

DE LA RECHERCHE À L'INDUSTRIE



A thin horizontal bar consisting of three segments of increasing greenness from left to right.

CADARACHE



NCBJ
ŚWIERK

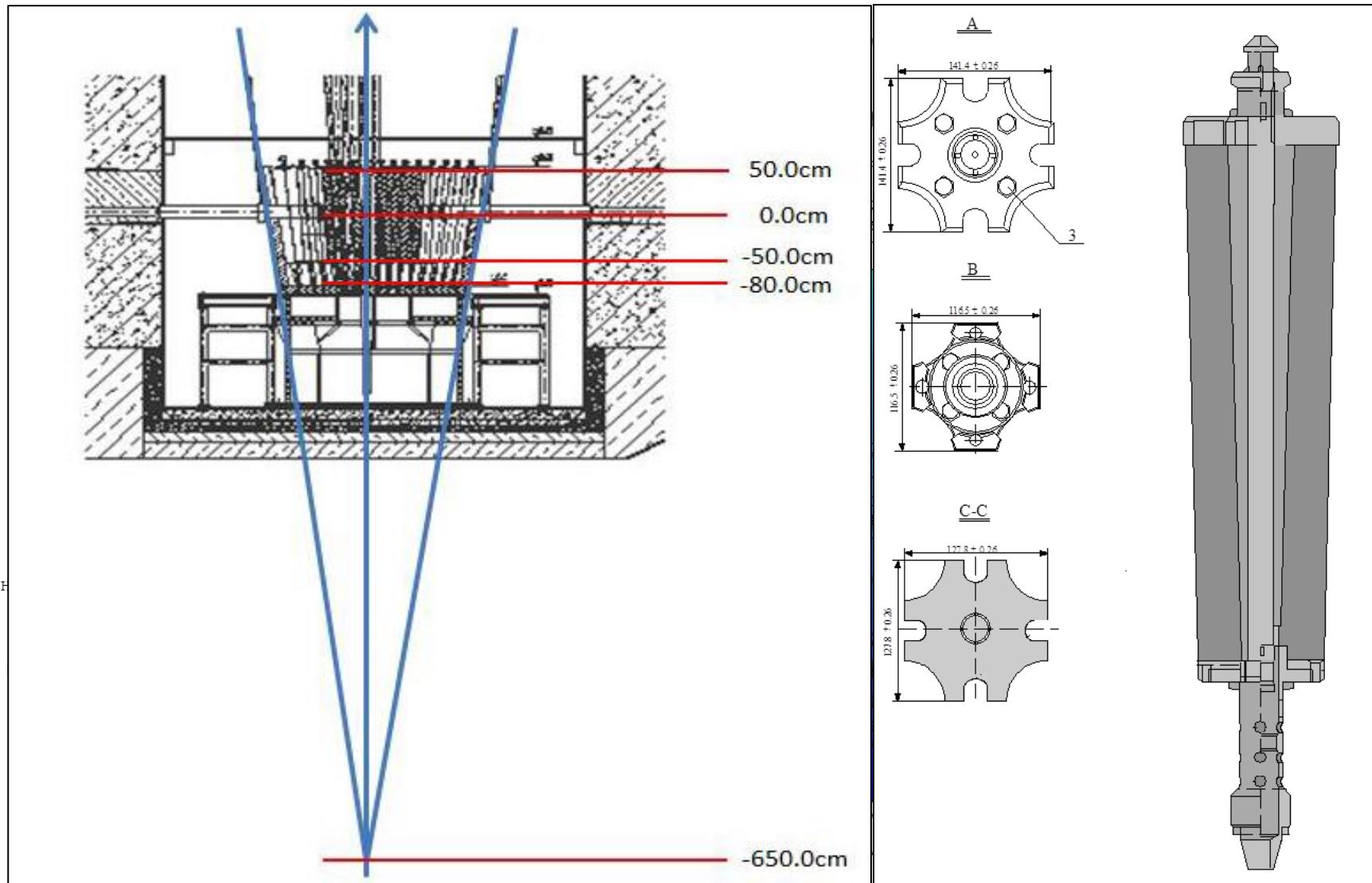
QUALIFICATION OF BERYLLIUM POISONING MODELS FOR MARIA AND JULES HOROWITZ RESEARCH REACTORS

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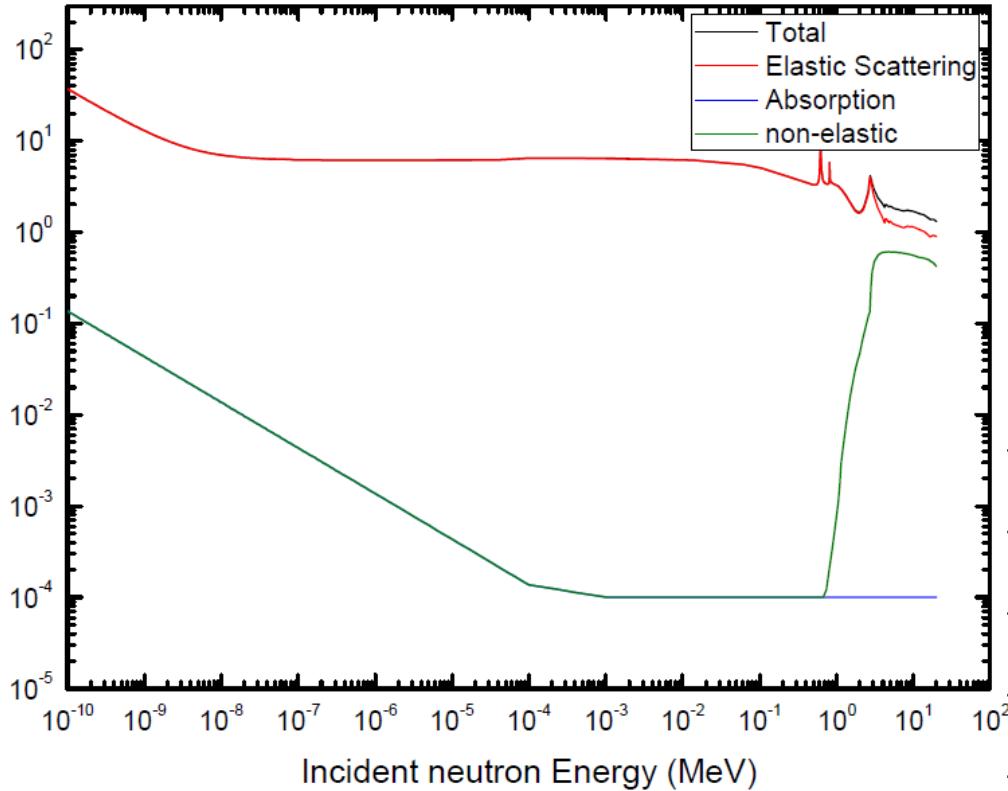


