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AN ELECTRON/PHOTON TRANSPORT BIBLIOGRAPHIC DATABASE

John C. Garth
7305 New Dawn Court NE
Albuquerque, NM 87122
jgarth75@comcast.net

ABSTRACT

This paper describes a bibliographic database to be made available to participants at this workshop as well as other researchers. This database for the PC includes over 4000 bibliographic references in the general field of coupled electron/photon transport (covering the energy range 10 eV ï 30 MeV) and many of its applications in radiation physics. It was developed during the last ten years as an aid for writing a book on electron/photon transport. It is expected to be a valuable research tool for workers in fields involving x-rays, electron beams, and beta-ray and gamma-ray radioactive sources.

The references are categorized under 64 different topic headings. Example topic categories include: photon and electron cross section data; multiple scattering and stopping power; mathematical methods, including Monte Carlo simulation, transport equation solution, semi-empirical models, and 3-D transport methods; ñstandardò computer programs, such as PENELOPE, EGSnrc, MCNPX, and GEANT4; data for electron backscatter, transmission, energy and charge deposition; radiation therapy physics; radiation treatment planning ; medical imaging; radiation processing; radiation biology; theoretical and experimental dosimetry, including dosimetry at material interfaces; positron transport; x-ray target spectrum prediction; electron probe microanalysis; x-ray fluorescence analysis; x-ray photoelectron spectroscopy; Auger electron spectroscopy; secondary electron emission; charging of insulators; electron slowing down; microdosimetry; track structure; and several electron spectroscopy areas such as EELS,REELS, and EPES.

The database will be made available in the form of comma-delimited text files and Microsoft Excel files. Files for use with the commercial database program ñLotus Approachò will also be distributed.

KEYWORDS: Electron/photon transport, bibliographic database

1. INTRODUCTION

This paper describes a bibliographic database written for the PC to be made available to attendees at this workshop as well as others. The database consists of 4039 bibliographic references in the field of coupled electron/photon transport (covering the energy range 10 eV - 30 MeV) and its many applications in radiation physics. It was developed during the past ten

years as an aid for writing a book on electron/photon transport. A paper surveying this field and describing the book project was presented at the MC2005 conference in Chattanooga in 2005 [1].

This database was developed using the commercial database program, ñLotus Approachò. However, the information in it can also be displayed and manipulated using Microsoft Excel or database programs such as Microsoft ACCESS and FileMaker Pro.

2. MAJOR FEATURES OF THE DATABASE

2.1. Topics Covered in the Database

The 4039 references in this database cover a very wide range of electron/photon transport physics topics. A partial listing includes: (a) photon and electron cross section and mean free path data; (b) electron multiple scattering theories; (c) mathematical methods of transport, including Monte Carlo simulation, solution of the transport equation, semi-empirical models, and many others; (d) 3-D transport methods; (e) standard computer codes, such as PENELOPE, EGSnrc, MCNPX, GIANT4, etc.; (f) experimental and Monte Carlo data for electron backscatter, transmission, energy and charge deposition; (g) radiation therapy physics; (h) radiation treatment planning (including IMRT); (i) medical imaging; (j) radiation processing of materials; (k) theoretical and experimental dosimetry; (l) the radiation dose at material interfaces; (m) positron transport; (n) x-ray generation; (o) electron probe microanalysis; (p) x-ray fluorescence analysis; (q) x-ray photoelectron spectroscopy; (r) Auger electron spectroscopy; (s) secondary electron emission; (t) electron transport in insulators; (u) electron slowing down; (v) microdosimetry; (w) electron and ion track structure; and (x) electron spectroscopy areas, such as EELS, REELS and elastic peak electron spectroscopy (EPES).

Table I gives a listing of all the 62 topical categories used in the database. Each category is preceded by an alphanumeric code for identifying the topic assigned to each reference. Since Table I provides the alphanumeric code for each topic, it is to be used as a guide in conjunction with the database. In addition, we have listed the number of references found in the database under each category. For example, in Table I there are 411 references in the database under the category ñ4C3 - Electron beam microanalysis (EPMA)ò. Only a few other topics have such large numbers. As can be seen from the table, there are typically between 40 and 100 references for each topic.

These numbers of references in Table I also gives an estimate of the relative amount of research activity in each subfield. It seems reasonable that the more articles there are associated with a topic, the more activity in the field. Likewise, a way to determine which topics are currently the most active is to count the number of the references in the database on a topic published during a recent time period, such as in the last ten years.

2.2. Assignment of a Topical Category to a Reference

For simplicity in compiling this database, only a single topical category was assigned to each reference. This approach has the advantage of having the database in the form of a single large table. Thus, this database is of the ñflat-fileò type, as compared to the ñrelationalò type, which is more powerful but more difficult to construct. This ñflat-fileò feature is also necessary in order to work with this database using a spreadsheet program like Microsoft Excel.

