Appendix E

CONTENTS OF THE EGS5 DISTRIBUTION

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The EGS5 distribution archive contains six main groups of files: documentation; EGS FOR-TRAN source codes; PEGS FORTRAN source codes; material data files; example and tutorial run-time scripts and user codes (including FORTRAN source codes, input files and sample output); and FORTRAN source codes for auxiliary functions which users may find useful.

E.1 Documentation

Documentation has been included within the EGS5 distribution for two reasons. First, the most heavily used parts of SLAC-R-730/KEK-2005-8 are expected to be the user manuals, and so .pdf versions have been placed in the archive so that they can be accessed (or printed) at the discretion and convenience of the user. Second, it is anticipated that when changes and additions are made to the EGS5 code base, the user manuals will be updated appropriately, while SLAC-R-730/KEK-2005-8 may not be. Documentation files includes with the EGS5 distribution are:

egs5_user_manual.pdf	Appendix B of SLAC-R-730/KEK-2005-8
pegs_user_manual.pdf	Appendix C of SLAC-R-730/KEK-2005-8
installation_guide.pdf	Appendix D of SLAC-R-730/KEK-2005-8
distribution_contents.pdf	Appendix E of SLAC-R-730/KEK-2005-8
Writing_HOWFAR.pdf	Presentation describing construction of user code subroutine `HOWFAR`

These files can be found in the subdirectory **docs** of the under the main **egs5** directory in the distribution. In addition, a complete copy of SLAC-R-730/KEK-2005-8 is included in the main **egs5** directory, as the .pdf file **slac730.pdf**.

E.2 EGS-Related FORTRAN Source Files

There are two types of files which are part of the EGS Monte Carlo shower simulation package. As described in the EGS5 User Manual (Appendix B of SLAC-R-730/KEK-2005-8), some of the utility of MORTRAN macro substitutions used in EGS4 has been retained in EGS5 by having all FORTRAN `COMMON` blocks be defined in the subprograms of the source code through `include` statements which reference files containing just the FORTRAN listing of each `COMMON` block. This makes changing variables and parameters in any `COMMON` block a global process, similar to what could be done with a MORTRAN macro in EGS4. Each EGS5 `COMMON` block is thus contained in a unique file which is named after the `COMMON` block as in **egs5_media.f** for the file containing the declarations for `COMMON` block `MEDIA`. All of the FORTRAN `PARAMETERS` used to the specify array dimensions in the various `COMMON` blocks have been collected in a single "header" file called **egs5_h.f**, and all of the EGS5 `COMMON` block files have been placed in a directory called **include** under the main **egs5** directory. These files contain nothing other than the declarations of the variables in each `COMMON`, along with some documentation.

All of the actual FORTRAN source code files used in simulating showers have been collected in a subdirectory of **egs5** called **egs**. Each file contains the source code for one EGS5 subroutine (some source code files actually contain more than one subroutine, when groups of subprograms are very closely related), and the naming convention used with the COMMON block files in **include** has been followed. Descriptions of the functionality of the various subprograms of **egs** can be found both in Chapter 2 of SLAC-R-730/KEK-2005-8 and in the EGS5 User Manual. List below are the names of all of the files in **egs** and **include**, which are subdirectories of **egs5** in the EGS5 distribution.

EGS FORTRAN source files:

counters_out.f	egs5_eii.f	egs5_mscat.f
egs5_annih.f	egs5_electr.f	egs5_pair.f
egs5_aphi.f	egs5_hardx.f	egs5_photo.f
egs5_bhabha.f	egs5_hatch.f	egs5_photon.f
egs5_block_data.f	egs5_kauger.f	egs5_raylei.f
egs5_block_data_atom.f	egs5_kshell.f	egs5_rk1.f
egs5_block_set.f	egs5_kxray.f	egs5_rmsfit.f
egs5_brems.f	egs5_lauger.f	egs5_shower.f
egs5_collis.f	egs5_lshell.f	egs5_uphi.f
egs5_compt.f	egs5_lxray.f	randomset.f
egs5_edgbin.f	egs5_moller.f	rluxinit.f

EGS "included" COMMON block files:

counters.f	egs5_edge.f	egs5_mscon.f	egs5_useful.f
egs5_bcomp.f	egs5_eiicom.f	egs5_mults.f	egs5_userpr.f
egs5_bounds.f	egs5_elecin.f	egs5_photin.f	egs5_usersc.f
egs5_brempr.f	egs5_epcont.f	egs5_scpw.f	egs5_uservr.f
egs5_cdcsep.f	egs5_h.f	egs5_stack.f	egs5_userxt.f
egs5_cdcspl.f	egs5_media.f	egs5_thresh.f	randomm.f
egs5_coefgs.f	egs5_misc.f	egs5_uphiin.f	
egs5_csplcf.f	egs5_ms.f	egs5_uphiot.f	

Also included in the **egs** subdirectory is the EGS5 copyright file, **COPYRIGHT**, in a version suitable for inclusion with FORTRAN user codes.

