



Wholistic VVUQ and Increasing Verification & UQ Activities

Jim Ferguson, Ph.D.
LANL ASC-V&V Verification PL

08Aug2023

The Bottom Line

We need balance between Verification / Validation / UQ activities in PSAAP Centers.

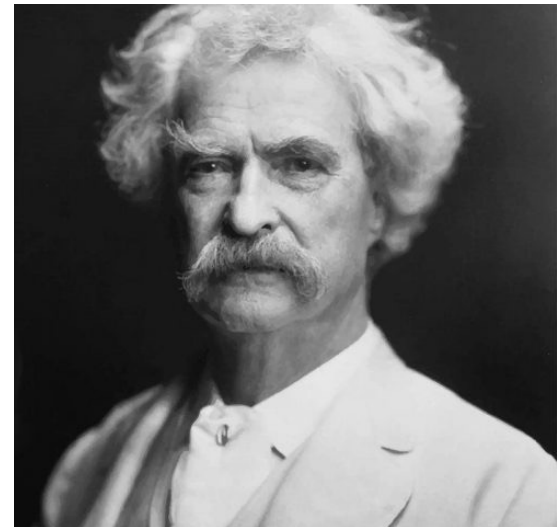
Want continued work on validation, but emphasize communication of verification and UQ methods and tools.

The benefits to the NNSA Complex include training, tools, and methods for wholistic VVUQ, on a diverse set of problems.

“It ain’t what you don’t know
that gets you into trouble.

It’s what you know for sure
that just ain’t so.”

-- probably Mark Twain,
but not Samuel Clemens



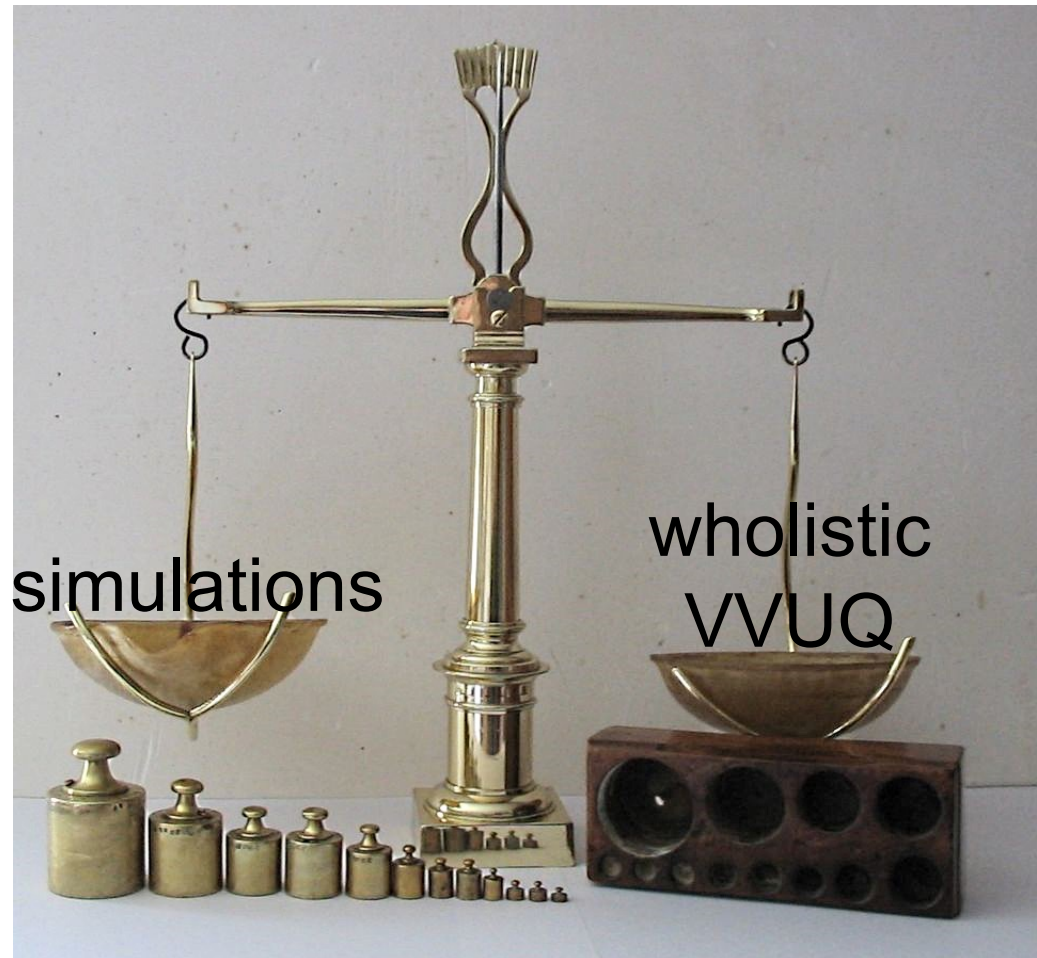
But what are verification, validation, and uncertainty quantification?

