SIMulation Status Report

SOFTWARE STATUS

- SIMGAM (all new versions now require GEANT 3.21)
  - v15 (Mar 6)
    - Added use of GEANT 3.21
    - Updated algorithm for diffuse source simulation. Photon beam is now constant area for all angles.
    - ToF computed using energy-averaged start/stop times.
  - v16 (Apr 12)
    - Secondary particle generation now performed in all materials.
    - Added "wide beam" input geometry for telescope mode.
    - Increased GEANT memory allocation to handle more complicated mass model structures.
  - v17 (May 6)
    - Corrects GEANT initialization problem which existed in v15/16.
    - D1 background mode modified to work properly with high-resolution mass models.
  - v18 (imminent)
    - ^{40}K mode (^{40}K distributed within D1 PMTs)
  - v19 (imminent)
    - ^{24}Na cascade event simualtion now includes β-particle. (Requires UNH-IDT-1019 or UNH-IDT-1020.)

SIMulation Status Report

SOFTWARE STATUS (cont)

- **SIMENE (all new versions now require GEANT 3.21)**
  - **v11 (Mar 6)**
    - » **Added use of GEANT 3.21**
    - » **ToF computed using energy-averaged start/stop times.**
  - **v12 (Apr 12)**
    - » **Secondary particle generation now performed in all materials.**
    - » **Added "wide beam" input geometry for telescope mode.**
    - » **Increased GEANT memory allocation to handle more complicated mass model structures.**
  - **v13 (May 6)**
    - » **Corrects GEANT initialization problem which existed in v11/12.**
    - » **D1 background mode modified to work properly with high-resolution mass models.**

SIMulation Status Report

SOFTWARE STATUS (Cont)

- **SIMTRK**
  - **unchanged, still at v2**
    - » **still uses old GEANT**
    - » **no secondaries**
    - » **only narrow input beam available**
    - » **cannot handle new IDTs**
    - ⇒ **OUT OF DATE!!**

- **SIMFIN - unchanged, still at v10**
  - **v11 (undergoing testing)**
    - » **PSD broadening applied to each event (G. Weidenspointner)**
  - **v12 (under development)**
    - » **Option to produce EVS file (for use in SIMRSP)**

- **SIMSPG - unchanged, still at v3**

- **SIMSRV**
  - **v3 (Apr 12)**
    - » **Incident beam area is now a task parameter. Allows flexibility to use different SIMGAM beam geometries.**

SIMulation Status Report

Modified Architecture of SIM Subsystem

Modified architecture will:

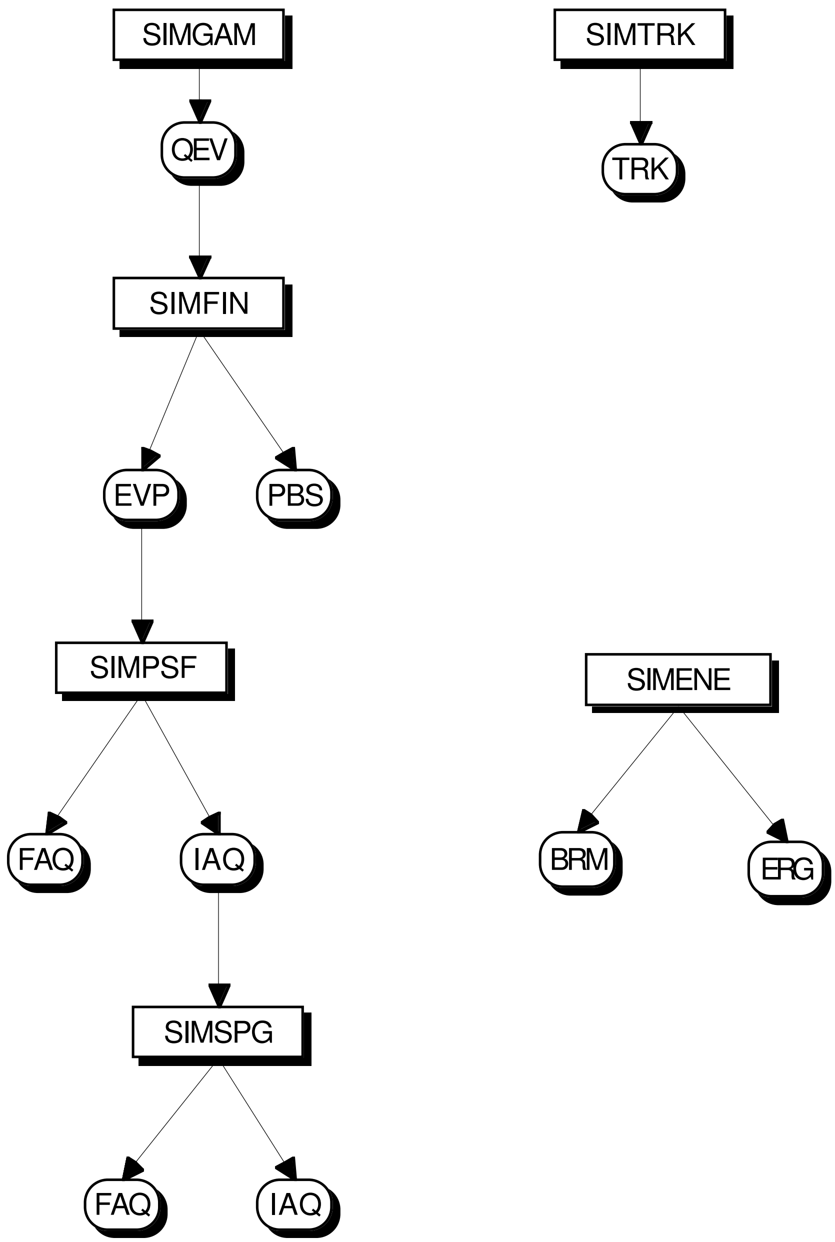
- **Make more effective use of CPU time (SIMENE is presently an all-in-one task, which can require 2-3 weeks of CPU and must be repeated for each set of event selections).**
- **Eliminate code duplication within SIM (e.g., updates made to SIMGAM require a duplication of those updates in SIMENE).**
- **SIMENE will be broken up into three separate steps (SIMGAM, SIMFIN, SIMRSP).**
- **SIMGAM will be modified to generate TRK files as an option.**
- **SIMFIN will generate either EVP files (for SIMPSF), PBS files or EVS files (for SIMRSP).**

Status:

- **Modified version of SIMFIN is in progress.**
- **SIMRSP should be fairly straightforward.**
- **TRK option in SIMGAM is further down the line.**

