KINETIC PARAMETERS CALCULATION AND MEASUREMENTS DURING THE OPAL COMMISSIONING

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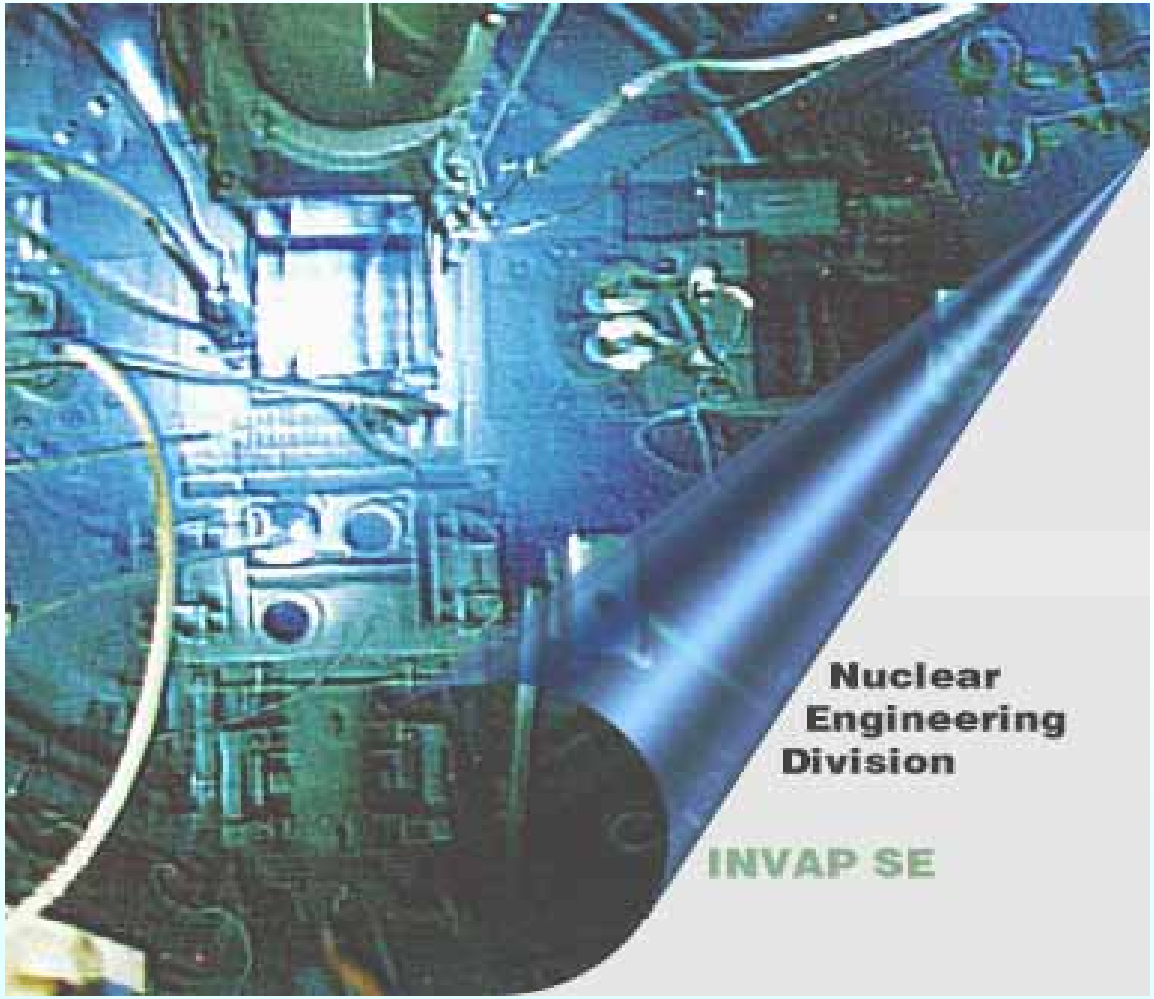

