Offline computing

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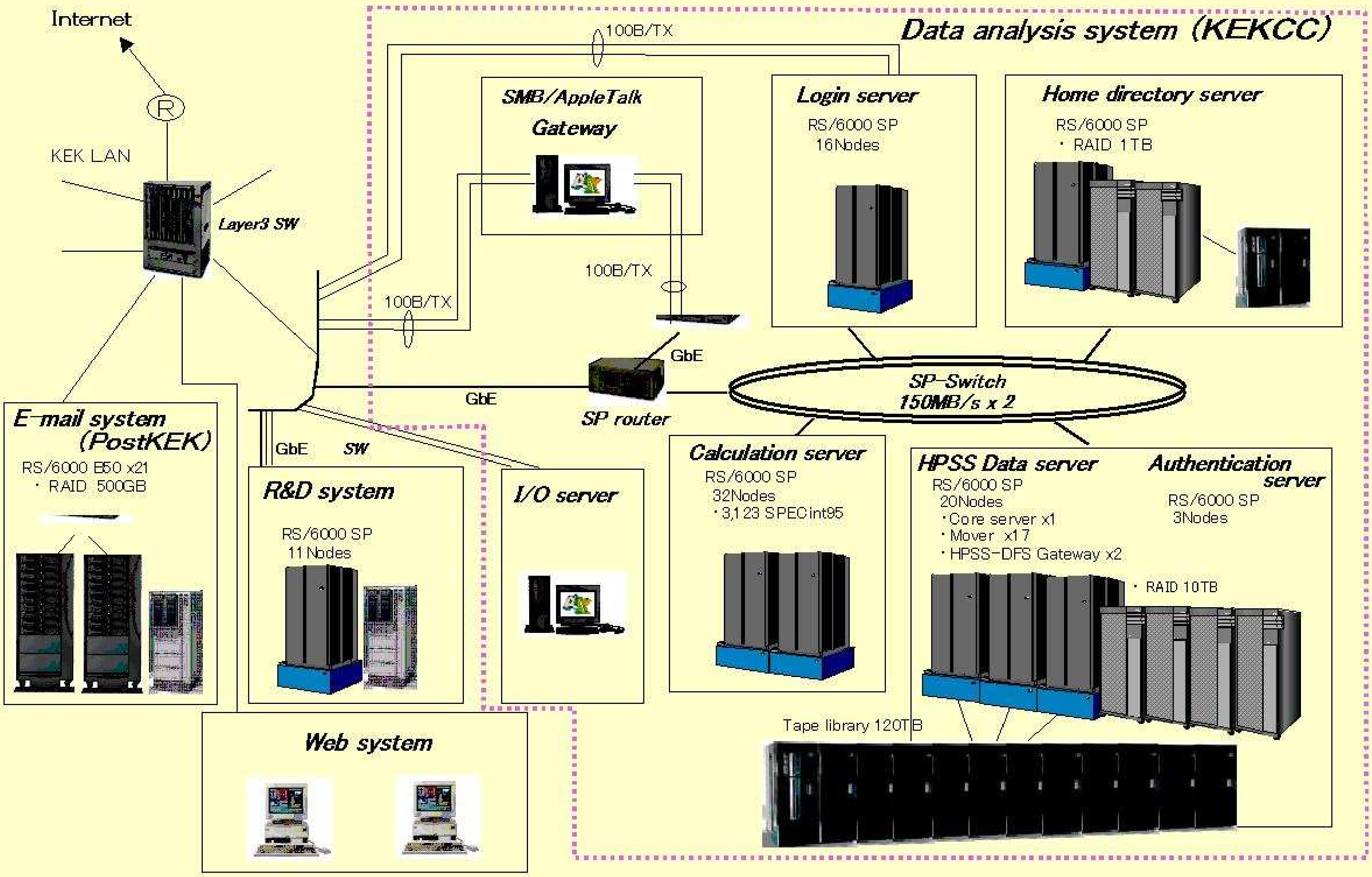
Introduction to KEKCC

New system started operation on January 2001.