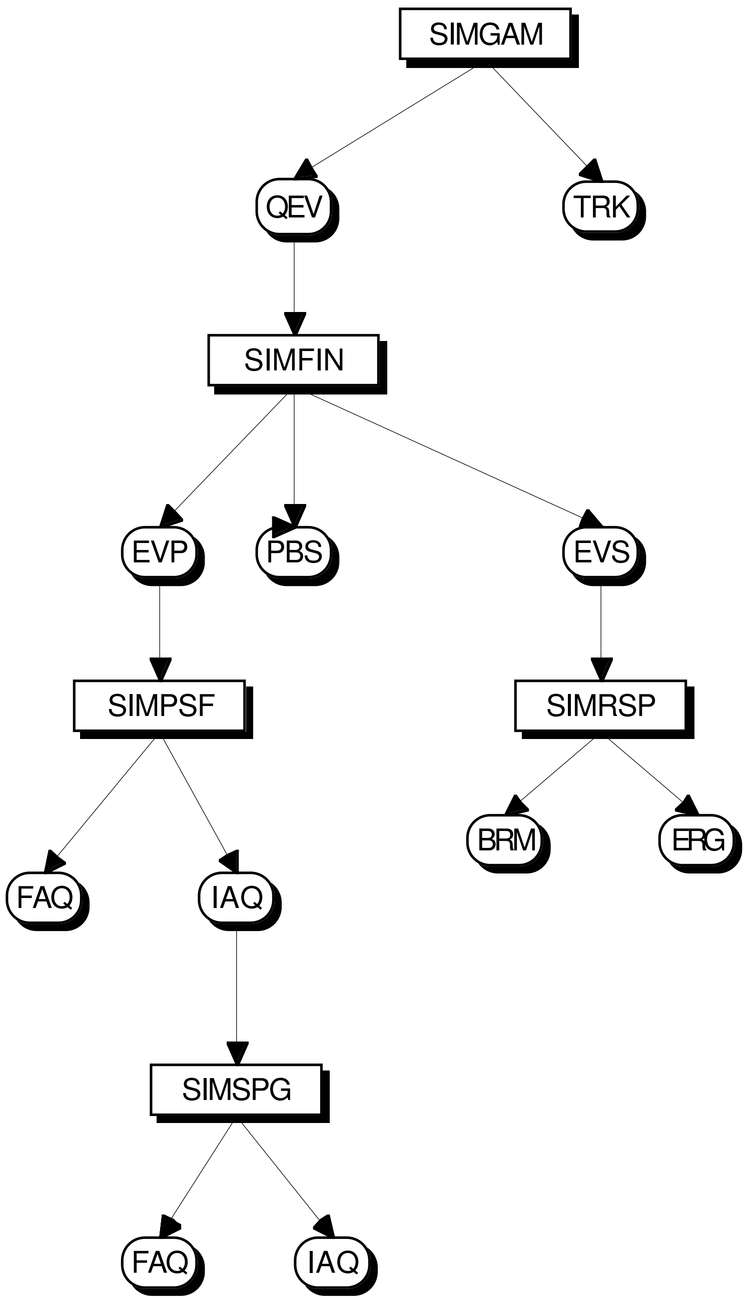
SIMulation Status Report

Present SIM Arcitecture



SIMulation Status Report

Planned SIM Architecture



SIMulation Status Report

COMPTEL Mass Models *(COM-RP-UNH-SIM-047, issue 2)*

- **The SIM mass models (IDT files) have been thoroughly updated based on detailed measurements by Georg and Marc (with a little help from their friend John).**
- **The following major changes have been incorporated :**
  - **More detailed model of the mass distribution in the detector housings.**
  - **More realistic model of the detector electronic boxes.**
  - **More accurate model of the mass and geometry of the detector platforms.**
  - **More realistic model of the veto dome assemblies.**
  - **More realistic model of the veto PMT/electronics assemblies.**
  - **More realistic model of the COMPTEL support structure.**
- **Two versions of the mass model have been developed :**
  - **HIres model, which includes all of the above details, but results in a much slower SIMGAM execution time.**
  - **LOres model, which contains fewer elements and lacks much of the complexity of HIres model. Represents a slightly improved version of previous mass model. Sufficient for most cases.**