Science is about comparing to some sense of “Ground Truth”.

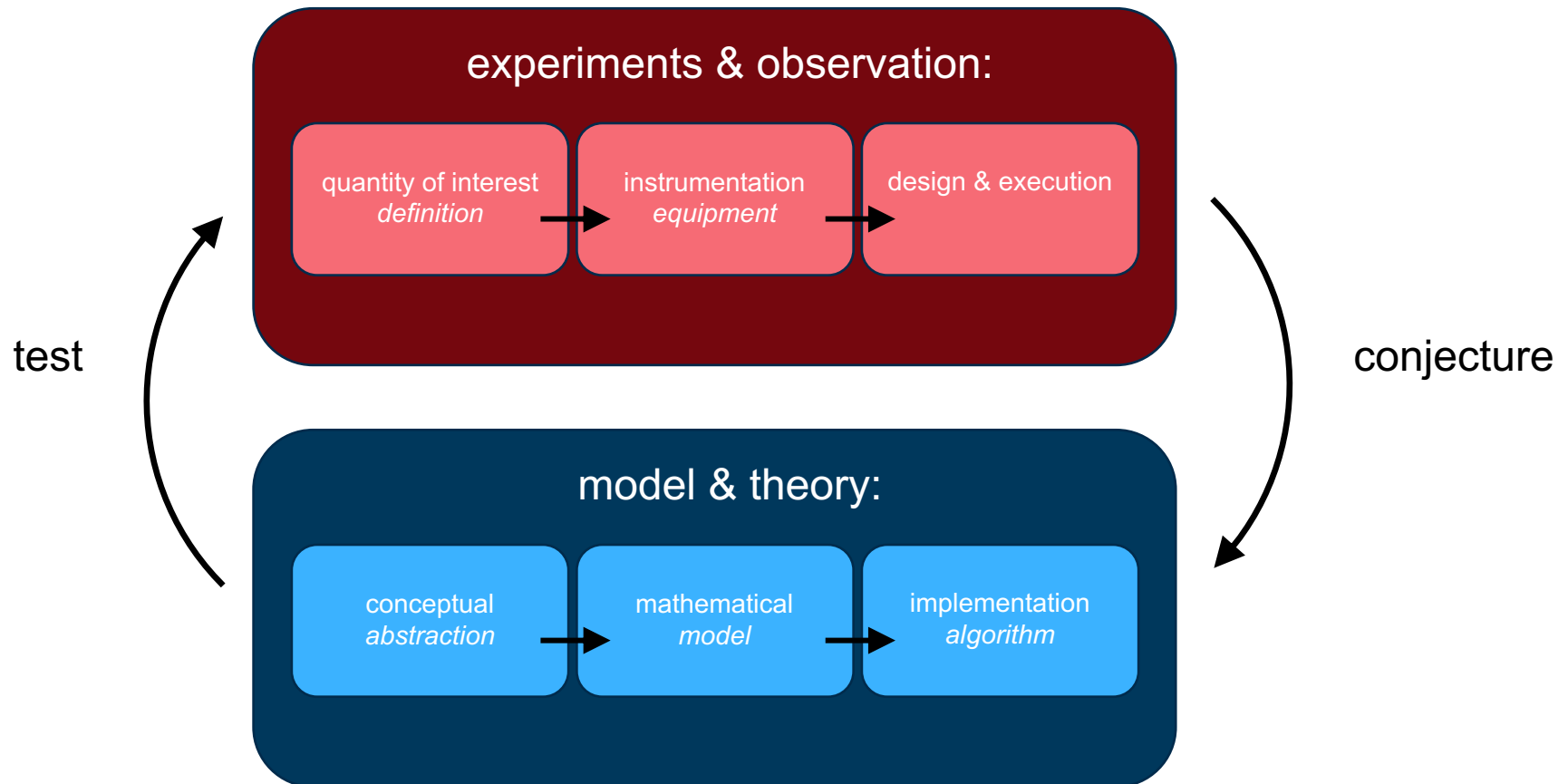
Verification:
ground truth is
MATHEMATICAL

