^{106}Ru (2017)

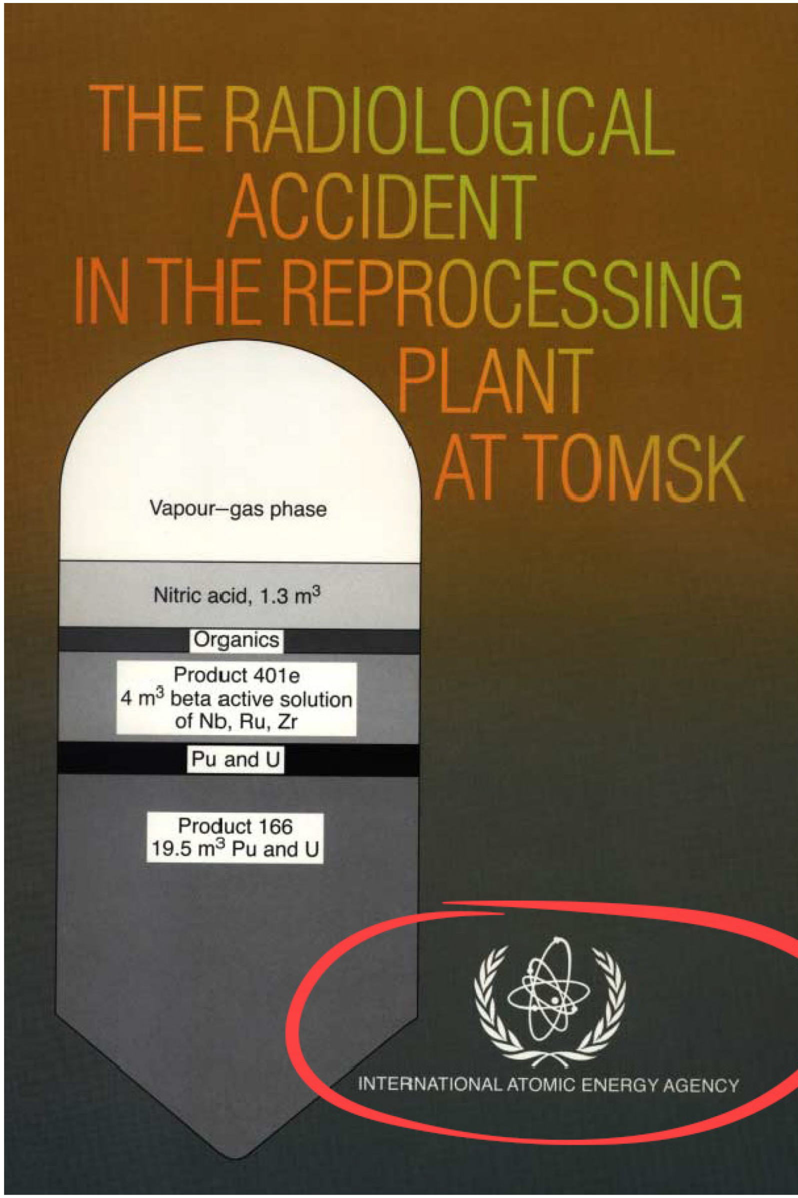
Masson et al., 2019

Undeclared release of ^{106}Ru in 2017 (250 TBq)

Tracked by the Ro5

Likely source: volatile RuO_4
From a nuclear
fuel reprocessing facility

^{106}Ru (2017)



Undeclared release of ^{106}Ru in 2017 (250 TBq – near Mayak)