MARIA REACTOR



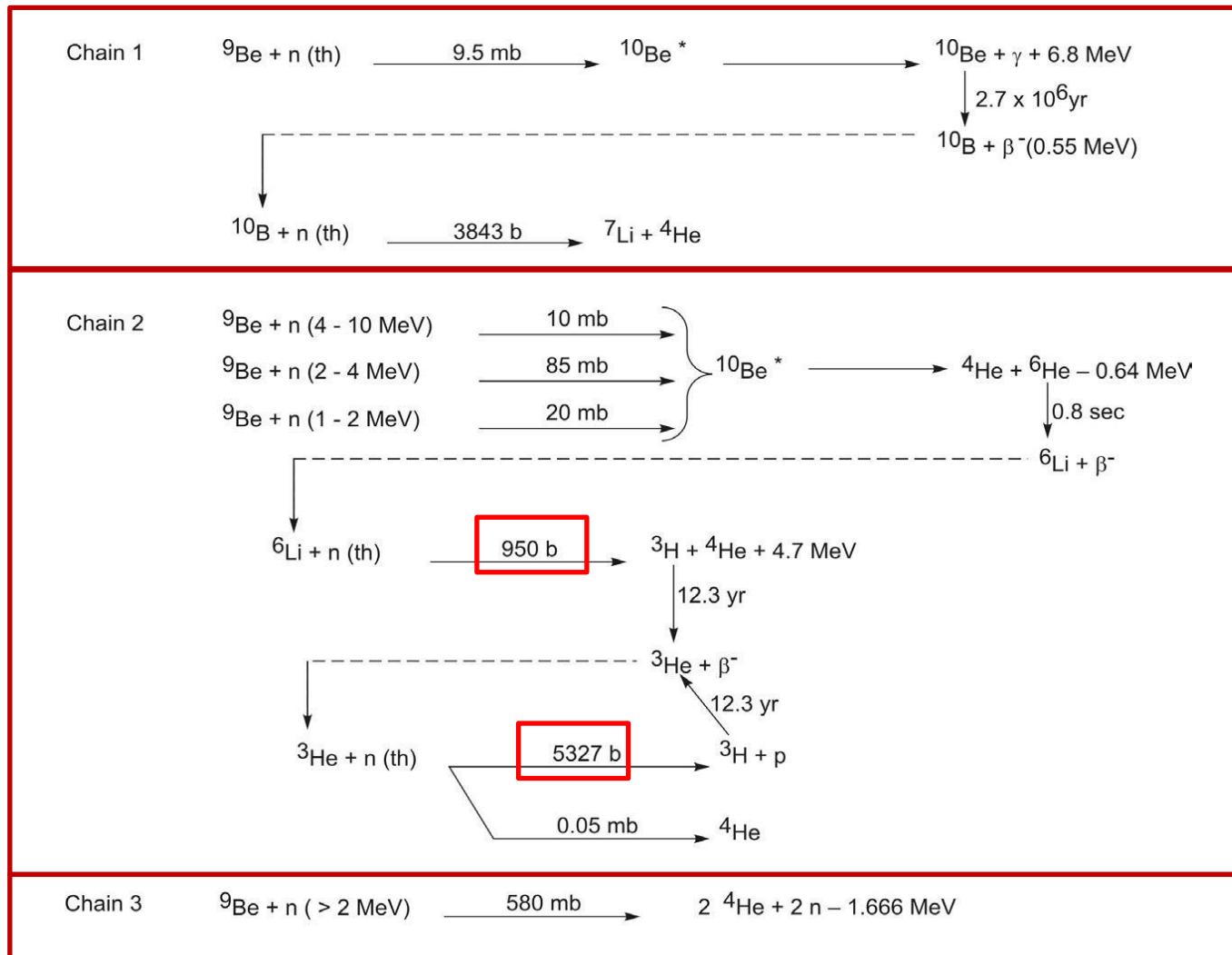
BERYLLIUM

Cross section (b)



Atomic weight	9.012
Density	1.85 [g·cm ⁻³]
σ_a	0.0011cm ⁻¹
diffusion coef.	0.54 cm
moderationg ratio	145
melting point	1287°C
Coefficient of linear expansion	$11.4 \cdot 10^{-6}$ cm/cm/°C

BERYLLIUM



DETERMINISTIC CODES

Apollo2 (CEA France)

- MOC method; SHEM 281-group energy mesh

MONTE CARLO

TRIPOLI4.10® (CEA France)

Serpent 2.1.26 (VVT Finland)

Library: JEFF3.1.1

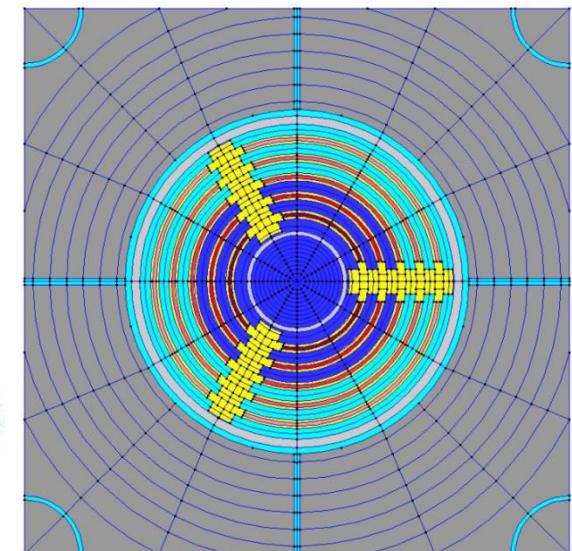
CALCULATIONS



- Graphite reflector**
- Beryllium block**
- Water**
- Hydraulic rabbit system**
- Graphite plug**
- Beryllium plugs**
- Fuel channel**
- Isotopic channels**
- Control and safety rods**

