00-30130 (113) [10]
Translated from Russian

UDC 002.63: 539.17: 681.3

WEB SERVER OF THE CENTRE FOR PHOTONUCLEAR EXPERIMENTS DATA OF THE SCIENTIFIC RESEARCH INSTITUTE FOR NUCLEAR PHYSICS, MOSCOW STATE UNIVERSITY: HYPERTEXT VERSION OF THE NUCLEAR PHYSICS DATABASE

I.N. Boboshin, A.V. Varlamov, V.V. Varlamov, D.S. Rudenko, M.E. Stepanov
D.V. Skobel'tsyn Scientific Research Institute for Nuclear Physics,
M.V. Lomonosov Moscow State University,
Centre for Photonuclear Experiments Data

WEB SERVER OF THE CENTRE FOR PHOTONUCLEAR EXPERIMENTS DATA OF THE SCIENTIFIC RESEARCH INSTITUTE FOR NUCLEAR PHYSICS, MOSCOW STATE UNIVERSITY: HYPERTEXT VERSION OF THE NUCLEAR PHYSICS DATABASE. The nuclear databases which have been developed at the Centre for Photonuclear Experiments Data of the D.V. Skobel'tsyn Scientific Research Institute for Nuclear Physics, M.V. Lomonosov Moscow State University, and put on the Centre's web server, are presented. The possibilities for working with these databases on the Internet are described.

At the current stage of development in science, wide use is being made of computer technology and automated systems not only to carry out experiments and process the results, but also for subsequent analysis and evaluation of the data. On the one hand the experiments themselves are getting much more complex, and on the other hand much higher requirements are being imposed as regards the quality of the results. The problems of elaborating dependable and reliable methods for processing the data already available, and for evaluating the data both with and without using theoretical models, are becoming more and more acute. If we are to solve these problems, we need to create large databases and data banks, and effective software packages for working with them. Producing different types of data bank, database and electronic data library provides a good basis for achieving a new qualitative level in fundamental and applied research. The development and improvement of computerized data manipulation techniques facilitates not only the effective processing and analysis of the results of previous experiments, but also the planning of new experiments, and the modelling of experiments which - for one reason or another - cannot be carried out.

These trends in various fields of science and technology play a significant role in nuclear physics as well, where it is more often than not impossible to measure certain values directly; this means that indirect methods must be used to study them, as well as various combinations of the available data. This makes for significantly higher requirements as regards the accuracy and reliability of such data and means that effectiveness of scientific research is directly linked to progress in information technology. Moreover, using modern information technology [1] not only facilitates effective work with the currently available data; it also in many cases allows new physical results to be obtained [2, 3].

The Centre for Photonuclear Experiments Data of the Scientific Research Institute for Nuclear Physics, M.V. Lomonosov Moscow State University, and the International Nuclear Data Centres Network

Large volumes of nuclear physics information are generated and maintained by special organizations, the Nuclear Data Centres, which have been organized into a global system by the International Atomic Energy Agency (IAEA). In recent years this system has become a kind of network (Nuclear Data Centres Network) [4]. Nuclear data groups and centres from Austria, Hungary, China, Russia, the USA, Ukraine, France and Japan are participating in this collaborative effort. Russia is represented here by three organizations: the Nuclear Data Centre of the Institute for Physics and Power Engineering, Obninsk; the Centre for Nuclear Structure and Reaction Data of the Kurchatov Institute, Moscow; and the Centre for Photonuclear Experiments Data of the Scientific Research Institute for Nuclear Physics, M.V. Lomonosov Moscow State University. These centres prepare specific sections of the numerical nuclear data files in a co-ordinated manner, and they then combine them and organize work with the data within the framework of various databases or data banks which meet practically all data requirements for research into the physics of the nucleus and low- and intermediate-energy nuclear reactions.

Within the context of this international collaboration with the IAEA, the Centre for Photonuclear Experiments Data is responsible for photonuclear data, i.e. data on nuclear reactions induced by photons and electrons. In addition, the Centre processes data on reactions involving radiative capture of neutrons and various charged particles. To date, the Centre has prepared 80% of the photonuclear data included in the data collections produced by this international co-operation.