Validation:
ground truth is
EXPERIMENTAL

UQ:
Grappling with the
UNKNOWN



VVUQ is the Scientific Method in Predictive Science



NNSA labs are seeking varied methods to better understand and quantify uncertainties



Diversity of problems and VVUQ methods is desired.

Initial plans are important.

Boundaries between topics become blurred.

Differences between small- and large-scales make for a beautiful landscape.

NNSA labs use simulations to help decision makers

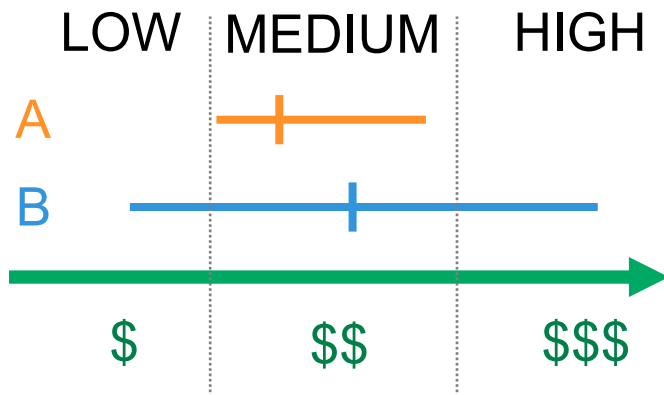
We must check for errors.

- Expert judgement is not going away, nor is the need to care.

We must understand uncertainties on quantities of interest.

- Managing uncertainties in simulations matters to us all!

Predicting uncertainties for resource allocation vis-à-vis model fidelity and risk



Can your manager spot 9 out of 10 mistakes in a simulation?

Verification and Why We Do It?

Numerically: Consistent and Bounded means Convergent

Code
Verification

The Answer
The Answer
The Answer

✓ Great!

Solution
Verification

Am Amsw3r
An Amsw3r
An Answer



What
Else?!