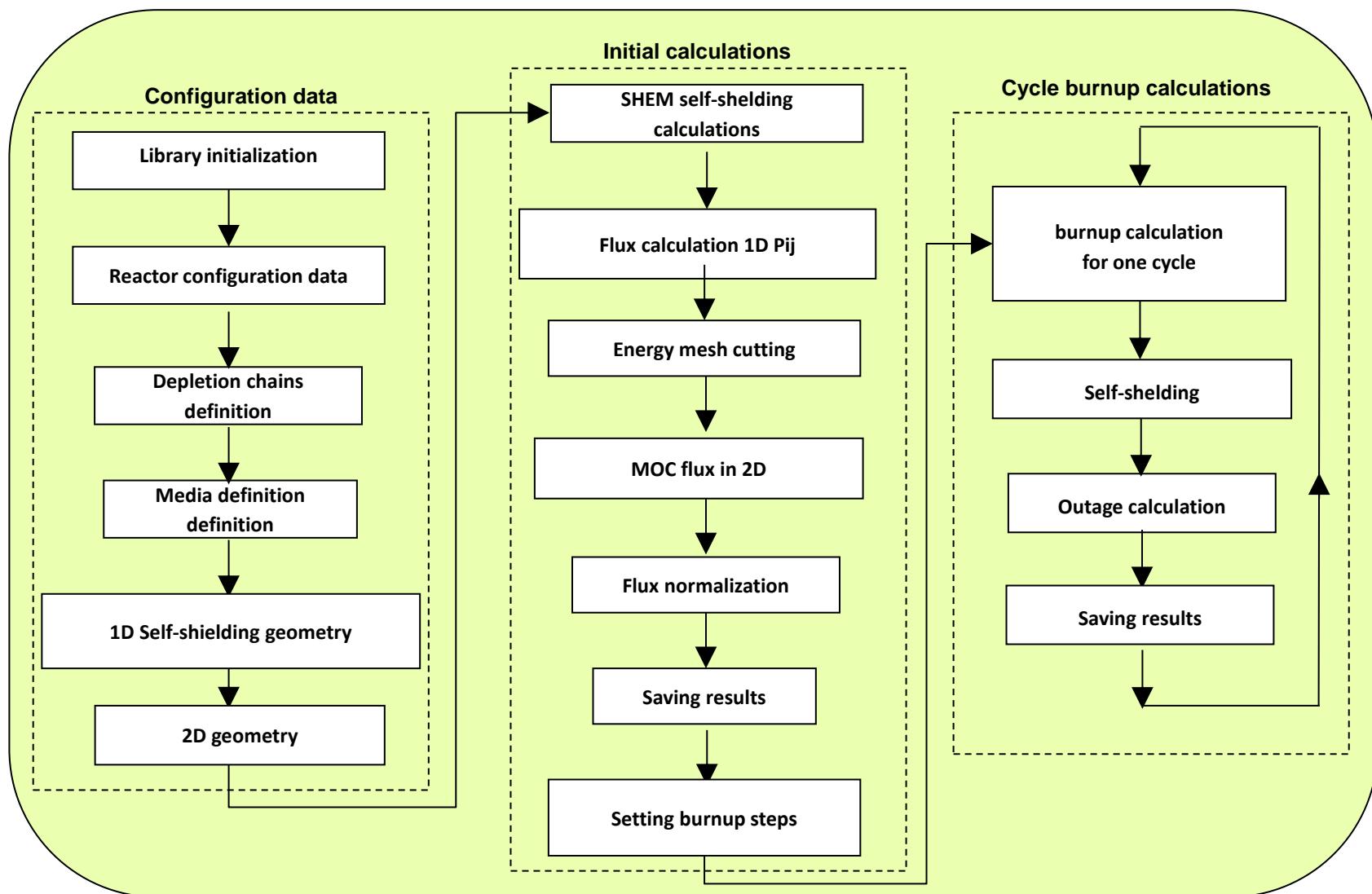
GEOMETRY

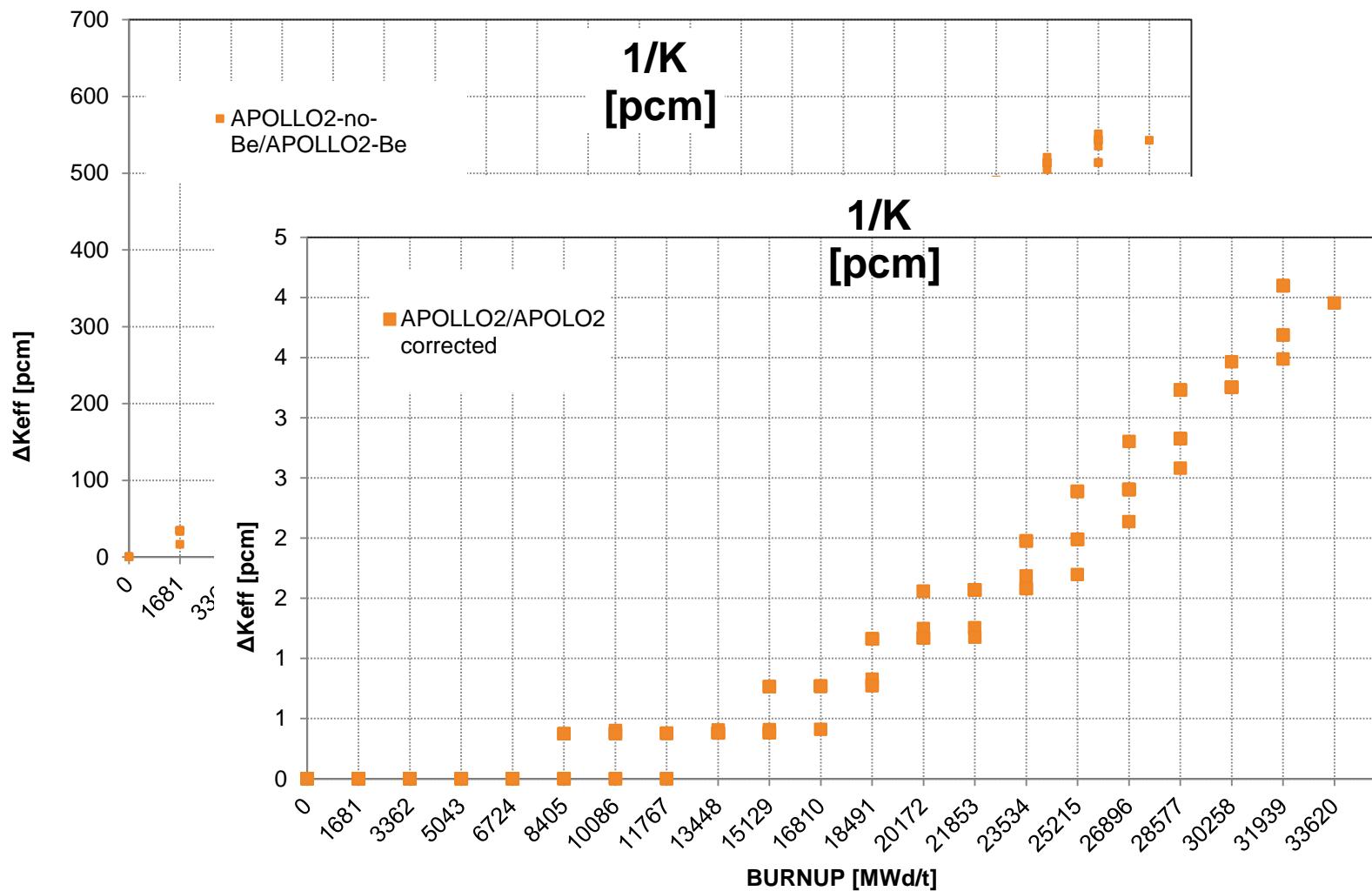
Apollo2, TRIPOLI4.10
SERPENT2



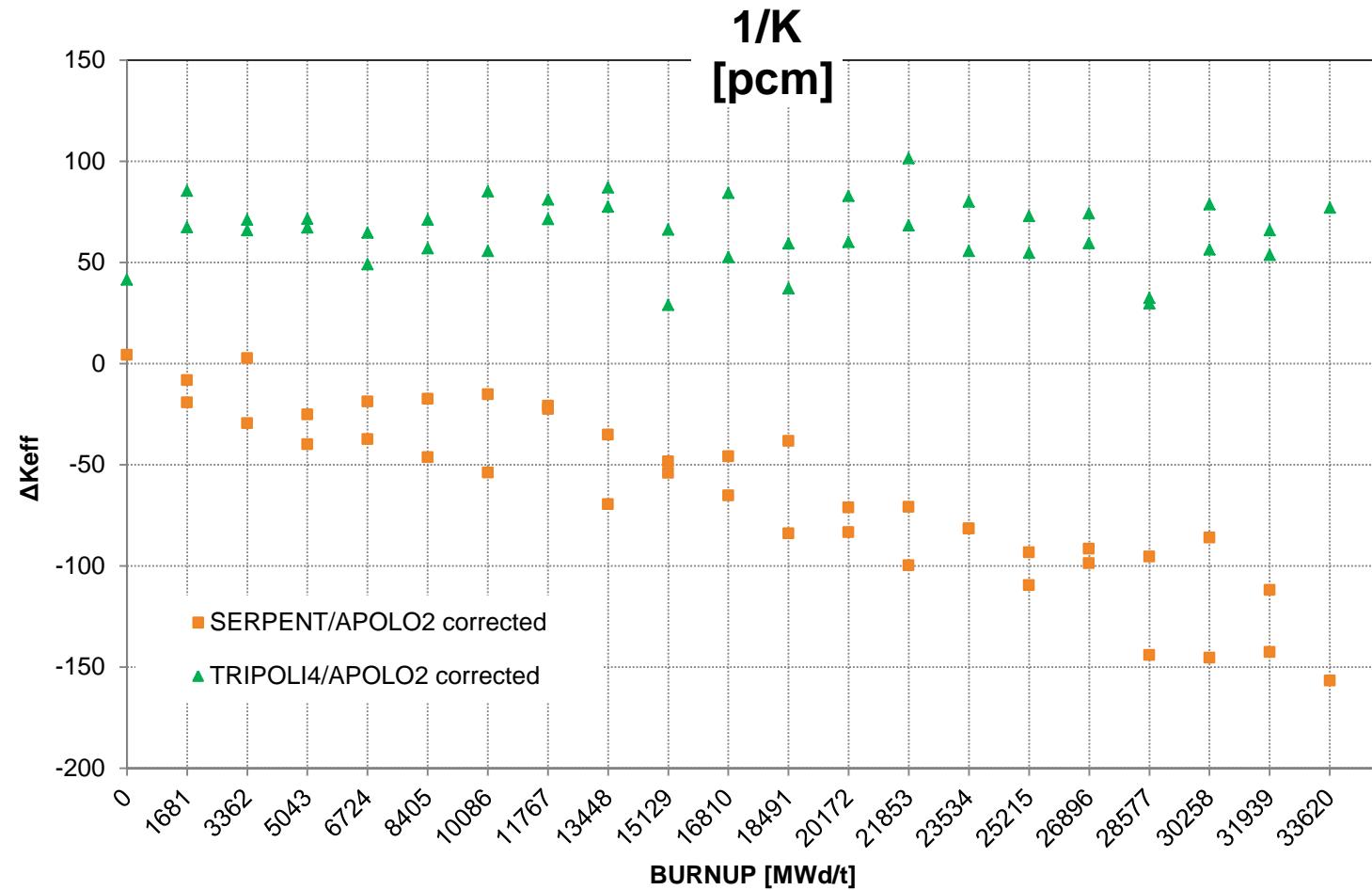
Based on REBUS model Z. Marcinkowska

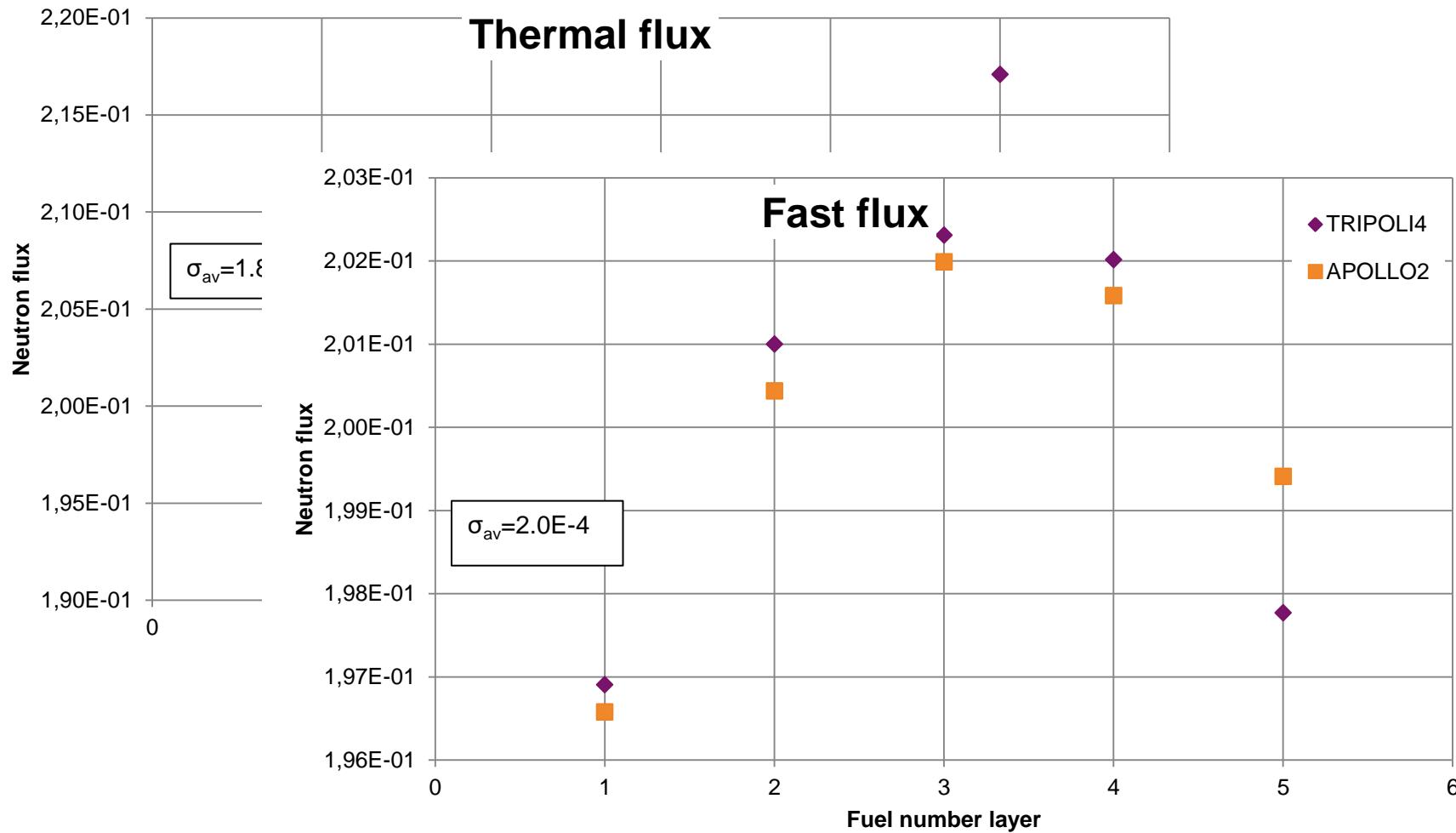
