Contribution ID: **227** Type: **Oral Presentation**

Decay of the stretched resonance at 19.6 MeV in 12C investigated via (p,p') reactions

Stretched resonances are rather simple nuclear excitations, even though in light nuclei they appear in the continuum energy region. The structures of these states are dominated by a single particle-hole component for which the excited particle and the residual hole couple to the maximal possible spin value available on their respective shells. The simplicity of their configurations results from the expected low density of other one-particle-one-hole configurations of high angular momenta in this energy region. Therefore, their theoretical description could provide clean information about the role of continuum couplings in stretched states.

In p-shell nuclei, these excitations are realized through the $p_{3/2} \rightarrow d_{5/2}$ stretched transitions [1] and are observed in high-energy regions above the nucleon separation energies. Therefore, the decays of stretched resonances are expected to be dominated by the proton and neutron emission, however, the knowledge about their decay patterns is rather scarce. The direct measurement of stretched states decay paths should provide data which can be used as a very demanding test of state-of-the-art theory approaches –such as, for example, Gamow Shell Model (GSM) [2] - which is an adequate tool for describing these excitations. Recently, experimental findings on the proton and neutron decay branches from the 21.47-MeV stretched state in the ^{13}C nucleus were compared with theoretical calculations from the GSM, extended to describe stretched resonances in p-shell nuclei [3]. A very good agreement obtained between the measured and predicted decay properties of the 21.47-MeV state in ^{13}C demonstrated the high quality of the GSM calculations.

Preliminary results from an experiment performed at the Cyclotron Centre Bronowice (CCB) at IFJ PAN in Kraków (Poland), aiming at the first experimental investigation of the decay of the 19.6-MeV stretched resonance in ^{12}C, will be presented. The state of interest in ^{12}C was populated in the proton inelastic scattering reaction ^{12}C(p,p') at 135 MeV proton energy. The detection setup consisted of: i) the KRATTA telescope array for detection of scattered protons, ii) two clusters of the PARIS scintillator array and four $LaBr_3$ detectors for γ-ray measurement, and iii) four thick DSSD units for light charged particles detection. Information on the decay paths from the 19.6-MeV stretched state in ^{12}C was obtained by measuring the protons inelastically scattered off a ^{12}C target in coincidence with γ rays from daughter nuclei and charged particles emitted in the decay of the resonance.

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Author: CIEPLICKA-ORYNCZAK, Natalia (Institute of Nuclear Physics Polish Academy of Sciences)

Co-authors: MAJ, Adam (IFJ PAN); KRZYSIEK, Agata (Heavy Ion Laboratory University of Warsaw); GIAZ, Agnese (INFN-Milano Università degli studi Milano); SPACEK, Andrej (Heavy Ion Laboratory University of Warsaw); BRACCO, Angela (Univesità degli studi di Milano & INFN sezione di Milano); KUSOGLU, Asli; WASILEWSKA, Barbara; MILLION, Benedicte (INFN sezione di Milano); Prof. FORNAL, Bogdan (IFJ PAN); SOWICKI, Bogdan (IFJ PAN); WLOCH, Boguslaw (LP2i Bordeaux); SCHMITT, Christelle (IPHC Strasbourg); BOIANO, Ciro (INFN - MI); CLISU, Cristina (IFIN-HH); IANCU, D.A. (IFIN-HH); Prof. BALABANSKI, Dimiter (ELI-NP, IFIN-HH); DUDA, Dominik (IFJ PAN); VAN ROMPU, Eben (KU Leuven); CRESPI, Fabio (University of Milan - INFN); CAMERA, Franco (University of Milan and INFN Milano); CORBARI, Giacomo (Università degli Studi di Milano and INFN

Milano); SZYMANEK, Grzegorz (Heavy Ion Laboratory University of Warsaw); MATEA MACOVEI, Iolanda (IJCLab); BURDUCEA, Ion (IFIN-HH); CIEPAŁ, Izabela (IFJ PAN); GREBOSZ, Jerzy (IFJ PAN, Krakow, Poland); ŁUKASIK, Jerzy (IFJ PAN); DHANMEHER, Karishma (IFJ PAN); Dr HADYNSKA-KLEK, Kasia (Heavy Ion Laboratory University of Warsaw); GAJEWSKA, Katarzyna (IFJ PAN); MAZUREK, Katarzyna (Institute of Nuclear Physics PAN); STAN, Lucian (IFIN-HH); ISKRA, Lukasz (Institute of Nuclear Physics PAN); MATEJSKA-MINDA, Magdalena (Institute of Nuclear Physics, PAN, Cracow); PLOSZAJCZAK, Marek (GANIL); KMIECIK, Maria (IFJ PAN Krakow); LUCIANI, Massimiliano (INF Sezione di Milano, Università degli Studi di Milano); KRZYSIEK, Mateusz (Institute Of Nuclear Physics); CIEMAŁA, Michał (IFJ PAN Kraków, Polska); SFERRAZZA, Michele (Université Libre de Bruxelles); ZIEBLINSKI, Miroslaw (IFJ PAN Krakow); HARAKEH, Muhsin N. (GSI/KVI); MĂRGINEAN, Nicolae (Horia Hulubei National Institute for Physics and Nuclear Engineering, Măgurele, Romania); FLOREA, Nicoleta (IFIN-HH); WIELAND, Oliver (INFN-Milano); SODERSTROM, Par-Anders (ELI NP); KULESSA, Paweł (IFJ PAN); DEY, Piku (Heavy Ion Laboratory University of Warsaw); BEDNARCZYK, Piotr (IFJ PAN); PAWŁOWSKI, Piotr (IFJ PAN); MARGINEAN, Raluca (IFIN-HH); BAN, Sara Rebeca (ELI NP); ZILIANI, Sara (Università degli Studi di Milano and INFN); BRAMBILLA, Sergio (Dipartimento di Fisica e INFN Milano); LEONI, Silvia (University of Milano and INFFN Milano); Dr BOTTONI, Simone (University of Milano and INFN); PAROL, Wiktor (IFJ PAN); JAGANATHEN, Yannen (National Centre for Nuclear Research, Pasteur 7, Warsaw, Poland)

Presenter: CIEPLICKA-ORYNCZAK, Natalia (Institute of Nuclear Physics Polish Academy of Sciences)

Session Classification: Parallel session

Track Classification: Nuclear Structure, Spectroscopy and Dynamics