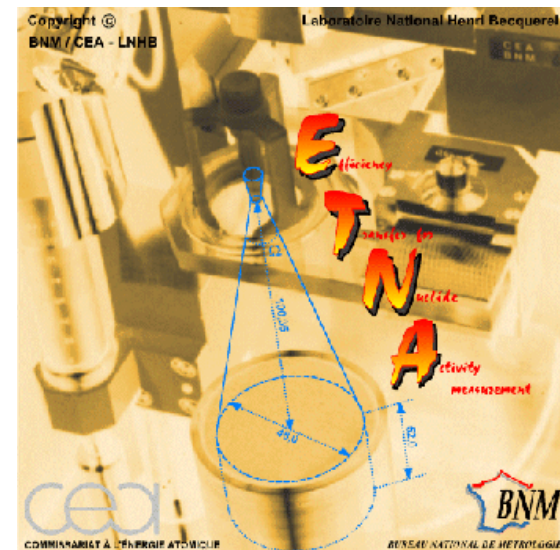
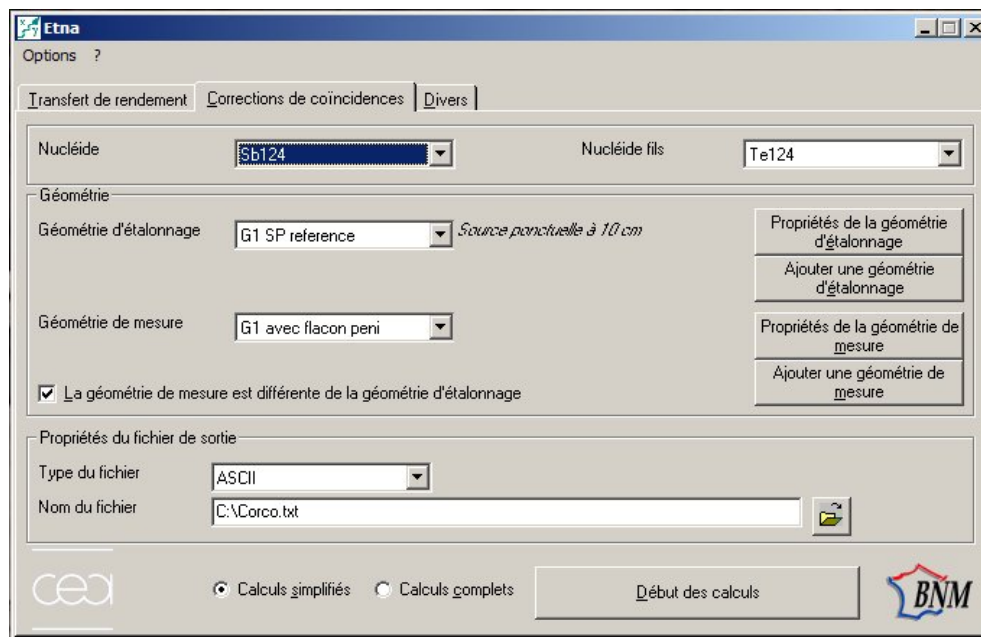


ETNA

(Efficiency Transfer for Nuclide Activity measurement)

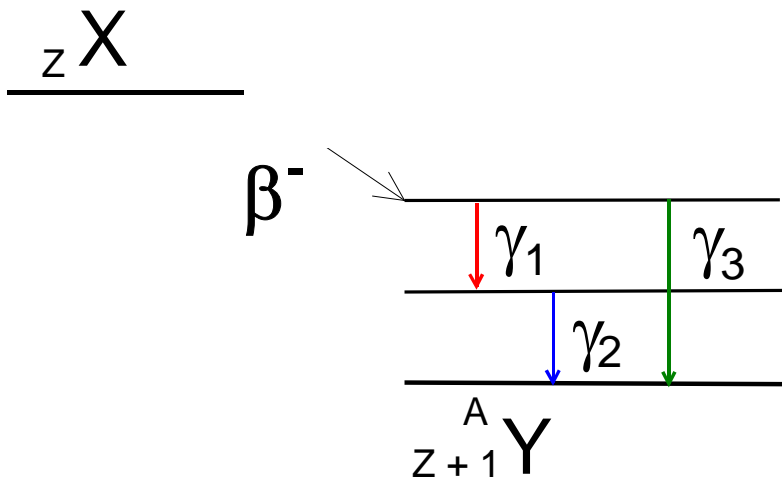
ETNA is a software for computing efficiency transfer and coincidence summing corrections for gamma-ray spectrometry.

The software has been developed at the Laboratoire National Henri Becquerel and is available upon request.



ETNA - Principle

- ETNA uses a numerical method, according to Andreev, Mc Callum principle:



$$C_1 = \frac{1}{1 - P_{12} \cdot \varepsilon_{T2}}$$

$$C_2 = \frac{1}{1 - P_{21} \cdot \varepsilon_{T1}}$$

$$C_3 = \frac{1}{\left(1 + \frac{I_{\gamma 1}}{I_{\gamma 3}} \cdot \frac{\varepsilon_{P1} \cdot \varepsilon_{P2}}{\varepsilon_{P3}} \cdot P_{12} \right)}$$

P_{12} : probability for emitting γ_2 simultaneously with γ_1

ε_{Pi} : FEP efficiency for energy E_i

ε_{Ti} : Total efficiency for energy E_i

ETNA – Input data

ETNA requires:

1. Decay scheme (Nucleide database)
2. FEP and total efficiency for at least one source-to-detector geometry («calibration geometry » recorded in the « user » database)

ETNA – Coincidence tab

Options ?

Efficiency transfer | Coincidence summing correction | Miscellaneous

Nuclide: Ba133 Daughter nuclide: Cs133

Geometry

Calibration geometry: G1 SP reference *Source ponctuelle à 10 cm*

Measurement geometry: G1 SP reference *Source ponctuelle à 10 cm*

Measurement geometry different from calibration geometry

Output file properties

File type: ASCII

File name: C:\Corco.txt

Simplified computing Complete computing

Start computing

CEA BNM

Calibration geometry window

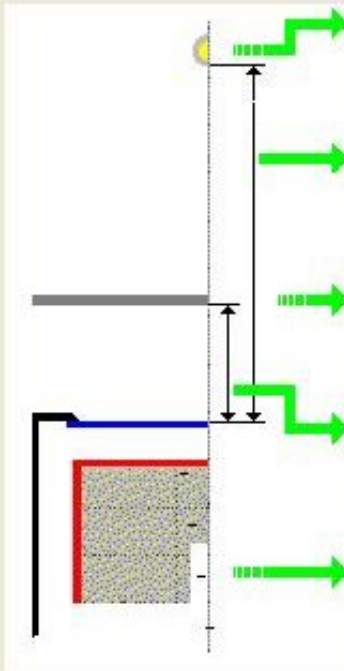
Calibration geometry properties

Geometry

Geometry: Comment: Calibration geometry

Creation date: Last modification date:

Geometry properties



The diagram illustrates the calibration geometry. A source (yellow circle) is positioned at the top. A source-detector distance of 100 mm is indicated. Below the source is an absorber (grey rectangle). An absorber-detector distance of 0 mm is indicated. At the bottom is a detector (red rectangle). Green arrows point from the labels to the corresponding components in the diagram.

Source:

Source-detector distance: ± mm

Measurement environment:

Absorber:

Absorber-detector distance: ± mm

Detector:

Efficiency calibration

Efficiency coefficients

Full energy peak efficiency origin

- Manual input
- Function applying
- Data import

Function properties

File import

Total efficiency origin

- Manual input
- Function applying

Function properties

Energy	Efficiency	Total Efficiency
20,0000	8,72E-03	9,50E-03
30,0000	9,12E-03	1,05E-02
40,0000	9,40E-03	1,08E-02
50,0000	9,62E-03	1,12E-02
60,0000	9,72E-03	1,14E-02
80,0000	9,60E-03	1,17E-02
90,0000	9,43E-03	1,18E-02
100,0000	9,23E-03	1,18E-02
110,0000	9,01E-03	1,18E-02
120,0000	8,79E-03	1,19E-02
200,0000	6,43E-03	1,18E-02
250,0000	5,19E-03	1,16E-02
300,0000	4,20E-03	1,14E-02

Modify

Exit

Results

- dimanche 22 février 2009
- ETNA _____ Version 5.5 Rev 51
- Filename :C:\Documents and Settings\ML118236\Bureau\Workshop_ICRM\Presentations\ETNA\test_ETNA
- dimanche 22 février 2009
- Processing identification : Coincidence summing correction (simplified computing)
- Nuclide :Ba133
- Daughter nuclide :Cs133
- Half-life threshold :0,000001 s
- Calibration geometry : G1 SP reference (Source ponctuelle à 10 cm)
- Calibration source :Source ponctuelle
- Calibration source - detector distance :100 mm
- Calibration absorber :None
- Calibration absorber - detector distance :0 mm
- Measurement geometry :Calibration geometry
- Detector :G1 - pièce 6A
- Results :
- Error codes : 0 0
- X-ray correction : 01,015880
- Starting level Arrival level Energy (keV) Gamma-gamma correction Gamma-X correction Total
- 004 003 00053,162 01,013962 01,010219 01,024324
- 002 001 00079,614 01,015207 01,012325 01,027720
- 001 000 00080,998 01,011478 01,007984 01,019554
- 002 000 00160,612 00,993490 01,007235 01,000678
- 003 002 00223,237 01,009461 01,019791 01,029439
- 004 002 00276,399 01,008560 01,015827 01,024522
- 003 001 00302,851 01,005028 01,015414 01,020519
- 004 001 00356,013 01,003565 01,011468 01,015074
- 003 000 00383,849 00,991597 01,010308 01,001818
- :
- CEA\LNHB _____ BNM

Calcul with efficiency transfer

The screenshot shows the 'Etna' software window with the 'Options' menu open to the 'Efficiency transfer' tab. The 'Nuclide' is set to 'Ba133' and the 'Daughter nuclide' is 'Cs133'. Under the 'Geometry' section, the 'Calibration geometry' is 'G1 SP reference' (with a note 'Source ponctuelle à 10 cm') and the 'Measurement geometry' is 'G1-SG50 à 10 cm', which is circled in red. A checkbox for 'Measurement geometry different from calibration geometry' is checked. The 'Output file properties' section shows 'File type' as 'ASCII' and 'File name' as 'C:\Corco.txt'. At the bottom, there are radio buttons for 'Simplified computing' (selected) and 'Complete computing', a 'Start computing' button, and logos for 'cea' and 'BNM'.

Options ?

Efficiency transfer | Coincidence summing correction | Miscellaneous

Nuclide: Ba133 Daughter nuclide: Cs133

Geometry

Calibration geometry: G1 SP reference *Source ponctuelle à 10 cm*

Measurement geometry: G1-SG50 à 10 cm

Measurement geometry different from calibration geometry

Output file properties

File type: ASCII

File name: C:\Corco.txt

Simplified computing Complete computing

Start computing

cea BNM

Material management

The image shows two overlapping windows from the Etna software. The background window, titled 'Etna', has a menu bar with 'Options ?' and two tabs: 'Efficiency transfer' and 'Coincidence summing correction'. A red arrow points to a dashed rectangular box in the 'Coincidence summing correction' section. The foreground window, titled 'Material', is the active window and contains the following sections:

- List of materials:** A dropdown menu showing 'Polyéthylène' and buttons for 'Add new', 'Modify', 'Suppress', and 'Exit'.
- Material properties:** Fields for 'Material' (Polyéthylène), 'Density' (0,92 g/cm³), 'Creation date' (16/06/1999), and 'Last modification date' (08/09/1999). Checkboxes are present for 'Detector crystal', 'Detector window', 'Detector side cap', 'Source', 'Container', 'Absorber', and 'Measurement environment'. 'Update' and 'Exit' buttons are also present.
- Coefficients:** A table with columns 'Energy' and 'Mass attenuation coefficient'. The table contains data points for energies from 1,0000 to 8,0000.
- Import data:** A button at the bottom right.

Energy	Mass attenuation coefficient
1,0000	1,89E03
1,5000	5,99E02
2,0000	2,58E02
3,0000	7,69E01
4,0000	3,20E01
5,0000	1,61E01
6,0000	9,17E00
8,0000	3,79E00

ICRM action

- 2 series of calculation for 5 and 2 cm:
 - With geometry transfer using 10 cm efficiency calibration as reference
 - Without geometry transfer with efficiency calibrations at 5 and 2 computed from the experimental spectra