AUGMENTED CINCH

Augmented cooperation in education and training in nuclear and radiochemistry

Calculation of results for Pb-210 in sediment by proportional counter

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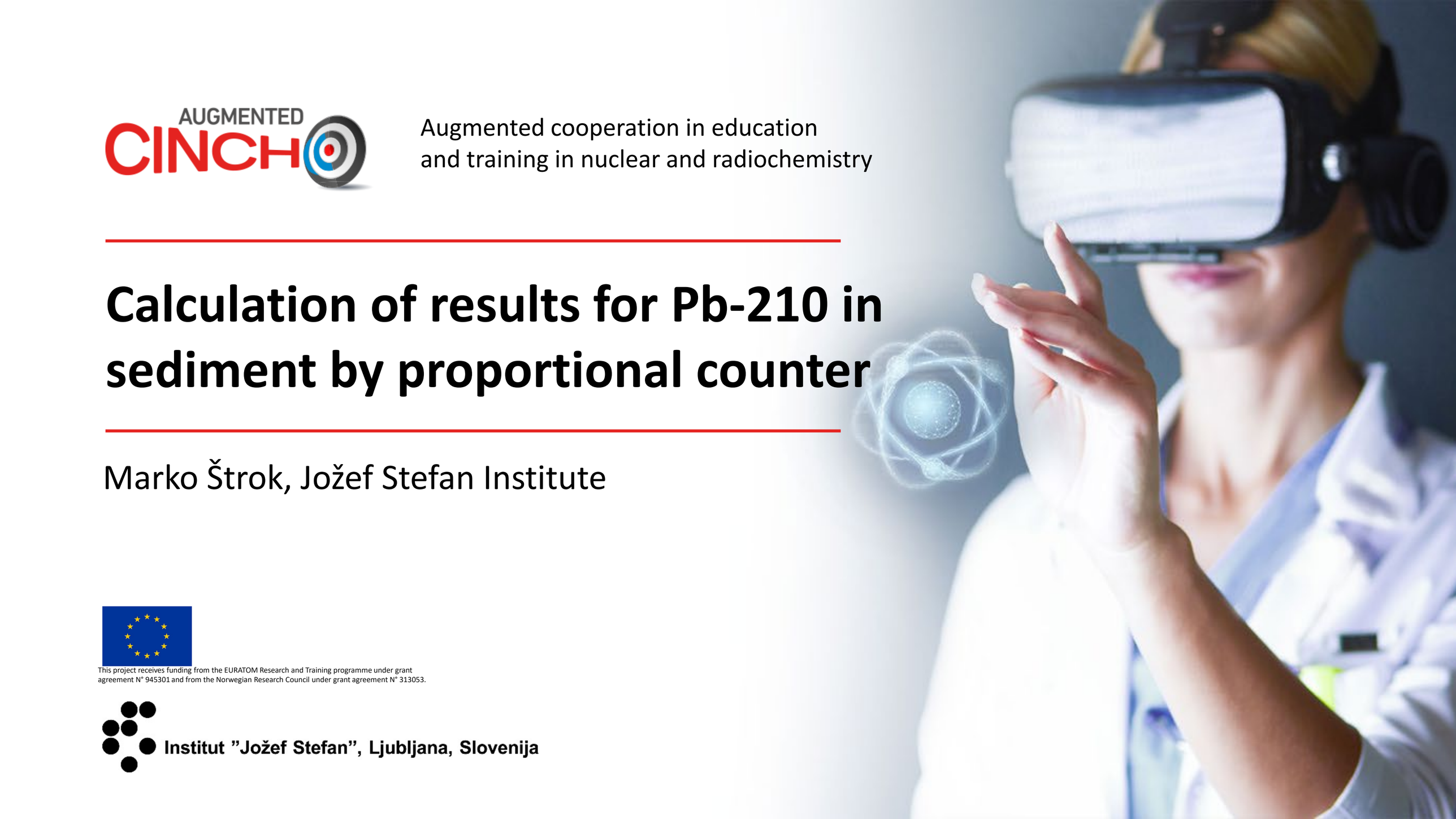

