

Relational Nuclear Databases upon the MSU INP CDFE Web-site and Nuclear Data Centres Network CDFE Activities I.N.Boboshin, V.V.Varlamov, E.M.Ivanov, S.V.Ivanov, N.N.Peskov, M.E.Stepanov, V.V.Chesnokov

Progress Report to the IAEA Technical NRDC Meeting (28 - 30 May 2001, Vienna)

This report contains the only **short review** of the works carried out by the CDFE concern the IAEA Nuclear Reaction Data Centres Network activities for the period of time from the IAEA Advisory Group Meeting (15 - 19 May 2000, Obninsk, Russia) till May 2001 and the description of the main results obtained.

1. The **new** CDFE EXFOR **TRANS M030** has been produced and transmitted to the IAEA NDS. The TRANS contains (**Annex 1**) 10 retransmitted and 11 new (M0613 - M0623) ENTRYs with 150 data SUBENTs.

2. The CDFE photonuclear databases have been put upon the Web-site (http://depni.npi.msu.su/cdfe) before were upgraded significantly by adding a new data and software improvement:

- the "1999" part was added to the "Photonuclear Data Index"; the 2000 "part" is in processing; as whole the "**Photonuclear Data Index 1955 -1999**" database was added by a number of entries from /1/;
- in addition to the former data collection of the CDFE database "Giant Dipole Resonance Parameters" 180 new entries and 150 new reaction cross sections were added; the last database version includes now altogether 1710 entries and 1230 various photonuclear reaction cross section EXFOR data sets available in forms of both table and graph;
- the new CDFE Web-site **Search Engines** were produced using the Linux MySQL database management system (DBMS) instead of former hypertext data presentations for the following databases (the correspondent search forms are presented in **Annexes 2** -4):
 - "Giant Dipole Resonance Parameters. Photonuclear Reaction Cross Sections";
 - "Photonuclear Data Index 1955 -1999";
 - "CAJAD Charge Particle Reaction Cross Section Catalogue".

3. Using the MySQL Data Base Management System (Linux) two new relational databases "Nucleus Ground State Parameters" and "Nuclear Reaction Database (EXFOR)" were developed:

• "Nucleus Ground State Parameters" database was produced (Annexes 5, 6) for all known stable and radioactive nuclei using several well known sources /2, 3/ of nucleus parameters information and new CDFE data /4/ for first isobar analogue state energies includes the following data:

P7

- nucleus Z and A numbers;
- $T_{1/2}$ or Γ or Abundance /2, 3/;
- spin-parity J^{π} /2/;
- atomic mass M (with correspondent uncertainty) /3/;
- mass excess M-A (with correspondent uncertainty) /3/;
- nucleus binding energy (with correspondent uncertainty) /3/;
- nucleus ground state isospin (N-Z) /2 value;
- first isobar analogue T_>-state energy /4/ (Annex 7);
- nucleus dipole and quadrupole moments /5/;
- "Nuclear Reaction Database (EXFOR)" database was produced (test version is available now); Search Engine (Annex 8) gives to one the possibility to find the following data from the complete international EXFOR charge particle and photonuclear reaction data fund (the possibility to add the neutron reaction data fund exists and is under discussion now):
 - Target Nucleus (REACTION SF1);
 - Incident Particle (REACTION SF2);
 - Inc-Source;
 - Outgoing Particle/Process (REACTION SF3)
 - Product nucleus (REACTION SF4);
 - Quantity (REACTION SF5 SF9);
 - Energy/Angle range;
 - Method;
 - Facility;
 - Detector;
 - Status;
 - Reference;
 - Author;
 - Institute.

4. The "**Relational Nuclear Spectroscopy Database NESSY**" (New ENSDF Search SYstem) has been put upon the CDFE Web-site before. The main advantages of the NESSY PC version search system /6/ are the following:

- configuration on both search conditions and output information is not limited;
- automatic formation of tables containing the search parameters can be included into the common query configuration:
 - Query_1 (ENSDF) \Rightarrow Result_1,
 - Query_2 (Result_1) \Rightarrow Result_2,
 - and so on;
- requests are posed by means of both values and the relations between them;
- Arithmetical and other operations over searched values are possible.