E.3 PEGS-Related FORTRAN Source Files

As with EGS, there are two types of files comprising PEGS, those containing actual FORTRAN source code (in a subdirectory of **egs5** called **pegs**) and those containing just COMMON block declara-

tions (in a subdirectory called **pegscommons**). While all of the `COMMON` blocks in PEGS are found in unique files (named after the `COMMON` block with no prefix) all of the subroutines and functions previously a part of PEGS4 are contained in one file **pegs5.f**. All of the other source code files in the **pegs** subdirectory are new to EGS5 and are either required for calculating the scattering strength and scattering power data needed for the new electron transport mechanics of EGS5, or are part of the implementation of the new multiple scattering distribution, both of which are described in Chapter 2 of SLAC-R-730/KEK-2005-8. The full lists of the PEGS-related files found in **pegs** and **pegscommons**, which are both subdirectories of **egs5** in the EGS5 distribution, are given below.

PEGS FORTRAN source files:

```
csdar.f      elinit.f      g1e.f        k1e.f          sumga.f
dcsel.f      esteplim.f    gauleg.f     legenp.f       wmsfit.f
dcsn.f       estepmax.f    gscoef.f     makek1.f
dcsstor.f    findi.f       gsdist.f     pegs5.f
dcstab.f     fitms.f       inigrd.f     prelastino.f
elastino.f   g1dedx.f      integ.f      spline.f
```

PEGS "included" `COMMON` block files:

```
bcom.f      elemtb.f    lbhabm.f    mimsd.f     radlen.f
bremp2.f    elmtbc.f    lbremr.f    mixdat.f    rngspl.f
cohcom.f    epstar.f    lbremz.f    molvar.f    rslts.f
cpcom.f     funcs.f     lcompm.f    mscom.f     scpspl.f
dbrpr.f     funcsc.f    legacy.f    mxdatc.f    sfcom.f
dcsstr.f    k1spl.f     lpairr.f    phpair.f    spcomc.f
dercon.f    lamolm.f    lpairz.f    pmcons.f    spcomm.f
eimpact.f   lanihm.f    lspion.f    pwlfin.f    thres2.f
```

E.4   Material Data Files

The EGS5 distribution contains six primary data files plus five subdirectories containing material dependent data files, as described below. All files and directories are found in the subdirectory **data** of **egs5**. More complete descriptions of the data contained in the files can be found in Chapter 2 of SLAC-R-730/KEK-2005-8.

Data files: The main material data files in **data** are briefly described below:

aprime.data	Data for empirical bremsstrahlung correction.
bcomp.dat	Bound total Compton cross section data (σ_{bC}) for elements $Z = 1 \sim 100$.
incoh.dat	Incoherent scattering function data ($S(x, Z)$) for all elements $Z = 1 \sim 100$.
K1.dat	Tables of optimal initial scattering strengths as a function of geometry region size at various energies for various reference materials.
pgs5form.dat	Rayleigh scattering form factor data ($F(x, Z)$), identical to **pgs4form.dat** from PEGS4.
pgs5phtx.dat	Photo-electric cross section data, pair-production cross section data (for photon energies less than 50 MeV), and Rayleigh scattering cross section data from PHOTX for all elements $Z = 1 \sim 100$.

Data subdirectories: Data subdirectories of **data** are briefly described as follows:

dcslib	Differential nuclear elastic scattering cross sections for electrons and positrons for elements $Z = 1 \sim 95$.
density_corrections	Explicit values of the density effect correction to stopping power which can be used to reproduce ICRU-37 values. Placed in two subdirectories, **elements** and **compounds**.
int_coherent_cs	Coherent scattering cross sections (with interference effects modeled) for selected materials.
int_form_factor	Form factors (including interference effects) for selected materials.
shellwise_Compton_profile	Shellwise Compton profiles for elements $Z = 1 \sim 100$.