The Centre uses the various data banks, databases and data files which are generated or obtained through exchange arrangements, and which contain information on nuclear reactions induced by neutrons and charged particles and reference and bibliographical data on the structure of nuclei, to meet the requests of its users. The Centre carries out this work as part of the work programmes under an IAEA research contract, a similar State-level activity, the BAPHYS programme, and with a grant from the Russian Foundation for Fundamental Research.

Nuclear Data in the Internet

Recently, what one might call "on-line service" Internet-based information systems have become very common in the Nuclear Data Centre Network. Two main access routes to the data are used, depending mainly on the capabilities of the user's PC:

- **Internet** (multifunctional search systems containing a large amount of additional visual information (graphs and diagrams); the most recent Internet browser versions have the greatest capabilities thanks to the use of the latest data presentation resources (frames, JavaScript, JScript, JAVA, CGI, ASP, etc.));

- **Telnet** (search systems where the user's options are significantly limited because the data is presented in text form; the advantages of this route are that it can be used with low-transmission-capacity connections and offers additional specialized real-time data processing facilities).

The Internet addresses of the various nuclear physics data collections of some of the Nuclear Data Centres are well known to the experts:

BNL NNDC Brookhaven National Laboratory, National Nuclear Data Center (USA):

telnet://bnlnd2.dne.bnl.gov
http://www.nndc.bnl.gov

IAEA NDS International Atomic Energy Agency, Nuclear Data Section (Austria):

telnet://iaeand.iaea.org
http://www-nds.iaea.org

LUND Lund University, Lund Nuclear Data Web Service (Sweden):

http://nucleardata.nuclear.lu.se/nucleardata/

NIST National Institute of Standards and Technology, Physics Laboratory (USA):

http://physics.nist.gov/

NEA-DB OECD Nuclear Energy Agency Data Bank (France):

http://www.nea.fr

A web server has been set up at the following address to provide permanent access for remote Internet users to the nuclear physics information available at the Centre for Photonuclear Experiments Data:

http://depni.npi.msu.su/cdfe;

the Centre's main photonuclear databases are available here [5-7].

Web Server of the Centre for Photonuclear Experiments Data

A hypertext version of the Centre's main database was developed so that the data could be placed on the Centre's web server. This hypertext version has advantages and disadvantages. Users who are not acquainted with the database format will find this presentation of the data more convenient. More experienced users will find that a search system based on - for example - the MySQL or Oracle DBMS, and specially adapted to the web environment, will offer them greater possibilities. We are currently developing this type of presentation of the data at the Centre.

The hypertext tables on the Centre's web server are being created with help of several software packages, chief among which is the Borland Paradox relational DBMS. A program has been written in Pascal to generate automatically the hypertext files from the source file, which is in Paradox DBMS format. All the documents in the databases are written only in HTML, without using such technologies as JavaScript, Java, CGI, ASP, etc.

Main web page of the server

The databases on the Centre's server are accessed through the *"On-line Services"* section of the server's main (home) page (see Fig. 1). The other sections of the main page contain the following information:

- **"About"**: information on the aims and main emphases of the Centre's activities;
- "**People**": list of the Centre's principal staff;
- "**Partners**": list of the Centre's main partners for international collaboration;
- "**Contact Us**": contact addresses for the Centre.

Main system menu

The main system menu is used to search for the required data. Data can be searched for by element (nucleus, isotope) and reaction.

For the purposes of searches by element, part of the main system menu is organized in the form of the familiar periodic table of the elements. Selecting a specific element calls up an intermediate system menu which can be used to select one of the main databases on the server (DB1, DB2 and DB3).

For the purposes of searches by reaction, the relevant part of the main system menu is organized in the form of a full list of the reactions for which data is available on the web server (see Fig. 2). Selecting a specific reaction also calls up an intermediate menu which allows the user to make a selection among the databases on the server (DB1, DB2 and DB3).

