Neutron Scattering Models of Computer Hardware using MCNP6

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Motivation

- Cosmic radiation, including high-energy neutrons, bombard the Earth's surface 24/7
- Neutron collisions with CPUs and other computer hardware cause bits to flip and can increase a computer's error rates.
- Vendors determine the estimated error-rate of CPUs from natural radiation by placing them in the ICE-House neutron beam at LANSCE.

Code

- Consists of the 3 sections surfaces, cells, and data.
 - Surface cards shape all geometry

-307 -308 fill=34

3 RPP -3.3 3.3 -3.8 3.8 0.24 0.28 \$ Composite Chip

Cell cards define each piece of the geometry

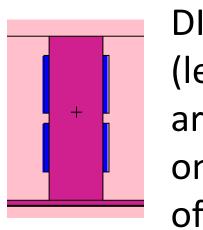
 Data cards define the materials, radiation source(s), tally counters, etc.

u=333 imp:n=1

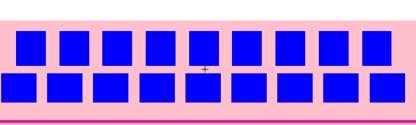
sdef pos=0 0 1 erg=14.0 \$ Nuetron source.

Hardware Models

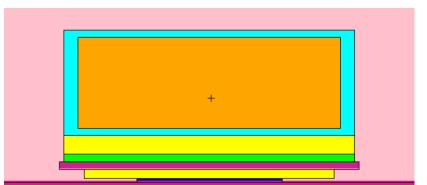
 MCNP6 has a rudimentary plotter program built in to generate models of the input files...



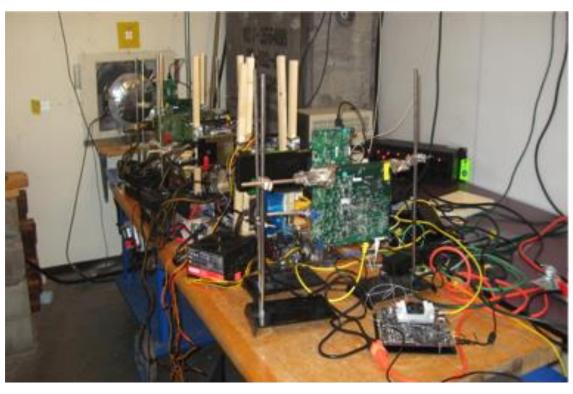
DIMM card side view (left), DIMM cards chip arrangement (below) on both front and back of DIMM

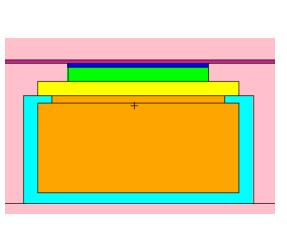


Two simplified Raspberry
Pis (above) – chip on top
of motherboard

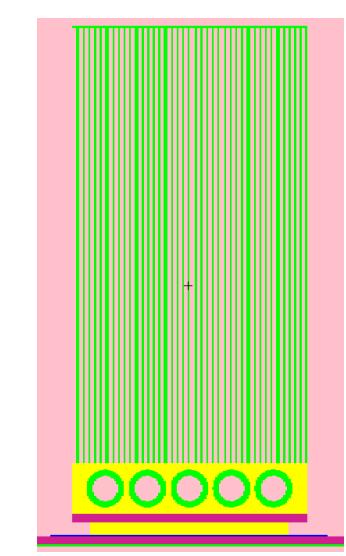


Knight's landing
(above) – similar to the
Broadwell, includes a
heat spreader plate on
top of the chip with a
liquid-based heat sink



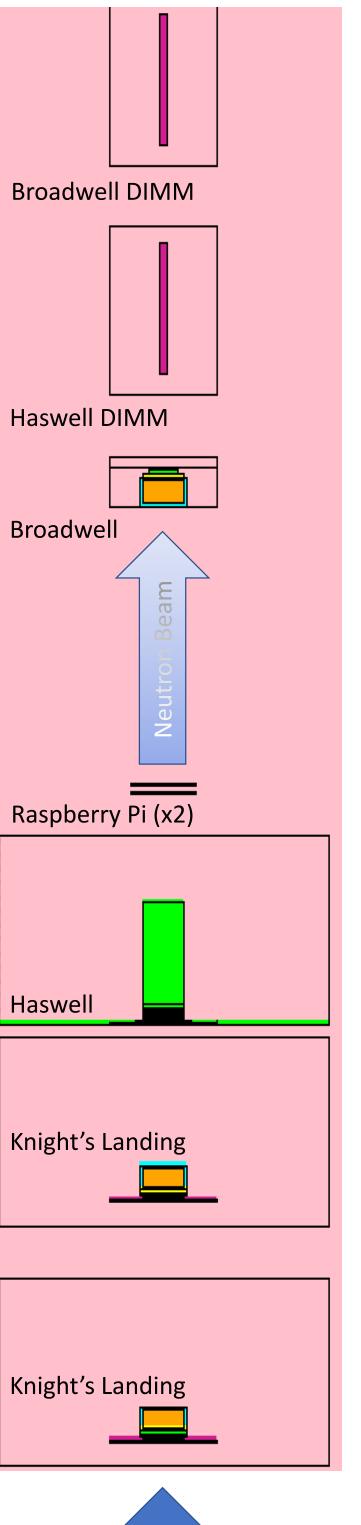


Broadwell (above)
including heat spreader
on the chip and a
liquid-based heat sink