CALCULATIONS



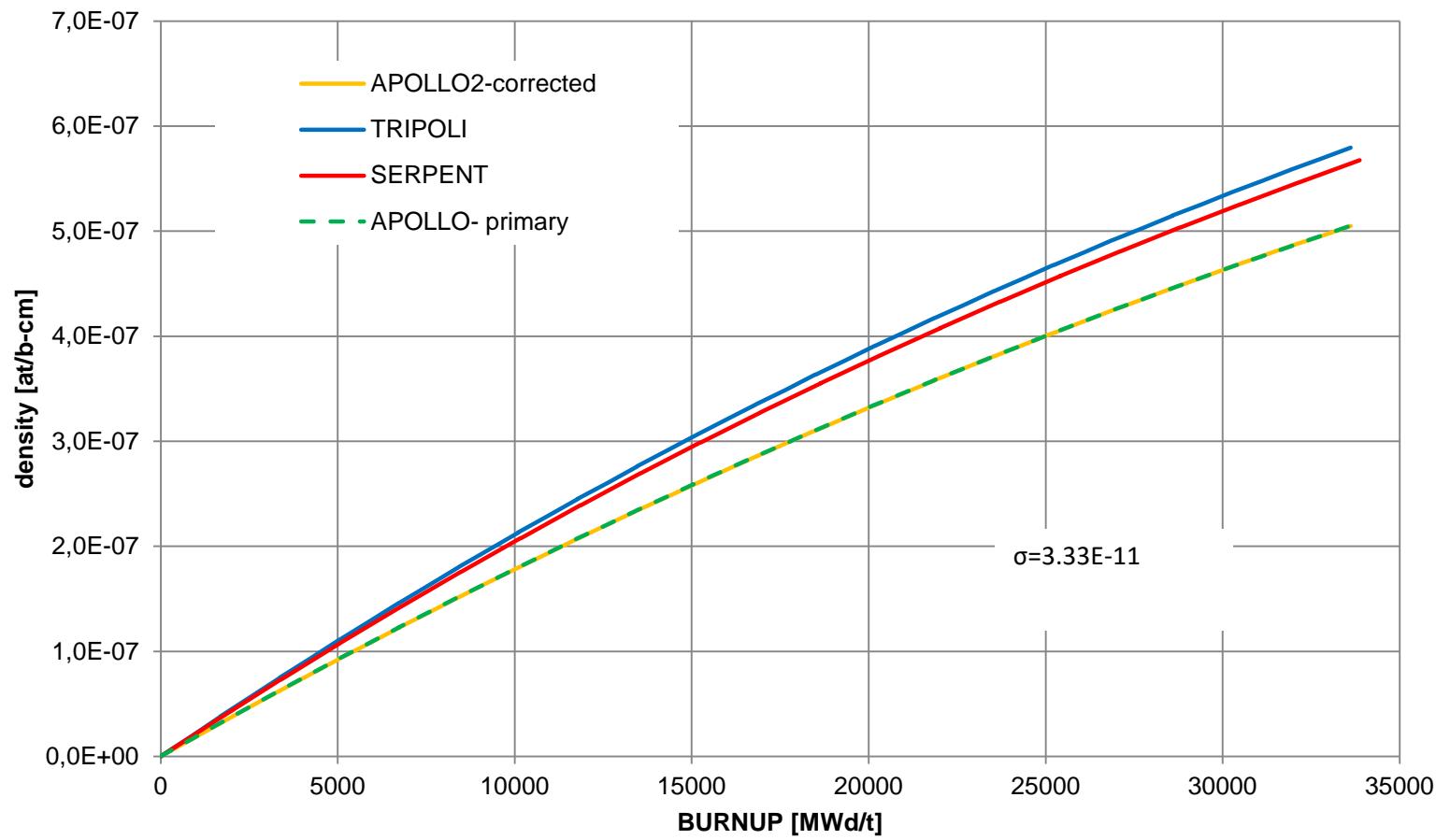


APOLLO2 – TRIPOLI4.10®

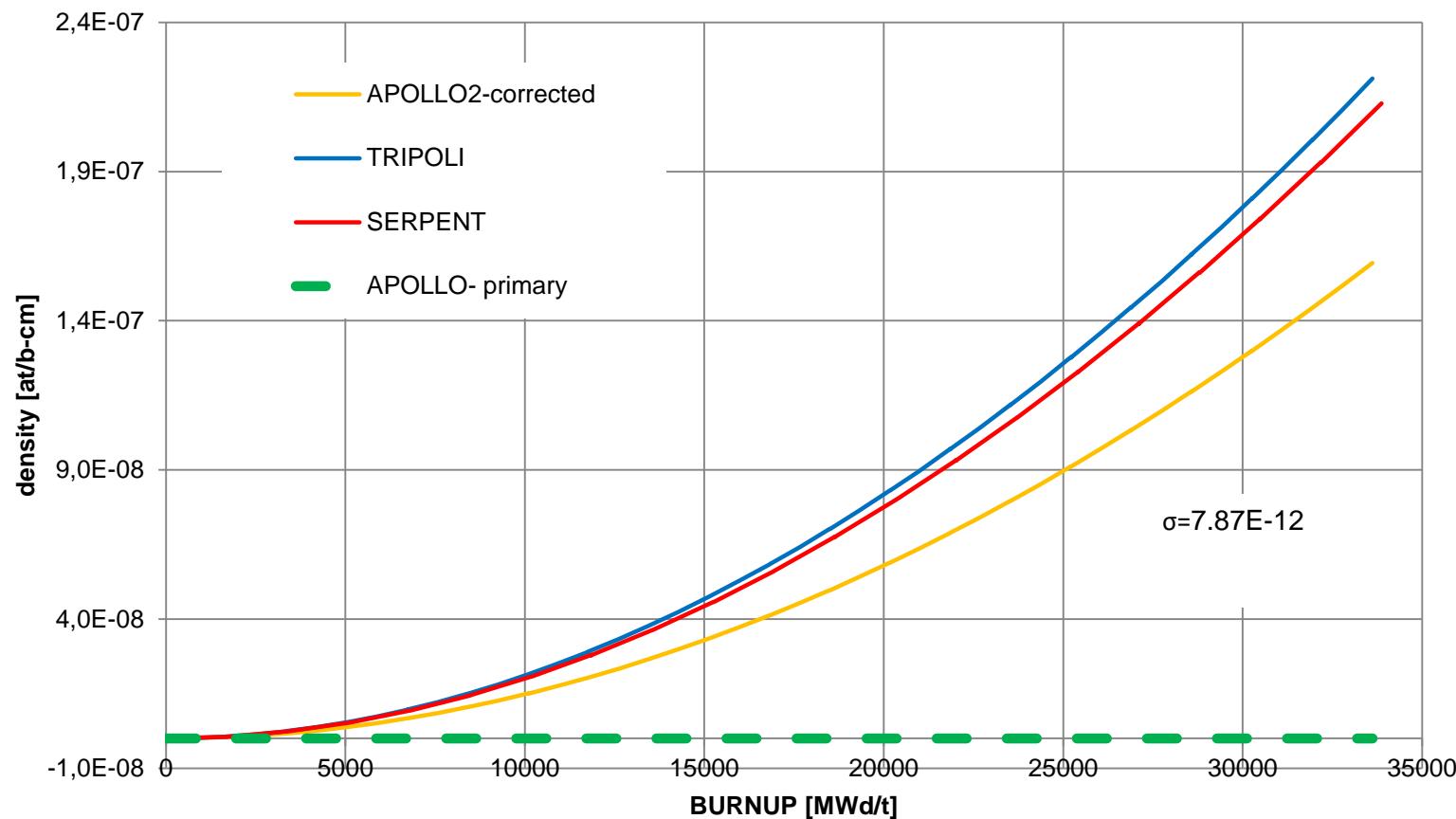




Li6

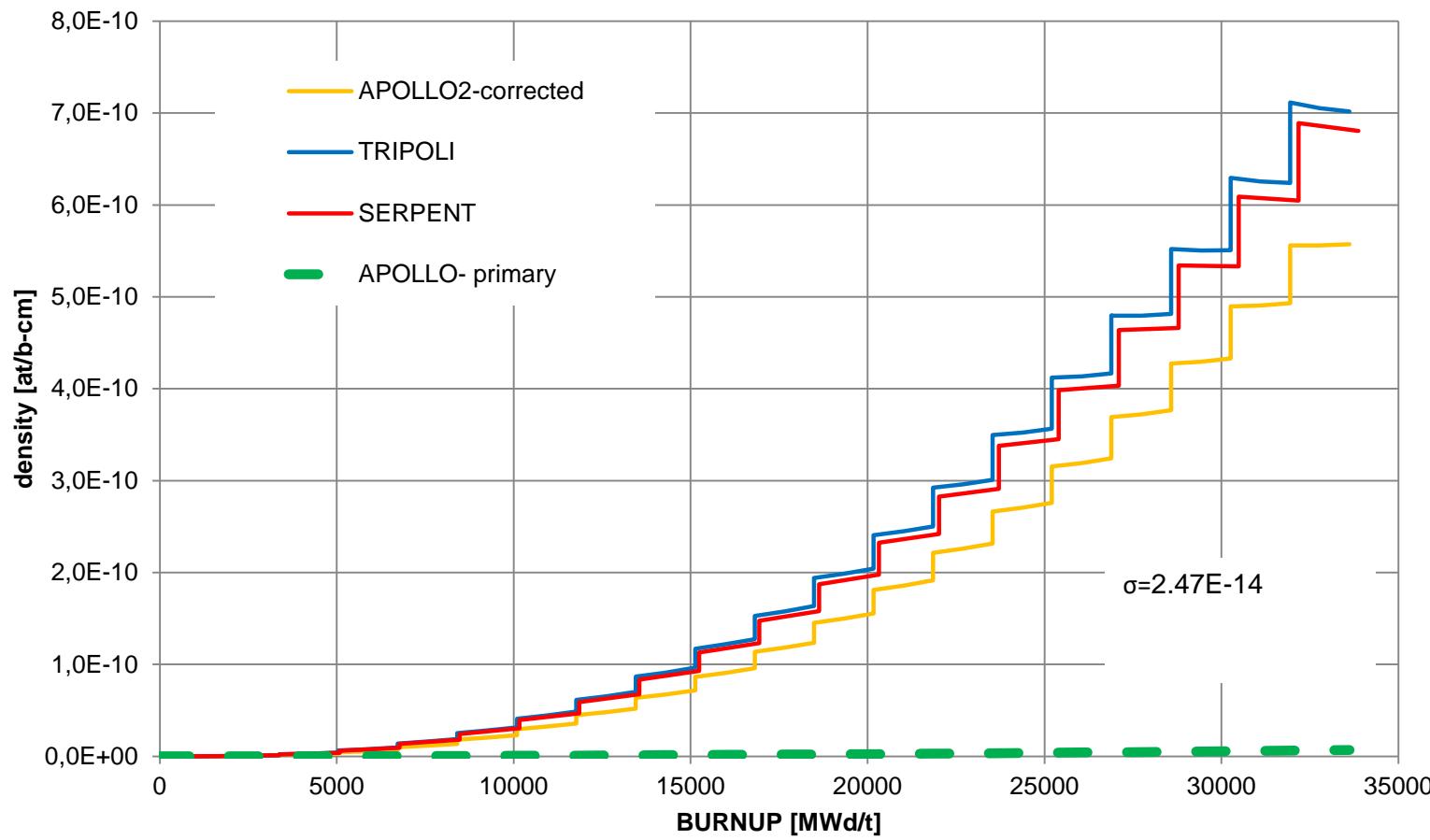


H3

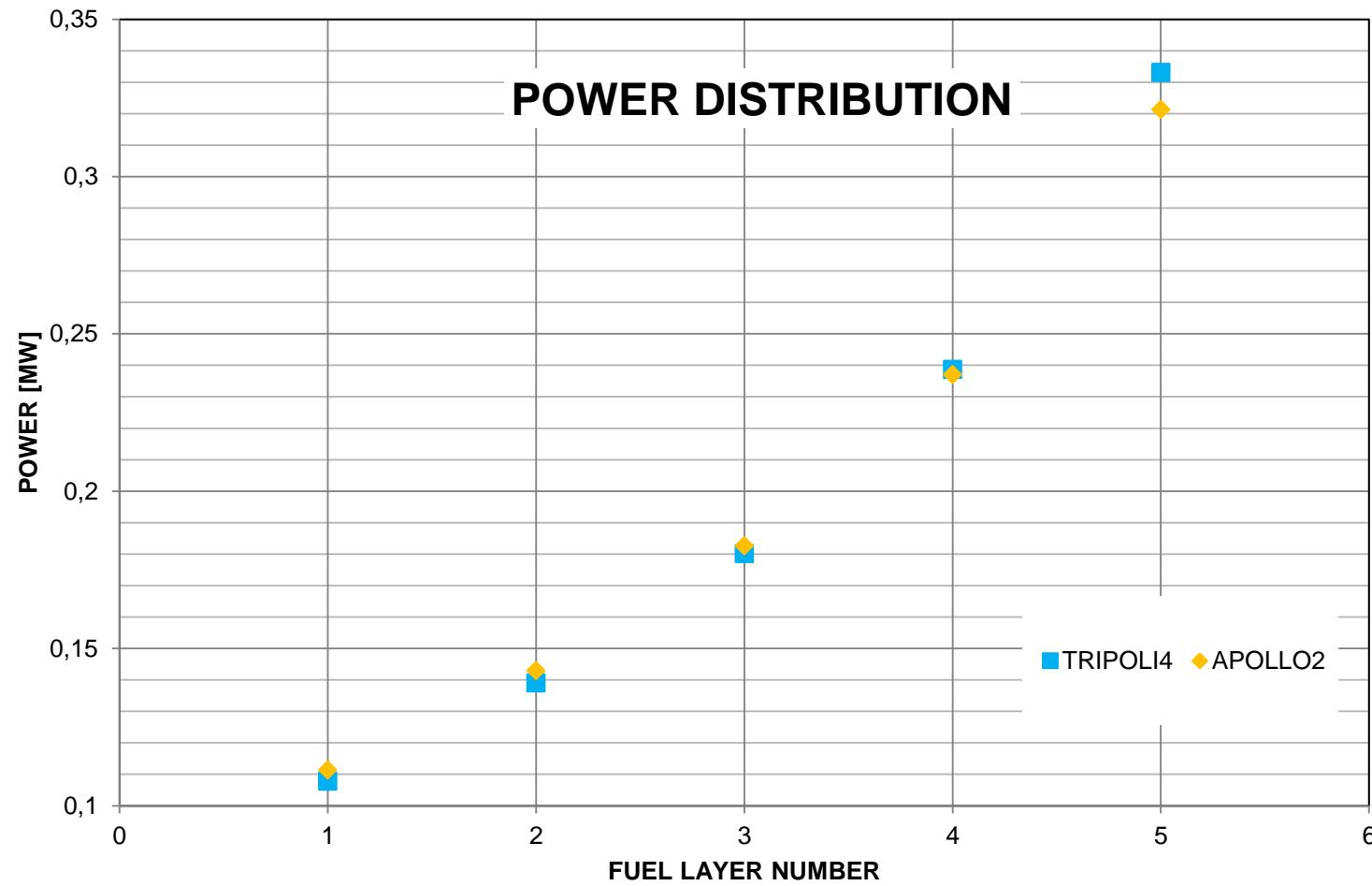


APOLLO2 – TRIPOLI4.10®

He3