Intermediate system menus

The intermediate system menu for an element search comprises a table of the abundances of the stable isotopes of the selected element (see Fig. 3; in this case we are dealing with the isotopes of tin: ^{112,114,115,116,117,118,119,120,122,124}Sn) in their naturally occurring mixture, together with a list of the databases on the server which may be selected for the actual data search.

The intermediate system menu for a reaction search only includes a list of the databases on the server:

DB1 - database of giant dipole resonance parameters and photonuclear reaction cross-sections (Giant Dipole Resonance Data);
DB2 - database of the abundances of the stable isotopes of nuclei and the energy

thresholds of photonuclear reactions (Reaction Thresholds Data);

DB3 - bibliographical reference database of photonuclear reaction data published over the whole research history (as of the middle of 1999 - for 1955-1996) (Photonuclear Data Index).

Database of giant dipole resonance parameters and photonuclear reaction cross-sections (DB1)

DB1 [8, 9] (see Fig. 4) contains data on the following characteristics (a reference and the name of the primary author of the relevant publication is also given) of resonances observed in the cross-sections of a large number of the most important photonuclear reactions, which are listed below, for the majority of known nuclei:

EXFOR	sub-accession number (SUBENT) in the EXFOR international database;
NUCL	nucleus studied (symbol);
A	nucleus studied (mass number);
REACT	reaction studied;
E-MAX	energy (in MeV) of the resonance maximum in the reaction cross-section;
SIG	cross-section (in mb) at the resonance maximum in the reaction cross-section;
FWHM	full width (in MeV) at half maximum of the resonance in the reaction cross-section;
E-INT	energy (in MeV) of the upper integration limit;
SIG-INT	integrated cross-section (in MeV*mb);
SIG-INT-1	first moment (in mb) of the integrated cross-section;
REFERENCE	reference;
AUTHOR	last name and initials of primary author ((+) indicates that there are other authors).

G,ABS	total photoabsorption	$[(\gamma,n) + (\gamma,p) + (\gamma,np) + (\gamma,2n) + (\gamma, d) + (\gamma,t) +...+ (\gamma,F)]$
G,XN	neutron yield	$[(\gamma,n) + (\gamma,np) + 2(\gamma,2n) + 3(\gamma,3n) + ... + \nu\ (\gamma,F)]$
G,SN	total neutron production	$[(\gamma,n) + (\gamma,np) + (\gamma,2n) + (\gamma,3n) + ... + (\gamma,F)]$
G,N	single neutron	$[(\gamma,n) +(\gamma,np)]$
G,NP	neutron-proton	(γ,np)
G,1N	pure one-neutron	(γ,n)
G,2N	double neutron	$[(\gamma,2n) + \gamma,2np)]$
G,3N	triple neutron	$[(\gamma,3n) + (\gamma,3np)]$
G,P	single proton	$[(\gamma,p) + (\gamma,np)]$
G,1P	pure one-proton	(γ,p)
G,D	deutron	(γ,d)
G,T	triton	(γ,t)
G,HE-3	He-3 nucleus	$(\gamma,{}^3He)$
G,A	alpha-particle	(γ,α)
G,F	fission/neutron for actinides	$[(\gamma,f) + \nu(\gamma,nf) + ...]$

Since the information for the various maxima, which may be clearly observed in the cross-sections is given in separate rows of the table, the data can also be used to obtain a general picture of the shape of the resonances in the reaction cross-sections.

As of the middle of 1999, the database contained information (1317 sections in total) on 82 elements (220 isotopes and their naturally occurring mixtures) with values of Z = 1 - 95. In addition, numerical and graphical information on the energy dependences of the cross-sections (excitation functions) of the various types of photonuclear reaction has been prepared for the majority of the sections of the database (846 as of the middle of 1999) based on the EXFOR international nuclear reactions database [10].