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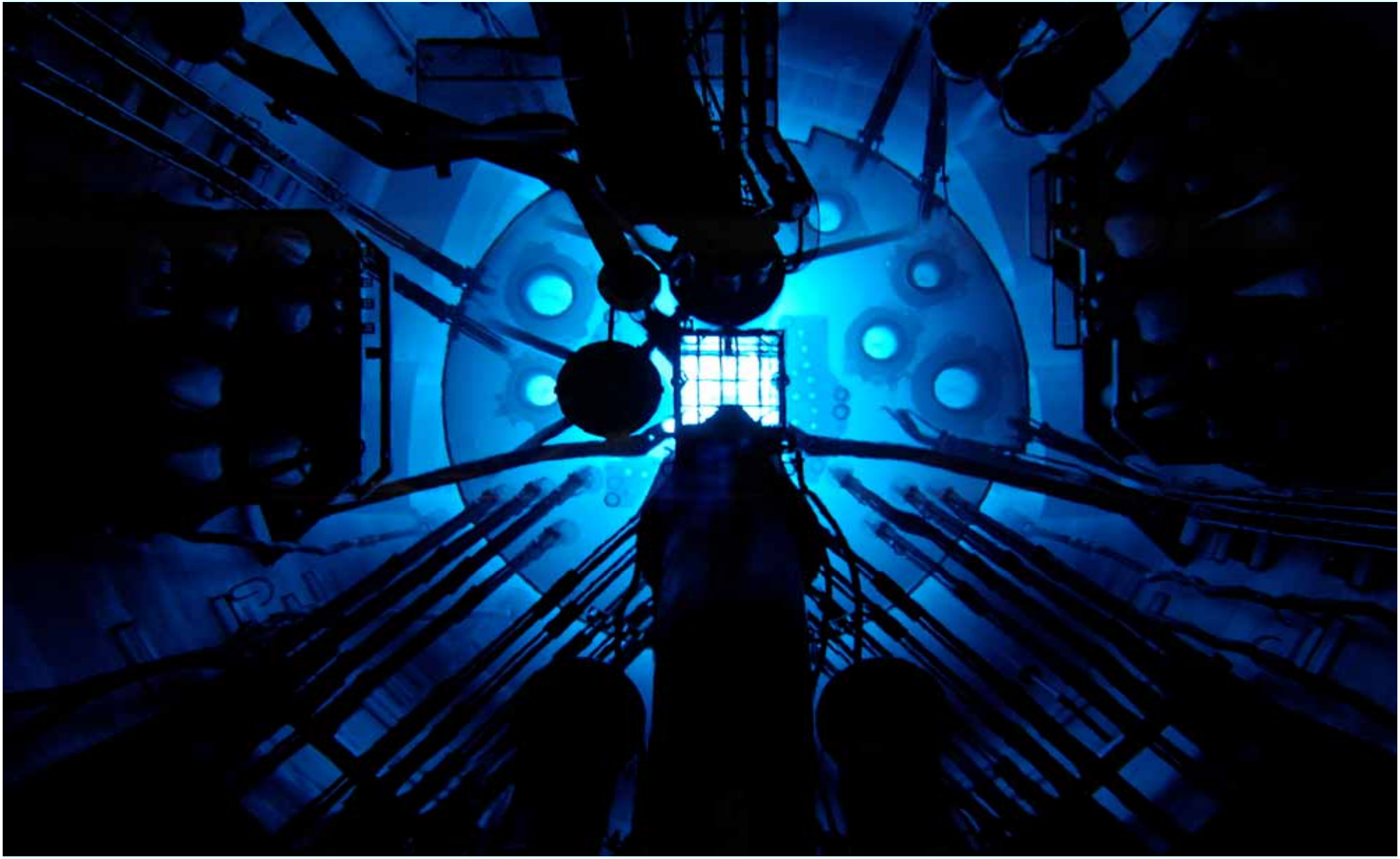
Outline

- OPAL General Description
- Kinetic Parameters Calculation
- Prompt Neutron Decay Constant Measurement
- Results
- Conclusions

OPAL General Description

- Multi-purpose open-pool type 20 MW reactor
- Core 16 Fuel Assemblies and five Absorber Plates
- Heavy Water Reflector Tank
- Radioisotope Production: Bulk Irradiation Rigs, Pneumatic Facilities, NAA, DNAA and NTD Facilities
- Neutron Beam Facilities: Cold Neutron Source, Thermal Neutron Source, Beams and Neutron Guides