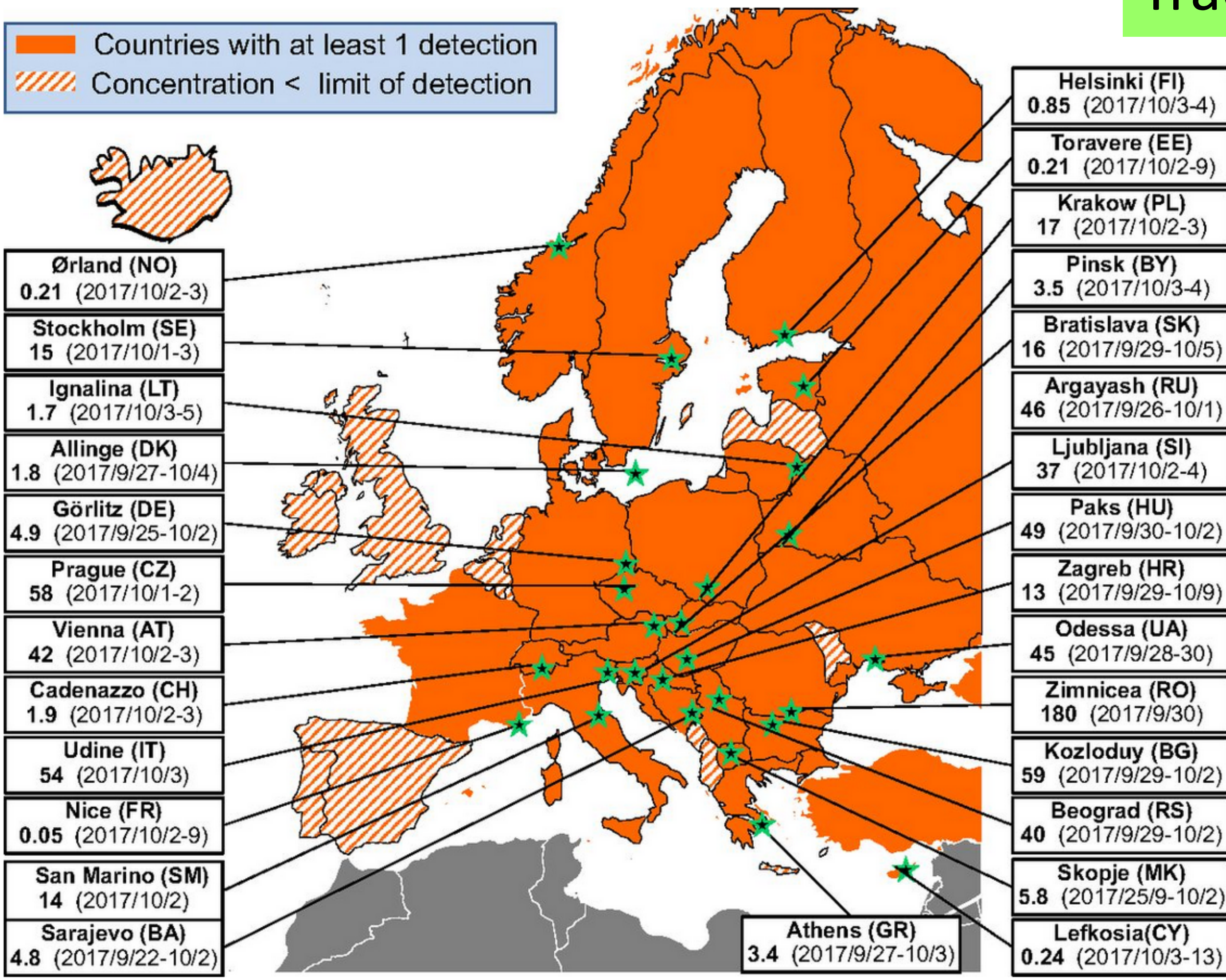
Declared release of ^{106}Ru in 1998 (11 TBq – Tomsk)

Photo 1. View of Building 201 after the accident.

Photo 7. Removal of contaminated soil and snow from Georgievka.

^{106}Ru (2017)

Tracked by the Ro5



← Highest value

First sample: 29.9.