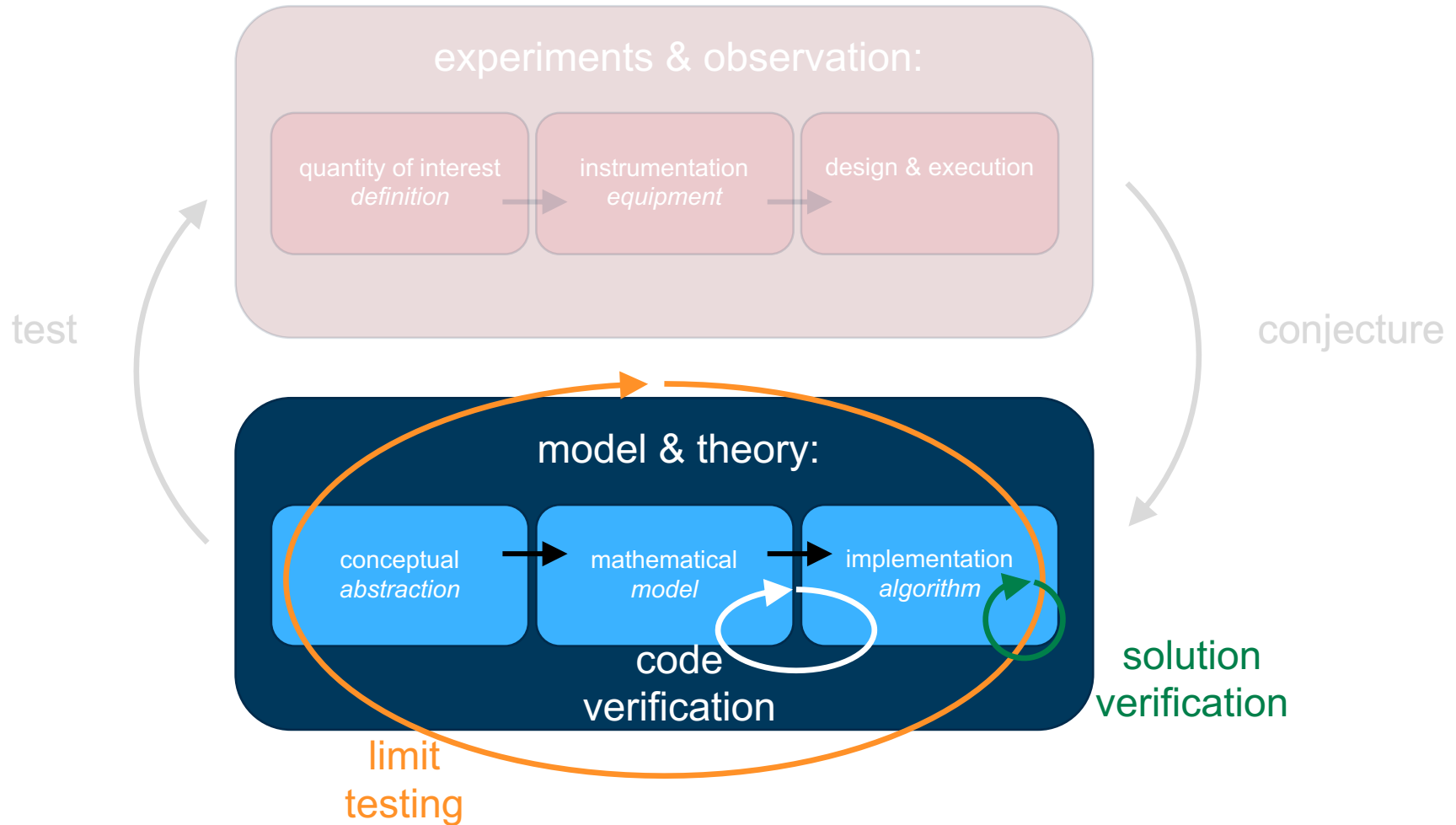
???