The DB1 pages (Giant Dipole Resonance Data) provide the option of looking at a graphical representation of the selected reaction cross-section. The column containing the numbers of the sections of the EXFOR system in which the relevant numerical data are contained are used for this (see Fig. 4).

The source data in the table for the selected reaction cross-section can be downloaded to the user's computer for further use. In addition, the user is given summarized information on the publication in which the data on the selected cross-section were published.

Database of the abundances of isotopes and the thresholds of photonuclear reactions (DB2)

DB2 (see Fig. 6) contains numerical data on the abundances of the majority of the known stable isotopes of nuclei in their naturally occurring mixture.

The database also includes data on the energy thresholds (the rounded values from Ref. [11] are used) of the main reactions involving interaction of photons with all stable isotopes of nuclei (in the case illustrated, the isotopes of tin (Sn)) where there is accompanying emission of nucleons, various charged particles and certain combinations thereof.

Bibliographical reference database on photonuclear reactions (DB3)

The database contains a bibliography of publications (reference, primary author) in scientific periodicals from 1955 to the present day on experimental research into reactions involving interaction of low- and intermediate-energy electrons and photons with atomic nuclei, and reactions involving radiative capture of neutrons and charged particles.

The database also includes short descriptions (coded abstracts) of the experimental conditions (target nucleus, incident and emitted particles, nucleus excitation energy region or incident particle energy region, emission angle region of the reaction products) and the main results.

The database is based on the data in a file containing textual and numerical information prepared at the Centre for the period 1976-1996 [8] and at JAERI (Japan Atomic Energy Research Institute) for the period 1955-1992 [12].

DB3 (Photonuclear Data Index) contains (see Fig. 7) bibliographical reference information on publications in the scientific press on electromagnetic interaction of nuclei (the reactions listed in Fig. 3) for the period 1955-1996.

The database also includes a description of the experimental conditions (nucleus excitation energy region or incident particle energy region (**EN-MIN**, **EN-MAX**)), particle emission angle region (**ANG-MIN**, **ANG-MAX**)) and a list (in the form of codes from the relevant dictionary) of the main results obtained (**QUANTITY**):

NUMBER	relevant numbers of the sections in the indexes of the Centre for Photonuclear Experiments Data [8] and JAERI [12];
E	code for numerical data in the EXFOR system;
NUCL	nucleus studied (symbol);
A	nucleus studied (mass number);
REACT	reaction studied;
QUANTITY	codes for main results obtained;
EN-MIN	minimum energy (in MeV);
EN-MAX	maximum energy (in MeV);
ANG-MIN	minimum angle (in degrees);
ANG-MAX	maximum angle (in degrees);
REFERENCE	reference;
AUTHOR	last name (and initials) of primary author ((+) indicates that there are other authors).

The required information can be extracted from DB3 by element and by reaction in a similar manner to DB1.

The Centre's web server provides options for moving around DB1 (Giant Dipole Resonance Data) and DB2 (Reaction Thresholds Data) and selecting information on other reactions or nuclei, and for transferring from DB1 to DB2 and vice-versa. At present, DB3 (Photonuclear Data Index) is independent.

Access statistics for data on the server and prospects for its development

The Centre's web server has two standard user access counters. As of the end of June 1999, these were giving the following figures:

- Rambler's Top 100 (since the beginning of 1998) - 1182;

- ALPHA COUNTER (after 1998-11-10) - 556.

At present at the Centre:

- **we are working on adding data on photonuclear reactions published in 1997-1998 to the bibliographical reference database (DB3);**

- we are working on placing on the server data on the structure of nuclei prepared

at the Centre [13] using the international ENSDF file, and data on the cross-sections of reactions induced by charged particles prepared at the Centre for Nuclear Structure and Reaction Data using the new version of the catalogue in Ref. [14];

- we are developing a search version with a single universal presentation of the data from the Centre's databases based on the MySQL DBMS (using CGI) and the Oracle DBMS (using JAVA).

This work is being done with the support of the Russian Foundation for Fundamental Research (RFFI)
RFFI grant 99-07-90015

Fig. 1.