The method of the realisation of the advantages mentioned above has been the using of so-called bank of standard requests /6/. Several new standard requests were realised for the NESSY Internet version /7/ during the period reviewed.

The following searches are available now:

• "Show Levels".

This query allows one to search the levels of any number of nuclei using several criteria.

• "Show Decay Modes".

This query shows to one the scheme of decay modes for the selected nucleus.

• "Show Levels and Gammas".

This query shows to one the scheme of gamma-transitions between the levels of selected nucleus.

• "Show Scheme of Levels".

This query shows to one the scheme of levels of selected nucleus.

• "Show Levels with Equivalent Energies".

This query allows one to search the various nuclear levels with energies equivalent to entered.

References

- 1. E.G.Fuller, H.Gerstenberg. Photonuclear Data Abstracts Sheets 1955 1982. NBSIR 83-2742. U.S.A. National Bureau of Standards, 1986.
- 2. G.Audi, A.H.Wapstra. The 1995 Update to the Atomic Mass Evaluation. Nucl.Phys., A595 (1995) 409.
- 3. J.K.Tuli. Nuclear Wallet Cards (Sixth Edition), U.S.A. Brookhaven National Laboratory National Nuclear Data Center, January 2000.
- I.N.Boboshin, B.S.Ishkhanov, V.V.Varlamov. Energy of the first T_>–isospin Nuclear State New Formula. International Conference on Nuclear Data for Science and Technology. Embracing the Future at the Beginning of the 21st Century (October 7 - 12, 2001). Tsukuba, Japan, JAERI (submitted Abstract N50, Annex 7).
- 5. N.Stone. Table of New Nuclear Moments. 1997 Preprint (A revision of the Table of Nuclear Moments by P. Raghavan (Atomic Data Nuclear Data Tables 42, 189 (1989))).
- 6. I.N.Boboshin, V.V.Varlamov. The New ENSDF Search System NESSY: IBM/PC Nuclear Spectroscopy Data Base. Nucl.Instr. and Meth., A369 (1996) 113 119.
- I.N.Boboshin, V.V.Varlamov, E.M.Ivanov. The CDFE Relational Nuclear Spectroscopy Data Base NESSY in Internet. Report on the IAEA Advisory Group Meeting on Network of Nuclear Reaction Data Centres (15 - 19 May 2000, Obninsk, Russia). INDC(NDS)-418, IAEA NDS, Vienna, Austria, 2000, pp. 142 - 143.

Annex 1.

The CDFE EXFOR TRANS M030 contents (corrected old and new ENTRYs)

ENTRY's Number	Amount of DATA TABLEs
M0043	26
M0045	24
M0166	2
M0296	2
M0397	7
M0428	11
M0431	3
M0434	2
M0539	10
M0598	4
M0613	2
M0614	6
M0615	5
M0616	5
M0617	2
M0618	10
M0619	12
M0620	3
M0621	3
M0622	3
M0623	9
Total: 21	Total: 150

Annex 2.

The search form for the relational database "Photonuclear Data Index 1955 -1999"

COFE provides the major photonuclear (databases. On-Line Services N	letscope	_ E X
Ele Edit View Go Communicator Help		and the second	111111
Back Peload Home	Search Netscape Print S	ecurity Shop	N
Bookmarks 🄏 Location Mp.//deprin	pi msu su/odła/services/prisearch Mr	n	- 🕐 What's Related
	NUMBER OF A DE LA DELLA DE		
CONTRE FOR PHOTOMUCLEARE	CERIMINES DATA		
	Onio	Services (Berbers Alcol Team (Publications Contexts	Ithit Events
COPE: On-Line Services > PHI S	earch Erigine		
	OILINE SERVICES. PN	Search Engine,	
Each field in this form is upfor	ral - nay be blank		
		[Click here for help.]	
Advanced Search	X	Lampins	
Edior Handber		MOST 0 MODES	
Index Bandser :		90000 00000	
Bacteus Investig	ated (ZA)	52 10,20 7-82	
Reaction Target	ZA)	15 12,24,90 4-65	
breidert Particle	o mist and m		
Outgoing Particle			
Quantities		DST.POL,A-POW SG	
Energies Interva	(MeV):	0 - 12.54 15-24.79 103.04 - 20000	
Angles Internal (Degreei	0 - 180 90 - 360	
Reference	_	ANEXA,339,205,1980 JNP/A	
Author		ALLEN D./ HOLT	
Year(a)		1963 1998 - 2000	-
Document Done			19 14 2P IR V

Annex 3.