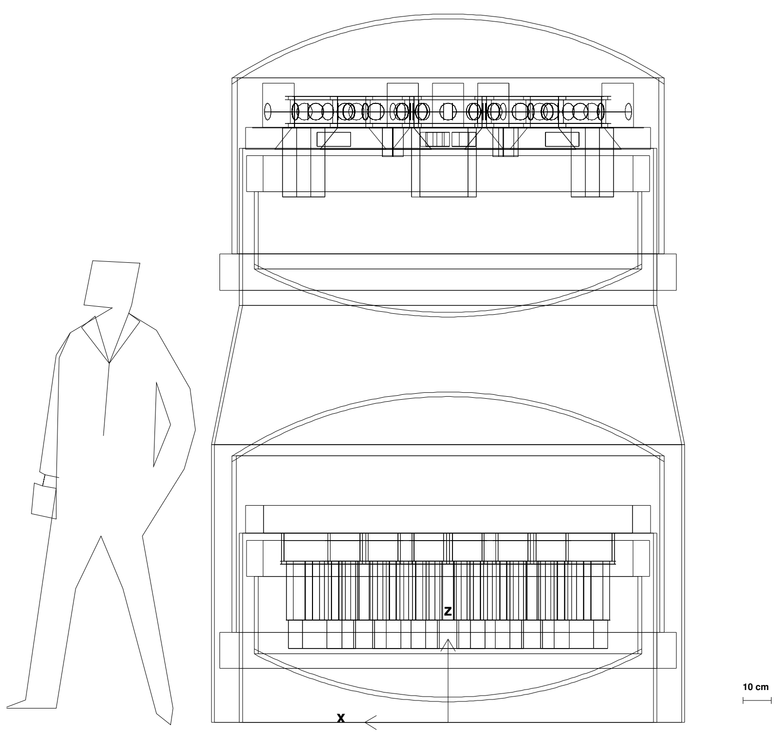
SIMulation Status Report

HIres Mass Model

- **Calibration Version (UNH-IDT-1019)**
  "empty" regions filled with air

- **In-flight Version (UNH-IDT-1020)**
  "empty" regions filled with vacuum

COMPTEL SIM MODEL X-Z VIEW



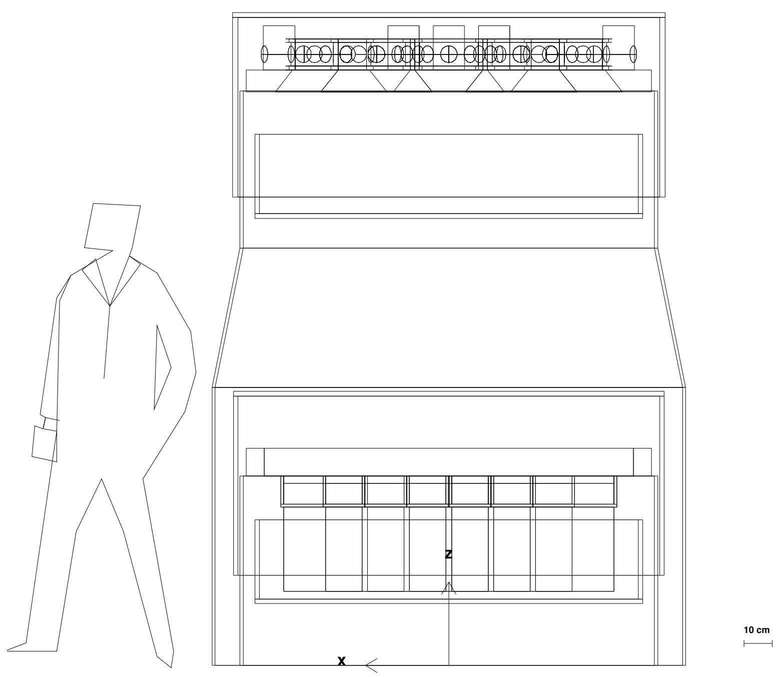
SIMulation Status Report

LOres Mass Model

- **Calibration Version (UNH-IDT-1017)**
  "empty" regions filled with air

- **In-flight Version (UNH-IDT-1018)**
  "empty" regions filled with vacuum

COMPTEL SIM MODEL X-Z VIEW



SIMulation Status Report

DEVELOPMENT ISSUES

- **Have investigated the effects of three major modifications :**
  - **inclusion of secondary particle production**
  - **use of wide incident beam (covering all of D1 subassembly)**
  - **use of more detailed mass model**
- **Initial results of these investigations were reported at the last team meeting.**
- **More recent results are contained in three reports:**
  - **COM-RP-UNH-SIM-046**
    “Effect of Secondary Particles on PSF”
  - **COM-RP-UNH-SIM-047**
    “Revised COMPTEL SIM Mass Model Description”
  - **COM-RP-UNH-SIM-048**
    “Effect of Secondary Particles on the Telescope Response”

SIMulation Status Report

Effect of secondaries with wide input beam:

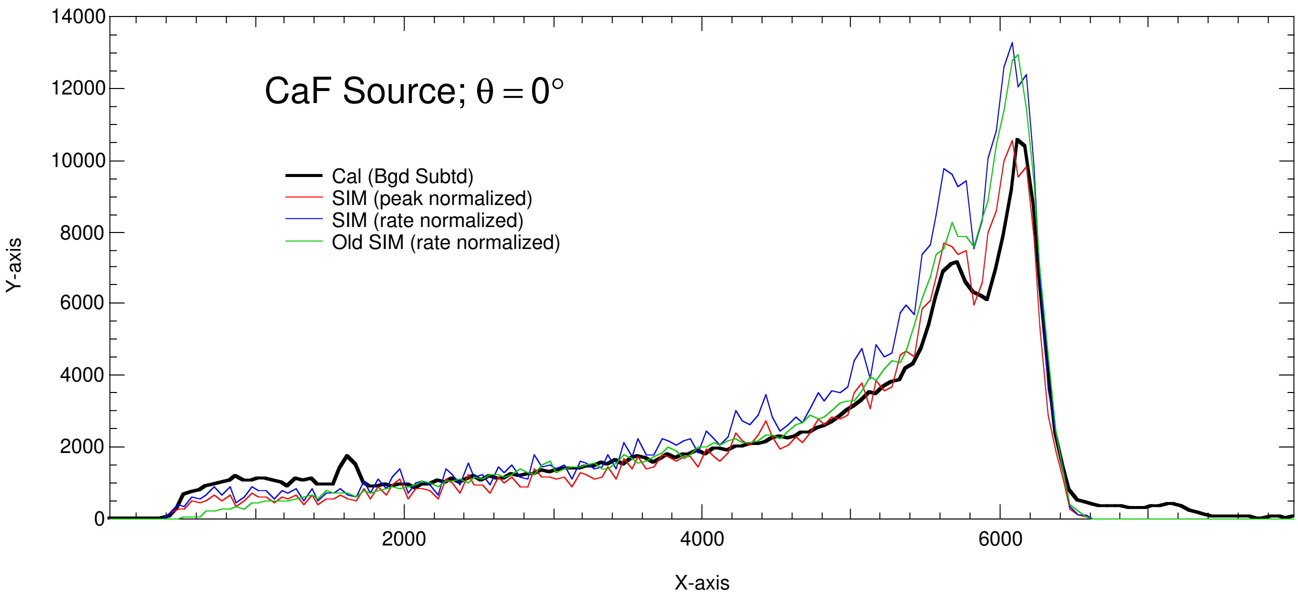
- Telescope events generated from secondaries contribute to a low energy tail not seen in previous simulations.
- Secondary-induced events are most important for incident photon energies > 10 MeV (where pair production is probable) and at large zenith angles (where more material is traversed).
- Most evident features include:
  - low-energy tail in total energy spectrum
  - pronounced 511 keV line in D2 energy spectrum

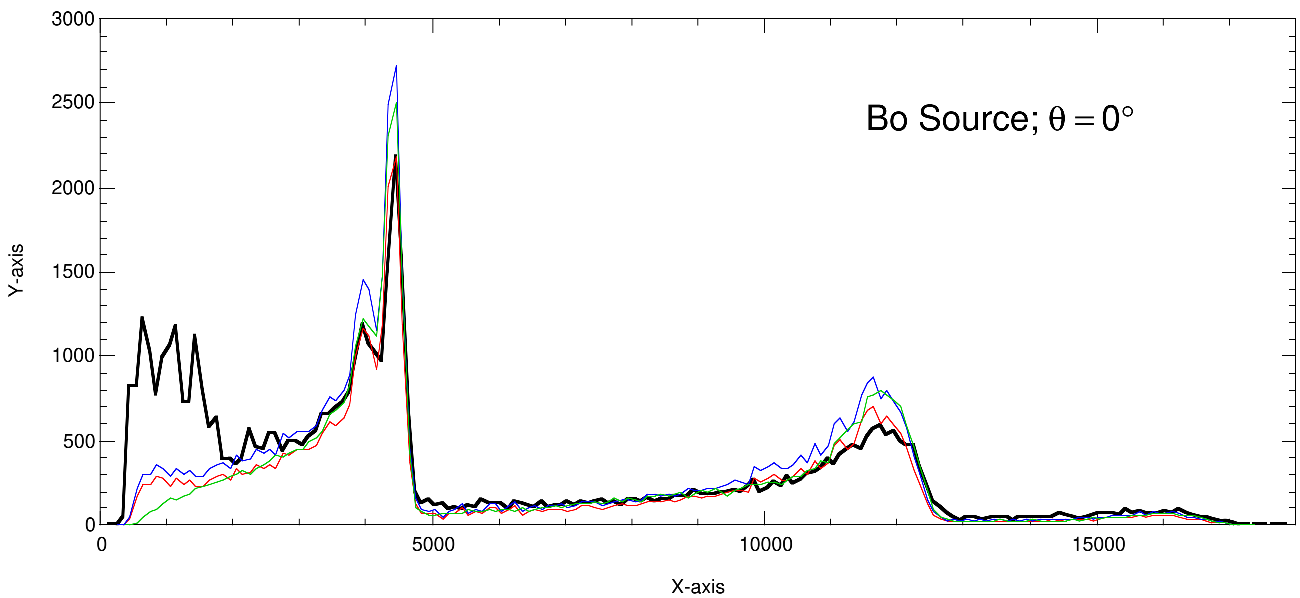
Comparison of HIres versus LOres mass model:

- HIres mass model requires ~twice as much CPU.
- No significant difference in telescope response.
- HIres model may be important for those simulations (e.g., ^{40}K or ^{24}Na) which depend more criticaly on mass distribution.
- For telescope response, LOres mass model is recommended.