CDFE Home Page - Netscape
File Edit View Go Communicator Help
Bookmarks Location: http://depni.npi.msu.su/cdfe/
What's Related
ЦЕНТР ДАННЫХ ФОТОЯДЕРНЫХ ЭКСПЕРИМЕНТОВ
CENTRE FOR PHOTONUCLEAR EXPERIMENTS DATA
CDFE
About People Partners On-Line Services Contact Us
Welcome to CDFE!
UPDATE
What's New?
18.05.99 Photonuclear Data Index updated.
18.01.99 new EXFOR data sets added.
02.12.98 Giant Dipole Resonance data updated.
10.11.98 new Counter added.
14.09.98 Reaction Thresholds data updated.
Document: Done

Fig. 2.

Select the reaction to view:

(following abbreviations are in use:
GDRPRM - included into Giant Dipole Resonance data, **RTHR** - included into Reaction THResholds data, **PNI** - included into PhotoNuclear Data Index.) _

incident particle - G	incident particle - E
	(PNI only)
G,E - (PNI only)	
G,G - (PNI only)	E,E
G,G~ - (PNI only)	E,E~
G,N	E,E~N
G,1N	E,E~NP
G,NP	E,E~2N
G,N2P	E,E~3N
G,NA	E,E~P
G,NPA	E,E~2P
G,N+X - (PNI only)	E,E~D
G,2N	E,E~T
G,2N+X - (PNI only)	E,E~HE
G,3N	E,E~F
G,SN - (GDRPRM only)	E,XN
G,SNF - (GDRPRM only)	E,XP
G,XN	E,X
G,P	E,ION
G,PA	E,ABS
G,PD	E,MESON
G,PT	**incident particles - N, P, D, T, HE, IONS**
G,P+X - (PNI only)	(PNI only)
G,2P	
G,2PN	N,E
G,2P+X - (PNI only)	N,G
G,XP	N,2G
G,D	N,ABS
G,D+X - (PNI only)	P,G
G,2D	D,G
G,T	T,G
G,T+X - (PNI only)	HE,G
G,HE - (PNI only)	ION,G
G,HE3	
G,XHE - (PNI only)	
G,ION - (PNI only)	
G,F	
G,X - (PNI only)	
G,ABS	
G,MESON - (PNI only)	
G,A	
G,3A	
G,4A	

Fig. 3.

Return to the CDFE On-Line Services Main Menu

	A	ABUNDANCE(%)
50-SN	112	1.00
	114	0.70
	115	0.40
	116	14.70
	117	7.70
	118	24.30
	119	8.60
	120	32.40
	122	4.60
	124	5.60

[**Photonuclear Data Index**]

[**Giant Dipole Resonance Data** | **Reaction Thresholds Data**]

Fig. 4.

Data for *50-SN*

Return to the CDFE On-line Services Main Menu

[Reaction Thresholds Data]