The search form for the relational database "Giant Dipole Resonance Parameters. Photonuclear Reaction Cross Sections"

ECOFE provi	des the major photonuclear databases. On-Line Services	Netscape	_ E X
Ele Edit Ve	w Go Communicator Help	and the second	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Back	Peload Home Search Netscape Print	Security Shop	N
Bookma	ska 🔏 Lacation [http://deprinpi.msu.su/cdle/services/gdrsearch.h	Arri	- C Whot's Related
	MOROOW STATE UNIVERSITY, INSTITUTE OF MUCH CAR PROVIDES CUITIN FOR PROTONICALIAN COPERIMENTS DATA	n Services (Barbanta Bacad Tanato Budikonistas Continutas Mat.Do	
	CONE: On-Line Services - GBRYON Search Englise On Line Services, GDR Each field in this form is optional - may be blank.	RM Search Engine.	
		Elick have for help. 3	
	Advanced Search:	Laurutes	
	Exter number :	#0001027 8044805	
	z	12 10;20 7:82	
	A:	16 13,24,98 4-65	
	Reaction	CARS GNGP GNG,T	
	Maximum energy (MeV)	12.54 16.2470	
	Maximum cross section value	10 4.90-9	
	Integrated cross section (MeV * mit)	3.1 5-10.09	
	Referenceiyear	PHYS/REV.,C4,140 NUCLIPHYS 1871	
	First author	PULLER	
	Elist have to make it yound to so	anetha riske dow for sender	_
	Dokton Section Entrep Annal I Same	l Euliisatonal Contactel Hot.Econtel	
	Document Done	6	A R P P P

Annex 4.

The search form for the relational database "CAJAD Charge Particle Reaction Cross Section Catalogue"

COFE provi	des the major pho	tonuclear database	es. On-Line	Services	- Netscop			2 E X
Ble Edit Vie	🖬 Go Communic	apo, Piedo						
Back	Peload	Home Search	Netscape	Print	Security	Shop	1	N
Bookma	ska 🎄 Location 🛛	//tepninpi meu eu	(odle/service)	s/cprsearc	hhmi			 What's Related
	200000000000000000000000000000000000000	NAMES IN AN ADDRESS	MURI EAR PHYSI	15		_		
	CUITIN FOR PHOT	IONNELLARI DEPENMENT	SDATA					
	CORP. Do Line For	and the second second second		- On	Line Services	Extens Ab	ad I Team (Publications Cont	anta (15al Reseata
	COLOR OF CHARGE	WORLD CHUSCHED CH						
			08-1.88	STRUCTS.	CPR Search E	ngine,		
	Each field in f	his form is optional - may be	e blark					
							Click here for belo-1	
		Advanced Search:	-			amples		
		Exter number				A0165	002 10011002	
		2				12 (10,20 7-82	
		A.	· · · · ·			16 1	124,88 4.65	
		Reaction				A LARSH	7,7 340-7,7,0,H+HE3	
		Final nusleus :	1				4.86-7	
		Guardity				TARS	0,2991,50,	
		Energy interval (MeV	9: [-	12.54 15-3	4.78 103.04 - 200000	
			The base is an	head action of R	an an alkan sin	from Part speed Bull		
			Cold start is in	Hard Boards O	44 39 10 10 90 9	SHATE TELES		
		Do-Line.	Internal Eastern	al Sheat Ta	and failuate	el Contacto I d	Contract, Elemental, Elemental, Elemental, Elemental, Elemental, Elemental, Elemental, Elemental, Elemental, E	
	Last Maddad	Manday Salambar 04, 20	00 12 84 81					
Local Street	True here at	a station to state to	for manual por	in sec. cardin	a			×1
-0-	Document D	lone						I S S P A Z

Annex 5.