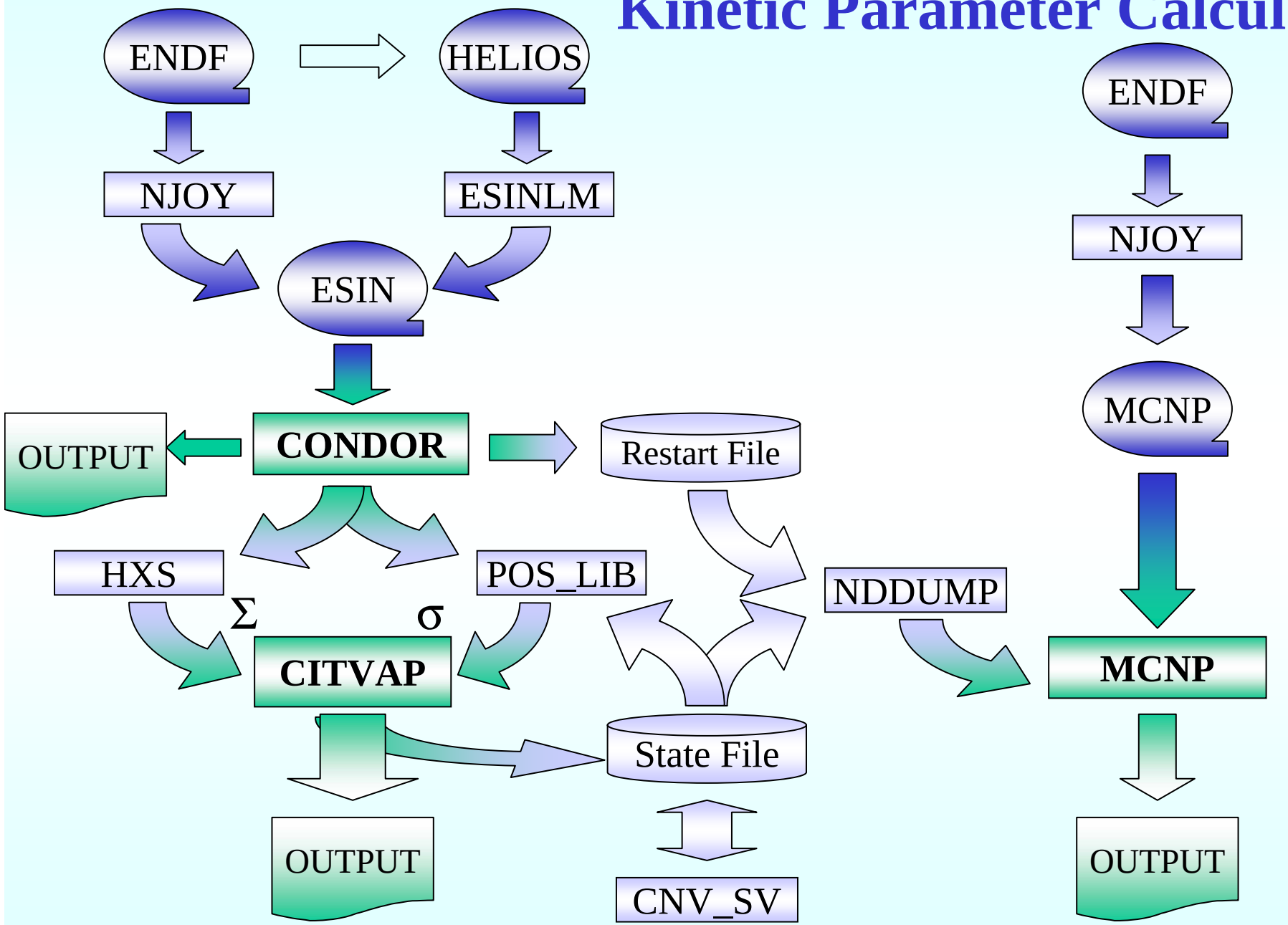


Kinetic Parameters

- Effective delayed neutron fraction (β_{eff})
- Neutron lifetime (Λ)
- Prompt neutron decay constant (α)