SIMulation Status Report

COMPARISON WITH CALIBRATION (TELESCOPE MODE)





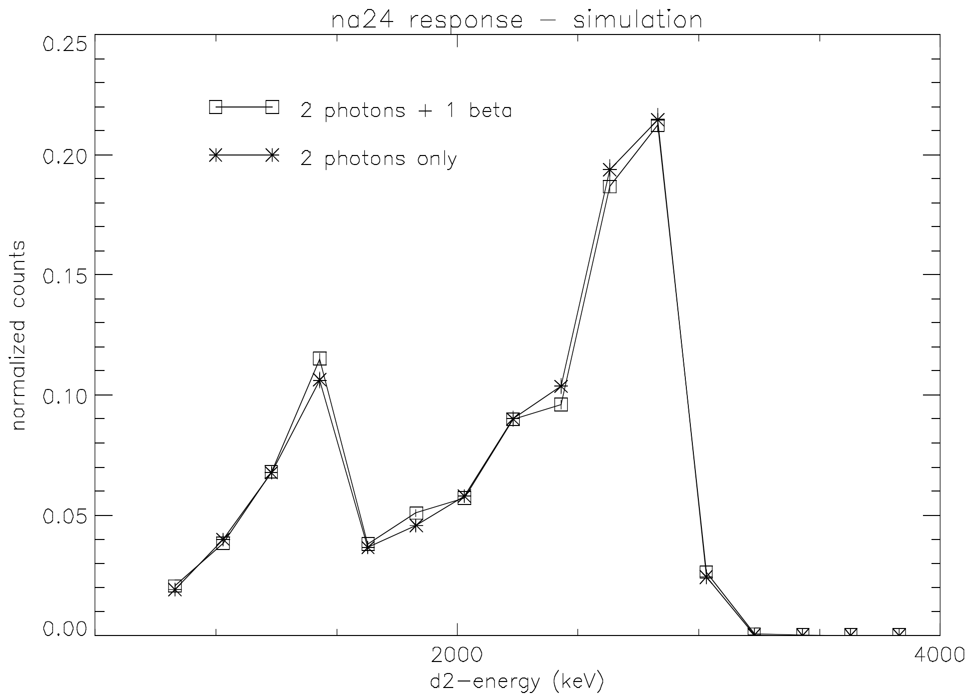
SIMulation Status Report

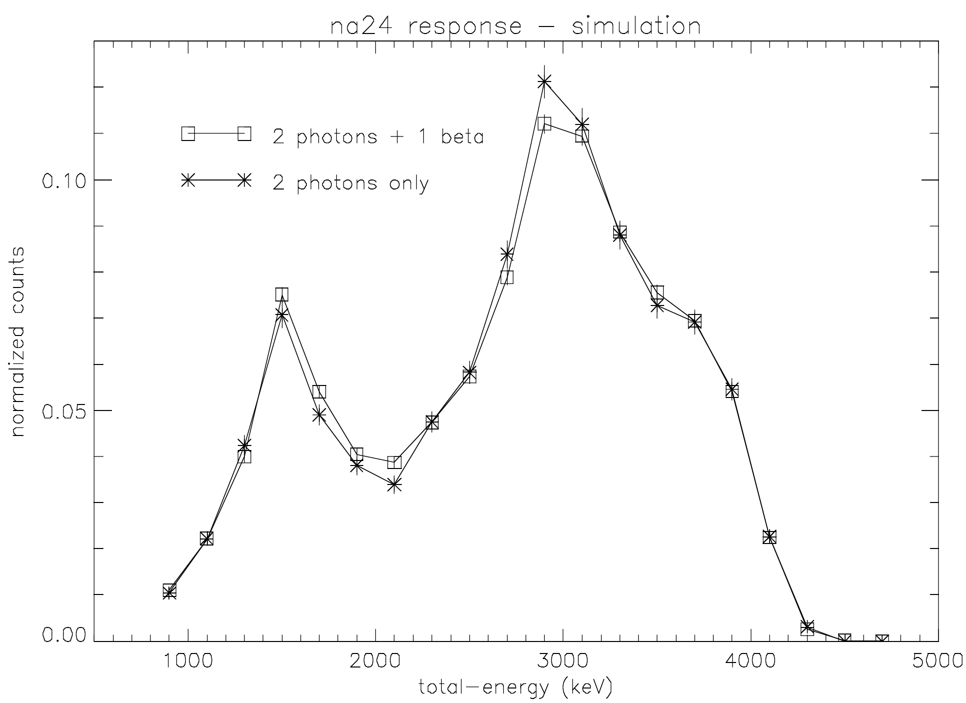
^{24}Na Cascade Event Simulation

- **Latest version incorporated in SIMGAM v18 (not yet in production). Requires HIres mass model (IDT-1019 or 1020).**
- **Simulates 2 photons (1.368 & 2.754 MeV) and 1 β-particle.**
- **The β-particle spectrum has an endpoint of 1.389 MeV with an average β-particle energy of 0.554 MeV.**
- **Starting positions are only those volumes that contain Al. The relative intensity is proportional to relative abundance of Al.**
- **All three particles start from same geometric position. They each have random momentum vectors.**
- **The simulation detection efficiency of a ^{24}Na decay is now (at most) ~10% higher in the current version.**
- **Although the D2 energy spectrum remains roughly the same (in terms of shape), the total energy spectrum shows some differences.**

SIMulation Status Report

24Na Cascade Event Simulation (cont)





SIMulation Status Report

PROCESSING STATUS

SIMGAM Processing

- **A new set of SIMGAM runs has now been completed for a zenith angle of 30°.**
- **A total of 140 SIMGAM jobs run between June 6 and July 15.**
- **These jobs were made using latest version of SIMGAM (v17) :**
  - » **secondaries turned on**
  - » **wide input beam**
  - » **LOres mass model**

SIMFIN Processing

- **Processing of 30° data has begun, but not yet completed.**

SIMPSF Processing

- **A script is now available which uses the command-line COMPASS to generate a complete library of IAQs for a given energy range.**
- **IAQ lists (which can be used in SIMSPG) have now been generated for a number of energy ranges using the 10° simulations.**

SIMulation Status Report

SIMSPG

- **Brief write-up is planned (as requested by DRG).**
- **Help text is, however, fairly complete.**
- **IAQ libraries have been optimized for power-law spectra with indices ranging from -1.4 to -3.**
- **For spectra which are significantly different from such power-laws (e.g., Wien spectra), SIMSPG with the presently-available IAQ libraries, is not recommended.**
