P(^{18}Ne,p):resonances 2003An02,2005De15,2008Pe02

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. H. Kelley, G. C. Sheu	ENSDF	29-July-2015

There have been a few separate campaigns to measure the structure of ^{19}Na using the Inverse Kinematics technique to obtain the resonant ^{18}Ne(p,p) excitation function. See also the theoretical analysis in (2014Ja05).

2003An02,2003An28,2004An28: ^{18}Ne ions were produced using the ^{19}F(p,2n) reaction, accumulated in an ECR source and re-accelerated to yield E(^{18}Ne)=21, 23.5 and 28 MeV beams using the Louvain-la-Neuve CYCLONE110 cyclotron. The beams, with average intensities of 4×10^6 pps, impinged on 0.520 mg/cm^2 polyethylene (CH_2) targets. A thin 8.0 μg/cm^2 layer of ^{197}Au was evaporated on the target's upstream surface. Recoil protons from scattering in the target were measured using two segments of the Louvain-la-neuve Edinburg Detector Array (LEDA) Si array; the protons were identified by their energy signal along with the relative time-of-flight when compared with the the cyclotron Rf signal. Only the forward angles at θ_{lab}=4.9°−11.7° and 22.6°−29.9° were covered with angular resolutions of $\Delta\theta\approx$0.2° and 0.9°, respectively. Mylar absorber foils of sufficient thickness to stop any scattered ^{18}Ne particles were place infront of all but one LEDA detector sectors; the "bare" sector was used to measure the ^{197}Au(^{18}Ne,^{18}Ne) reaction and provide an intrinsic normalization to the Rutherford cross section.

The data, which covered the energy range of E_{cm}=0.7-1.5 MeV and various angles in the range of θ_{cm}=120°−170°, were evaluated via R-matrix analysis. A single $J^\pi=1/2^+$ resonance with E_{cm} =1066 keV *3* and Γ_p=101 keV *3* is deduced.

2005De15,2006DeZU: A beam of E(^{18}Ne)=7.2 MeV/nucleon ions was produced by fragmenting ^{20}Ne on a ^{nat}C target to yield ^{18}Ne atoms. The ^{18}Ne atoms were accumulated and re-accelerated using the GANIL/SPIRAL CIME cyclotron. The beam impinged on a 1.050 mm thick cryogenic solid hydrogen target that was contained by two 6 μm Mylar windows. While the target was thick enough to fully stop the incident beam, scattered protons escaped the target and were detected using a position sensitive ΔE-ΔE-E Si detector telescope that covered ±4.5° in the lab frame. The ejected energy spectrum was evaluated using standard Thick Target Inverse Kinematics (TTIK) analysis techniques to obtain the reaction excitation function. The energy resolution was measured as 30 keV *10*.

Six peaks were evident in the excitation spectrum at $E_{cm}\approx$1100, 2400, 3100, 4400, 5000 and 5900 keV. The spectrum was analyzed using the ANARKI R-Matrix code with significant input from a shell model calculation that relied heavily on a comparison with analog states in ^{19}O. Guided by the ^{19}O comparison, elastic scattering resonances were deduced at E_x= 756 keV *18*, 4371 keV *10* and 4903 keV *10*, with $J^\pi=1/2^+$, $3/2^-$ and $3/2^-$ and Γ=80 keV *20*, 30 keV *10* and 50 keV *10*, respectively.

By including inelastic scattering from $J^\pi=5/2^+$ and $3/2^+$ states predicted at $E_x\approx$3200 and 3700 keV to ^{18}Ne*(1887), the peaks at $E_{cm}\approx$2400, 3100 keV could be qualitatively reproduced, but the amplitude for these inelastic states was unreasonable. However, in order to fit these peaks it was necessary to consider inelastic scattering to the proton-unbound states of ^{18}Ne and the subsequent p-decay to ^{17}F. The two-proton (multiplicity=2) events were analyzed to gain insight into likely contributions from this more complex reaction process. The analysis is consistent with ^{19}Na states at E_x=5585, 5815 and 5809 keV that 2-p decay, via ^{18}Ne*(4523,4589,5106,5153) intermediate states to ^{17}F*(0,495).

