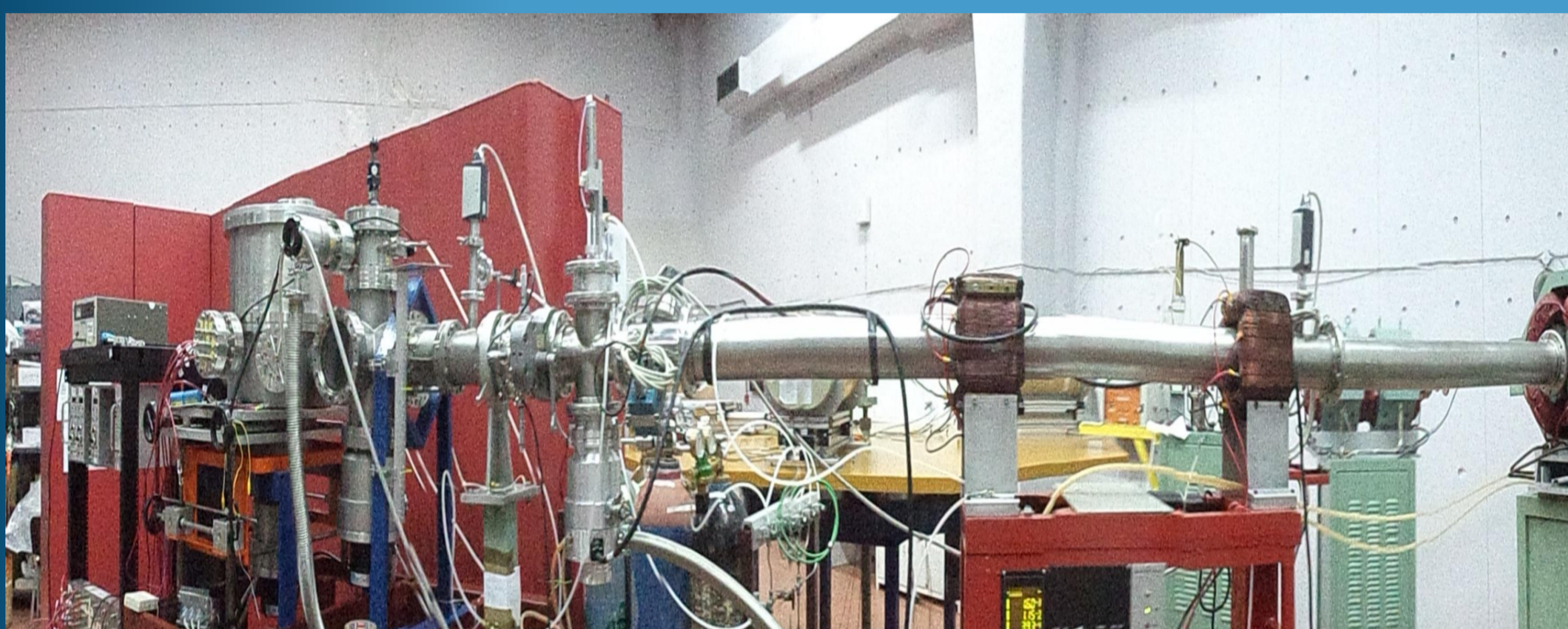


Fig. 1 - Panoramic view of the APAPES beam line at the 5MV Demokritos Tandem

APAPES establishes the new (for Greece) discipline of Atomic Physics with Accelerators, with important contributions to fusion, hot plasmas, astrophysics, accelerator technology and basic atomic physics of ion-atom collision dynamics, structure and technology. This is being accomplished by combining the existing interdisciplinary atomic collisions expertise from three Greek universities, the strong support of distinguished foreign researchers and the high technical ion-beam know-how of the DEMOKRITOS TANDEM group into a cohesive initiative.

This high efficiency high resolution ZAPS system is ideally suited for use in the electron spectroscopy of weak ion beams such as the ones called for in this proposal and also is the only existing high efficiency high resolution system in the world making it about 15-20 times more efficient than conventional single channel devices (e.g. two-stage parallel plate electron spectrometers<sup>2</sup>). Additionally, the paracentric entry of the HDA is a novel feature adding further high resolution capability not available to conventional centric HDAs<sup>3</sup>.

