Study of the low-lying states in the unbound nucleus ^{16}F by ^{15}O+p elastic scattering*

C. Angulo[1], O.R. Kakuee[1,2], N. de Séreville[1], N.L. Achouri[3], N.I. Ashwood[4], E. Casarejos[5], M. Couder[6], N. Curtis[4], P. Descouvemont[7], Th. Keutgen[1], B. Laurent[3], P. Leleux[1], V.F.E. Pucknell[8], J. Rahighi[2]

[1]CRC and FYNU, Université catholique de Louvain, B-1348 Louvain-la-Neuve, Belgium
[2]Van de Graaff Laboratory, Nuclear Research Center, P.O. Box: 14155-1339, Tehran, Iran
[3]LPC, ISMRA and Université de Caen, IN2P3-CNRS, 14050 Caen Cedex, France.
[4]School of Physics and Astronomy, University of Birmingham, Birmingham, B15 2TT, UK
[5]Dpto. De Física de Partículas, Universidad de Santiago de Compostela, Spain
[6]Nuclear Structure Laboratory, Department of Physics, University of Notre Dame, IN 46556, USA
[7]PNTPM, CP-229, Université Libre de Bruxelles, B-1050 Brussels, Belgium
[8]Surface & Nuclear Division, CCLRC Daresbury Laboratory, Daresbury, Warrington, WA4 4AD, UK

The study of the structure and decay modes of drip-line nuclei [1] and of halo nuclei [2] is a major source of interest in nuclear-physics research nowadays [3]. In the recent years, the development of radioactive beams has made the experimental study of such exotic nuclei possible. The radioactive beams available at the Centre de Recherches du Cyclotron at Louvain-la-Neuve allow performing unique experimental studies in this research area (see, for example, [4]).

A powerful direct experimental method to study light proton-rich nuclei is the elastic scattering at low energies and inverse kinematics [5]. The use of intense radioactive beams has already permitted to obtain important results in this research area (see, for example, the review article [6]). The proton-unbound nucleus ^{16}F is an interesting case: four excited states (0^-, 1^-, 2^-, 3^-) are expected to be present in ^{16}F at energies below 1 MeV above the proton threshold (-535 keV) [7]. While there is fair agreement in the location of the states from investigations using transfer reactions [8], the widths and the spin assignments are not known with sufficient precision.

Here we present a study of the low-lying states of ^{16}F using an intense and isobarically pure ^{15}O radioactive beam and proton-rich targets. The LEDA silicon multi-strip detector systems [9], set in different configurations, allowed covering a large angular range. The expected four resonant states in ^{16}F are clearly observed. A detailed R-matrix analysis [10] of the cross sections will allow obtaining the location, widths and spins of the states. We will describe the experimental method and setup, present the data analysis and results and compare them with previous investigations.

* This work is supported by the Belgian IAP program P5/07 on inter-university attraction poles of the Belgian-State Federal Services for Scientific, Technical and Cultural Affairs.

[1] P.G. Hansen, A.S. Jensen, B. Jonson, Ann. Rev. Nucl. Part. Sci. 45 (1995) 591.
[2] I. Tanihata et al. , Phys. Rev. Lett. 55 (1985) 2676.
[3] B. Jonson, Phys. Rep. 389 (2004) 1.
[4] R. Raabe et al., Nature 431 (2004) 823.
[5] T. Delbar et al., Nucl. Phys. A542 (1992) 263.
[6] C. Angulo, Nucl. Phys. A746 (2004) 222c.
[7] R. Tilley et al., Nucl. Phys. A564 (1993) 1.
[8] C.E. Moss and A.B. Comiter, Nucl. Phys. A178 (1971) 241 ; W. Bohne et al., Phys. Lett. 47B (1973) 342; T. Otsubo et al., Nucl. Phys. A259 (1976) 452; H. Nann et al, Phys. Rev. C16 (1977) 16; R.H. Pern and J. Cerny, Phys. Lett. 14 (1965) 137.
[9] T. Davinson et al., Nucl. Instr. Meth. A288 (1990) 245
[10] A.M. Lane and R.G. Thomas, Rev. Mod. Phys. 30 (1958) 257.