The disadvantage of this approach is that there are many references in the database that could have been categorized under more than one topic. As an example, the article in the journal ñMedical Physicsò with the reference name, ñKEALL(1996C)" has the title, ñSuper-Monte Carlo: A 3-D electron-beam dose calculation algorithmò. We see that this reference could have been categorized in one of several ways, such as (a) ñ2B - Monte Carlo simulationò, (b) ñ2F ï Multi-dimensional transportò, (c) ñ3C - Electron energy depositionò, or (d) ñ4A3A - Medical treatment planningò. We assigned it to the topic ñ2B - Monte Carlo simulationò because it appears to describe a new Monte Carlo method.

On a much larger scale, there are certainly many more articles employing the Monte Carlo method than the 164 references under the heading ñ2B ï Monte Carlo simulationò in Table I. To deal with this problem, we suggest that the user not rely exclusively on the rather arbitrarily assigned topical categories to find articles of interest. In addition, one should consider trying to search for significant technical terms within the titles of the references and also the short summaries in the database..

A striking ñindexò to the many subjects covered in the database can be obtained by sorting the 4039 summaries alphabetically and browsing through this list. This operation quickly reveals the great breadth of topics encompassed by ñelectron/photon transport and its applicationsò!

It turns out that over 200 different journals have been referenced in the database. However, table II indicates that just 32 journals account for most of the references in the database! This further suggests that these journals should be looked at first for finding both older and more recent papers involving electron/photon transport.

2.3. Fields Used in this Database

Each bibliographic record has been specified using the following 8 fields:

1. Ref. Name ï the reference name formed from first authorôs last name in Capital letters with the publication year in parenthesis. A letter (A, B, C, etc.) is also added after the year if there is more than one publication in that year.
   Some example reference names are:
   a) **AHNESJO(2006),**
   b) **SALVAT(2004B)**
   c) **WERNER-W(1994F)**
2. Year ï the year of publication of the reference
3. Type of reference ï e.g., journal article, report, conference paper, book, etc.

4. Category ï the alphanumeric code for the topic assigned to the reference (as listed in Table I).
5. Summary ï a brief summary of the contents of the reference (about 50 characters).
6. Citation ï the full citation for the reference
   Some example citations are:
   a) Journal article: ñ**Med. Phys. 10, 741-771(1983)**ò
   b) Report: ñ**NASA TM X-2440, pp 816-820 (Jan 1972**)ò
   c) Conference paper: ñ**4th Int'l Conf on X-ray Optics and Microanalysis, p.120-126(1965)**ò
7. Author(s) ï a list of all authors, unless it is very long.
8. Title ï The title of the reference

In developing the database, I also used three additional fields to help keep track of the status of each reference:

9. Date obtained ï the date when the reference was obtained
10. Pdf ï marked ñ**P**ò if I have a copy of the PDF file for this article. Otherwise this field is left blank.
11. Form of reference ï this indicates the form in which I have the reference. Example entries for this field are the following:
    a) **ARTICLE** (this indicates that I have a paper copy for this reference)
    b) **PDF** (this indicates that I only have a PDF file for this reference)
    c) **ARTICLE-P** (I have both a paper copy and a PDF file)
    d) **ABSTRACT** (I have a paper copy of abstract)
    e) **ABSTRACT-P** (I have a paper copy of abstract plus a PDF file)
    f) **REFERENCE** (I have only the title, authors and citation for this reference)

3. ADVANTAGES AND APPLICATIONS OF THIS DATABASE

3.1 Advantages of Using the Database

There are several advantages of this database over a simple bibliographic listing or table:

1. It is a very large but manageable set of references on a computer database containing an enormous amount of information in just the field of electron/photon transport.
2. Because it is computer-based, it is searchable and also able to be sorted in various ways. It thus can furnish far more information than a ñstaticñ bibliography.
3. As stated earlier, references were obtained from as many as two hundred journals. We also note that literally thousands of authors have been contributors to the field!

3.2 Ways to Use the Database

Some possible ways to use this database include the following:

1. It can be used to find articles published in one particular journal. This can be handy while browsing in a technical library.
2. If the database is kept up-to-date, it can be used to identify recent publications as well as those from past years.

3. It can be used to print bibliographies for a given subject category or set of categories. Each bibliography can be ordered in several ways: alphabetically by reference name, chronologically by year of publication, or alphabetically by journals cited.
4. References of particular interest may be found by sorting and searching, using various combinations of the publication year, journal, authorsônames, and technical terms in the reference titles or short summaries.
5. The database can be considered to have an educational purpose. It permits one to browse and explore areas of electron/photon transport outside of a particular specialty. This might well provide a stimulus for future research.
6. For people desiring to check the validity of computer code predictions, the database is useful for locating sources for various types of electron/photon transport data.