Press here to view legend

EXFOR	NUCL	A	REACT	E-MAX MEV	SIG MB	FWHM MEV	E-INT MEV	SIG-INT MEV*MB	SIG-INT-1 MB	REFERENCE	AUTHOR
	50-SN		G,XN	16.	300.	5.	40.00	1640.	134.	PHYS.REV.,112,554(1958)	E.G.FULLER+
	50-SN	112	G,XN	15.8	295.	5.5	27.00	2230.		YAD.FIZ.,20,233(1974)	YU.I.SOROKIN+
	50-SN	112	G,SN	15.8	295.	5.5	27.00	1900.		YAD.FIZ.,20,233(1974)	YU.I.SOROKIN+
	50-SN	112	G,N	16.	340.	5.	21.00	1820.	152.	ZHETF,40,85(1961)	KU0 CHI-DI+
	50-SN	114	G,XN	15.7	265.	7.5	27.00	2260.		IZV.AN SSSR,39,114(1975)	YU.I.SOROKIN+
	50-SN	114	G,SN	15.7	265.	7.	27.00	1860.	108.	IZV.AN SSSR,39,114(1975)	JU.I.SOROKIN+
	50-SN	116	G,XN	15.6	260.	9.	27.00	2400.		IZV.AN SSSR,39,114(1975)	YU.I.SOROKIN+
10035017	50-SN	116	G,XN	15.44	277.3	7.5	22.10	1823.		NUCL.PHYS.,A219,39(1974)	A.LEPRETRE+
10017006	50-SN	116	G,XN	15.362	272.	6.	29.60	2083.		PHYS.REV.,186,1255(1969)	S.C.FULTZ+
10017006	50-SN		G,XN	18.769	168.9						
10017006	50-SN		G,XN	27.131	76.						
	50-SN	116	G,SN	15.6	260.	6.	27.00	2850.	110.	IZV.AN SSSR,39,114(1975)	YU.I.SOROKIN+
10035046	50-SN	116	G,SN	15.44	277.3	7.5	29.50	1630.	104.	NUCL.PHYS.,A219,39(1974)	A.LEPRETRE+
10017030	50-SN	116	G,SN	15.982	262.	4.	29.60	1669.	99.	PHYS.REV.,186,1255(1969)	S.C.FULTZ+
10017030	50-SN		G,SN	27.131	55.						
10035018	50-SN	116	G,N	15.44	277.3	7.5	22.10	1437.		NUCL.PHYS.,A219,39(1974)	A.LEPRETRE+

Fig. 5.

SUBENT	L0017006 970129
TITLE	Photoneutron cross sections for Sn116, Sn117, Sn118,
	Sn119, Sn120, Sn-124, and indium.
AUTHOR	(S.C.FULTZ,B.L.BERMAN,J.T.CALDWELL,R.L.BRAMBLETT,
	M.A.KELLY)
REFERENCE	(J,PR,186,1255,6910)
INC-SOURCE	Positron annihilation
REACTION	(50-SN-116(G,X)0-NN-1,,SIG)
	The sum: (G,N)+(G,N+P)+2(G,2N).

If you need the source data, you may download the
the source data file

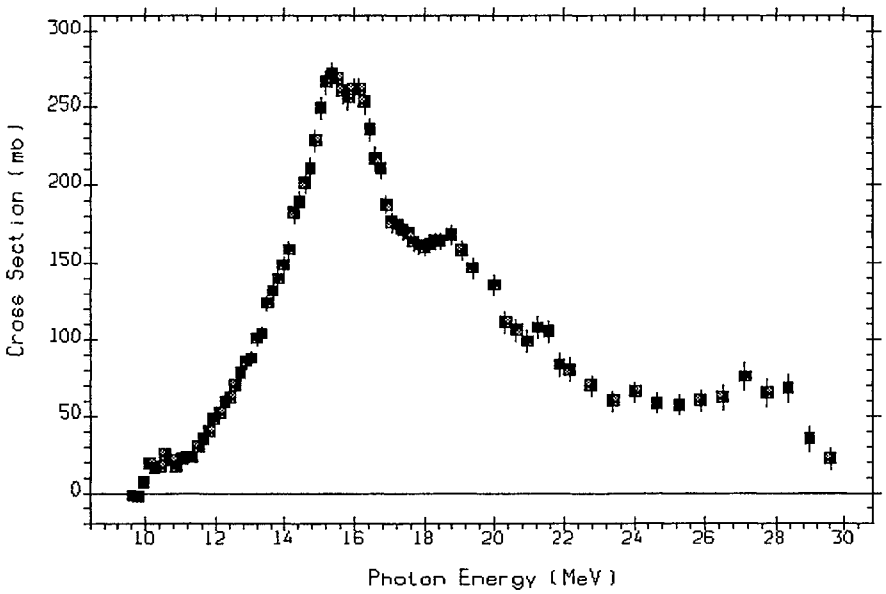

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Fig. 6.