The new relational database "Nucleus Ground State Parameters" (Berilium isotopes part example)

ЖN	ucleus	G	ound State Pa	iramo	eters - Netscape								_ 8 ×
<u>F</u> ile	<u>E</u> dit	⊻ie	ew <u>G</u> o <u>C</u> omi	munic	ator <u>H</u> elp								
•	Back	F	Forward Rela) ad	da 🤌 🯄 Home Searc	m) h Netsca	🦂 pe Print S	💕 ecurity	👌 👔 Shop Stop				N
ž 💙	🎸 Boo	km	arks 🤳 Loca	tion:	nttp://depni.npi.msu.	su/cgi-bin/g	search.cgi?z=4					👻 🅼 What	t's Related
<u> •</u>						Data			in Mana				
							Nucleus Ground Stat	e Parameter	'S				
							₄ Be (Berylli	um)					
					One direct								
	_				See alpoie	e and quadrupo	Die moments for snown	nuclei both	dround and excited states				
			T., or F or		Atomic Mass	$\Delta_{\Lambda M}$	Mass Excess	Δ _{MF}	Nucleus Binding	$\Delta_{\rm RF}$	Ground	First T_State	
		r	Abundance	J^{π}	M, Micro-U	Micro-U	M-A, keV	keV	Energy, keV	keV	State	Energy, keV	
	_										Isospin		
		5	*	(1/2+)	5 040790#	4290#	37996#	3996#	-768#	3996#	3/2	*	
		6	92 KEV 6	0+	6 019725.804	5.871	18374.465	5.468	26924.058	5.468	1	*	
		7	53.29 D 7	3/2-	7 016929.246	0.507	15769.489	0.472	37600.358	0.472	1/2	11010	
		8	6.8 EV 17	0+	8 005305.094	0.038	4941.662	0.035	56499.506	0.037	0	16626	
		9	100.%	3/2-	9 012182.135	0.425	11347.584	0.396	58164.907	0.396	1/2	14392.2	
		10	1.51E+6 Y 6	0+	10 013533.720	0.430	12606.577	0.400	64977.237	0.400	1	21220	
		11	13.81 S 8	1/2+	11 021657.653	6.823	20173.970	6.356	65481.167	6.356	3/2	20881.99*	
		12	21.3 MS 1	0+	12 026920.631	16.109	25076.402	15.005	68650.058	15.005	2	25212.75*	
		13	0.17 MEV 11	(1/2-)	13 036133.834	539.449	33658.445	502.494	68139.338	502.494	5/2	*	
		14	4.35 MS 17	0+	14 042815.522	116.009	39882.396	108.061	69986.710	108.062	3	*	
	☑	AI	listed isotopes										
							Select database v	ou need:					
					Giant Di	pole Resonanc	ce Parameters, Photonu	iclear React	tion Cross Sections 💌				
													_
		_				Searc	ch for selected nuclei	Sea	irch Engine				•
6 –)=		Docum	ent: D	lone							🗏 🔆 🖊 🚮 🖓	🔛 🎸

Annex 6.

The search form for the relational database "Nucleus Ground State Parameters"

Ele Edit Vie	des the major photonuclear date Go Communicator Help	abases. O	nline Services.	Netscope	ř.		LE X		
Back	Reload Home Se	a la	scape Privi	Security	Shop	31	N		
- Dourina	eer V ande het Vathruite H	neu eu/cate/							
	CONTRACTOR PROTORNOL CAR CAPER	THE OF MUCLES	AR PHYSICS				î		
				tite Services	Extens Ale	out I Team (Publications) G	antimata, i that Resents		
	COTE: Online Services - Nucleus Gr	round State P	hrametern Search I	Engine					
		Iberte	CHLINE S	URVICES.	arch Franker				
			THE OF DEFINI STATE IT	ameter 6 set	and digite.				
	Each field in this form is optional	- mey be bara	verseles.	here for heat					
	2	_	12 10,20	10-15					
	A		16 13,24,98	4.65					
	C At known instances								
	T Statute centre		Select the slata set you want to	elect the state set your	Select the data set you want t	wartto see			
	C Only natural			2014/03.001683.420					
	Dalidas								
	Abundance	P Atom	ée mass						
	E 14	P Unce	stainty in atomic ma						
	Cround state isospin	P Mass							
	Pirst T, state energy	P lince	rtainty in mann exce	-					
		2 and	nding energy						
	SAME IN COLUMN	P Unce	rtainty in binding on	Hergy					
		100	14106 - 68						
	Club have to address	distant lies a	to the second and his second	W.					
2-2-	Document Done								

Annex 7.

