Thesis Title: ***Nuclear Shell Structure of Odd-A Magnesium Isotopes within USDA Hamiltonian.***

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ABSTRACT

The USDA is the latest universal shell model interaction in the SD (0s1d) shell. It is derived by fitting more than 600 energy levels from experimental data. We assess the accuracy of the USDA Hamiltonian in the nuclear structure calculations for odd-A magnesium isotopes with neutron numbers between 9 and 17 on the basis of the recently reported experimental data. This study provides an example of the applicability and the accuracy of the shell model calculations limited to the *sd* shell. The assessments rely on the evaluation of the Hamiltonian's eigenvalues with the corresponding positive parity energy states up to 10 MeV for most isotopes and the Hamiltonian's eigenvectors with the transition strength probability and inelastic electron-nucleus scattering. We show the regions in which the Hamiltonian is effective and demonstrated the possibility of confirming the known experimental data and suggesting some new nuclear energy levels. The calculations of the energy states are performed by using the OXBASH code and the results show a good agreement with the experimental states for the $^{21-27}$Mg isotopes while a clear difference is

found with the ^{29}Mg data. Many energy states are proposed and we have confirmed the existence of some states that were experimentally uncertain . The reduced electric quadrupole transition probabilities, reduced magnetic dipole transition probabilities, and multipole mixing ratio results show the same precision for related energy states. The longitudinal inelastic electron scattering form factors have been calculated for the states 0.974(J=$3/2_1^+$), 1.611(J=$7/2_1^+$), 1.964(J=$5/2_2^+$), 2.563(J=$1/2_2^+$), 2.801(J=$3/2_2^+$), 3.405(J=$9/2_1^+$), 4.059(J=$9/2_2^+$) and 5.252(J=$11/2_1^+$) MeV in the ^{25}Mg spectrum. The wave functions of the radial single-particle matrix elements have been calculated with the Woods-Saxon and Skyrme interaction potentials with the one-body transition densities (OBTDs) obtained from the USDA calculations. The result of the longitudinal form factors C2 and C4 show good agreement with the available experimental data for all states in the first sequence whereas, in the second sequence the accuracy of the results vary according to the energy of the states. Two shell-model codes, CPM3Y and OXBASH, have been used to calculate the transverse form factors for the 1.611 and 3.405 MeV states in the ^{25}Mg spectrum with the OBTDs obtained from USDA Hamiltonian. The results of the two codes show good agreement with the available experimental data for the J=7/2$^+$ state at energy 1.611 MeV. For the second state J=9/2$^+$ at energy 3.405 MeV, the CPM3Y and OXBASH results are higher and lower than the experimental data, respectively. The effective g factors values are used as adjustable parameters to get an agreement with the experimental data for OXBASH calculations due to the core-polarization effects.