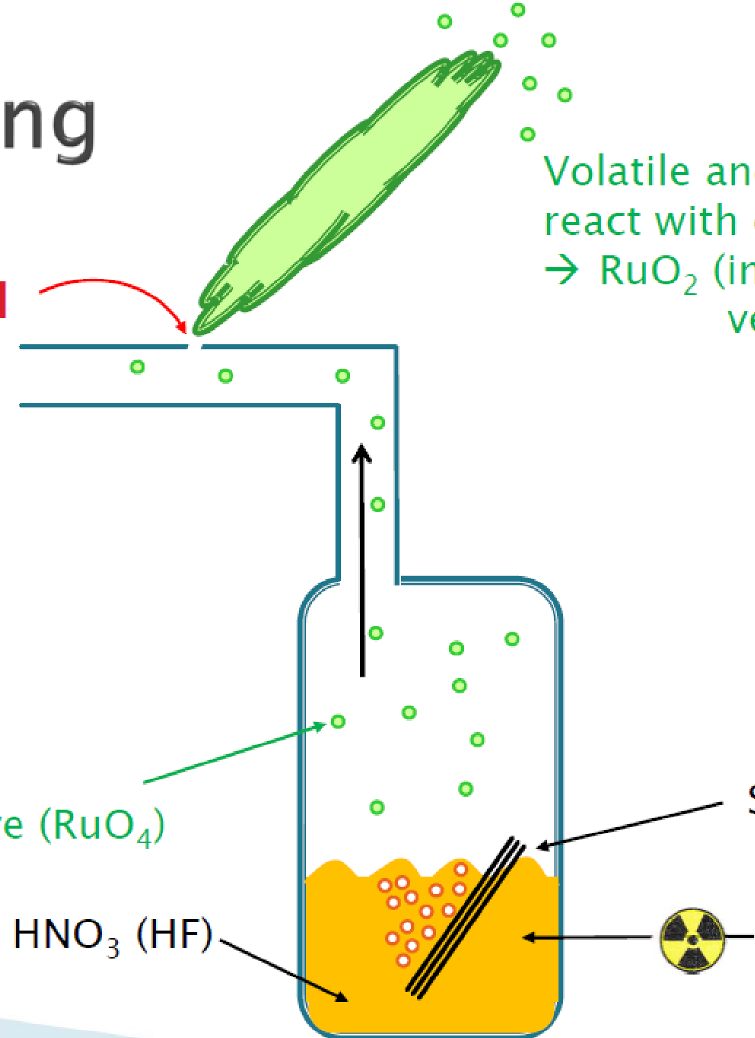
First reports:
Milano 2.10. (16:15)
Prague 2.10. (17:17)

Masson et al., 2019

https://www.pnas.org/content/116/34/16750

^{106}Ru

Reprocessing



G. Steinhauser et al., 2019
see also:
Masson et al., 2019
https://www.pnas.org/content/116/34/16750

Likely source: a nuclear fuel reprocessing facility Mayak, 25/26 Sept. 2017

Reproces

Possibility

^{106}Ru: 
Gaseous and highly rea

G. Steinhauser et al., 2
see also:
Masson et al., 2019
https://www.pnas.org/conte

96elements.ch

new Mendeleev-style tables

tables *about*

valencies & Mendeleev

<table>
<tr><td></td><td>1 H -1|1</td><td>2 He 0</td><td>3 Li 1</td><td>4 Be 2</td><td>5 B 3</td><td>6 C -4|.|4</td><td>7 N -3|3|5</td><td>8 O -2</td><td></td></tr>
<tr><td></td><td>9 F -1</td><td>10 Ne 0</td><td>11 Na 1</td><td>12 Mg 2</td><td>13 Al 3</td><td>14 Si 4</td><td>15 P 3|5</td><td>16 S -2|6</td><td></td></tr>
<tr><td></td><td>17 Cl -1</td><td>18 Ar 0</td><td>19 K 1</td><td>20 Ca 2</td><td>21 Sc 3</td><td>22 Ti 4</td><td>23 V 5</td><td>24 Cr 3|6</td><td>25 Mn 2|4|7</td></tr>
<tr><td>26 Fe 0|2|3</td><td>27 Co 0|2|3</td><td>28 Ni 0|2</td><td>29 Cu 0|1|2</td><td>30 Zn 2</td><td>31 Ga 3</td><td>32 Ge 4</td><td>33 As -3|3|5</td><td>34 Se -2|6</td><td></td></tr>
<tr><td></td><td>35 Br -1</td><td>36 Kr 0</td><td>37 Rb 1</td><td>38 Sr 2</td><td>39 Y 3</td><td>40 Zr 4</td><td>41 Nb 5</td><td>42 Mo 4|6</td><td>43 Tc 4|7</td></tr>
<tr><td>44 Ru 0|.|8</td><td>45 Rh 0|3</td><td>46 Pd 0|2|4</td><td>47 Ag 0|1</td><td>48 Cd 2</td><td>49 In 3</td><td>50 Sn 4</td><td>51 Sb 3|5</td><td>52 Te -2|6</td><td></td></tr>
<tr><td></td><td>53 I -1</td><td>54 Xe 0|4|8</td><td>55 Cs 1</td><td>56 Ba 2</td><td>57 La 3</td><td>58 Ce 3|4</td><td>59 Pr 3|(5)</td><td>60 Nd 3</td><td>61 Pm 3</td></tr>
<tr><td></td><td></td><td></td><td>62 Sm 3</td><td>63 Eu 2|3</td><td>64 Gd 3</td><td>65 Tb 3</td><td>66 Dy 3</td><td>67 Ho 3</td><td></td></tr>
<tr><td></td><td></td><td>68 Er 3</td><td>69 Tm 3</td><td>70 Yb 3</td><td>71 Lu 3</td><td>72 Hf 4</td><td>73 Ta 5</td><td>74 W 4|6</td><td>75 Re 0|.|7</td></tr>
<tr><td>76 Os 0|4|8</td><td>77 Ir 0|3|4</td><td>78 Pt 0|2|4</td><td>79 Au 0|3</td><td>80 Hg 0|1|2</td><td>81 Tl 1|3</td><td>82 Pb 2|4</td><td>83 Bi 3|5</td><td>84 Po -2|2|4</td><td></td></tr>
<tr><td></td><td>85 At -1</td><td>86 Rn 0</td><td>87 Fr 1</td><td>88 Ra 2</td><td>89 Ac 3</td><td>90 Th 4</td><td>91 Pa 5</td><td>92 U 4|6</td><td>93 Np 2|.|7</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>94 Pu 4</td><td>95 Am 3</td><td>96 Cm 3</td><td></td></tr>
</table>

hydrogen and the halogens : RH

noble gases and (rather) noble metals : R, RO_4

group I : R_2O

^{106}Ru

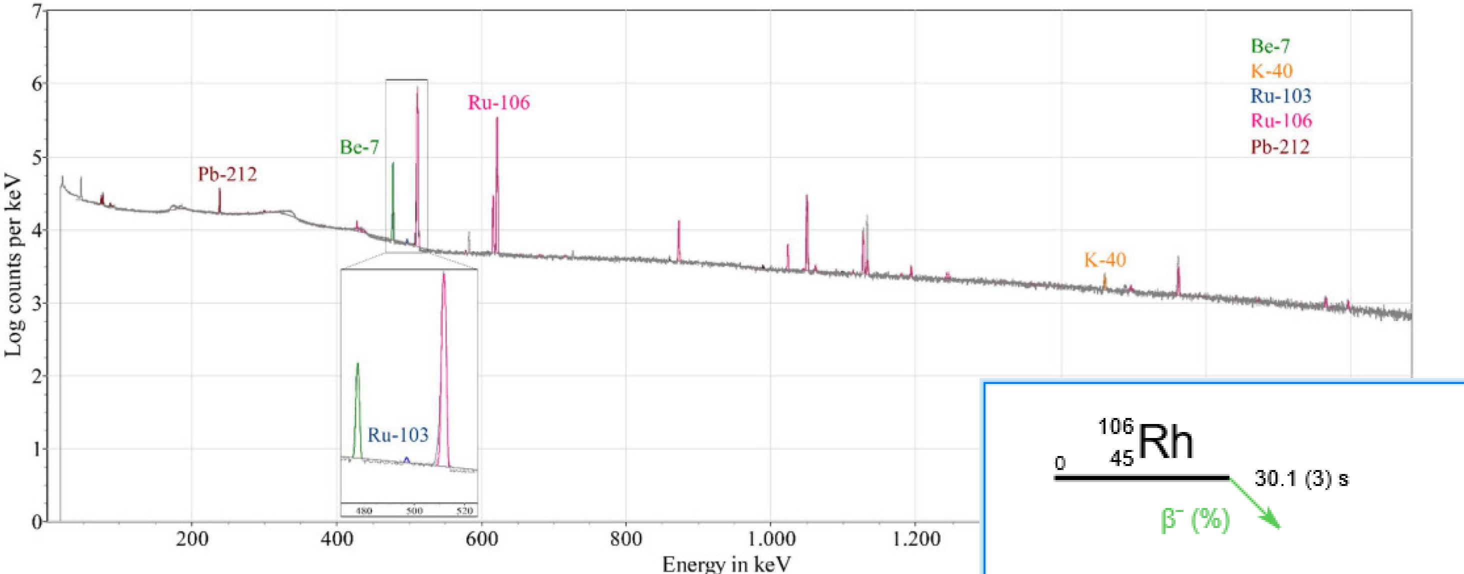
oxidizing RuO_4 will
/reducing aerosols
in water,
volatility)

uclear fuel

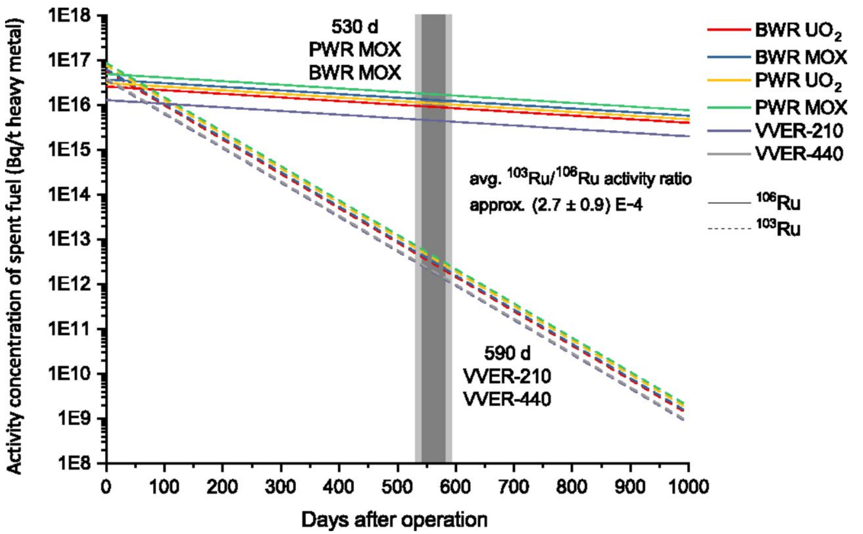
ed:
n, plutonium,
products (Cs, Sr, Ce, etc.)

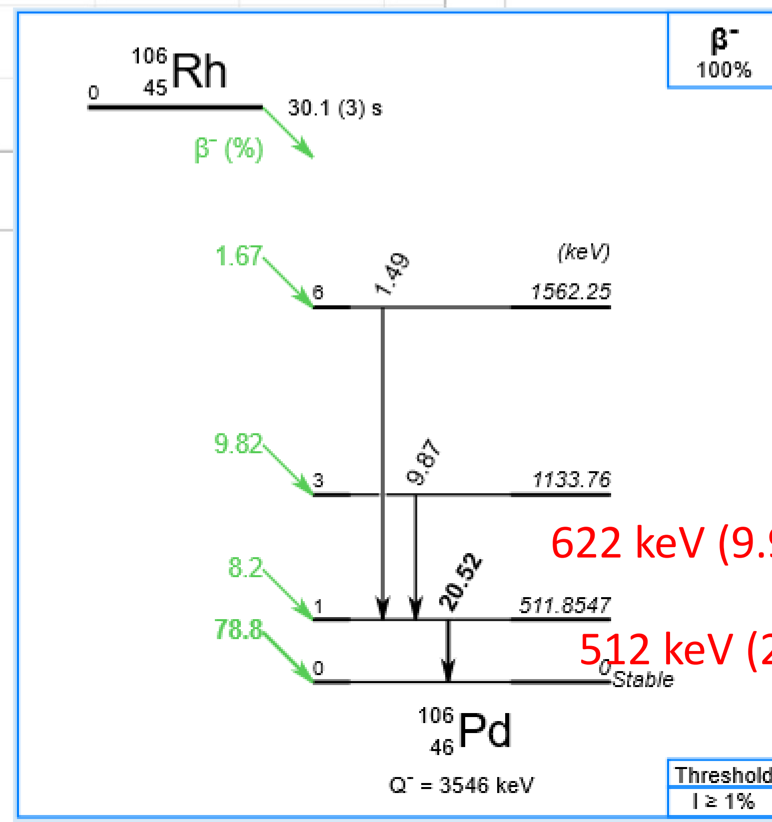
: a nuclear
ssing facility
6 Sept. 2017

Gamma-spectrometry of $^{106}Ru/^{106}Rh$



Masson et al., 2019





622 keV (9.9 %)

512 keV (20.5 %)

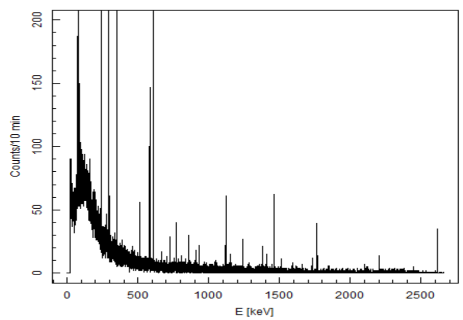
www.nucleide.org/Laraweb

In-house development:

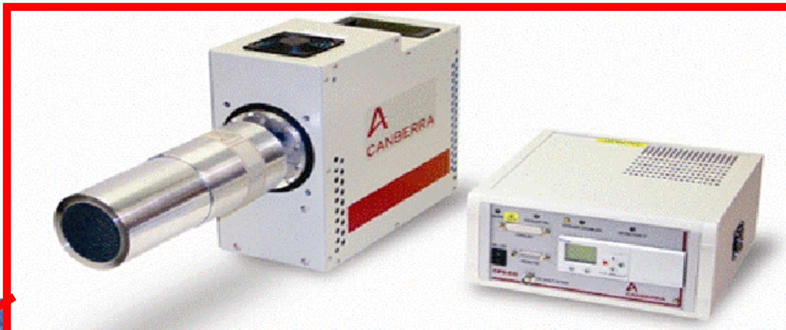
Miroslav Hýža, Prague

SÚRO

AMARA system - MSA ≈ 1 mBq/m^3

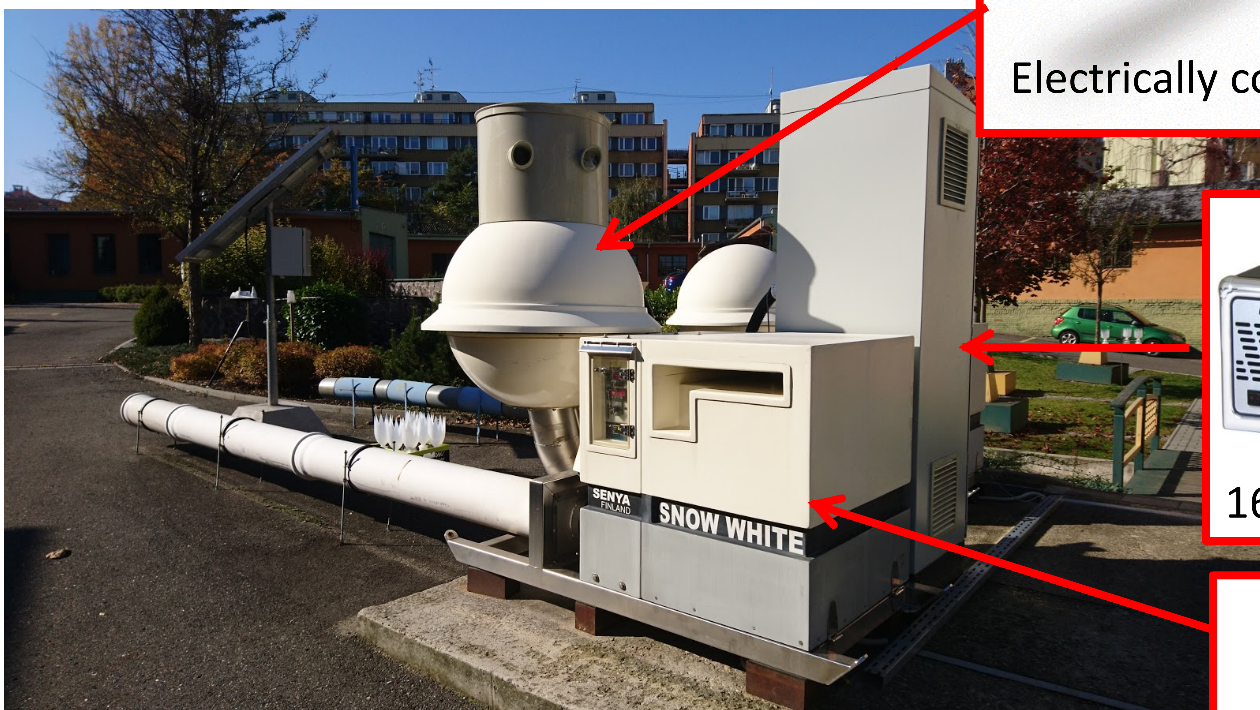


Complex real time analysis of measured spectra



Electrically cooled HPGe spectrometer

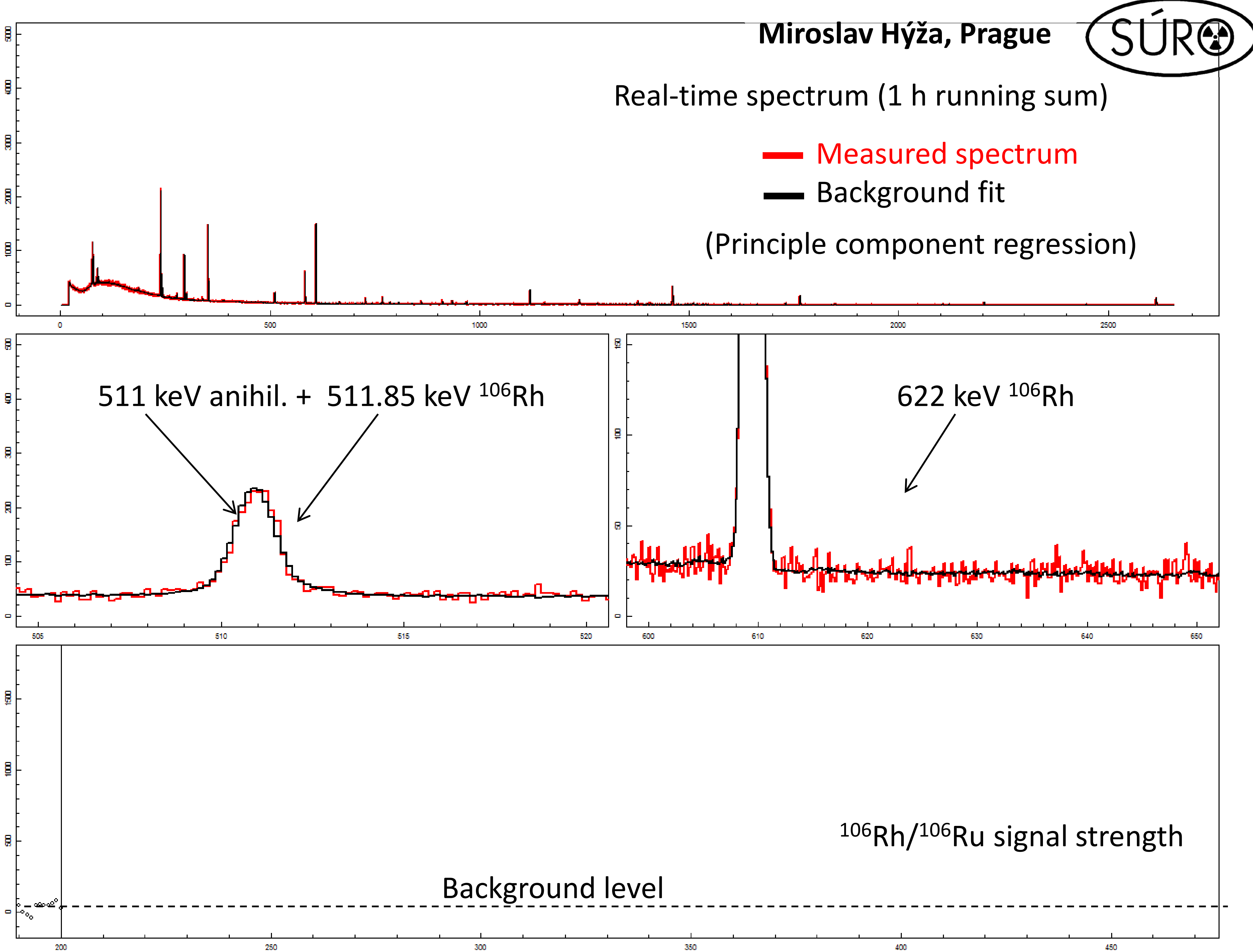
16K channel digital analyzer



Snow White sampler
900 m^3/h

In-house development:

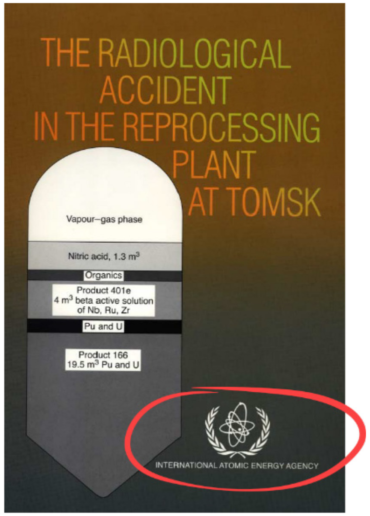
Miroslav Hýža, Prague

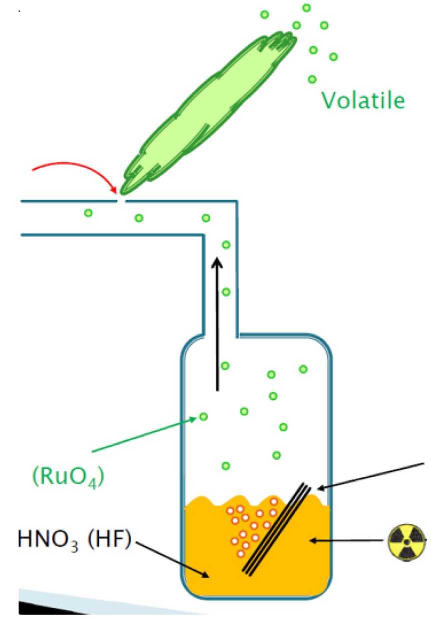

Miroslav Hýža, Prague
SÚRO
Real-time spectrum (1 h running sum)
Measured spectrum
Background fit
(Principle component regression)
511 keV anihil. + 511.85 keV 106Rh
622 keV 106Rh
106Rh/106Ru signal strength
Background level

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

^{106}Ru (2017)

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs





undeclared RuO_4 tracked by Ro5