 $\label{eq:thm:total} The \ T_{>}\ state \ energy \ values \\ for \ the \ new \ relational \ database \ ``Nucleus \ Ground \ State \ Parameters''$

ENERGY OF THE FIRST T_>–ISOSPIN NUCLEAR STATE NEW FORMULA

I.N.Boboshin, B.S.Ishkhanov, V.V.Varlamov

D.V.Skobeltsyn Nuclear Physics Institute, M.V.Lomonosov Moscow State University 119899 Moscow, Russia

In the frame of nuclear physics isobaric state formalism the lowest isobar-analog state (isospin $T_{>}= |N-Z|/2+1$) energy value is very important parameter for many research concerned to various nuclear processes (giant dipole resonance decay, various nuclear reaction mechanisms, etc.). But there is evident lack of such information in the modern databases. For example the Evaluated Nuclear Structure Data File (ENSDF) /2, 3/ contains these values for slightly more than 100 nuclei. Therefore a formula for the first $T_{>}$ -isospin state energy value calculation is very actual. As a rule a well-known semi-empirical formula /1/ is used

$$E = E_{be}(N, Z) - E_{be}(N + 1, Z - 1) + 1.444 \cdot (Z - 1/2) / A^{1/3} - 1.131, MeV$$

where $E_{be}(N, Z)$ and $E_{be}(N + 1, Z - 1)$ are the correspondent nucleus binding energy values (in MeV).

The check of this formula was carried out using the $T_>$ -isospin state energy experimental data from the ENSDF modern version for 118 nuclei from ⁶Li to ⁶¹Zn. It was found out that above formula describes correctly the $T_>$ -isospin state energy values only for nuclei with N > Z. The disagreements between experimental and calculated values for other nuclei are too high, for example, -274.95 keV instead of 12255.00 keV for ¹⁵O, 100.44 keV instead of 11192.90 keV for ¹⁷F, and -9348.88 keV instead of 5900.00 keV for ²⁸P.

For improving the situation it was proposed that for nuclei with $N \le Z$ the formula must be changed. Using the symmetry assumptions it was shown that the following two formulae must be used instead of the above one:

$E = E_{be}(N, Z) - E_{be}(N + 1, Z - 1) + 1.484 \cdot (Z - 1/2) / A^{1/3} - 1.293, MeV$	for $N > Z$,
$E = E_{ba}(N, Z) - E_{ba}(N - 1, Z + 1) - 1.484 \cdot (Z + 1/2) / A^{1/3} + 1.293$. MeV	for $N \leq Z$.

Instead of above formula second parameter 1.131 the neutron-proton mass difference 1.293 MeV parameter was used: the formula term concerned described the isospin symmetry violation. After that the new value of the formulae first parameter (1.484 instead of 1.444) was obtained using the variation of formulae for the same accuracy obtaining.

The averaged disagreement $\Delta = 0.107$ MeV between estimations calculated using proposed two new formulae and experimental ENSDF data has been obtained for 116 nuclei from 118 investigated. The only two exceptions for ¹⁵O ($\Delta = 1.40$ MeV) and ²⁶Mg ($\Delta = 5.04$ MeV) have been found out. Both items could be interpreted as results of possible mistakes in the ENSDF. The point is that the spins of states under discussion are not in accordance with the spins of the ground states of the correspondent isobar–analog nuclei. It looks like that in the ENSDF for both nuclei mentioned above the data are presented for not first but second T_>–isospin states.

The $T_{>}$ -isospin state energy data calculated for 2560 nuclides using above formulae are available now at the MSU INP CDFE Web-site (<u>http://depni.npi.msu.su/cdfe</u>).

The Grant N 99-07-90015 of Russian Foundation for Basic Research.

- 1. J.D.Anderson, C.Wong, V.MacClare. Phys.Rev., 138 (1965) B615.
- 2. T.W.Burrows. Nucl.Instr. & Meth., A286 (1990) 5953.
- 3. J.K.Tuli. National Nuclear Data Center, Brookhaven National Laboratory. Report BNL–NCS–51655–Rev. 87. 1987.

Annex 8.