"α is used in the Safety Analysis Report"

Kinetic Parameter Calculation



β_{eff} MCNP Calculation

$$\beta_{eff} = \frac{\upsilon_d N_d}{\upsilon_t N_t} \qquad N_d = \frac{\nu_t FR_d}{\nu_d} \qquad N_t = \frac{\nu_t FR_t}{\nu_t}$$

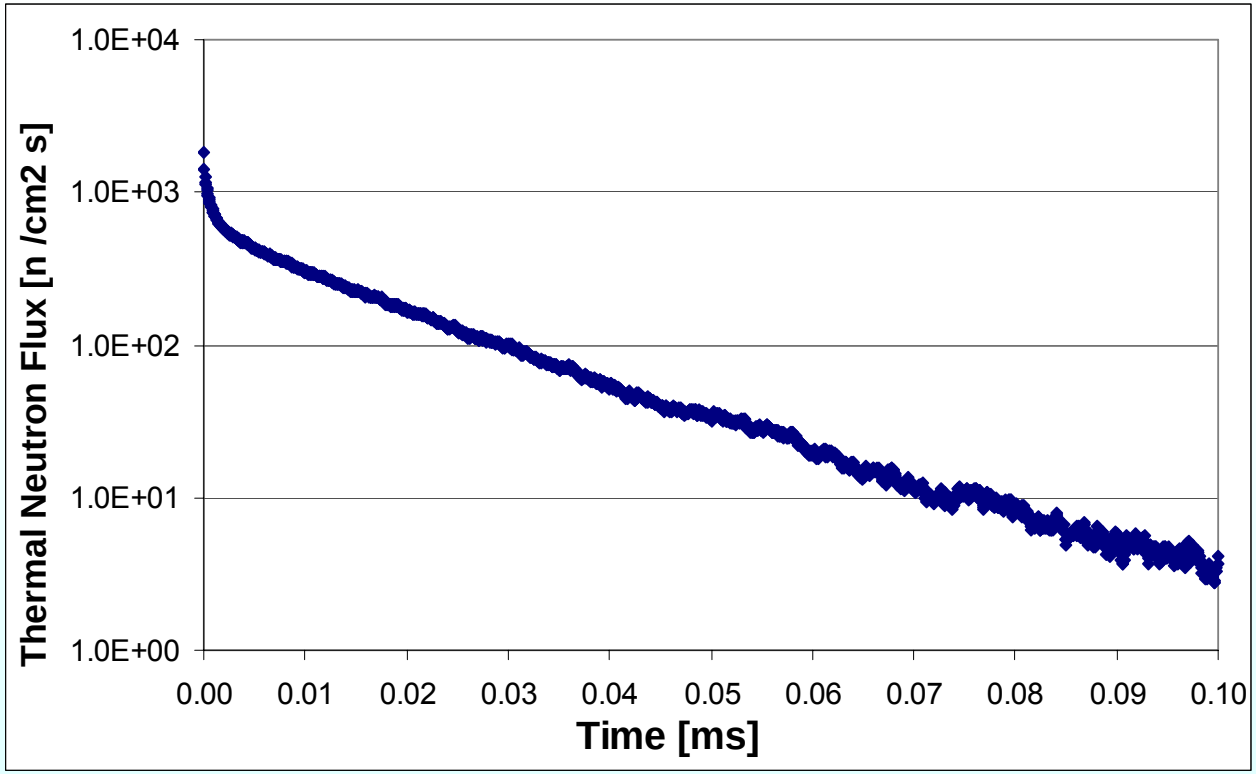
$$\beta_{eff} = \frac{FR_d}{FR_t}$$