- IBM AIX on RS6000/SP
- DCE/DFS system (Distributed Computing Environment / Distributed File Service)
- HPSS (High Performance Storage System)
- LSF (Load Sharing Facility) for the batch system.

2001/1/19

KEK central computer system



Introduction to KEKCC (cont.)

- Login server
  - 4 nodes assigned for PS experiment group. (li01i $\sim$ li04i)
    ps.cc.kek.jp ... representative hostname
    Use '`ssh`' to login.
  - Your home directory size is limited to **100 MB**.
- DCE/DFS
  - Employed for the security, scalability, replication, ...
  - Time limit of one login session : **10** hours.
    To refresh the authentication, use '`kinit`' command.
- HPSS
  - HSM (Hierarchical Storage Management)
  - Accessible via ClientAPI (fast) or DFS interface (slow).

Introduction to KEKCC (cont.)

- Calculation server
  - Batch system on LSF
  - 7 hosts with 4 CPUs (cl01i $\sim$ cl07i) $\rightarrow$ 28 CPUs in total
  - Queues : e,s,m,l,h

```
% bsub -q m yourjob.csh

% bql
      <<<<< JOB QUEUES >>>>
queue|Prio|JOBS/Hst|JOBS/usr|CPU(h:m)| MEM(MB)|NICE| comments
    e|  30|       4|       4|      10|     128|   0|  PREEMPTIVE[s m l h]
    s|  20|       4|      28|    1:00|     128|  20|  PREEMPTIVE[m l h]
    m|  15|       4|      28|    8:00|     128|  20|  PREEMPTIVE[l h]
    l|  10|       4|      28|   24:00|     512|  25|  PREEMPTIVE[h]
    h|   5|       2|       8|  168:00|     512|  30|  PREEMPTABLE
  Default queue = m
```

  - Useful command : `bsub, bjobs, bkill, lsload, bqueues, ..`

Introduction to KEKCC (cont.)

- Tools to compile/make program
  - Compilers:
    cc, xlC, xlf, f77

    ```
    % cc -O3 -qstrict -qarch=pwr3 -Dextname "source_file.c"
    % xlC -O3 -qstrict -qarch=pwr3 -Dextname "source_file.cc"
    % f77 -O3 -qstrict -qarch=pwr3 -qextname "source_file.F"
    ```

  - Libraries:
    CERN library (2000)
    GEANT4 (4.3.1)
    ...

Introduction to KEKCC (cont.)

Information about KEKCC is available on the web page.

http://www.cc.kek.jp/

http://www.cc.kek.jp/english/usagemanual/cc/top.html

http://www-ccce.kek.jp/kekcc/

http://ccwww.kek.jp/kek/cc/general/guide/

...

Workspace (disks/tapes) for E391a group

- Your home directory (100 MB)
- /dfs/g/ps/klea/ (6 GB)

  For the official library, database, ...
- /dfs/g/ps/w5b/klea/ (6 GB)

  For your analysis tools, small files, ...
- /:/hpss/ps/klea/ (HPSS, 240 GB)

  DST, MC samples, your large data, ...

Please DO NOT keep SMALL files ($<\sim$1 MB) on HPSS as far as you can, since HPSS cannot achieve good performance for small files.

Please DO NOT keep LARGE files on DFS as far as you can.

E391 library

Software kits for the E391a experiment.

- Supported platform :

  Linux on PC , AIX on ps.cc.kek.jp
- Requirement :

  CERN library, CLHEP library, GNU make (gmake)
- Programming Language :

  Most of the code in E391 library are written in C, C++.
- Distribution :

  Directory tree of source files in tar.gz format.
- Version control :

  By hand (for now). CVS in the future (may be).
- Will be updated frequently for a while to fix the major bugs.

Contents of the E391 library

Current version (e20010928_1657) includes

- GEANT3 full-simulation
- MIDAS library
- Some utilities; e.g. TupleManager, ..
- Example scripts, Makefiles for your analysis

Near future

- GEANT4 full-simulation
- (Trigger simulator, Beamline simulator)

All collaborators are encouraged to contribute to grow this library up.

