An algebraic solution of the multichannel problem applied to low energy nucleon-nucleus scattering

K. Amos amos@physics.unimelb.edu.au School of Physics, University of Melbourne, Victoria 3010, Australia

L. Canton luciano.canton@pd.infn.it G. Pisent gualtiero.pisent@pd.infn.it Istituto Nazionale di Fisica Nucleare, sezione di Padova,

J. P. Svenne svenne@physics.umanitoba.ca Department of Physics and Astronomy, University of Manitoba, and Winnipeg Institute for Theoretical Physics, Winnipeg, Manitoba, Canada R3T 2N2

D. van der Knijff dirk@unimelb.edu.au Advanced Research Computing, Information Division, University of Melbourne, Victoria 3010, Australia

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abstract Compound resonances in nucleon-nucleus scattering are related to the discrete spectrum of the target. Such resonances can be studied in a unified and general framework by a scattering model that uses sturmian expansions of postulated multichannel interactions between the colliding nuclei. Associated with such expanded multichannel interactions are algebraic multichannel scattering matrices. The matrix structure of the inherent Green functions not only facilitates extraction of the sub-threshold (compound nucleus) bound state spin-parity values and energies but also readily gives the energies and widths of resonances in the scattering regime. We exploited also the ability of the sturmian-expansion method to deal with non-local interactions to take into account the strong non-local effects introduced by the Pauli principle. As an example, we have used the collective model (to second order) to define a multichannel potential matrix for low energy neutron-$^{12}$C scattering allowing coupling between the $0^+_1$ (ground), $2^+_1$ (4.4389 MeV), and $0^+_2$ (7.64 MeV) states. The algebraic $S$ matrix for this system has been evaluated and the sub-threshold bound states as well as cross sections and polarizations as functions of energy are predicted. The results are reflected in the actual measured data, and are shown to be consistent with expectations as may be based upon a shell model description of the target and of the compound nucleus.