Two Standard MCNP runs

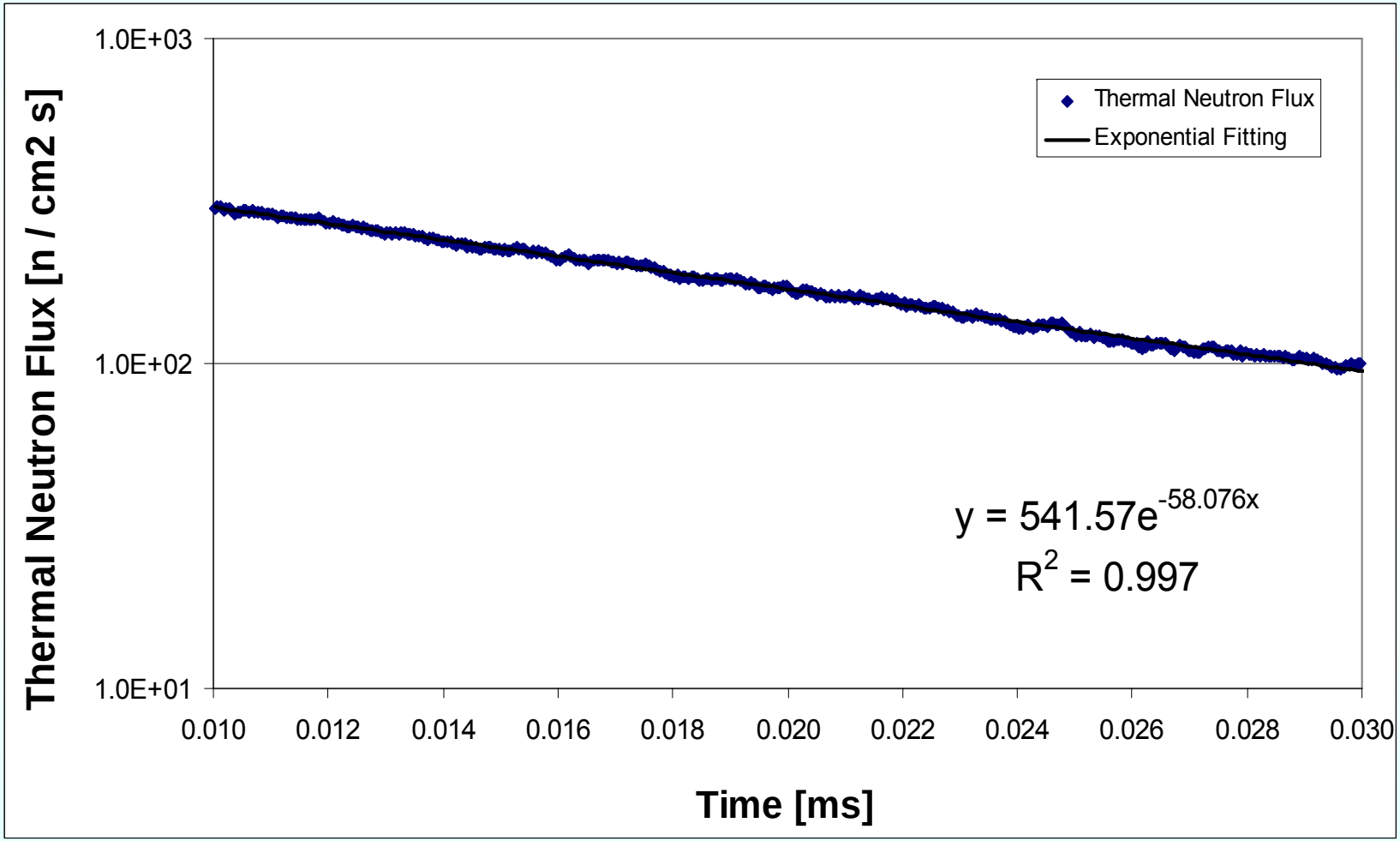
- Run with only prompt neutrons
- Run with total neutrons (prompt + delayed)

Λ MCNP Calculation

- Simulation of the Rossi-α experiment
- SDEF calculation in a subcritical core Configuration
- Neutron population in the core as function of time



