AFC WORKSHOP WORKING GROUP B 08/11/06

Two natural approaches – call them pragmatic and philosophical (shorter term and longer term)

PRAGMATIC

Reactor specialists define specific needs reaction, isotope, energy range

Nuclear physicists identify the facilities accelerator, detector systems

National Labs
e.g., Luhan and WNR at LANSCE
DANCE and GEANIE

University Labs
e.g., TUNL; Ohio; RPI

Identify key personnel
divide up work

LONGER TERM

Models not sufficiently developed for accurate predictions

Analysis often incomplete

Experimental data lacking

Keys – cross sections, level densities, strength functions
All have difficulties

CROSS SECTIONS

e.g., preequilibrium very important
active investigation – Chadwick and Kawano

Difficult to predict charged particle cross sections following neutron induced reactions -- Haight

need both theory and experimental efforts

LEVEL DENSITIES

Standard level density models are semi-empirical
Dangerous to extrapolate off stability line

Shell Model Monte Carlo methods promising
Not widely applied

DATA

Most neutron resonance data very old

ANALYSIS

Even for high quality neutron resonance data analysis is often inconsistent or incomplete

Example -- missing level correction

Nature of width distribution – Porter-Thomas –
Leads to many weak levels
Therefore normally miss some fraction of levels

Often – no correction is applied

Standard correction method
Determine weakest observed width
Assume that all levels above cutoff observed
Assume Porter-Thomas
From cutoff and the distribution –
determine fraction of levels that are missed

Flaw – if non-statistical effects present
this method can be very misleading
non-statistical effects are very common 2p1h, 3p2h, etc
These effects artificially increase average width
Therefore reduce cutoff value
And leads to underestimate of missing levels

In RMT widths and spacings are independent
Spacing distribution is very little affected by non-statistical effects
Therefore use the spacing distribution to make correction
Never done before because more complicated

We worked this out
Applied to a sample of neutron resonance data
Two methods sometimes agree, often not
A striking example is 238U -- we analyzed using both methods
Standard analysis 3% missing levels – consistent with no missing levels
Spacing analysis 11% missing levels

Need more careful analysis

STRENGH FUNCTIONS

Focus on radiative strength function (RSF)

Much effort on giant resonance region
Some effort on pygmy resonances

Little effort on low energy region – below 3 MeV

Low energy region not well understood
Very hard to measure
Very important for neutron capture

Low energy behavior – to zero? constant? Enhanced?
Need a signature

For neutron capture
Value of RSF at low energy determines
number of steps in the statistical cascade

Since low energy behavior determines multiplicity
Invert logic and measure multiplicity to learn about RSF
Need a multiplicity meter

There is one – DANCE

We have lots of interesting new data
Need more data
Especially need better theory!

CONCLUSION

Lots of work to be done experimentally and theoretically

Clearly we want to improve understanding of statistical models, level density models, reaction models

Key point – physical questions are sufficiently general Not tied to specific nuclides

This is similar to stewardship science – Answer physics general questions By studying nuclides of programmatic interest

Therefore no conflict Between shorter and longer term approaches

A physicist from outside this community
would be amazed by this discussion
He/she would probably say
I thought that all of these issues were settled 30 or 40 years ago

It is true that victory was declared
And that the general nuclear physics community moved on
But many issues remain unsettled

Nuclear physics relevant for this workshop
I like to call classical nuclear physics –
The physics of Wigner and Dyson, of Feshbach and Weisskopf, of Lane, of Porter and Thomas
This is also the physics of stewardship science

This physics is not taught in nuclear physics classes
Classical nuclear physics has vanished from the curriculum

This is a serious problem for almost everyone here

As an optimist I try to find positive signs
This workshop is positive
Nuclear Physicists and Nuclear Engineers have a mutual interest
Of course in the success of a new generation of reactors
Also in a continuation of support for classical nuclear physics

I hope that one outgrowth of this workshop
is increased collaboration between the two communities.