5.3 Some Specific Application Examples

5.3.1 Example 1: Finding all references for a given topic category

1) Select a category (such as, for example, 4A1A Radiation therapy ï photon beams or 4C4 X-ray fluorescence)
2) Using a table, sort the references by year (descending) with the most recent references first.
3) As a secondary sort, the references could be sorted alphabetically by either reference name or citation

5.3.2 Example 2: Finding articles published in a particular journal

1) Select a particular journal by finding it using the citation field. Sometimes just typing a few letters along with punctuation will suffice to locate a particular journal. (For example, one may use simply ñx-rò to select out the journal ñX-ray Spectrom.).
2) After selecting out references for this journal, one might like to sort the references by category.
3) One could also add another sort by year or by citation to obtain a chronological listing.
   Note: This is handy in a library setting when looking at one particular journal

5.3.3 Example 3: Locating references involving a particular technical term

1) Select the technical term to be searched for in either the reference title or the summary (or both).
2) Some suggested terms: Monte Carlo, PENELOPE, MCNPX, backscattering, fundamental parameter method, elastic, inelastic, straggling, etc.
3) Search for all references containing this term within the title, the summary, or both.

4. DISCUSSION

4.1 Some Properties of Commercial Database Programs

The power of this database is best realized by using a commercial database program. Unlike word processing and spreadsheet programs, such programs can vary greatly in style and generality. Each has distinct capabilities and limitations. For example, it requires considerable learning and practice to adapt a general purpose program such as FileMaker Pro or Microsoft ACCESS to this bibliographic application. Simpler programs are also available, but due to this simplicity, they may well lack features that permit full utilization of the database. As it turned out, we found ñLotus Approachò was ideal for this application ï not too difficult to learn but able to provide all the capability needed..

It would be very useful, but ambitious, to convert this into a relational database. An immediate feature to include would be a ñlook-up tableò containing the information in Table I relating each alphanumeric code to its associated topic. Also, as discussed in section 2.2, it would be helpful to be able to assign more than one category to each reference as needed..

4.2 What About Using Available Bibliographic Programs?

There are numerous commercially available *bibliographic* database programs. Examples of these include ñEndNoteò, ñProCiteò, ñCitationò and ñBibTekò. It would be valuable to be able to take use these programsô capabilities for making publication-quality bibliographies with almost any style or format.

The problem is that, to use these programs, each bibliographic entry has to be encoded in a special ñtaggedò format. We, of course, know that bibliographic data of this type can be obtained through some of the bibliographic services at modern technical libraries. It would be very nice to have the entries in this database converted into this format. Unfortunately, with over 4000 references to convert, this is a formidable task.

5. FINAL REMARKS

As stated before, the purpose for this paper is to make available this interesting bibliographic database to people like yourselves. I feel that now is a good time, whether or not a book based on this material is completed. We will be distributing data files for this database at this workshop. We also expect them to be available on the Internet in the near future.

The five data files we are distributing are of three types: (1) a comma-delimited file, ñ4039REFS.txtò, as used for importing external data into database programs, (2) a Microsoft Excel file, ñ4039REFS.xlsò, and (3) three Lotus Approach files: ñ4039REFS.aprò, ò4039REFS.adx, and ñ4039REFS.dbfò. Files (1) and (2) utilize just the first 8 fields listed in section **2.3**, while the Lotus Approach files contain all 11 fields described there. In addition, this paper and reference 1 are included to provide documentation and background.

This will be a useful information resource for many application areas of electron/photon transport. Computational medical physics is, of course, one of these areas. These data files are available to anyone at this meeting and to others who might be interested.

REFERENCE

1. J. C. Garth, ñElectron/Photon Transport and Its Applicationsò, *The Monte Carlo Method: Versatility Unbounded in a Dynamic Computing World*, Chattanooga, Tennessee, April 17-21, 2005.

Table I. Topic List

Category	ELECTRON/PHOTON TRANSPORT TOPIC	References
0A	Introductory articles and reviews	11
	1. INPUT DATA & CROSS-SECTIONS	
1A	Photon interactions (including electron generation)	53
1B	Electron interactions (including photon production)	161
1C	Multiple scattering phenomena	51
	Total:	265
	2. CALCULATIONAL METHODS FOR ELECTRON/PHOTON TRANSPORT	
2A	Electron transport modeling	17
2B	Monte Carlo simulation	164
2C	Transport equation solution	86
2D	Semi-Empirical Models	28
2E	Other mathematical approaches	17
2F	Multidimensional transport (2-D, 3-D)	17
2G	Photon transport (mathematics)	4
2H	Computer codes	57
	Total:	390
	3. COMPARISONS WITH EXPERIMENTAL DATA	
3A	Electron backscattering	98
3B	Electron penetration (transmission)	34
3C	Electron energy deposition	49
3D	Charge deposition	14
3E	Inner-shell ionization profiles	16
	Total:	211