- Exponential Fitting



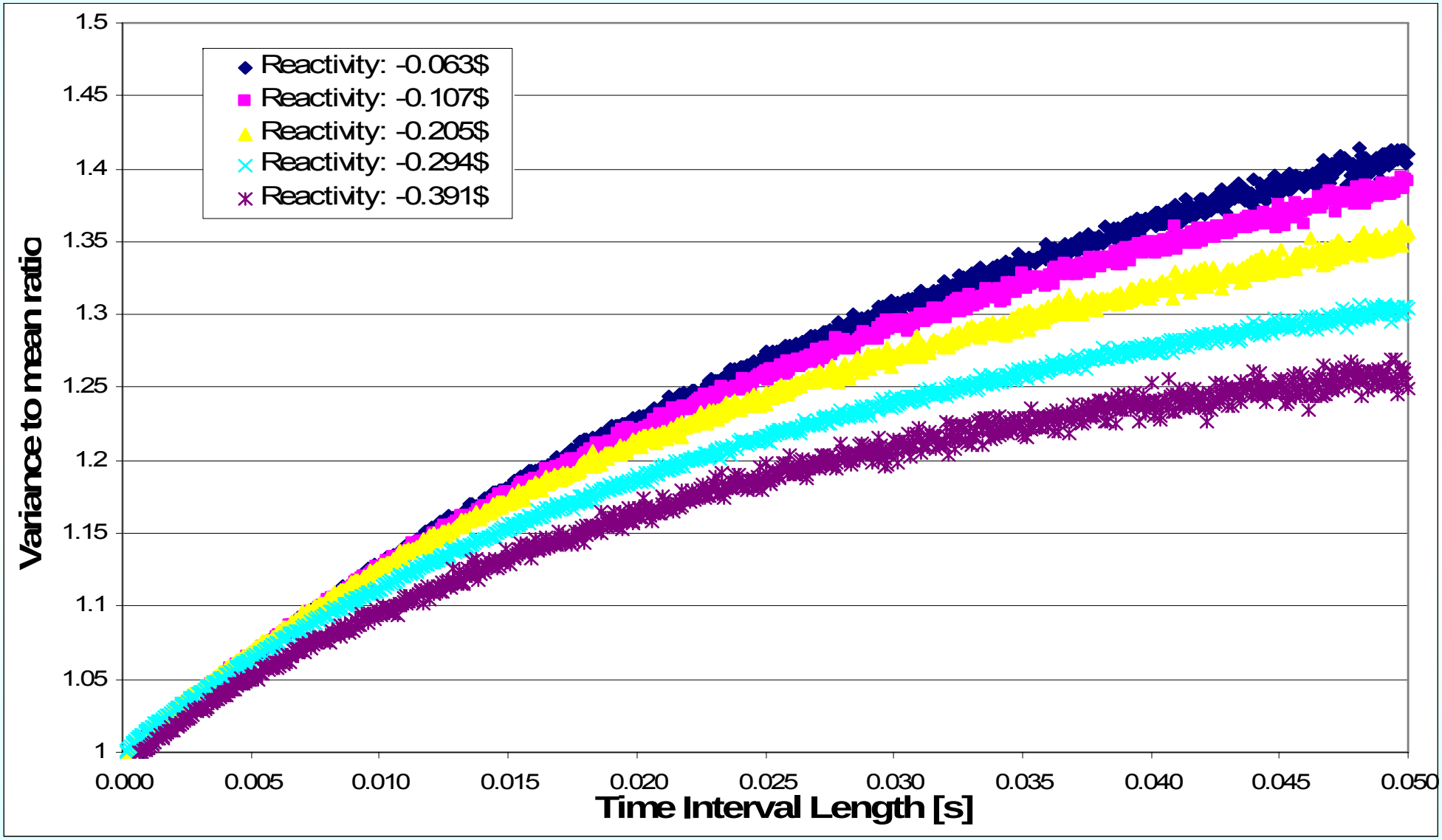
Measurement of α

Ratio of the Variance to the Mean number of Counts

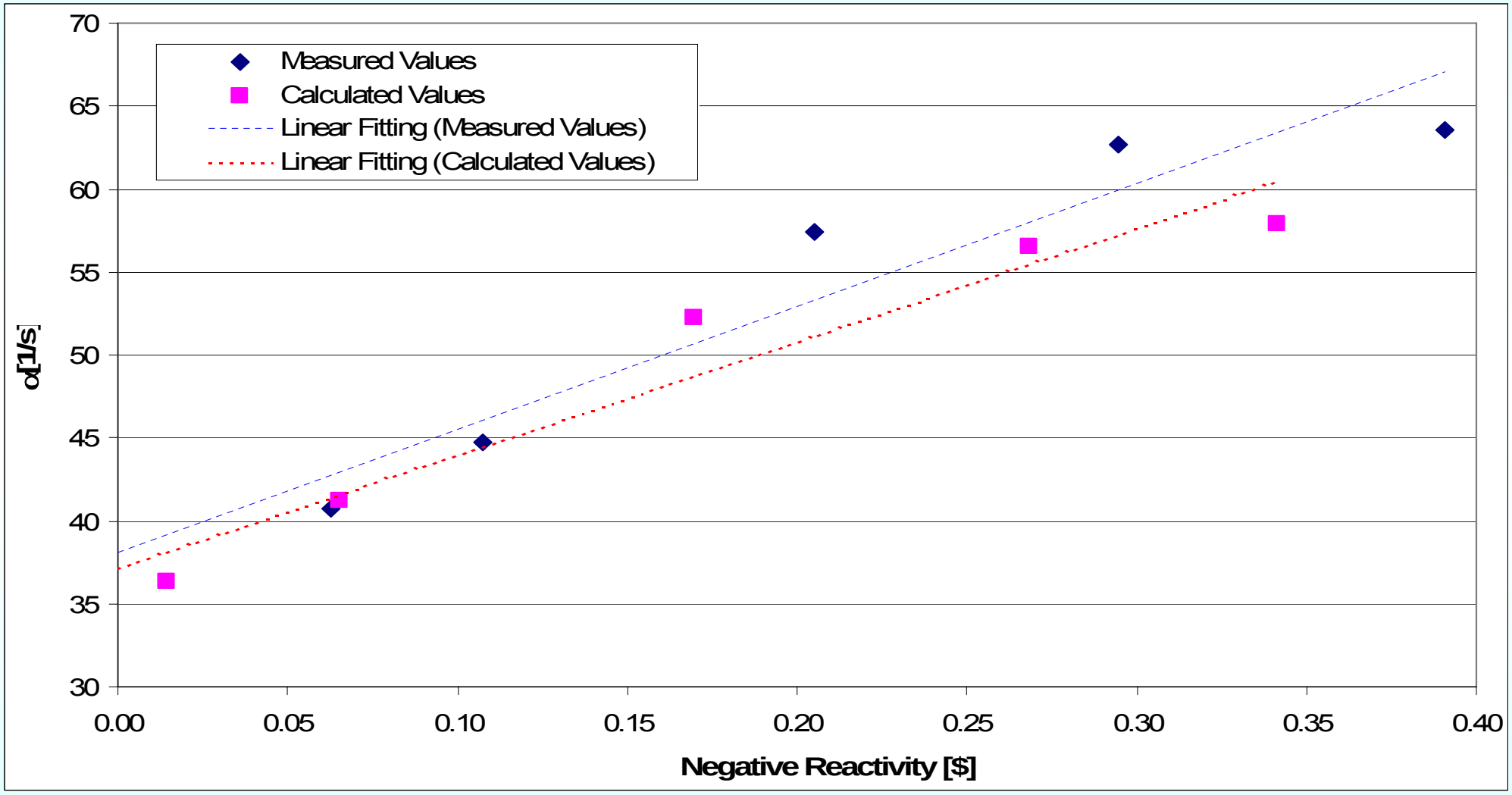
⇒ Feynman α Method

$$V(t) = \frac{N\sum_{i=1}^{N} C_i^2 - \left(\sum_{i=1}^{N} C_i\right)^2}{N\sum_{i=1}^{N} C_i} = 1 + \frac{\varepsilon\chi}{\left(\beta_{eff} - \rho\right)^2}\left[1 - \frac{(1 - e^{-\alpha t})}{\alpha t}\right]$$