Haswell (above)
including an aluminum
mounting plate for the
motherboard, a heat
spreader plate, heat
spreader with air
cooling pipes, and

spreader with air cooling pipes, and a large heat sink – alongside which is a fan (not modelled)

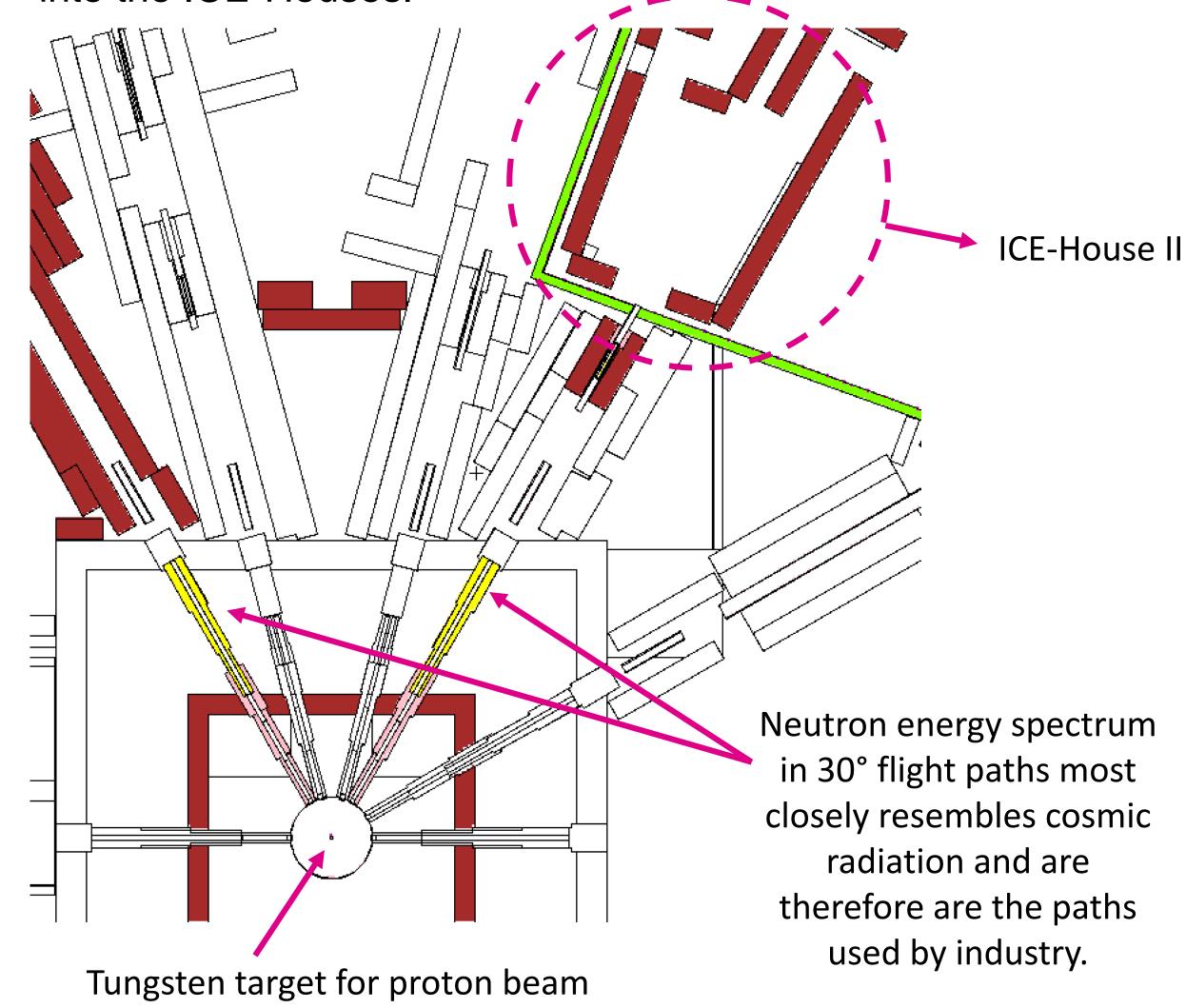




Fiberglass motherboard	Si Chip	Copper (Heat Spreader)	Aluminum	Plastic	Water- Propylene Glycol mix	Air

Beam Model

• This MCNP model, originally developed by Victor Gavron using MCNPX, is shared by users of the WNR facility for a variety of purposes including testing/development of shield for new or modified experiments. For this project it was used to create an accurate representation of the neutron beam-line when entering into the ICE-Houses.



Future Applications

These files have been written out to be as user-friendly as
possible so as to allow the models to be handed off to vendors
using the LANSCE ICE-House(s) and then be modified to suit
their individual needs. This allows them to get more accurate
models of CPU lifetime and efficiency when compared with
experimental results.