Table I. Topic List (continued)

Category	Electron/Photon Transport Topic	References
	4A. HIGH ENERGY APPLICATIONS (1 - 50 MeV)	
4A1A	Radiation therapy physics – Photon beams	63
4A1B	Radiation therapy physics – Electron beams	43
4A1C	Radiation therapy physics – General	65
4A2	Fermi-Eyges Theory /Pencil Beam Models	65
4A3A	Medical treatment planning – General	111
4A3B	Medical treatment planning – IMRT`	22
4A4	Radiation processing	21
4A5A	Medical imaging – General	47
4A5B	Medical imaging – Computed Tomography (SPECT & CT)	13
4A5C	Medical imaging – PET	73
4A6	Radiation biology	66
4A7	Radiation protection	4
	Total:	593
	4B. HIGH-TO-MEDIUM ENERGY APPLICATIONS (0.1 - 10 MeV)	
4B01	Radiation shielding (photons)	61
4B02	Photon transport (other than shielding)	49
4B03	Beta-ray dosimetry/spectroscopy	65
4B04	Gamma source spectrum characterization	8
4B05	Bremsstrahlung spectrum prediction	20
4B06	Theoretical dosimetry/cavity chamber theory	73
4B07	Dose perturbations at interfaces/dose enhancement	82
4B08	X-ray photoemission	29
4B09	Experimental dosimetry; dosimeters	81
4B10	Detector response to radiation	43
4B11	Radiation charging of insulators	21
	Total:	533
	4C. MEDIUM ENERGY APPLICATIONS (1 - 100 keV)	
4C1	Positron annihilation and transport	138
4C2	X-ray generation and target spectrum prediction	92
4C3	Electron beam microanalysis (EPMA)	411
4C4	X-ray fluorescence (XRF)	209
4C5	Electron-Beam-Induced-Current (EBIC)	56
4C6	Atmospheric electron transport, aurora	71
4C7	Electron beam and x-ray lithography	56
	Total:	1033

Table I. Topic List (continued)

Category	Electron/Photon Transport Topic	References
	4D. LOW ENERGY APPLICATIONS (1 eV - 10 keV)	
4D1	**X-ray photoelectron spectroscopy/Auger electron spectroscopy**	**385**
4D2	**Positron-annihilation-induced Auger electron spectroscopy (PAES)**	**9**
4D3	**Low energy electron transport, secondary electron emission**	**67**
4D4	**Low energy electron transport in dielectrics**	**45**
	Total:	**506**
	4E. MISCELLANEOUS TOPICS	
4E1	**Electron-hole pair creation**	**2**
4E2	**Electron slowing down**	**16**
4E3	**W-values in gases**	**23**
4E4	**Microdosimetry**	**68**
4E5	**Track structure**	**132**
4E6	**Proton transport**	**49**
4E7	**Ion transport**	**33**
4E8A	**Electron energy loss spectroscopy (EELS)**	**59**
4E8B	**Reflection electron energy loss spectroscopy (REELS)**	**41**
4E8C	**Elastic peak electron spectroscopy (EPES)**	**54**
4E8D	**Other electron spectroscopies**	**1**
4E9	**Electron Microscopy**	**9**
	Total:	**493**
5A	**Miscellaneous**	**3**
	TOTAL NUMBER OF REFERENCES IN DATABASE:	**4039**

Table II. Journals Having the Most References in the Database

JOURNAL	# References
Medical Physics	347
Physics in Medicine and Biology	306
X-ray Spectrometry	238
Nuclear Instruments and Methods (A & B)	210
Surface and Interface Analysis	210
Journal of Electron Spectroscopy and Related Phenomena	116
Journal of Applied Physics	115
Radiation Physics and Chemistry	108
IEEE Transactions on Nuclear Science	99
Radiation Protection Dosimetry	94
Physical Review B	84
Journal of Physics D	83
Scanning	77
Journal of Nuclear Medicine	75
Journal of Vacuum Science and Technology (A & B)	74
Microchimica Acta	74
Nuclear Science and Engineering	67
Surface Science	63
Radiation Research	60
Ultramicroscopy	54
Applied Surface Science	52
Analytical Chemistry	50
Applied Radiation and Isotopes	42
Radiation and Environmental Biophysics	37
Journal of Geophysical Research	32
Japanese Journal of Applied Physics	28
Health Physics	27
International Journal of Radiation Biology	25
Journal of Analytical Atomic Spectroscopy	24
Vacuum	21
TOTAL (72% of 4039 references)	2892