Files in dcslib: Files containing elemental partial-wave differential elastic scattering cross section data for both electrons and positrons are included in the EGS5 distribution in subdirectory **dcslib** of **data**. A straight-forward convention has been used to name these data files, which are listed below

```
eeldx001.tab   eeldx039.tab   eeldx077.tab   peldx020.tab   peldx058.tab
eeldx002.tab   eeldx040.tab   eeldx078.tab   peldx021.tab   peldx059.tab
eeldx003.tab   eeldx041.tab   eeldx079.tab   peldx022.tab   peldx060.tab
eeldx004.tab   eeldx042.tab   eeldx080.tab   peldx023.tab   peldx061.tab
eeldx005.tab   eeldx043.tab   eeldx081.tab   peldx024.tab   peldx062.tab
eeldx006.tab   eeldx044.tab   eeldx082.tab   peldx025.tab   peldx063.tab
eeldx007.tab   eeldx045.tab   eeldx083.tab   peldx026.tab   peldx064.tab
eeldx008.tab   eeldx046.tab   eeldx084.tab   peldx027.tab   peldx065.tab
eeldx009.tab   eeldx047.tab   eeldx085.tab   peldx028.tab   peldx066.tab
eeldx010.tab   eeldx048.tab   eeldx086.tab   peldx029.tab   peldx067.tab
eeldx011.tab   eeldx049.tab   eeldx087.tab   peldx030.tab   peldx068.tab
eeldx012.tab   eeldx050.tab   eeldx088.tab   peldx031.tab   peldx069.tab
eeldx013.tab   eeldx051.tab   eeldx089.tab   peldx032.tab   peldx070.tab
```

```
eeldx014.tab    eeldx052.tab    eeldx090.tab    peldx033.tab    peldx071.tab
eeldx015.tab    eeldx053.tab    eeldx091.tab    peldx034.tab    peldx072.tab
eeldx016.tab    eeldx054.tab    eeldx092.tab    peldx035.tab    peldx073.tab
eeldx017.tab    eeldx055.tab    eeldx093.tab    peldx036.tab    peldx074.tab
eeldx018.tab    eeldx056.tab    eeldx094.tab    peldx037.tab    peldx075.tab
eeldx019.tab    eeldx057.tab    eeldx095.tab    peldx038.tab    peldx076.tab
eeldx020.tab    eeldx058.tab    peldx001.tab    peldx039.tab    peldx077.tab
eeldx021.tab    eeldx059.tab    peldx002.tab    peldx040.tab    peldx078.tab
eeldx022.tab    eeldx060.tab    peldx003.tab    peldx041.tab    peldx079.tab
eeldx023.tab    eeldx061.tab    peldx004.tab    peldx042.tab    peldx080.tab
eeldx024.tab    eeldx062.tab    peldx005.tab    peldx043.tab    peldx081.tab
eeldx025.tab    eeldx063.tab    peldx006.tab    peldx044.tab    peldx082.tab
eeldx026.tab    eeldx064.tab    peldx007.tab    peldx045.tab    peldx083.tab
eeldx027.tab    eeldx065.tab    peldx008.tab    peldx046.tab    peldx084.tab
eeldx028.tab    eeldx066.tab    peldx009.tab    peldx047.tab    peldx085.tab
eeldx029.tab    eeldx067.tab    peldx010.tab    peldx048.tab    peldx086.tab
eeldx030.tab    eeldx068.tab    peldx011.tab    peldx049.tab    peldx087.tab
eeldx031.tab    eeldx069.tab    peldx012.tab    peldx050.tab    peldx088.tab
eeldx032.tab    eeldx070.tab    peldx013.tab    peldx051.tab    peldx089.tab
eeldx033.tab    eeldx071.tab    peldx014.tab    peldx052.tab    peldx090.tab
eeldx034.tab    eeldx072.tab    peldx015.tab    peldx053.tab    peldx091.tab
eeldx035.tab    eeldx073.tab    peldx016.tab    peldx054.tab    peldx092.tab
eeldx036.tab    eeldx074.tab    peldx017.tab    peldx055.tab    peldx093.tab
eeldx037.tab    eeldx075.tab    peldx018.tab    peldx056.tab    peldx094.tab
eeldx038.tab    eeldx076.tab    peldx019.tab    peldx057.tab    peldx095.tab
```