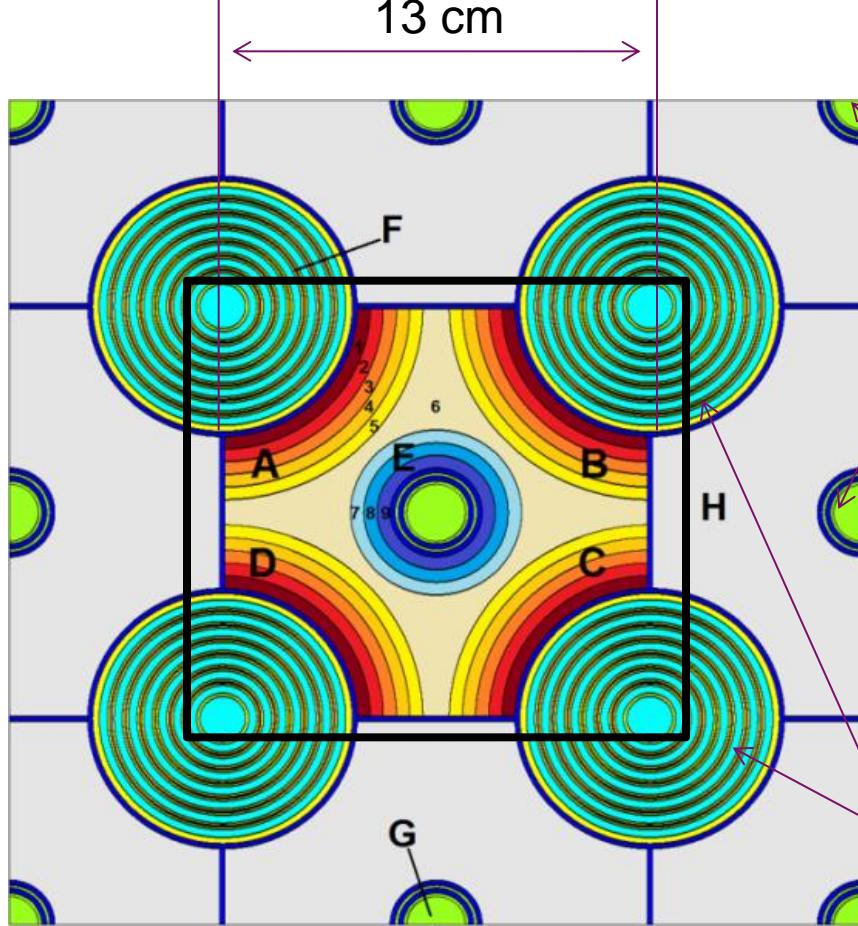
CALCULATIONS



EXPERIMENT

Middle of the core height

13 cm

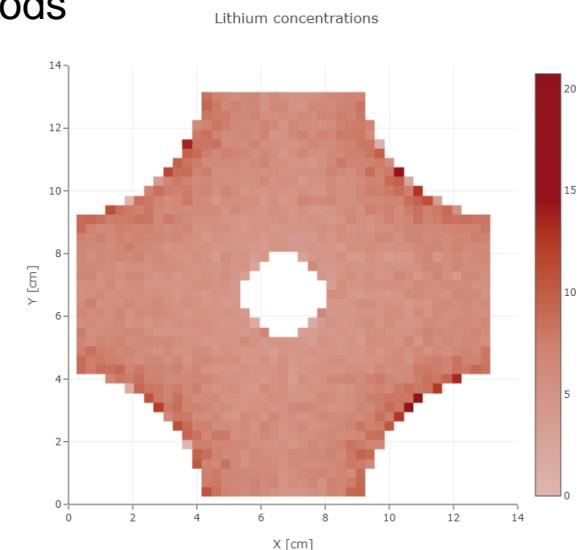


Control rods



FUEL ELEMENTS

Lithium distribution

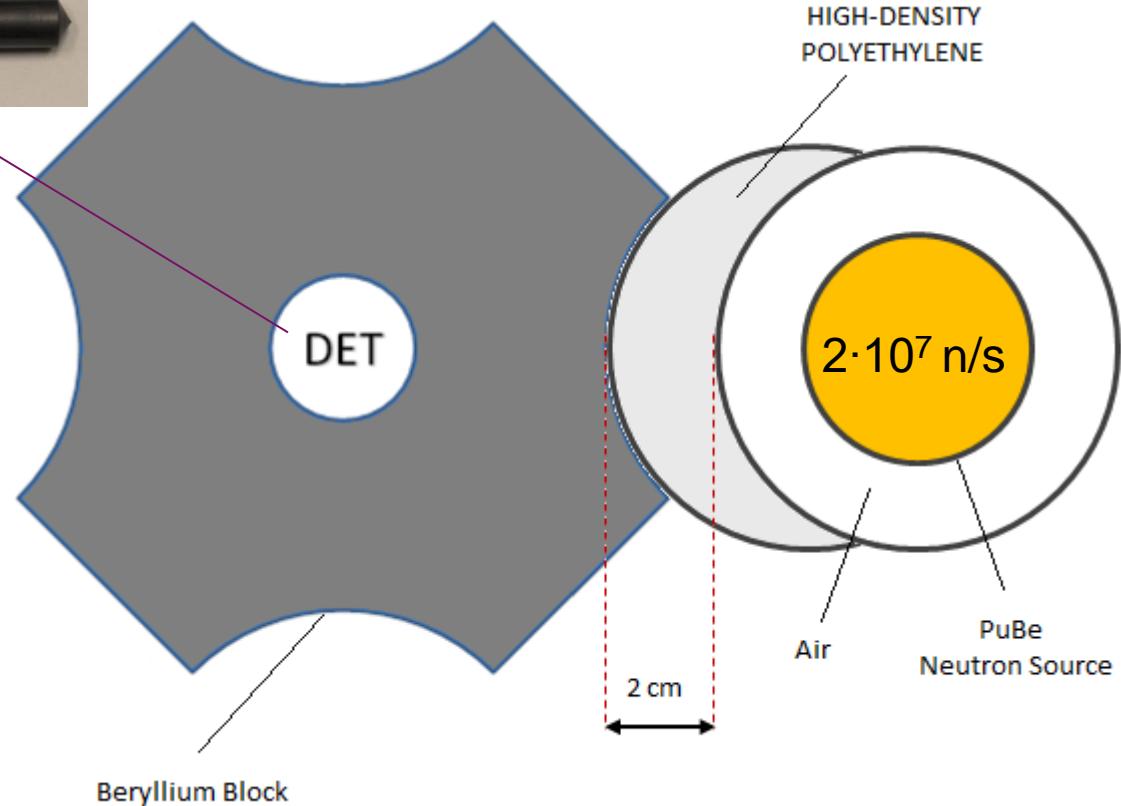
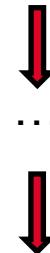


EXPERIMENT AND MEASUREMENTS



Fission chamber

$$I = \frac{\int_{E_0}^E \sigma(E) \varphi(E) dE \cdot \varepsilon \cdot s}{\sigma_{U5}}$$



$$t_p = \frac{I_o + I_1}{(I_o - I_1)^2 \cdot \left(\frac{\Delta x}{x}\right)^2} \quad \rightarrow \quad t_p \approx 200 \text{ [s]}$$

SUMMARY AND CONCLUSION

What do we know at the moment ?

- Beryllium depletion products in lattice calculations match Monte-Carlo results
- Measurable effect of poisons accumulation on the reactivity
- Important to include in core calculations

Further steps:

- Developement of core model
- Experiment followed by the model evaluation and corrections

THANK YOU FOR YOUR ATTENTION !!!

Questions?

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