Short status on nuclear data, simulations and uncertainties

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NRG capabilities

①   <u>nuclear data:</u> TENDL libraries (up to 2013), ENDF/B-VII.1, JEFF-3.1 and JENDL-4.0

②   <u>uncertainties:</u> TMC or fast TMC for Monte Carlo or deterministic calculations

③   <u>codes:</u> MCNP, Serpent, Dragon, Panther

④   <u>calculation types:</u> criticality, shielding, burn-up, full core, transient,

⑤   <u>quantities:</u> k_{eff} and related, decay heat, number densities, power, temperature, peaking factors...

2 examples: (1) full core local power

☺ Example: the Martin-Hoogenboom benchmark

MCNP model: 241 fuel assemblies, with 264 fuel pins each
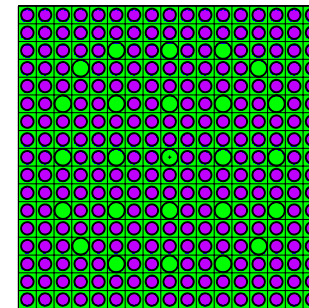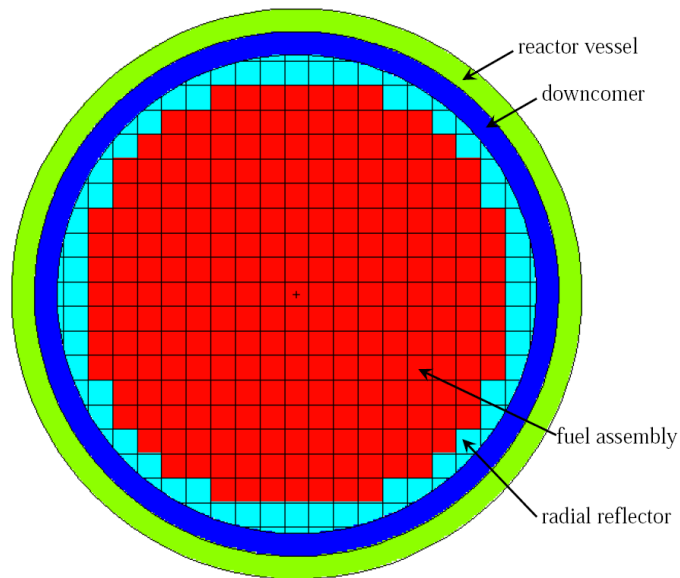
$\Longrightarrow 357 \times 357 \times 100$ regions ($1.26 \times 1.26 \times 3.66$ cm^3): 12.7 million cells