Files in density_corrections: To access values of collision stopping powers derived from ICRU Report 37, the user must provide density effect values explicitly for each material. Files containing the appropriate data for 450 elements and compounds are provided in the EGS5 distribution in subdirectories **elements** and **compounds** of **data** subdirectory **density_corrections**. Files are titled using a unique and explicit name for each material along with a **.density** extension. The full list of elemental material files (without the **.density** extension) is given below. A list of the 345 files containing data for compounds can be found in a **README** file provided in **density_corrections**.

```
actinium                germanium               protactinium
aluminium               gold                    radium
aluminum                hafnium                 radon
americium               helium                  rhenium
antimony                holmium                 rhodium
argon                   hydrogen                rubidium
arsenic                 hydrogen_liquid         ruthenium
astatine                indium                  samarium
barium                  iodine                  scandium
berkelium               iridium                 selenium
```

beryllium	iron	silicon
bismuth	krypton	silver
boron	lanthanum	sodium
bromine	lead	strontium
cadmium	lithium	sulfur
calcium	lutetium	sulfur_1.92g_cm3
californium	magnesium	sulfur_2.07g_cm3
carbon_graphite_1.700g_cm3	manganese	tantalum
carbon_graphite_2.000g_cm3	mercury	technetium
carbon_graphite_2.265g_cm3	molybdenum	tellurium
cerium	neodymium	terbium
cesium	neon	thallium
chlorine	neptunium	thorium
chromium	nickel	thulium
cobalt	niobium	tin
copper	nitrogen	titanium
curium	osmium	tungsten
dysprosium	oxygen	uranium
einsteinium	palladium	vanadium
erbium	phosphorus	xenon
europium	platinum	ytterbium
fermium	plutonium	yttrium
fluorine	polonium	zinc
francium	potassium	zirconium
gadolinium	praseodymium	
gallium	promethium	

Files in int_coherent_cs: For computations in which coherent scattering is modeled with interference effects included, the user must provide the interference coherent scattering cross section data. Included in subdirectory **int_coherent_cs** of **data** in the EGS5 distribution are files of coherent scattering cross section data with interference effects for seven materials: water, PMMA, fat, muscle, kidney, liver and blood. The data files are provided are named **ics_** followed by the first letter of the material, as below.

```
ics_b.dat        ics_k.dat        ics_m.dat        ics_w.dat
ics_f.dat        ics_l.dat        ics_p.dat
```

Files in int_form_factor: When coherent scattering interference effects are modeled, the user must also provide the appropriate form factors. Sample data files containing form factors with interference effects included are provided in subdirectory **int_form_factor** of **data** of the EGS distribution for the same seven materials in **int_coherent_cs**. The naming convention analogous to that described above is employed, and the exact EGS5 file names are listed below.

```
iff_b.dat        iff_k.dat        iff_m.dat        iff_w.dat
iff_f.dat        iff_l.dat        iff_p.dat
```

Files in shellwise_Compton_profile: The elemental shellwise Compton profile data files included in the EGS5 distribution in subdirectory **shellwise_Compton_profile** of **data** are named as follows. This data is used in modeling Compton scattering from bound atomic electrons on a shell-by-shell basis. The naming convention employed is intuitive.

```
z001.dat    z019.dat    z036n.dat   z054.dat    z072.dat    z090.dat
z002.dat    z020.dat    z037.dat    z055.dat    z073.dat    z091.dat
z003.dat    z021.dat    z038.dat    z056.dat    z074.dat    z092.dat
z004.dat    z022.dat    z039.dat    z057.dat    z075.dat    z093.dat
z005.dat    z023.dat    z040.dat    z058.dat    z076.dat    z094.dat
z006.dat    z024.dat    z041.dat    z059.dat    z077.dat    z095.dat
z007.dat    z025.dat    z042.dat    z060.dat    z078.dat    z096.dat
z008.dat    z026.dat    z043.dat    z061.dat    z079.dat    z097.dat
z009.dat    z027.dat    z044.dat    z062.dat    z080.dat    z098.dat
z010.dat    z028.dat    z045.dat    z063.dat    z081.dat    z099.dat
z011.dat    z029.dat    z046.dat    z064.dat    z082.dat    z100.dat
z012.dat    z030.dat    z047.dat    z065.dat    z083.dat    z101.dat
z013.dat    z031.dat    z048.dat    z066.dat    z084.dat    z102.dat
z014.dat    z032.dat    z049.dat    z067.dat    z085.dat
z015.dat    z033.dat    z050.dat    z068.dat    z086.dat
z016.dat    z034.dat    z051.dat    z069.dat    z087.dat
z017.dat    z035.dat    z052.dat    z070.dat    z088.dat
z018.dat    z036.dat    z053.dat    z071.dat    z089.dat
```

E.5   Sample User Codes and Run Scripts

The EGS5 distributions includes three sets of example user codes and two sample shell scripts for setting up and executing EGS5 simulations, as described below:

egs5run   Sample script for compiling and executing user code.

run5again   Sample script for rerunning previously compiled user code.

tutorcodes   Directory containing a series of sample problems, each in a unique subdirectory with FORTRAN source codes, input files, and output files for the step-by-step tutorials on using EGS5 found in Chapter 3 of SLAC-R-730/KEK-2005-8.

samplecodes Directory containing subdirectories with advanced user codes and input files for example problems described in Chapter 4 of SLAC-R-730/KEK-2005-8.

extra_ucodes Directory containing subdirectories with additional sample user codes.