- **Sample TPT:**

```
                        creation data
site PTT_ID number      user   date        time      status  parameter table descriptor name
____ ______ __________  ______ ___________________  ______  ________________________________
 UNH SIMSP2 3107        MCCONN 30 May 1996 09:31     C       Test Run

Task id Version         Task title
_______ _______         ____________________________________________________________________
SIMSPG  3               Generate Spectrally weighted PSF from list of SIM IAQ's


number parameter prompt text              index  value                 type
______ _________________________________  ______ _____________________ ______________________
1      Input  IAQ LIST    Identifier             UNH-IAQ-13424         <LIST IDENTIFIER>
2      Input  IAQ DATASET Identifier                                   <DATA SET IDENTIFIER>
3      Output IAQ DATASET Identifier             UNH-IAQ-13439         <DATA SET IDENTIFIER>
4      Output FAQ DATASET Identifier             UNH-FAQ-13368         <DATA SET IDENTIFIER>
5      Start: Normalization Energy (MeV)         1.00                  <COMPASS REAL>
6      End  : Normalization Energy (MeV)         1.60                  <COMPASS REAL>
7      Spectral Shape Type                       1                     <COMPASS INTEGER>
8      Input ISW DATASET Identifier                                    <DATA SET IDENTIFIER>
9      Spectral Shape Parameters          (1)    -2.0                  <COMPASS REAL>
9      Spectral Shape Parameters          (2)    0.0                   <COMPASS REAL>
9      Spectral Shape Parameters          (3)    0.0                   <COMPASS REAL>
9      Spectral Shape Parameters          (4)    0.0                   <COMPASS REAL>
9      Spectral Shape Parameters          (5)    0.0                   <COMPASS REAL>
10     Control Code                              00000000000000000000  <COMPASS CHARACTER>
```

SIMulation Status Report

The following two lists summarize the available IAQ libraries.