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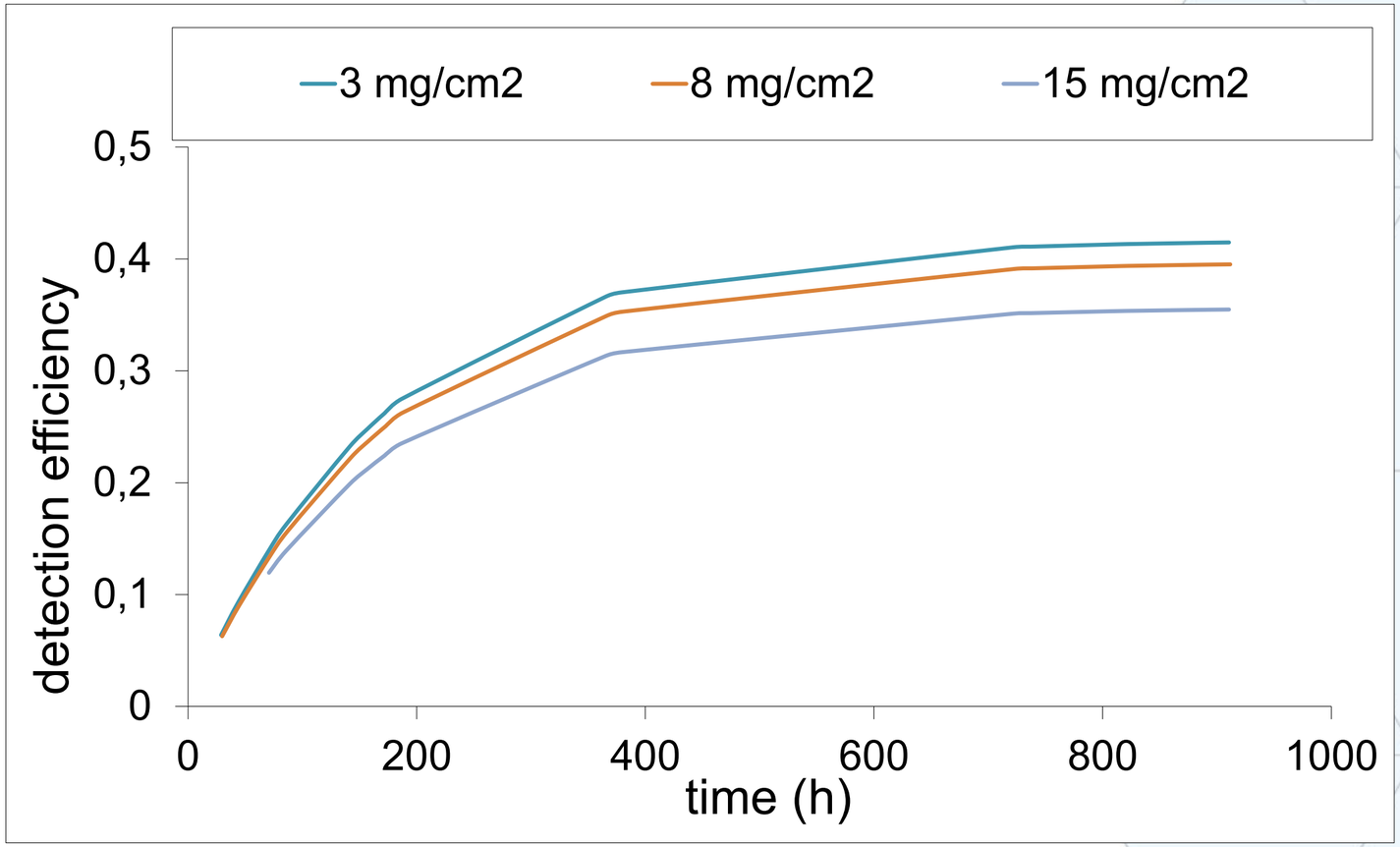
Bi-210 in-growth from Pb-210 at different sample thickness