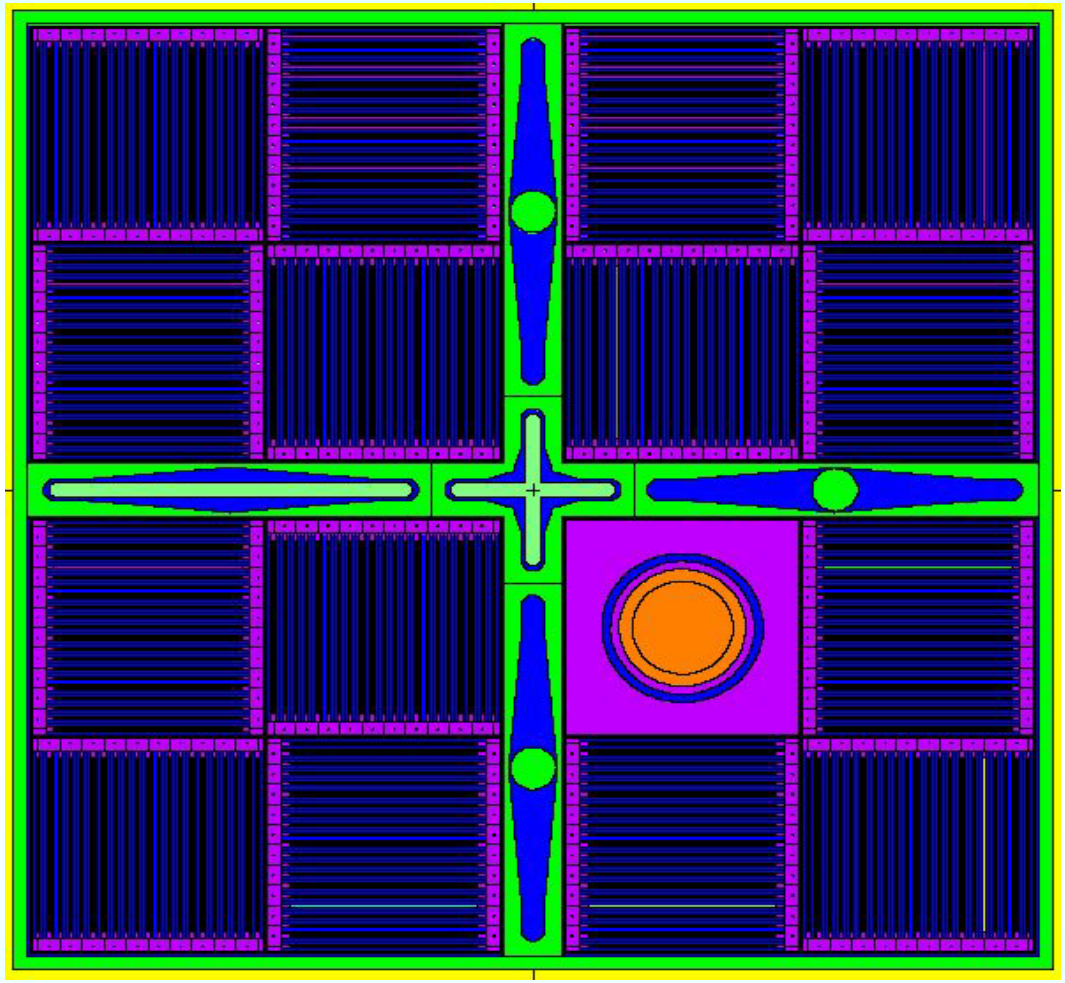
Variance to the Mean number of Counts



Measurement & Calculation Results



15 FA Core Results



- Measured Value: α =38.1 1/s
- MCNP Calculated Value : α =37.2 1/s

Comparison beetwen Calculation Lines

16 Fuel Assemblies Core

	CITVAP	MCNP
β_{eff} [pcm]	768	769.5
Λ [μs]	171	171.6
α [1/s]	44.9	44.8

Conclusions

- Standard MCNP code was used to obtain the kinetic parameters β_{eff} and Λ.

- Good agreement between the MCNP calculated values and the values obtained by the traditional calculation line for this parameters (CITVAP code).

- Good agreement between the measured α value and the MCNP calculated value following the Rossi-α experiment. (Measurement done with plant instrumentation).

ACKNOWLEDGMENTS

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