For complete info, see COM-RP-UNH-SIM-032 (issue 12).

Have been generated from the 10° SIMGAM library, i.e., with :

- **no secondaries**
- **older mass model**

For each energy range, SIMSPG has been used to generate power-law PSFs with indices ranging from -1.4 to -3.0.

Available IAQ Lists - Standard Energy Ranges

energy (MeV)	Phibar binning	Input energy range (MeV)	IAQ list	Number of members
0.75 - 1	1 deg	0.652 - 3	U9206	35
0.75 - 1	1 deg	0.652 - 9	U9204	70
0.75 - 1	2 deg	0.652 - 3	U9210	35
0.75 - 1	2 deg	0.652 - 9	U9264	70
1 - 3	1 deg	0.873 - 9	U9176	64
1 - 3	2 deg	0.873 - 9	U9263	64
3 - 10	1 deg	2.75 - 20	U8037	70
3 - 10	2 deg	2.75 - 20	U8038	70
10 - 30	1 deg	9 - 76	U9177	70
10 - 30	2 deg	9 - 76	U9178	70
0.75 - 30	1 deg	0.652 - 76	U9179	140
0.75 - 30	2 deg	0.652 - 76	U9180	140
1 - 30	1 deg	0.873 - 76	U9181	134
1 - 30	2 deg	0.873 - 76	U9182	134

SIMulation Status Report

Available IAQ Lists - Non-Standard Energy Ranges

energy (MeV)	Phibar binning	Input energy range (MeV)	IAQ list	Number of members
1 - 2	2 deg	0.873 - 4.388	U10137	40
2 - 5	2 deg	1.75 - 12.057	U10138	61
5 - 10	2 deg	4.537 - 19.757	U10139	56
1 - 10	2 deg	0.873 - 19.757	U10140	96
0.75 - 1.25	2 deg	0.652 - 2.445	U10141	29
1.25 - 3	2 deg	1.011 - 8.936	U10142	61
3 - 8	2 deg	2.749 - 19.757	U10143	70
8 - 30	2 deg	7.191 - 76.057	U10144	79
1 - 1.6	2 deg	0.652 - 76.057	U13424	134
1.6 - 2.1	2 deg	7.191 - 76.057	U13433	124
2.36 - 4	2 deg	7.191 - 76.057	U13425	114
4 - 5.6	2 deg	7.191 - 76.057	U13426	100
5.6 - 10	2 deg	7.191 - 76.057	U13432	90
4 - 10	2 deg	7.191 - 76.057	U13431	100
3 - 7	2 deg	7.191 - 76.057	U13430	108
7 - 30	2 deg	7.191 - 76.057	U13429	82
3 - 4.1	2 deg	7.191 - 76.057	U13437	108
4.1 - 4.8	2 deg	7.191 - 76.057	U13436	99
4.8 - 5.8	2 deg	7.191 - 76.057	U13428	95
5.8 - 6.5	2 deg	7.191 - 76.057	U13438	88
6.5 - 7	2 deg	7.191 - 76.057	U13427	84
7 - 12	2 deg	7.191 - 76.057	U13434	82
12 - 30	2 deg	7.191 - 76.057	U13435	61
.75 - .85	2 deg	.652 - 76.057	U15826	93
.85 - 1.0	2 deg	.652 - 76.057	U16749	122
1.0 - 1.4	2 deg	.652 - 76.057	U16526	132
1.4 - 2.0	2 deg	.652 - 76.057	U16720	127
5 - 30	2 deg	4.5 - 76.057	U17038	93

SIMulation Status Report

FUTURE ACTIONS

- **Complete new SIM subsystem architecture.**
- **Incorporate PSD broadening into SIMFIN**
- **Generate PSFs from recently-complete 30° QEV library.**
- **Generate QEV, PSF libraries for 20° zenith.**
- **Clarify the SIM-calibration comparison (report).**
- **Investigate the development of more flexible IAQ libraries for use in SIMSPG.**
- **Investigate the incorporation of a more realistic event location distribution into SIMFIN. (Is this necessary?)**
- **Investigate the feasibility of some angle-averaged PSF.**
- **Incorporate use of new PSD selection (60-90).**
- **Incorporate latest ToF corrections (from RvD). Although these corrections are not (yet?) universally used.**
- **Define simulation requirements for line analysis.**