Calculation of results

$$A_{\mathrm{Pb-210}} = \frac{\left(R_{\mathrm{beta}} - R_{\mathrm{b,beta}}\right)}{\eta_{\mathrm{Pb-210}}\ \varepsilon_{\mathrm{Pb-210}}\ m_{\mathrm{s}}} \qquad (1)$$

$$\eta_{\mathrm{Pb-210}} = \frac{m_{\mathrm{PbSO4}}\ M_{\mathrm{Pb}}}{m_{\mathrm{Pb}}\ M_{\mathrm{PbSO4}}} \qquad (3)$$

$A_{\mathrm{Pb-210}}$ → activity concentration of $\mathrm{Pb-210}$ [Bq/L]
R_{beta} → beta count rate [1/s]
$R_{\mathrm{b,beta}}$ → beta background count rate [1/s]
$\eta_{\mathrm{Pb-210}}$ → $\mathrm{Pb-210}$ chemical recovery
$\varepsilon_{\mathrm{Pb-210}}$ → $\mathrm{Pb-210}$ detection efficiency
m_{s} → sample mass [g]
R_{X} → count rate of radionuclide X or background [1/s]
N_{X} → number of counts of radionuclide X or background
t_{m} → measurement time [s]

$$R_X = \frac{N_{\mathrm{X}}}{t_{\mathrm{m}}} \qquad (2)$$

m_{PbSO4} → mass of $PbSO_4$ on planchet after separation [g]
M_{PbSO4} → molar mass of $PbSO_4$ [g/mol]
m_{Pb} → mass of added Pb carrier before separation [g]
M_{Pb} → molar mass of Pb [g/mol]

Calculation of measurement uncertainty

$$u_{\mathrm{c,Pb-210}} = A_{\mathrm{Pb-210}} \sqrt{\left(\frac{u_{R_{\mathrm{beta}}-R_{\mathrm{b,beta}}}}{R_{\mathrm{beta}} - R_{\mathrm{b,beta}}}\right)^2 + \left(\frac{u_{\eta_{\mathrm{Pb-210}}}}{\eta_{\mathrm{Pb-210}}}\right)^2 + \left(\frac{u_{\varepsilon_{\mathrm{Pb-210}}}}{\varepsilon_{\mathrm{Pb-210}}}\right)^2 + \left(\frac{u_{m_{\mathrm{s}}}}{m_{\mathrm{s}}}\right)^2} \quad (4)$$

$$u_{R_{\mathrm{beta}}-R_{\mathrm{b,beta}}} = \sqrt{\left(u_{R_{\mathrm{beta}}}\right)^2 + \left(u_{R_{\mathrm{b,beta}}}\right)^2} \quad (5)$$

$$u_{R_{\mathrm{X}}} = \frac{1}{\sqrt{N_{\mathrm{X}}}} \quad (6)$$

$u_{\mathrm{c,Pb-210}} \rightarrow$ combined standard uncertainty for $\mathrm{Pb-210[Bq/g]}$

$u_{\mathrm{X}} \rightarrow$ standard uncertainty of X

Reporting of the results

$$U_{\mathrm{Pb-210}} = k\, u_{\mathrm{c,Pb-210}} \qquad (7)$$

$U_{\mathrm{Pb-210}} \rightarrow$ expanded uncertainty for $\mathrm{Pb-210}$ activity concentration [Bq/g]

$k \rightarrow$ coverage factor ($k = 2$ for 95% coverage)

$$A_{\mathrm{Pb-210}} = A_{\mathrm{Pb-210}} \pm U_{\mathrm{Pb-210}}$$

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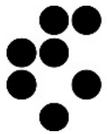

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