Reaction Thresholds for *50-SN*

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Return to the main index of Reaction Thresholds

NUCL	A	ABUNDANCE(%)	G,N	G,P	G,T	G,HE3	G,A	G,2N	G,NP	G,2P
50-SN	112	1.00	10.8	7.6	17.1	15.0	1.8	19.0	17.6	12.9
50-SN	114	0.70	10.3	8.5	17.1	16.2	2.6	18.0	17.9	14.6
50-SN	115	0.40	7.5	8.8	17.0	14.4	3.2	17.9	16.0	15.6
50-SN	116	14.70	9.6	9.3	17.1	17.4	3.4	17.1	18.3	16.1
50-SN	117	7.70	6.9	9.4	16.8	15.3	3.8	16.5	16.2	16.9
50-SN	118	24.30	9.3	10.0	17.1	18.5	4.1	16.3	18.8	17.5
50-SN	119	8.60	6.5	10.1	16.8	16.3	4.4	15.8	16.5	18.2
50-SN	120	32.40	9.1	10.7	17.1	19.6	4.8	15.6	19.0	19.0
50-SN	122	4.60	8.8	11.4	17.2	20.7	5.7	15.0	19.8	20.6
50-SN	124	5.60	8.5	12.1	17.4	21.5	6.7	14.4	20.0	22.2

RETURN TO CDFE

[Giant Dipole Resonance Data | Reaction Thresholds Data]

If you have questions, comments, and suggestions - please contact Webmaster

Fig. 7.

Data for *50-SN*

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NUMBER	E	NUCL	A	REACT	QUANTITY	EN-MIN MEV	EN-MAX MEV	ANG-MIN DEG	ANG-MAX DEG	REFERENCE	AUTHOR
87097		50-SN	0	G-MON,G	DST,SIG	.272	.662	10.5	59	J,NIM/A,255,59,87	D.A.BRADLEY+
89070		50-SN	0	G-BRST,G	DST,SIG,FMF	60.	662	5.	140	J,NIM/A,280,375,89	O.D.GONCALVES+
89079		50-SN	0	N,G	SIG,STFUN	20.	450			J,YF,50,609,89	V.M.TIMOKHOV+
92049		50-SN	0	G-BRST,G	DST,SIG	.122	245	50.	100	J,NIM/B,71,361,92	L.P.GUY+
94035		50-SN	0	G-BRST,ABS	SIG	300.	1200			J,PL/B,325,333,94	N.BIANCHI+
95062		50-SN	0	G-BRST,X	SIG	.0139	.0595			J,ARI,46,113,95	A.A.TAJUDDIN+
96021		50-SN	0	G-MON,ABS	SIG	300.	1200	9.	171	J,PR/C,54,1688,96	N.BIANCHI+
94084		50-SN	110	TI48,G	SPC,ABY,SIG	50.	90			J,ZP/A,349,213,94	A.BRACCO+
70027j		50-SN	112	E,E	DST	230.00				J,NP/A,146,15,70	KHVASTUNOV+
70027j		50-SN	112	E,E'	DST	230.00				J,NP/A,146,15,70	KHVASTUNOV+

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89079		50-SN	113	N,G	SIG,STFUN	20.	450			J,YF,50,609,89	V.M.TIMOKHOV+
74144j		50-SN	114	G,P	T:DST					J,SNP,18,21,74	TERTYCHNYI+
88027j		50-SN	114	G,X	ABY	4500.00				J,SNP,48,395,88	ARAKELYAN+
88090		50-SN	114	G-BRST,X	ABY,SIG,MDIS	0.	4500			J,YF,48,618,88	A.A.ARAKELJAN+
88091		50-SN	114	A,G	SPC,MULT,ISY,DNG,COINC,E,J-PI	24.	24			J,PL/B,200,13,88	A.STOLK+
89078		50-SN	114	G-BRST,N	SIG-M	0.	4500			J,YF,50,1226,89	A.A.ARAKELJAN+
92069		50-SN	114	G-BRST,XN+YP	ABY,SIG	0.	4500			J,YF,55,2593,92	A.A.ARAKELJAN+

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