Spectroscopy of ^{193}Os via the $(\vec{\mathrm{d}}, \mathrm{p})$ Reaction ◇

Y. Eisermann, H.-F. Wirth, R. Hertenberger, G. Graw, S. Christen [a], O. Möller [a], D. Tonev [a], and J. Jolie [a]

[a] IKP, Universität zu Köln

Strong evidence for the existence of supersymmetry in atomic nuclei has been found in the quartet of nuclei ^{194,195}Pt, ^{195,196}Au [1]. Our attention is now focused on a second quartet of nuclei, that is ^{193,194}Ir, ^{192,193}Os where the model is applicable [2]. We investigate the heaviest osmium isotope which is accessible in a single neutron transfer reaction: ^{193}Os. Excitation energies are known from (d,p)– [3] and (n,γ)–measurements [3,4], but there is limited information about quantum numbers. We measured absolute cross–sections and asymmetries of the ^{192}Os$(\vec{\mathrm{d}}, \mathrm{p})^{193}$Os reaction.

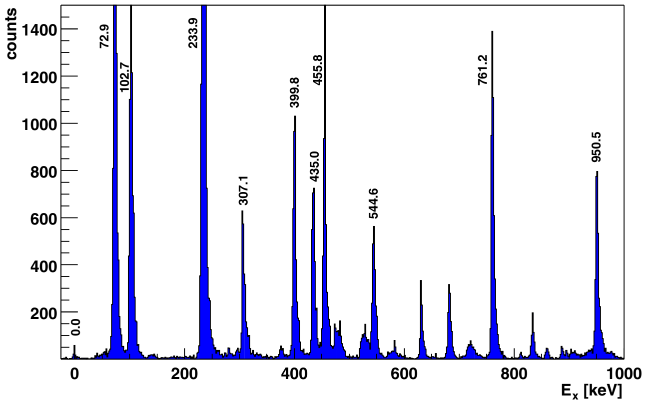

Fig. 1: Spectrum of the ^{192}Os$(\vec{\mathrm{d}}, \mathrm{p})^{193}$Os reaction measured with 22 MeV deuterons at a scattering angle of 20°.

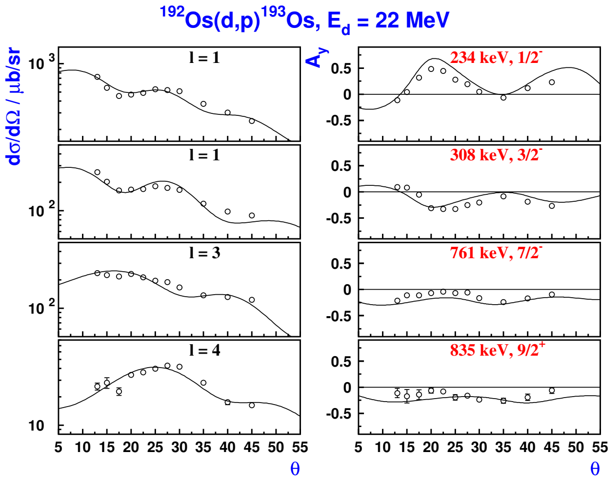

Fig. 2: Typical angular distributions of the ^{192}Os$(\vec{\mathrm{d}}, \mathrm{p})^{193}$Os reaction. The left part of the figure shows absolute cross sections of some levels. The right part shows corresponding analysing powers of these levels. Circles are experimental data, lines Distorted Wave Born Approximation calculations.

We used 22 MeV vector-polarised deuterons which were produced by our Stern-Gerlach atomic beam source. Deuterons were 65±5 % vector-polarised. Outgoing protons were analysed by the Q3D magnetic spectrograph and detected with the strip-detector. The target consisted of a metallic foil of 146 $\frac{\mu g}{cm^2}$ highly enriched ^{192}Os (99%). In the excitation energy range below 1400 keV 35 levels have been found of which 16 are new. For most of these levels (25) we could determine J^π. The table below shows our results in this energy range in comparison with Nuclear Data Sheet (NDS) information.

E_x [keV]		$(\frac{d\sigma}{d\Omega})_{20°}$	J^π		S_{lj}
NDS	(d,p)	[μb/sr]	NDS	(d,p)	[10^{-3}]
0.0	0.0	16	$3/2^-$	$3/2^-$	3.5
41.484(2)	—	—	$(1/2)^-$	—	—
72.901(2)	72.8(3)	502	$(5/2)^-$	$5/2^-$	134.9
102.733(1)	102.6(3)	504	$(3/2)^-$	$3/2^-$	108.9
233.856(2)	234.2(3)	468	$1/2^-, 3/2^-$	$1/2^-$	211.7
295.681(2)	—	—	$(5/2^-)$	—	—
307.083(2)	307.8(5)	167	$1/2^-, 3/2^-$	$3/2^-$	34.1
399.014(4)	—	—	$(5/2)^-$	—	—
—	401.1(3)	169	—	$7/2^-$	027.3
434.960(3)	435.5(3)	178	$1/2^-, 3/2^-$	$3/2^-$	38.9
455.767(5)	455.5(3)	197	$(5/2)^-$	$5/2^-$	47.5
544.551(4)	544.3(5)	65	$(5/2^-, 7/2^-)$	$5/2^-$	17.7
—	631.2(3)	37	—	$(11/2^-, 13/2^+)$	(41.6,102.6)
—	683.3(3)	56	—	$7/2^-$	8.8
709.200(10)	706?	*1	—	—	—
762	761.1(3)	232	$5/2^-, 7/2^-$	$7/2^-$	32.6
—	815	2	—	—	10
—	836	30	—	$9/2$‘$+$	15
—	859	5	—	$(1/2^+)$	1
888.62(3)	889	8	—	$7/2^+$	1.2
889.490(7)	—	—	—	—	—
—	897	3	—	—	1
—	905	3	—	—	1
—	913	4	—	—	0.5
952	950.7(4)	115	$5/2^-, 7/2^-$	$5/2^-$	26.7
—	974	*2	—	—	—
—	1044	2	—	—	—
1053.856(7)	1054	15	$1/2^-, 3/2^-$	$1/2^-$	7
1085.106(22)	1085.2(3)	160	$(1/2^-, 3/2^-)$	$3/2^-$	40
—	1132		—	$(3/2^-)$	1.5
—	1147	*14	—	$(5/2^-)$	2.7
1170.887(8)	1171	*36	$(1/2^+, 3/2^+)$	$3/2^-$	7
1178.421(22)	1178	*26	$(1/2^-, 3/2^-)$	$1/2^-$	12
1216.954(8)	1218	*5	$1/2^{(-)}, 3/2^{(-)}$	—	—
—	1227	12	—	$(7/2^-)$	3
—	1232	47	—	$5/2^-$	9
1281.467(19)	—	—	$1/2^-, 3/2^-$	—	—
1288.178(22)	—	—	$1/2^-, 3/2^-$	—	—
1333.5	1332	10	—	$3/2^-$	2.5
—	1340	27	—	$7/2^-$	4.8
1358.5	1357		—	$3/2^-$	3

*at 17.5° due to impurity

Fig. 3: The table shows a comparison between Nuclear Data Sheet (NDS) information and our results. Excitation energy E_x in keV, absolute cross section $(\frac{d\sigma}{d\Omega})_{20°}$ at a scattering angle of 20°, assignment of J^π and spectroscopic factor S_{lj}.

In the energy range above 1400 keV up to 2400 keV 70 further levels have been resolved. For most of these final J^π assignments will be made. Almost complete spectroscopy of ^{193}Os seems possible.

References

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