Installation and setup

- Installation on PC Linux :
  Please refer to README files under **`src`** directory.
- Setting up the environment variables :
  - E391_HOME
  - E391_LEVEL
  - E391_TOP_DIR
  - E391_LIB_DIR
  - E391_CONFIG_DIR
  - CERN
  - CERN_LEVEL
  - CERN_ROOT
  - CLHEP_BASE_DIR
  - CLHEP_LIB

  You can use an example script in the distribution.
  examples/gsim/e391a/gsim.dat

  On ps.cc.kek.jp,

```
% source /dfs/g/ps/klea/e391/local/etc/cshrc_e391
```

```
(E391_HOME)  (CERN)  (CERN_LEVEL)
e391 --+-- /cern ---- /2000 --+-- /bin
       |                      +-- /lib
       |                      +-- /include
       |
       +-- /cvssrc
       +-- /database
       +-- /local ---+-- /bin
       |             +-- /include ---- CLHEP/*/*.h
       |             +-- /etc     ---- cshrc_e391
       |             +-- /lib     ---- libCLHEP-x.x.x.x.a
       |
       +-- /e391 ----+-- /e20010927_1238 --+-- /bin
                     +-- /e20010928_1657   +-- /examples
                     +-- ...               +-- /include
                     +-- /pro              +-- /lib
                    (E391_LEVEL)           +-- /src ----+-- README
                                                        +-- Makefile
                                                        +-- /config
                                                        +-- /daq ---- /midas-x.x.x ---- ...
                                                        +-- /sim --+-- /gsim ----+-- /e391 --+-- /bin
                                                        |          +-- ...       +-- ...     +-- /lib
                                                        |                                    +-- /src
                                                        +-- /util -+-- /TupleManager --+-- /TupleManage
                                                                   |                   +-- /lib
                                                                   |                   +-- /src
                                                                   +-- /ccfortran ---- /ccfortran
                                                                   +-- ...
```

Play with gsim

Example scripts in a directory :

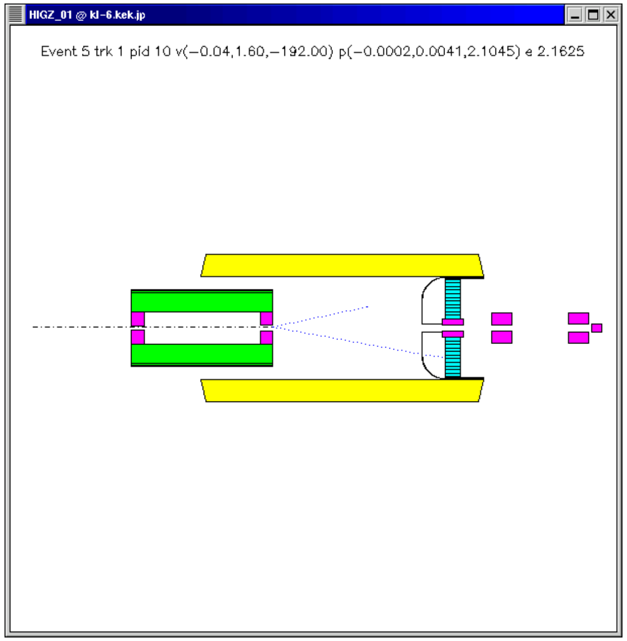
${E391_TOP_DIR}/examples/gsim/e391a

Copy and use them to play with gsim.