The search form for the relational database "Nuclear Reaction Database (EXFOR)"

囊 Extor II - Net	scape			_ # X
Elle Edit View	go gommunicator Help			
Back	Reload Home Se	anch Netscape Print Security	Shop	N
Bookmeri	ks 🙏 Location: http://depai.spin	isu.su/odfe/extor/index.php3		Vhat's Related
	NEXTRE FOR PHOTOMICLEAR EXPO	ITE OF NUCLEAR PHYSICS UNITED BATA Colora Sectors P	andranica i Alexant i Tananci (Suddiaudilanca i Scondars	ta (the Results
	Each field in this torm is actional	ONLINE SERVICES, EXPOR Search En	ighte.	
	t.	Matlear Reaction Database (EXPC	(R)	
	Burther	EVITRY SUBBVIRY	M0612 M0025-M0040 M0126, M0225, M 001 003-006 001, 006, 010	0537
		Reaction		
	Terget Hudeus : Z (digits) or Chemical symbol (lations) and Mass number (slight)	Z or Symbol:	A: [
	Insident Particle :	E No Incident particle - spontaneous decay A Agingo D Ceuterons E Electrons		
	Net-Searce I Source of the incident particle been	A-SE Abho-Berytkes ARAD Annihilation redistion ATOM Alonic been source BRST Brenestishing		
	Outgoing Particle / Process :	 No outgoing particle - property of compound nuclei A Alginas Decay Bita- D Ceuterons Generation 	*	
1 - P-	Document Done			

Annex 8 (continuation 1).

The search form for the relational database "Nuclear Reaction Database (EXFOR)" (continuation 1)

Back En	Reload Home S	React Netscape Print Security Stop	N
#*Bookmarks	s 🤱 Location: http://depoi.npi	msu su/edor/2/index.php3	 What's Related
		Integral crass sectors, general	A
	Quantity : Reaction perometer	Cross section contributions Cross sections Hegenited cross sections Resonance integral I	
	Energy/Angle range :	Low lint (4-min) ADDG ADDG AMM4	
	Status : Versus types of internation	APRIVD Approved by exthor COREL Data correlated with another data set OTX Data taken from edits (file of McGowan, et al. CURVE Data result from e curve	
		Methodic	
	Method : Experimental technique(s) wspitywel in the experiment	ABSFY Activities feation yield minisurement ACTIV Activities AKS Accelerator mass spectrometry ASSP Separation by mass-separator	
	Facility : Man apportus used in the experiment	ACCEL Accelerator BETAT Betation COV Coccent Waton accelerator CHOPF Part chopper	
	Detector : Detector(x) used in the expression	BF3 Boran Triflaoride neutran detector BOO Blanuth-Germanute crystal detector BFARF Bechol under sector boetter CEFEN Gerenkury detector	
	8	Bibliography	
	Descenario Cress	Tarac I	

Annex 8 (continuation 2).

The search form for the relational database "Nuclear Reaction Database (EXFOR)" (continuation 2)

💥 Exfor II - Netscape					_ 8 ×
<u>F</u> ile <u>E</u> dit ⊻iew <u>G</u> o	<u>C</u> ommunicator <u>H</u> elp				
Back Forward	🔹 🏦 🯄 🚵 🗳 💕 🔞 🎆 Reload Home Search Netscape Print Security Shop Stop				N
👔 🆋 Bookmarks 🙏	Location: http://depni.npi.msu.su/exfor//2/index.php3	•	[🕼]	What's	Related
<u> </u>	Bibliography	Π			^
	Reference: Type: Book Type, code and year of publication C Conference Year: 1999 1999 1965-1975 1999 1965-1975				
	Author : Name of any author of				
	Institute: Institute(s) at which experiment help was performed				
	Number of subentrys founded / page				
	SEARCH CLEAR ALL				
	Online Services Partners About Team Publications Contacts Hot Events				
	Last Modified: Thursday, January 01, 1970 03:00:00 If you have any questions, comments, and/or suggestions, please, contact				
	<u>CDFE Head: Vladimir V. Varlamov</u> @Webdesign by <u>Nikolai N. Peskov</u> and <u>Sergei V. Ivanov</u> , 2000.				•
ď =0=	http://depni.npi.msu.su/cdfe/about.html	*	4 P	1 P	A 🖋