PSAAP

help

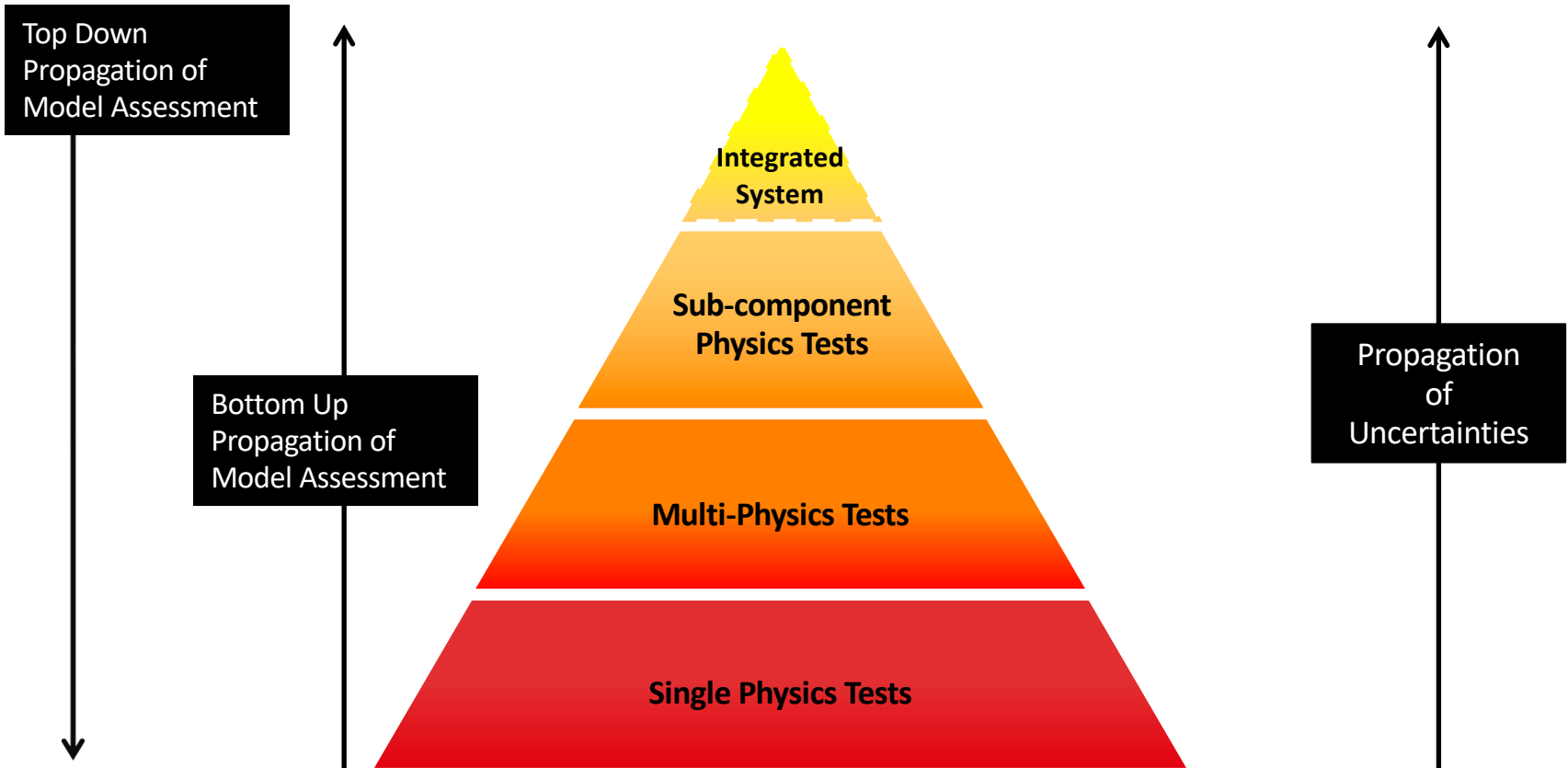


Verification is the mathematical basis within the Scientific Method and Predictive Science