## REFERENCES

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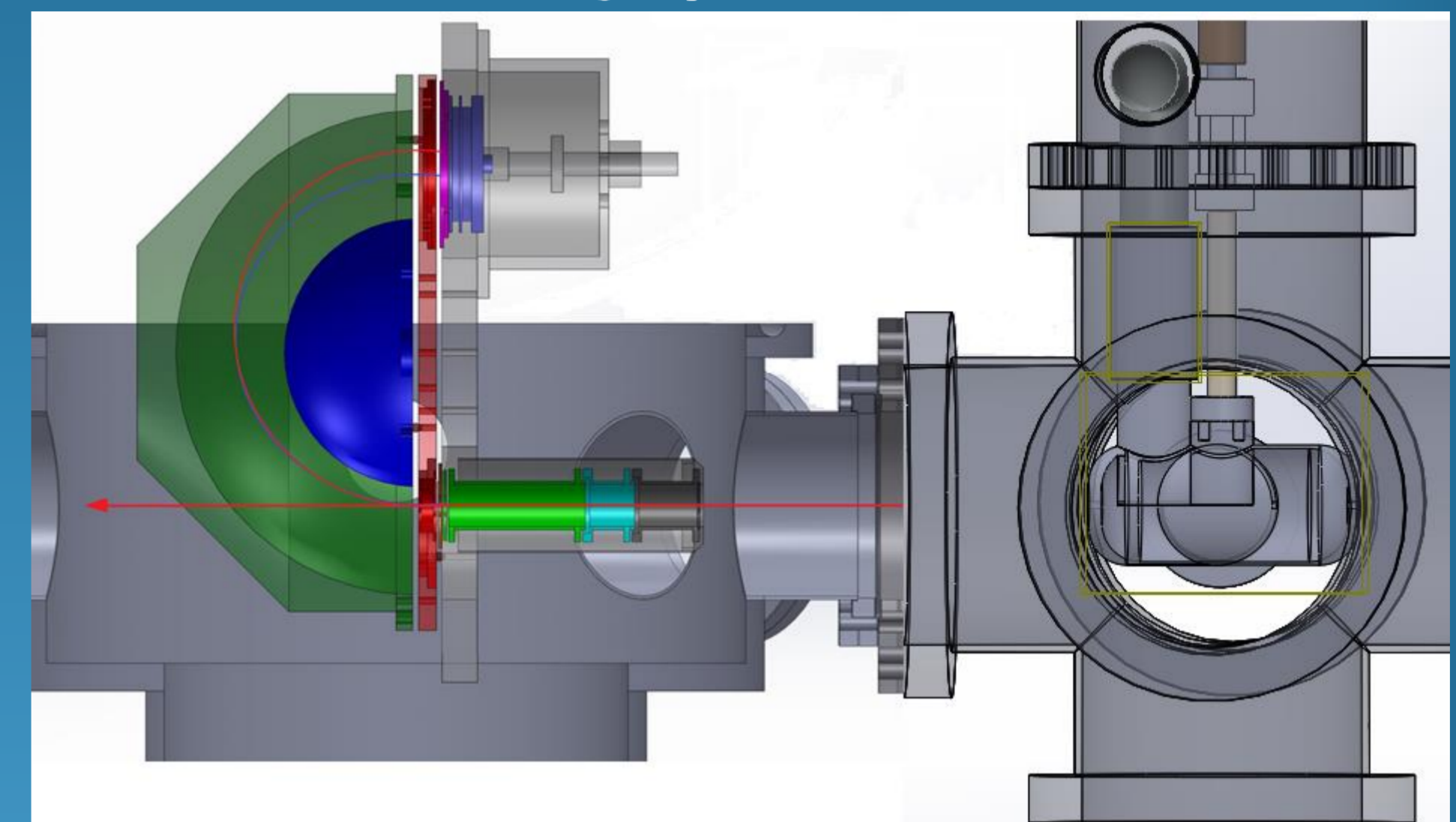


Fig. 2 - Double Differential pumped target gas cell, along with Paracentric Hemispherical Deflector Analyser (HDA), 4-element input lens and 2-D Position Sensitive Detector (PSD). Each color denotes a different voltage.