Uncertainty on generated local pin power (tally f7) due to ^{235}U, ^{238}U, ^{239}Pu
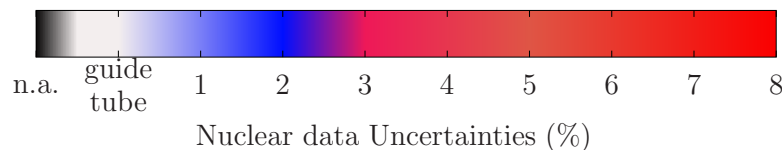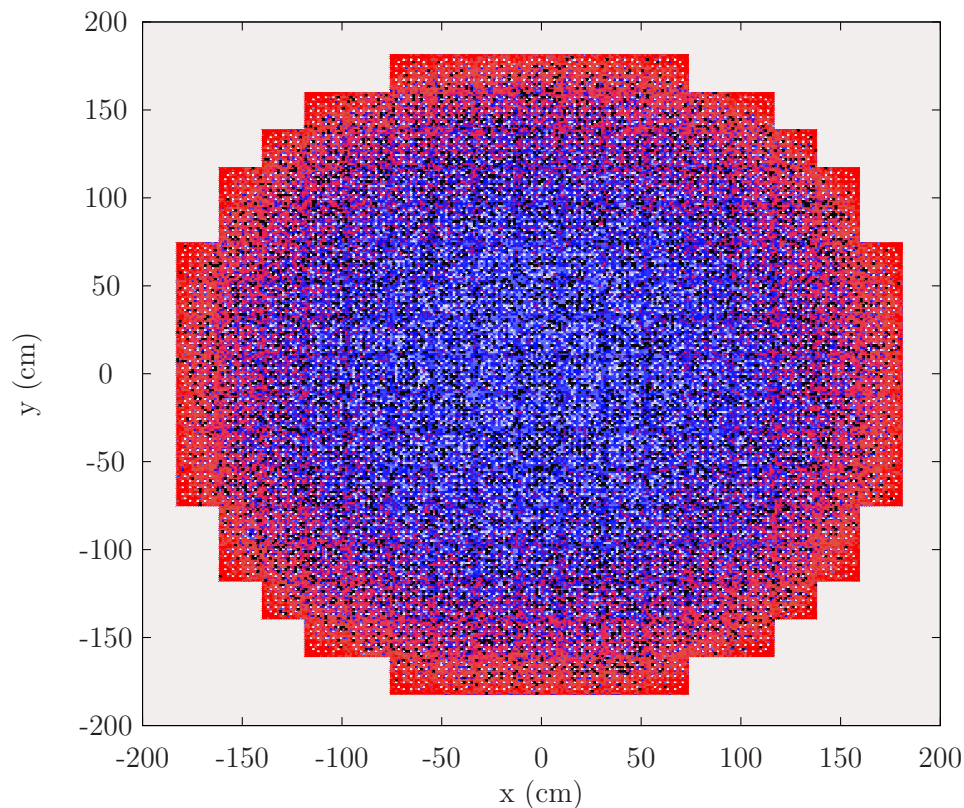and H in H$_2$O thermal scattering in each cell ?
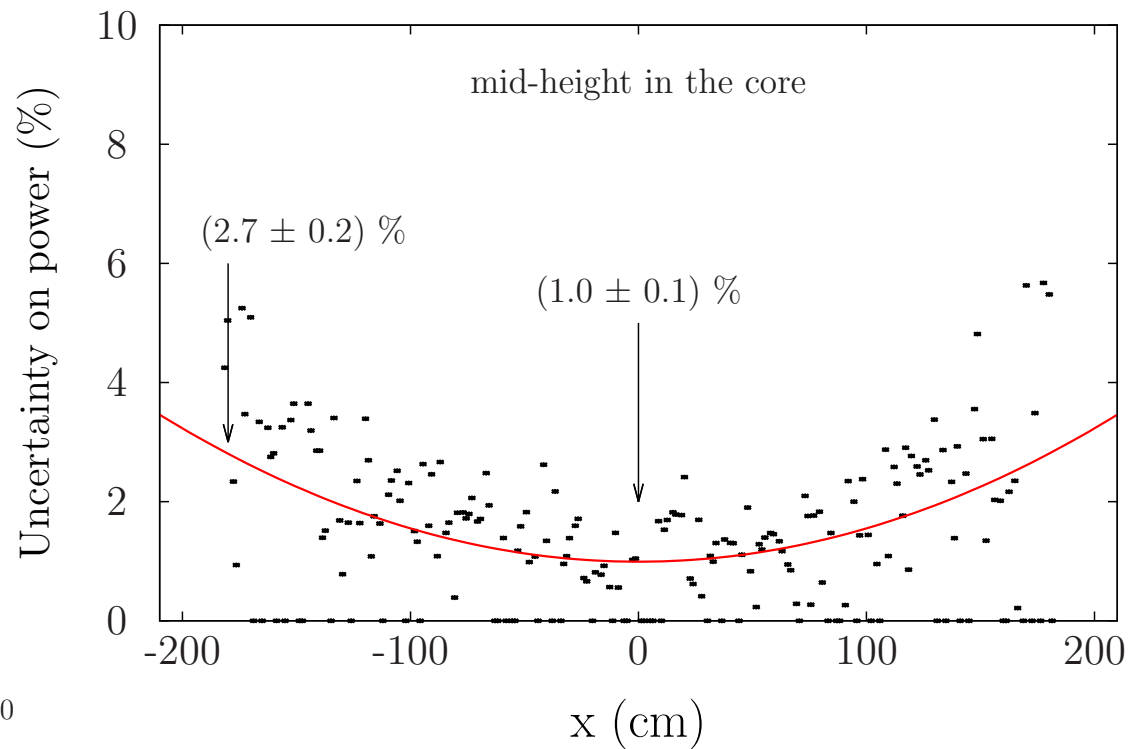
2 examples: (1) full core local power

1 normal calculation without nuclear data uncertainty takes $n = 2 \times 10^{11}$ histories ($\sigma_{\text{statistics}} = 0.25$ % at the center, 500 weeks on 1 cpu)

$\implies$ TMC: 500 random runs of $n = 2 \times 10^{11}$ histories (500 weeks for each)

$\implies$ fast TMC: 500 random runs of $n/500 = 4 \times 10^8$ histories (1 week for each)

Nuclear data Uncertainties (%)