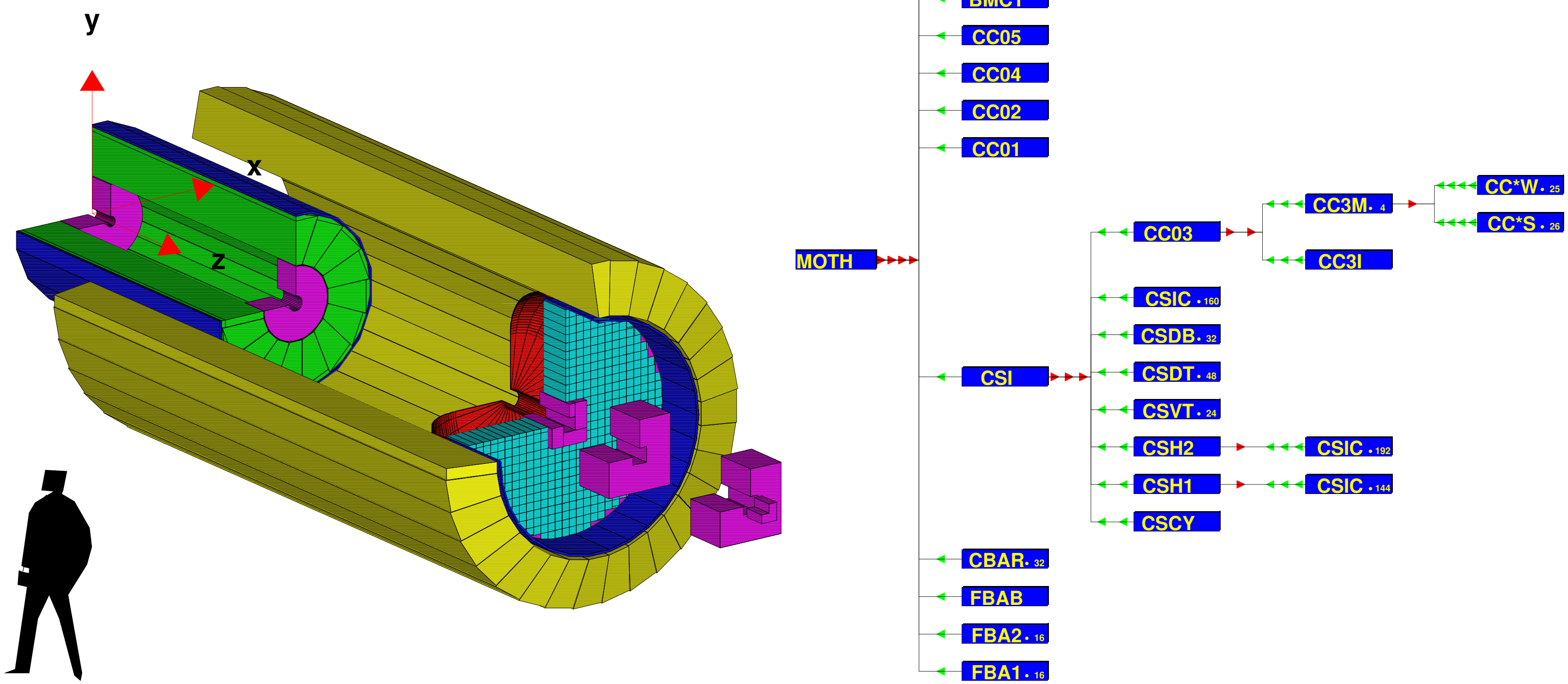
```
% cp -r ${E391_TOP_DIR}/examples/gsim/e391a your_work_area/.
% cd your_work_area/e391a
% ./lnk.csh
% ./gxsim

GEANT > exe disp
GEANT > trig 1
GEANT > quit

% ./gsim -display -psfile test.ps -gen 10
% ghostview test.ps
```



Gsim Detector



Input event for gsim (1)

- Internal event generator
  - Single particle generator :
    Particle type, vertex, momentum, decay mode ...
  - Klong generator :
    Profiles obtained from the result of beamline simulation. (preliminary)

  Controllable via data card file 'gsim.dat'.

Input event for gsim (2)

- Output of the beamline simulator. (Ntuple)

```
*******************************************************************
* Ntuple ID = 601    Entries = 982       COL6
*******************************************************************
* Var numb * Type * Packing *    Range     *  Block   *  Name    *
*******************************************************************
*      1   * R*4  *    16   * [-50.,50.]   * NRESULT  * XX
*      2   * R*4  *    16   * [-50.,50.]   * NRESULT  * YY
*      3   * R*4  *    16   * [0.,1100.]   * NRESULT  * ZZ
*      4   * R*4  *    16   * [-1.,1.]     * NRESULT  * PX
*      5   * R*4  *    16   * [-1.,1.]     * NRESULT  * PY
*      6   * R*4  *    16   * [-1.,1.]     * NRESULT  * PZ
*      7   * R*4  *    16   * [0.,16.]     * NRESULT  * PP
*      8   * R*4  *    16   * [0.,16.]     * NRESULT  * EE
*      9   * U*4  *    7    * [0,100]      * NRESULT  * PN
*******************************************************************
*  Block   *  Entries  * Unpacked * Packed *   Packing Factor    *
*******************************************************************
* NRESULT  *  982      * 36       * 17     *       2.118         *
* Total    *    ---    * 36       * 17     *       2.118         *
*******************************************************************
* Blocks = 1           Variables = 9           Columns = 9       *
*******************************************************************
```

Output of gsim

- Three ntuples for now.
  File size < 1 KB/event.

```
******************************************************************
* Ntuple ID = 1001   Entries = 13042     GSIM
******************************************************************
* Var numb * Type * Packing *    Range     *  Block   *  Name    *
******************************************************************
*      1   * I*4  *         *              * NRESULT  * EVTNO
*      2   * I*4  *         *              * NRESULT  * STATUS
*      3   * I*4  *         * [0,600]      * NRESULT  * NCSI
*      4   * U*4  *    10   * [0,600]      * NRESULT  * IDCSI(NCSI)
*      5   * R*4  *         *              * NRESULT  * ECSI(NCSI)
*      6   * I*4  *         * [0,16]       * NRESULT  * NFBR
*      7   * U*4  *    5    * [0,16]       * NRESULT  * IDFBR(NFBR)
*      8   * R*4  *         *              * NRESULT  * EFBR(NFBR)
*      9   * I*4  *         * [0,32]       * NRESULT  * NCBR
*     10   * U*4  *    6    * [0,32]       * NRESULT  * IDCBR(NCBR)
*     11   * R*4  *         *              * NRESULT  * ECBR(NCBR)
*     12   * R*4  *         *              * NRESULT  * ECC1
*     13   * R*4  *         *              * NRESULT  * ECC2
*     14   * I*4  *         * [0,4]        * NRESULT  * NCC3
*     15   * U*4  *    3    * [0,4]        * NRESULT  * IDCC3(NCC3)
*     16   * R*4  *         *              * NRESULT  * ECC3(NCC3)
*     17   * R*4  *         *              * NRESULT  * ECC4
*     18   * R*4  *         *              * NRESULT  * ECC5
*     19   * R*4  *         *              * NRESULT  * EBMC
*     20   * I*4  *         * [0,32]       * NRESULT  * NCHV
*     21   * U*4  *    6    * [0,32]       * NRESULT  * IDCHV(NCHV)
*     22   * R*4  *         *              * NRESULT  * ECHV(NCHV)
*     23   * I*4  *         * [0,24]       * NRESULT  * NCSV
*     24   * U*4  *    5    * [0,24]       * NRESULT  * IDCSV(NCSV)
*     25   * R*4  *         *              * NRESULT  * ECSV(NCSV)
******************************************************************
*  Block   *  Entries  * Unpacked * Packed *   Packing Factor    *
******************************************************************
* NRESULT  *  13042    * 5716     * Var.   *    Variable         *
* Total    *    ---    * 5716     * Var.   *    Variable         *
******************************************************************
* Blocks = 1            Variables = 25      Max. Columns = 1429  *
******************************************************************
```

```
******************************************************************
* Ntuple ID = 1002   Entries = 13042     GSIM
******************************************************************
* Var numb * Type * Packing *    Range     *  Block   *  Name    *
******************************************************************
*      1   * I*4  *         * [0,20]       * NRESULT  * NGEN
*      2   * R*4  *         *              * NRESULT  * XX(NGEN)
*      3   * R*4  *         *              * NRESULT  * YY(NGEN)
*      4   * R*4  *         *              * NRESULT  * ZZ(NGEN)
*      5   * R*4  *         *              * NRESULT  * PX(NGEN)
*      6   * R*4  *         *              * NRESULT  * PY(NGEN)
*      7   * R*4  *         *              * NRESULT  * PZ(NGEN)
*      8   * R*4  *         *              * NRESULT  * PP(NGEN)
*      9   * R*4  *         *              * NRESULT  * EK(NGEN)
*     10   * R*4  *         *              * NRESULT  * MASS(NGEN)
*     11   * U*4  *    7    * [0,100]      * NRESULT  * PN(NGEN)
*     12   * U*4  *    5    * [0,20]       * NRESULT  * MO(NGEN)
*     13   * I*4  *    6    * [-1,20]      * NRESULT  * DA1(NGEN)
*     14   * I*4  *    6    * [-1,20]      * NRESULT  * DA2(NGEN)
*     15   * I*4  *         *              * NRESULT  * MECH(NGEN)
*     16   * I*4  *         *              * NRESULT  * STATUS(NGEN)
******************************************************************
*  Block   *  Entries  * Unpacked * Packed *   Packing Factor    *
******************************************************************
* NRESULT  *  13042    * 1204     * Var.   *    Variable         *
* Total    *    ---    * 1204     * Var.   *    Variable         *
******************************************************************
* Blocks = 1            Variables = 16      Max. Columns = 301   *
******************************************************************
```

```
******************************************************************
* Ntuple ID = 1003   Entries = 13042     GSIM
******************************************************************
* Var numb * Type * Packing *    Range     *  Block   *  Name    *
******************************************************************
*      1   * I*4  *         *              * NRESULT  * SEED1
*      2   * I*4  *         *              * NRESULT  * SEED2
******************************************************************
*  Block   *  Entries  * Unpacked * Packed *   Packing Factor    *
******************************************************************
* NRESULT  *  13042    * 8        * 8      *       1.000         *
* Total    *    ---    * 8        * 8      *       1.000         *
******************************************************************
* Blocks = 1            Variables = 2           Columns = 2      *
******************************************************************
```

