# IPN Orsay involved in the first Spectroscopy of 79Cu held with success at Riken

*The $^{78}$Ni nucleus, with 28 protons and 50 neutrons, is a cornerstone for nuclear structure as it is one of the most exotic nuclei with two magic numbers. The study of its proton-neighbour $^{79}$Cu allows to understand the movement of a single proton around 78Ni and it is therefore a powerful tool for probing the magic character of $^{78}$Ni. We recently performed the first spectroscopy of 79Cu at Riken and the results were published in Physical Review Letters.*

About 80 years ago it was proposed that the atomic nucleus contains a shell structure, similar to the electron cloud that surrounds it. Its components, the protons and the neutrons, may arrange themselves in such way that interesting features arise. One of the most famous examples is the extra binding energy for nuclei with particular numbers of protons or neutrons, what we call magic numbers. With the development of new radioactive-beam facilities, it was found that the magic numbers are not firmly established throughout the nuclear chart: far from stability, the rearrangement of the internal structure of the nucleus can be strong enough to make the magic numbers disappear and create new ones.

Among these cases is the 78Ni nucleus with two magic numbers, 28 protons and 50 neutrons. The excess of neutrons is so large that only recently it has been possible to produce it in sufficient quantities to study its properties. An experiment with the aim to perform the first spectroscopy of this nucleus and the isotopes around it took place at the Radioactive Isotope Beam Factory at the Riken Nishina Center for Accelerator-Based Science in Japan. One of the isotopes of most interest was $^{79}$Cu, one proton more than $^{78}$Ni, which is the ideal probe to follow the motion of a single proton around $^{78}$Ni.

The study was made possible thanks to a unique experimental set-up combining the Minos liquid-hydrogen target, in which $^{79}$Cu was produced through the proton knock-out from a 80Zn beam at relativistic energies, and the Dali-2 high-efficiency scintillator array, with which the gamma rays emitted after the reaction were detected. The different transitions that were observed allowed us to build the level scheme of $^{79}$Cu for the first time, which was interpreted by means of a theoretical model that was developed at the Center for Nuclear Study at the university of Tokyo. The results show that the $^{79}$Cu nucleus can be understood in a simple manner in terms of a valence proton outside a $^{78}$Ni core, which provides us with evidence of the magic character of the latter. The measurement of the mass and direct spectroscopy of the $^{78}$Ni isotope are now the next steps for a final confirmation of this doubly magicity.

## Reference

L. Olivier et al., “Persistence of the Z = 28 shell gap around 78Ni: First spectroscopy of $^{79}$Cu"
Physical Review Letters (2017), scheduled for publication November 6
https://journals.aps.org/prl/accepted/2e072YefO9a1af5562a6648909dff7d9c1f78b974