The tutorial problems and advanced user codes are discussed in detail in Chapters 3 and 4 of SLAC-R-730/KEK-2005-8, respectively, while the programs (based on PEGS) included as "extra codes" are described briefly in Appendix C. Listed below are the input, source, and sample output files included in the EGS5 distribution in each of these subdirectories.

Files in subdirectories under egs5/samplecodes:

```
uc_lp/uc_lp.f          uccyl/uccyl.out        ucsampl5/ucsampl5.inp
uc_lp/uc_lp.inp        ucbend/ucbend.f        ucsampl5/ucsampl5.out
uc_lp/uc_wlp.out       ucbend/ucbend.inp      ucsampcg/ucsampcg.data
uc_lp/uc_wolp.out      ucbend/ucbend.log      ucsampcg/ucsampcg.f
uccyl/uccyl.f          ucbend/ucbend.pic      ucsampcg/ucsampcg.inp
uccyl/uccyl.inp        ucsampl5/ucsampl5.f    ucsampcg/ucsampcg.out
```

Files in subdirectories under egs5/tutorcodes:

```
tutor1/tutor1.f     tutor4/tutor4.f     tutor7/tutor7.f
tutor1/tutor1.inp   tutor4/tutor4.inp   tutor7/tutor7.inp
tutor1/tutor1.out   tutor4/tutor4.out   tutor7/tutor7_w.out
tutor2/tutor2.f     tutor5/tutor5.f     tutor7/tutor7_wo.out
tutor2/tutor2.inp   tutor5/tutor5.inp   tutor7/tutor7_wo_db.out
tutor2/tutor2.out   tutor5/tutor5.out   tutor8/tutor8.f
tutor3/tutor3.f     tutor6/tutor6.f     tutor8/tutor8.inp
tutor3/tutor3.inp   tutor6/tutor6.inp   tutor8/tutor8.out
tutor3/tutor3.out   tutor6/tutor6.out
```

Files in subdirectories under egs5/extra_ucodes:

```
uc_examin/uc_examin.f          ucpegs/ucpegs.f          uctestsr/uctestsr.out
uc_examin/uc_examin.inp        ucpegs/ucpegs.inp        uctestsr/hplt1.inp
uc_examin/uc_examin.out        ucpegs/ucpegs.pegs5dat   uctestsr/hplt1.pegs5lst
uc_examin/uc_e_mfps_AL.xvgr    uctestsr/uctestsr.f
uc_examin/uc_ph_mfp_AL.xvgr    uctestsr/uctestsr.inp
```

E.6   Auxiliary Subprogram FORTRAN Source Files

The final set of files included with the EGS5 distribution are the "auxiliary" FORTRAN source codes (in subdirectory **auxcode** of **egs5**) and files containing the COMMON blocks (in subdirectory

auxcommons) associated with these codes. The auxiliary codes contain functions and subroutines that are useful in performing input, geometry setup, distance-to-boundary, and scoring computations for many generic problems, and are referenced by some of the advanced user codes provided with the EGS5 distribution. Detailed descriptions of the functionality of the subprograms can be found in the comments in the source code and in Chapter 3 of SLAC-R-730/KEK-2005-8. Lists of the files provided with the distribution are given below.

Auxiliary FORTRAN source files found in auxcode:

```
cg_related.f  cyl2.f       edistr.f    plan2p.f    sph2.f
chgtr.f       cylndr.f     fintrn.f    plan2x.f    sphere.f
cone.f        decod_xyz.f  finval.f    plane1.f    sphtrn.f
cone2.f       decodeir.f   geomout.f   plotxyz.f   swatch.f
cone21.f      ecnsv1.f     ntally.f    rdistr.f    xyzbound.f
```

"Included" auxiliary COMMON block files found in auxcommons:

```
aux_h.f             etaly2.f         instuf.f    sphdta.f
condta.f            etaly3.f         lines.f     trndta.f
cyldta.f            geom_common.f    nfac.f      voxel.f
dataconst_common.f  geortz.f         ntaly1.f    watch.f
edata.f             georz.f          pladta.f
etaly1.f            geoxyz.f         rdata.f
```