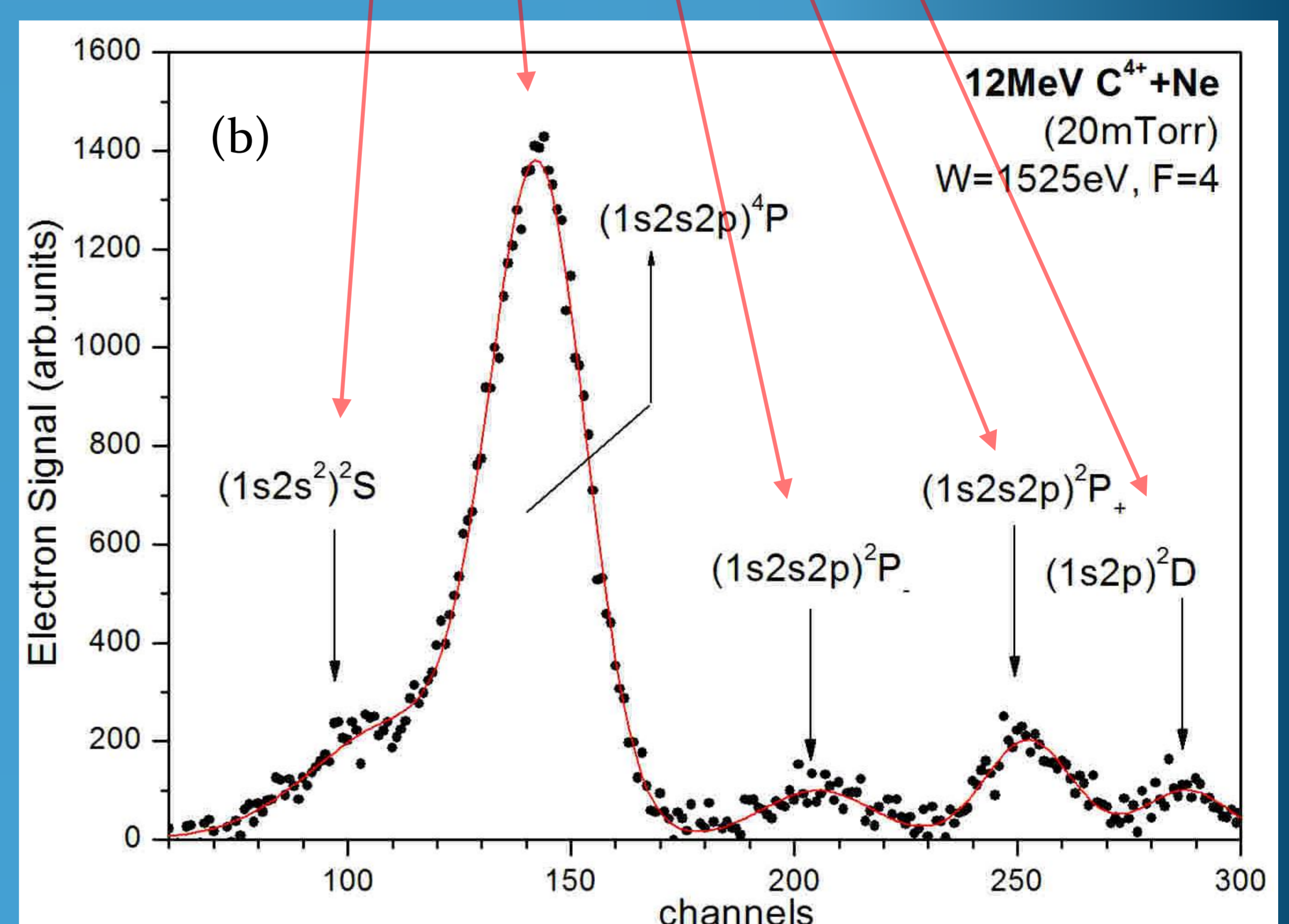
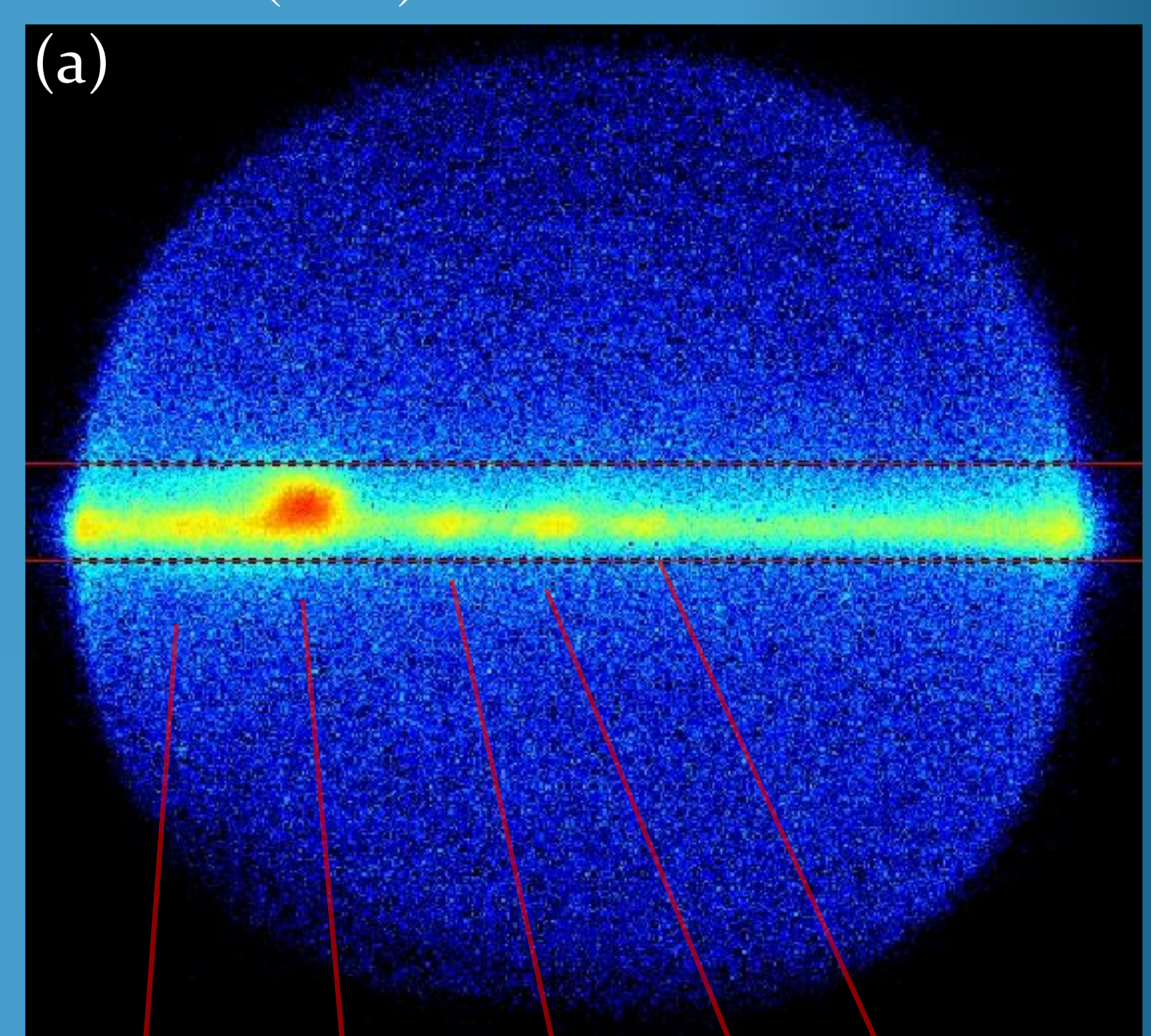


Fig. 3 - First high resolution Auger spectrum obtained by our spectrometer in collisions of 12MeV  $C^{4+} + Ne$ . The tuning energy  $W$  of the analyzer was set at 1525 eV and the deceleration factor at  $F=4$ . (a) 2-D PSD Image, (b) Projection of the PSD image within the selected region shown in (a). The similarity with previous published works is obvious<sup>4</sup>.

## 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)

## Open Postdoc Position

A Postdoctoral position is available. Check the APAPES project <http://apapes.physics.uoc.gr/> for further information.



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