Gsim options

```
% ./gsim
usage: gsim [-ohpss] [-ohid h] [-otitle Title] [-o ofile]
            [-save mode]
            [-psfile psfile] [-display]
            [-gen Nevent Nskip] [-rindex Index] [-rseeds seed1 seed2]
            [-ihpss] [-ihid h]
            [ -i inputfile [Nevent Nskip Nloop] -i ... ]
```

Useful options :

- -ohpss : Specify if you will put the output file onto HPSS (ps.cc.kek.jp)
- -o **ofile** : Output file name
- -gen **N** : Generate N events by internal generator.
- -rindex **N** : Index# (1-100) of random number seeds generated by RANECQ
- -ihpss : Specify if you will read the event file on HPSS (ps.cc.kek.jp)
- -ihid **h** : Ntuple ID of input event file. (e.g. h=601)
- -i **ifile N** : Read N event from ifile. N=0 (or omit N) processes all.

TupleManager

- Utility to access HBOOK file easily from C++ code.
  - 'Class' of C++.
  - You need not issue a fortran function-call (tiresome!) in your C++ code.
  - Only simple function is implemented for now.
    Create/Read/Write/ 1D-, 2D- histogram and CWN (Column-Wise ntuple).
- It should be a nice sample for the beginner of C++ to learn how to write C++ class from the scratch.

Writing your code with E391 library

- Example source code and Makefile with the standard directory tree is included in the 'example/' directory.
(Will be updated soon to be the better one.)

```
package_name/Makefile
            /bin/            ... executables
            /lib/            ... libpackage_name.a
            /package_name/   ... header (include) files
            /src/            ... Makefile and source files
```

- Source code of each file in the current version is not so long... you can read them.
- If you want your code to be included in the E391 library so that all collaborator could use it, contact me.

Things to do

- Common data base
  (Simple text file will be enough.)
  - Geometry of the setup
  - Calibration data
  - ...
- Event data format for the offline analysis.
  - Currently Ntuple in gsim.
  - What in GEANT4 simulator?

Need to discuss, unify and release them as soon as possible.

Contact

If you have problems, questions, comments or requests either about E391 library or about the computing on ps.cc.kek.jp, contact

yamaga@post.kek.jp

For the latest information about the software, see

http://psux1.kek.jp/~e391/software/index.html