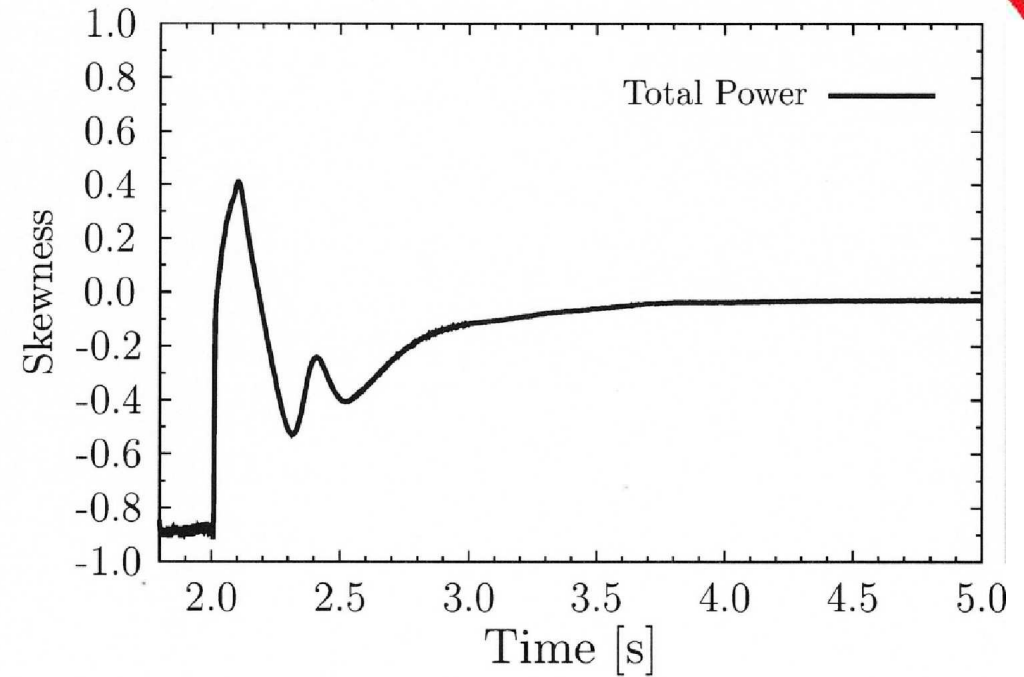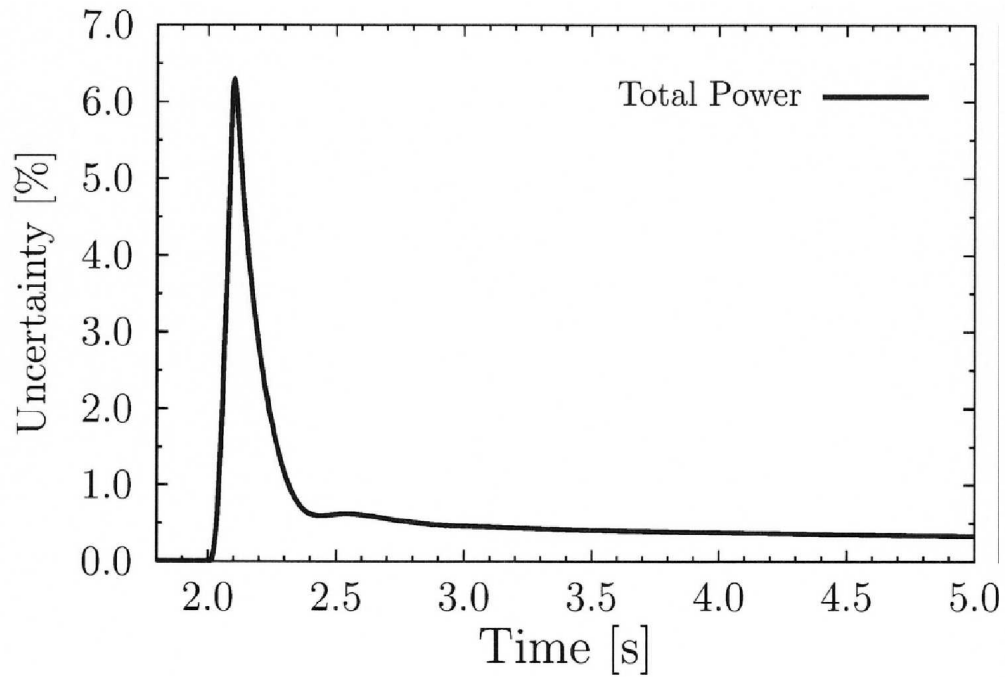Uncertainties due to ^{235}U, ^{238}U, ^{239}Pu and H in H_2O