2006Sk09: A beam of ^{18}Ne ions, produced via the ^{3}He(^{16}O,^{18}Ne) reaction at Notre Dame using an 80 MeV oxygen beam, was purified in the TwinSol magnetic analyzer brfore impinging on a 5.52 mg/cm^2 thick CH_2 polyethylene target that fully stopped the incident beam. Scattered protons were measured at θ_{lab}=7.5°, 22.5° and 37.5° with an energy resolution near 30 keV. The elastic scattering energy range from $E_{cm}\approx$0.75-2.5 MeV was covered in the excitation function measurement.

A $J^\pi=1/2^+$ state with E_x=0.74 MeV *3* and Γ=130 keV *50* was observed. In addition, no further states at higher energies are observed; this lends credibility to the interpretations of (2005De15). It supports the notion that the peaks observed in (2005De15) are populated by processes other than elastic scattering. Some discussion on spectroscopic factors is given in the text.

2008Pe02,2006AcZY: ^{18}Ne ions were produced using the ^{19}F(p,2n) reaction, accumulated in an ECR source and re-accelerated to yield a E(^{18}Ne)=66 MeV beam using the Louvain-la-Neuve CYCLONE110 cyclotron. The beam impinged on a 2 mg/cm^2 polyethylene (CH_2) target; afterward it was stopped in a Faraday cup. Recoiling protons were detected in an annular ΔE-E Si detector telescope that covered θ_{lab}=4.7°−20.2° with an overall energy resolution of 105 keV.

Elastic and inelastic scattering components were separated and obtained at seven angles. Two states at E_{res}=2.78 and 3.09 MeV, with Γ=105 and 250 keV, respectively, are observed strongly in the inelastic channel; a spin order of $J^\pi=5/2^+$ and $3/2^+$ is assumed.

S(p)(^{19}Na)=−322 *11* (2012Wa38).

P(^{18}Ne,p):resonances 2003An02,2005De15,2008Pe02 (continued)

^{19}Na Levels

E(level)	J^π	Γ	L	$(2J+1)\Gamma_0/\Gamma_{tot}$	Comments
745 *12*	$1/2^+$	101 keV *3*	0		E(level),J^π,Γ,L: from (2003An02). Others: (2005De15,2006Sk09). E_{res}(cm)=1066 keV *3* (2003An02). E_{res}(cm)=1076 keV *6*, Γ_p=80 keV *20* (2005De15), and E_x=740 keV *30*, Γ=130 keV *50* (2006Sk09). E(level): corresponding level is at 1471.7 keV in mirror nucleus ^{19}O.
2459† *32*	$(5/2,3/2)^+$†	105† keV *10*		0.43† *5*	E_{res}(cm)=2780 keV *30* (2008Pe02), uncertainty of 10 keV is also given in the abstract of (2008Pe02).
2769† *61*	$(3/2,5/2^+)$†	250† keV *50*		0.12† *4*	E_{res}(cm)=3090 keV *60* (2008Pe02), uncertainty of 50 keV is also given in the abstract of (2008Pe02).
4371‡ *10*	$3/2^-$‡	30‡ keV *10*			
4903‡ *10*	$3/2^-$‡	50‡ keV *10*			
5585‡# *32*		695‡ keV *72*			Sequential decay via ^{18}Ne*(4520,4523) to $^{17}F_{g.s.}$ is suggested.
5809‡# *76*		0.46‡ MeV *22*			Sequential decay via ^{18}Ne*(4589) to ^{17}F*(495) is suggested. E(level): 5809 and 5815 probably correspond to different decay modes of the same state.
5815‡# *17*		141‡ keV *18*			Sequential decay via ^{18}Ne*(5106,5153) to $^{17}F_{g.s.}$ is suggested.

† From (2008Pe02).
‡ From (2005De15).
# The TTIK excitation function of (2005De15) shows broad peaks consistent with $E_x \approx 2100$ and 2800 keV; a plausible explanation based on inelastic scattering by states near $E_x \approx 3500$ keV was explored, but not accepted since the expected amplitude was too low to explain the data.