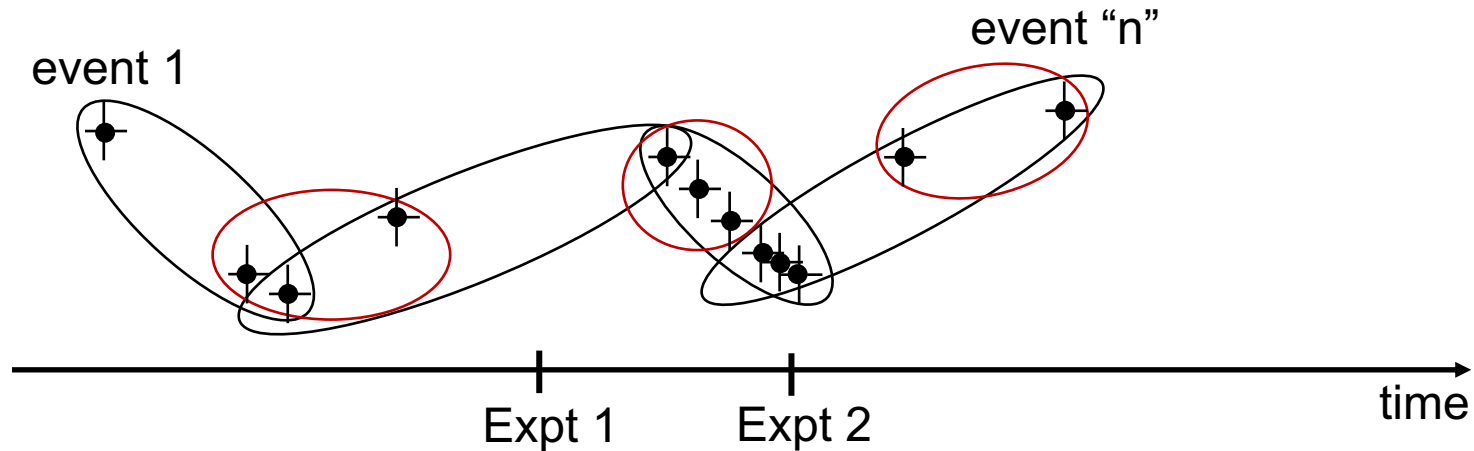


Helping understand hierarchical VVUQ in simulations

The goal is to reach the peak for every Question of Interest



Breaking down hierarchical VVUQ in simulations



How best to group different events?

How best to propagate uncertainties from cluster to cluster?

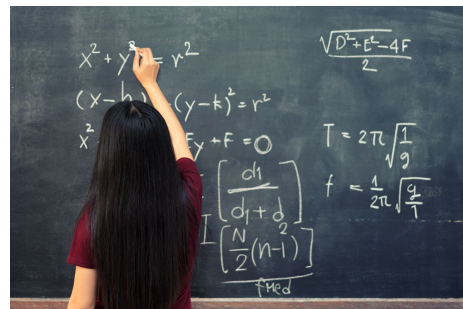
Are event generators completely represented by model switching and engineering features?

How PSAAP Centers can help?

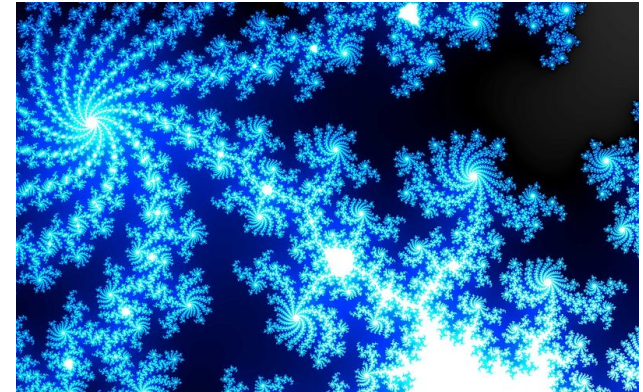
TRAINING



TOOLS



METHODS



Wikimedia Commons: Mandelbrot fractal

???

The Bottom Line

We need balance between Verification / Validation / UQ activities in PSAAP Centers.

Want continued work on validation, but emphasize communication of verification and UQ methods and tools.

The benefits to the NNSA Complex include training, tools, and methods for wholistic VVUQ, on a diverse set of problems.

“It ain’t what you don’t know
that gets you into trouble.

It’s what you know for sure
that just ain’t so.”

-- probably Mark Twain,
but not Samuel Clemens