Control Rod Ejection at HFP - Westinghouse 3-Loop

Single Rod Ejection - Rod A:7/ PANTHER+TMC

Time (sec.)
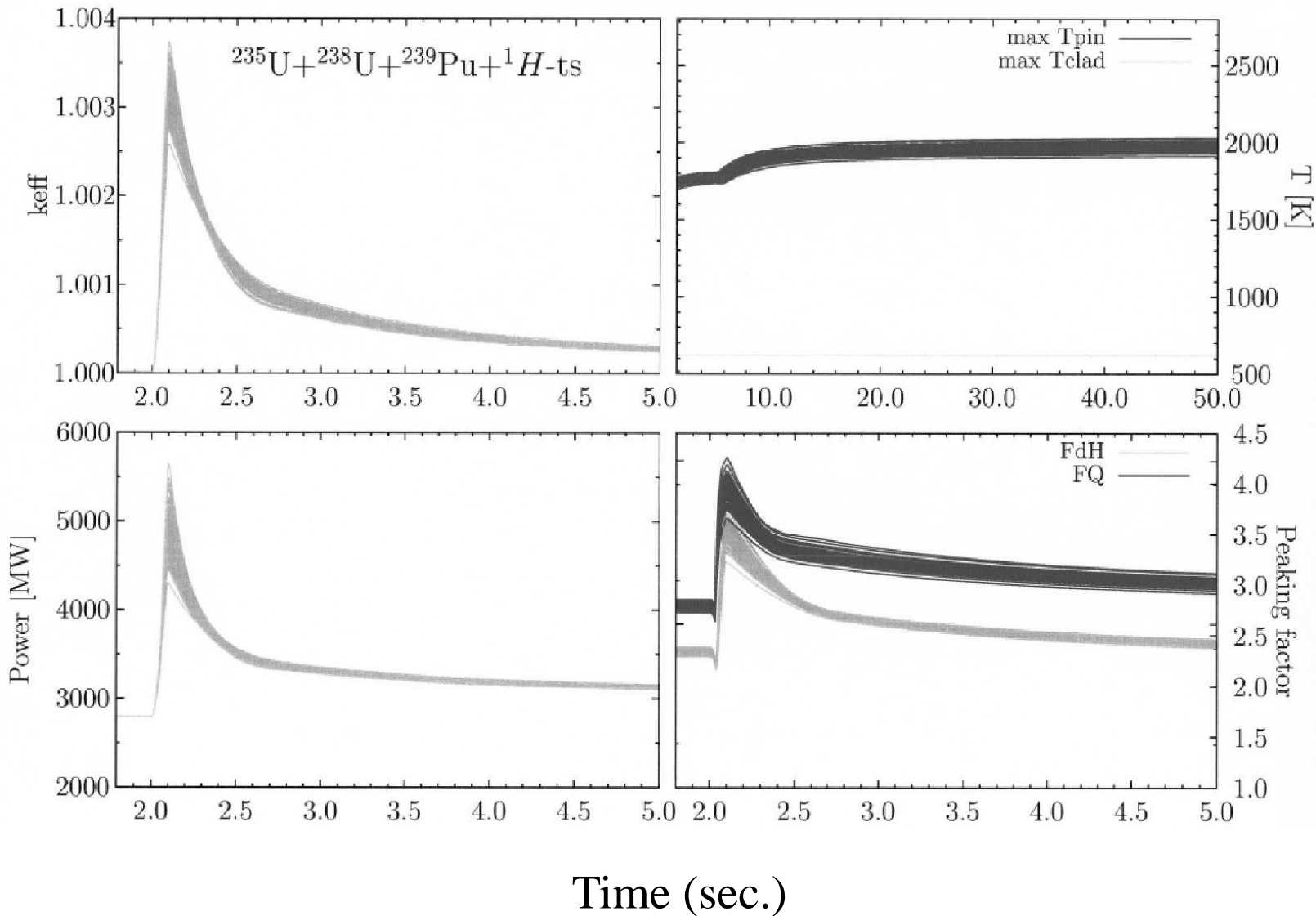
2 examples: (2) uncertainties on "control rod ejection" for a Westinghouse 3-loop

What can we do together ?

- what: calculate uncertainties & reducing uncertainties,
- system: assemblies, fuel storage (with experimental data),
- codes: Monte Carlo or deterministic (or yours) ?,
- how: