

AL and AH samples

NPL Environmental Radioactivity
Proficiency Test Exercise 2007 Workshop

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Radionuclides in AL and AH

- 7 nuclides:

^{226}Ra , ^{237}Np , ^{238}U , ^{238}Pu , ^{239}Pu , ^{241}Am & ^{244}Cm

- Two concentration levels:

AL 1 – 20 Bq kg⁻¹

AH 1 – 20 Bq g⁻¹



AL and AH composition

| | AL (Bq kg ⁻¹) | AH (Bq g ⁻¹) |
|-------------------|---------------------------|--------------------------|
| ²²⁶ Ra | 9.99(13) | 4.84(7) |
| ²³⁷ Np | 8.60(9) | 16.63(17) |
| ²³⁸ U | 3.72(9) | 2.02(5) |
| ²³⁸ Pu | 17.13(8) | 16.93(5) |
| ²³⁹ Pu | 19.48(12) | 7.84(4) |
| ²⁴¹ Am | 10.07(4) | 3.858(8) |
| ²⁴⁴ Cm | 13.20(6) | 17.23(6) |
| gross alpha | 82(6) | 69(3) |

- (i) Zeta test
pass if $\text{Abs}(\text{zeta}) \leq 2.58$

$$\zeta = \frac{L - N}{\sqrt{u_L^2 + u_N^2}}$$

- (ii) R_L outlier test
pass if not an Dixon outlier

$$R_L = \frac{u_L}{L}$$

- (iii) z test
pass if $\text{Abs}(\text{z test}) \leq 2.58$

$$z = \frac{L - N}{R_{\text{med}} N}$$

R_{med} = median of participants relative uncertainties (generally between 5% and 10%)

| Zeta test | R_L test | z test | |
|-----------|------------|--------|--------------------|
| pass | pass | pass | 'In agreement' |
| pass | fail | pass | 'Questionable' (a) |
| fail | pass/fail | pass | 'Questionable' (b) |
| pass | pass/fail | fail | 'Questionable' (c) |
| fail | pass/fail | fail | 'Discrepant' |

(a) Result close to NPL but unacceptable large uncertainty

(b) Result close to NPL but uncertainty is too small to pass zeta test

(c) Result not close to NPL but large uncertainty results in passing the zeta test

AL

15 results

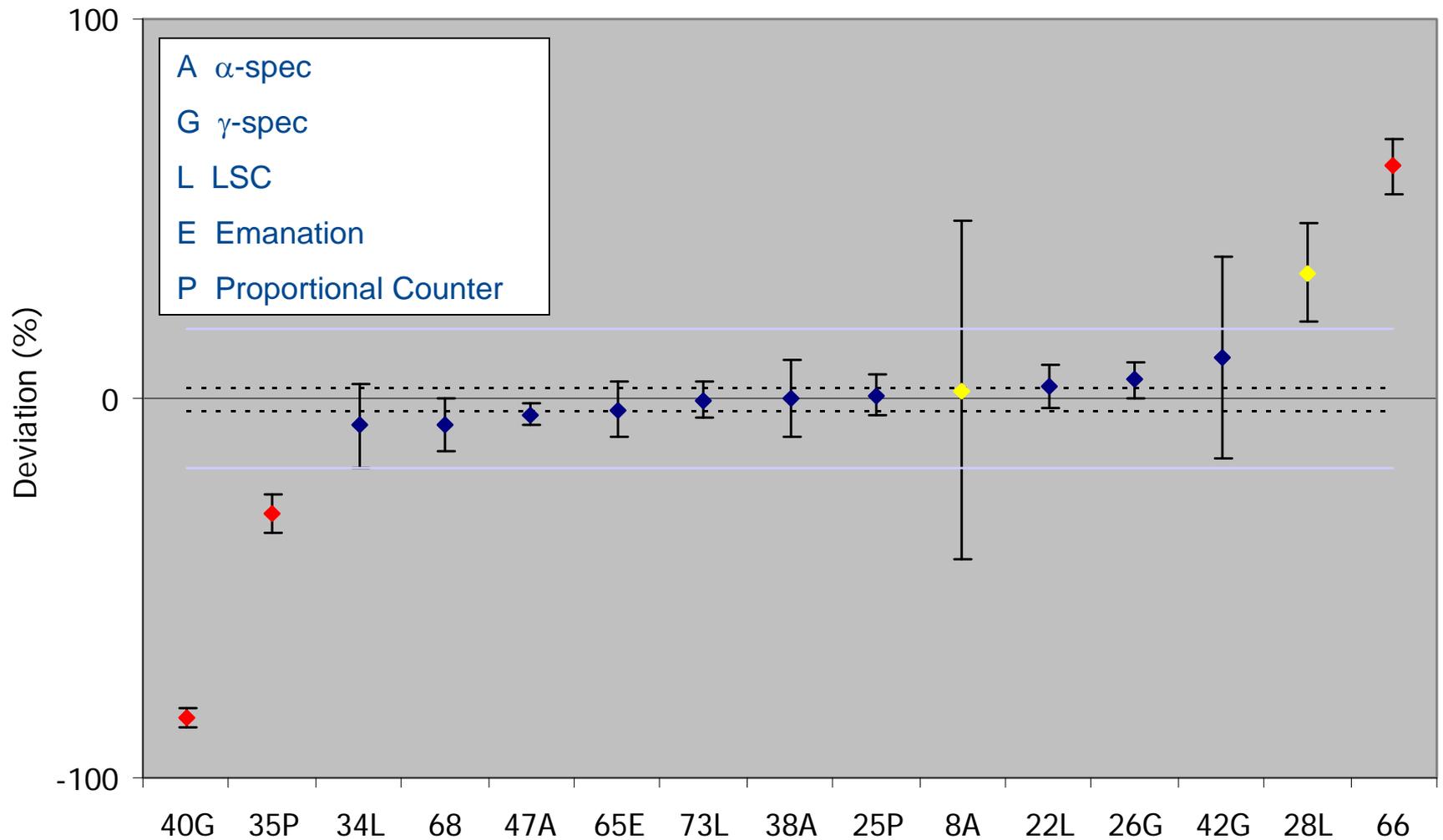
64% of the results 'in agreement'

AH

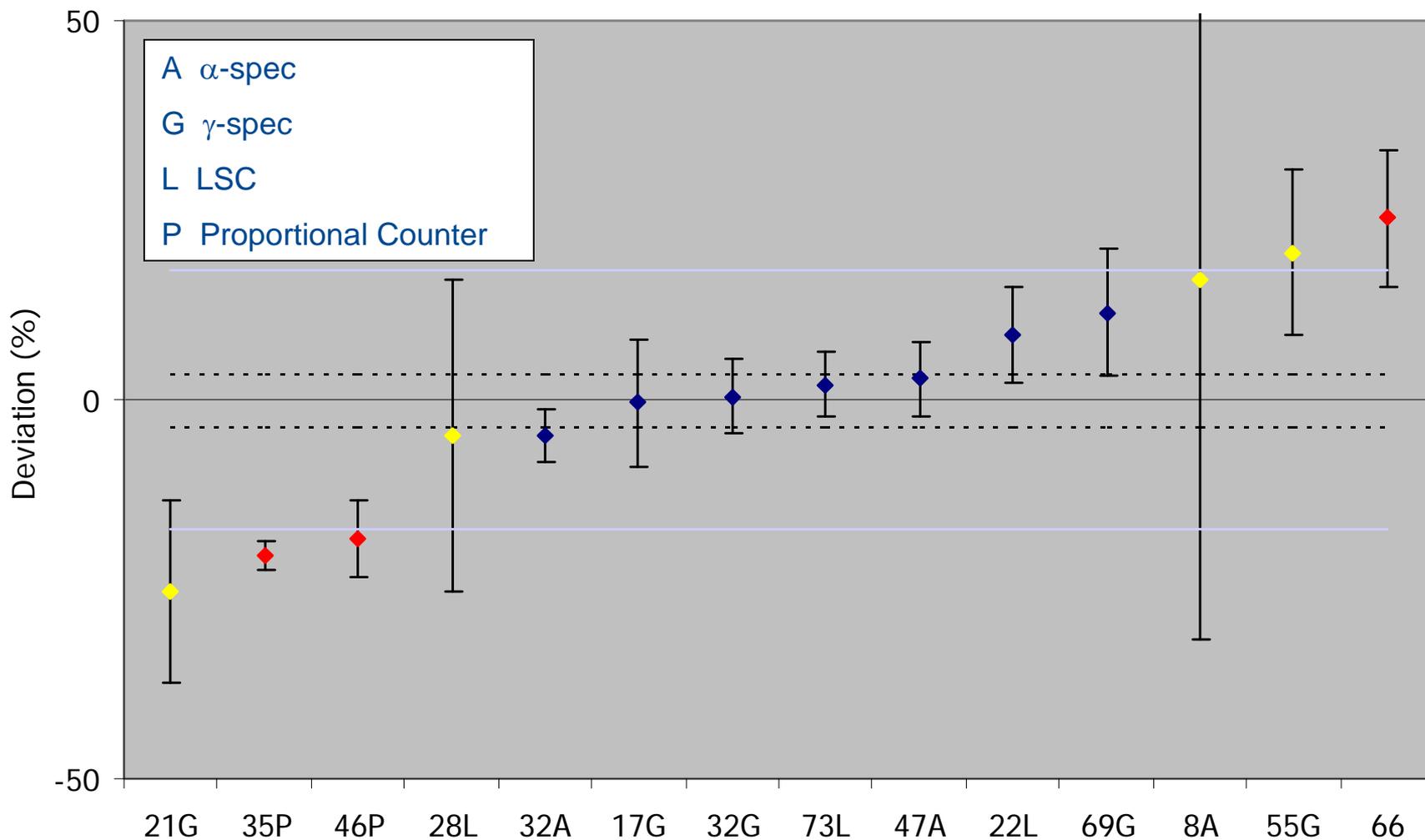
14 results

50% of the results 'in agreement'

Deviation Ra-226 AL



Deviation Ra-226 AH



AL

4 results

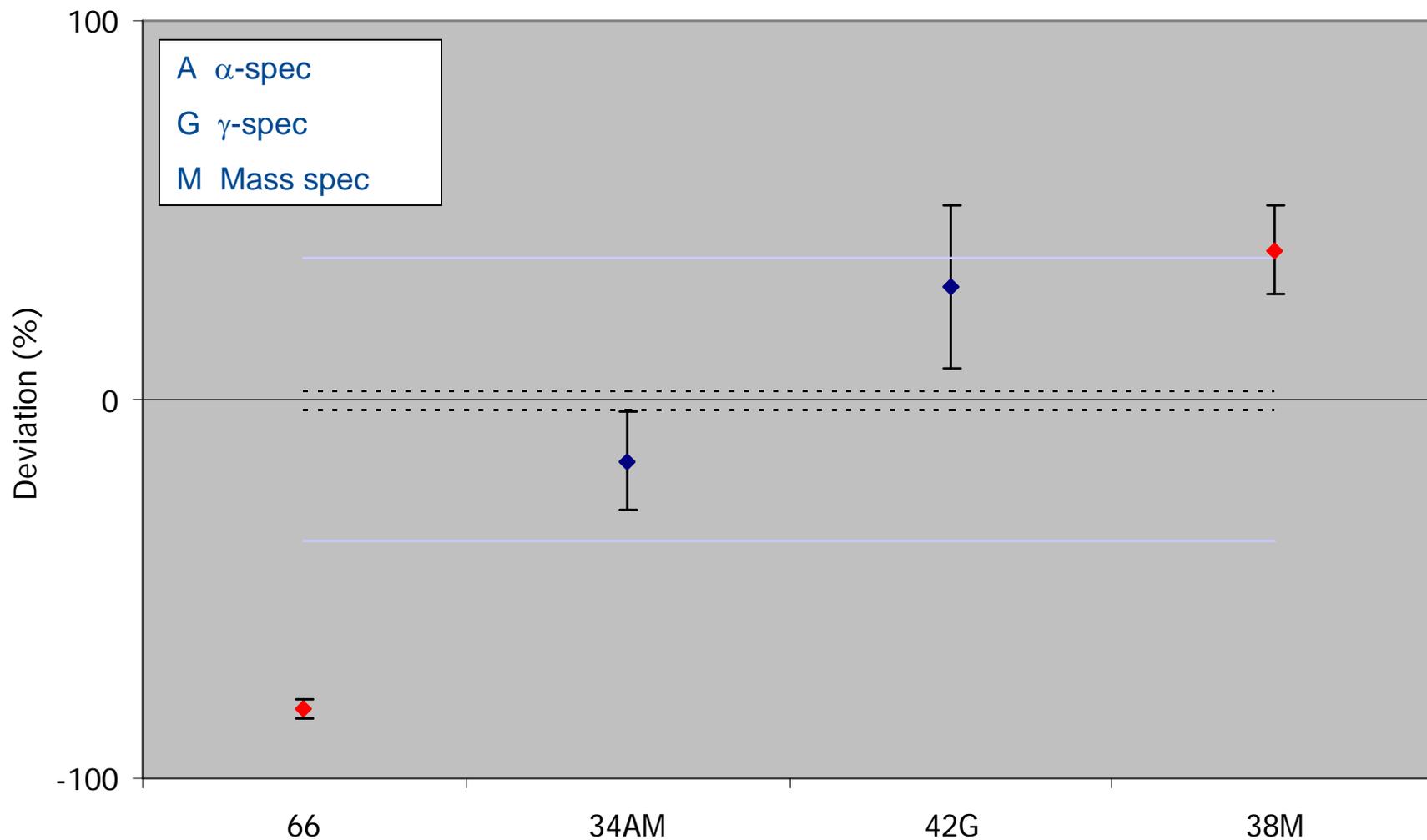
50% of the results 'in agreement'

AH

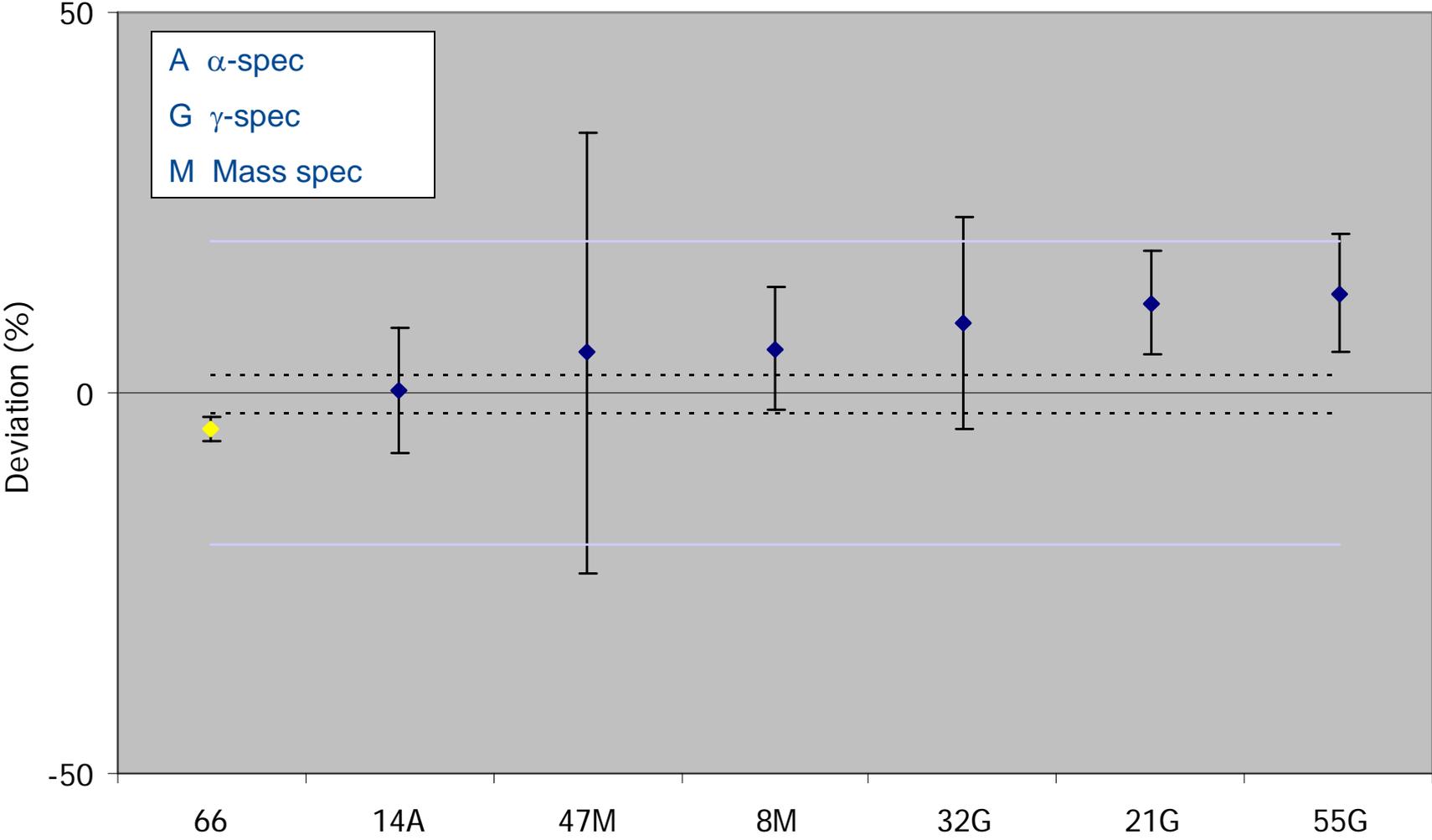
7 results

85% of the results 'in agreement'

Deviation Np-237 AL



Deviation Np-237 AH



AL

21 results

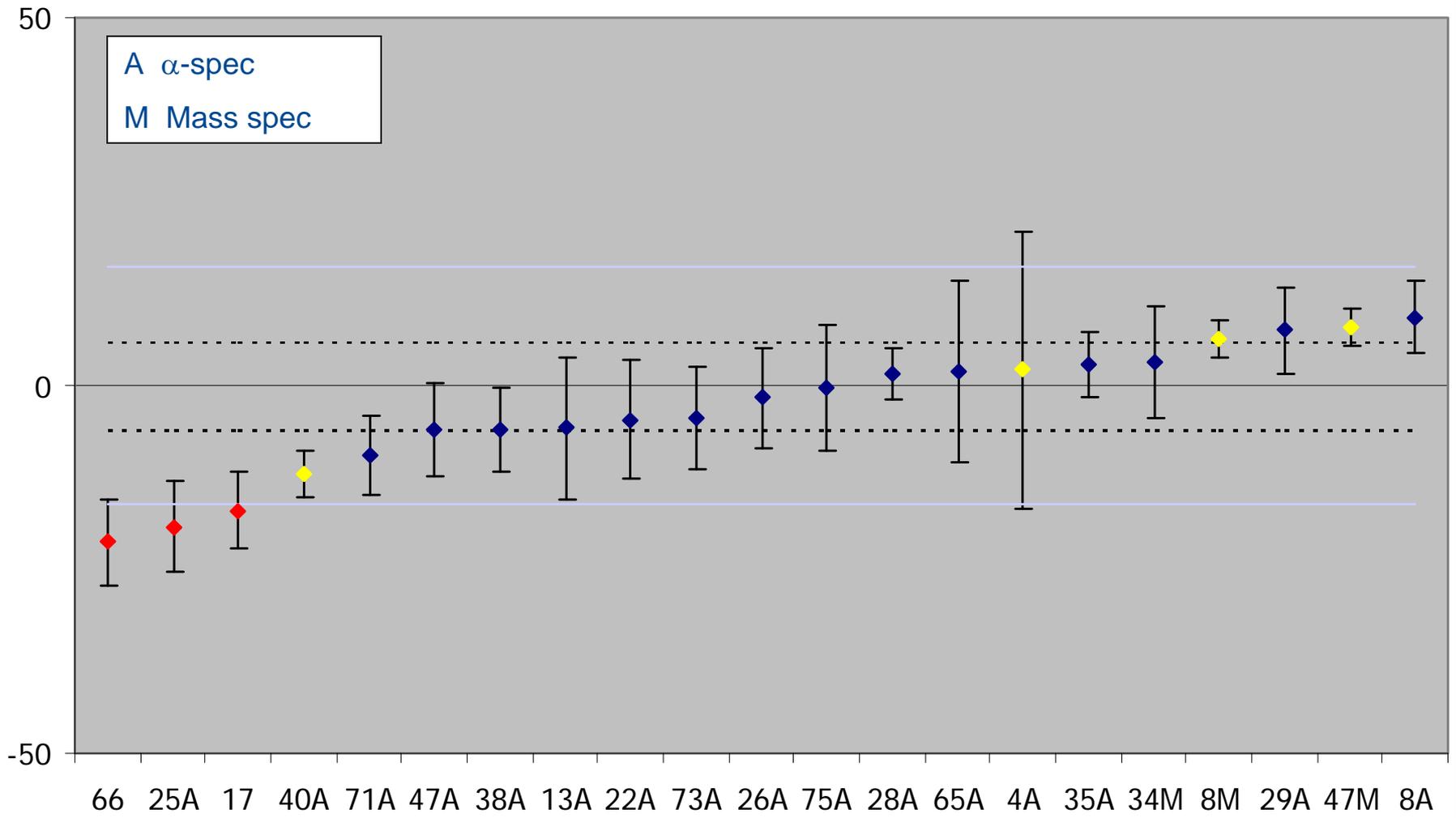
66% of the results 'in agreement'

AH

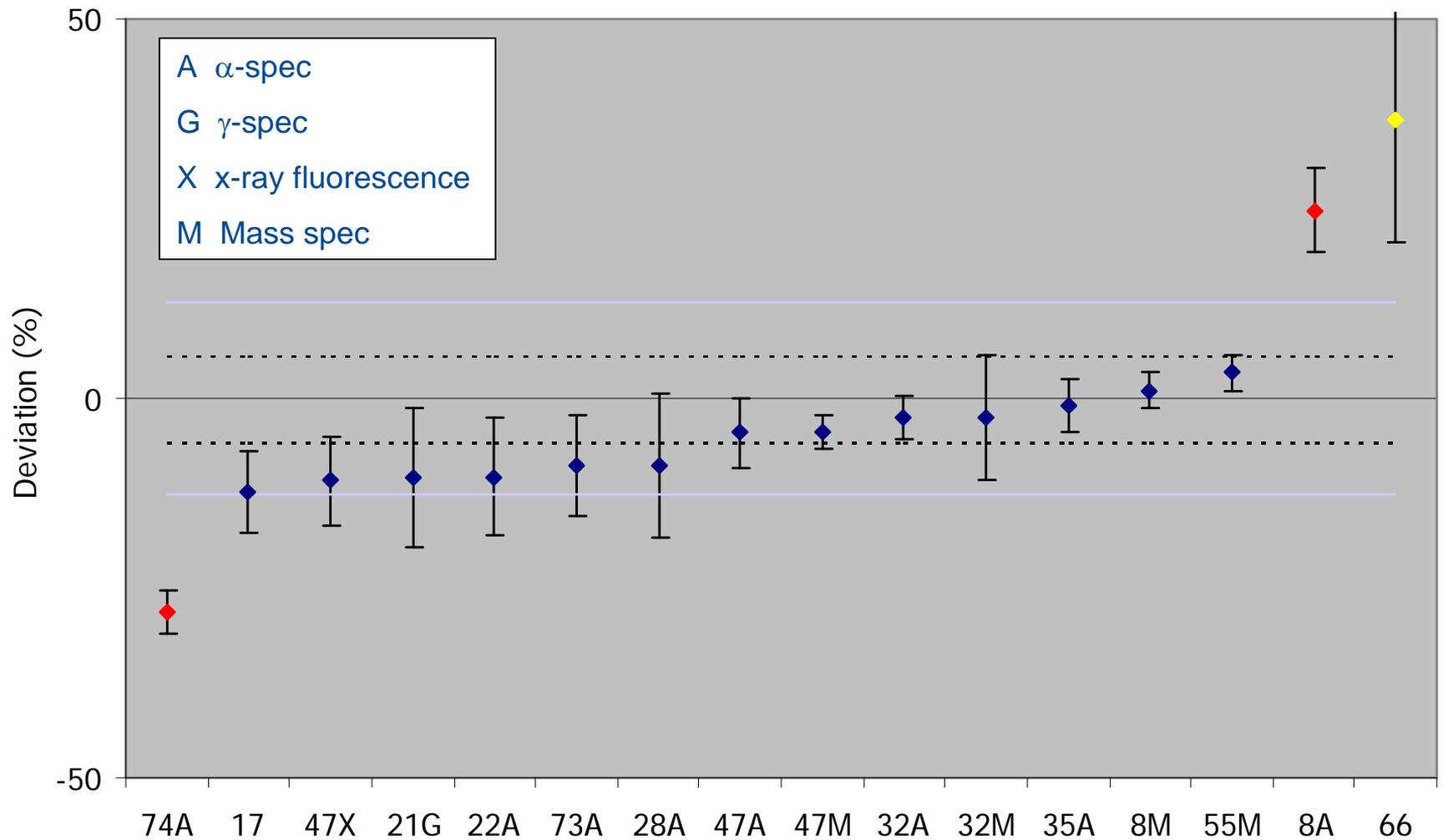
16 results

81% of the results 'in agreement'

Deviation U-238 AL



Deviation U-238 AH



AL

20 results

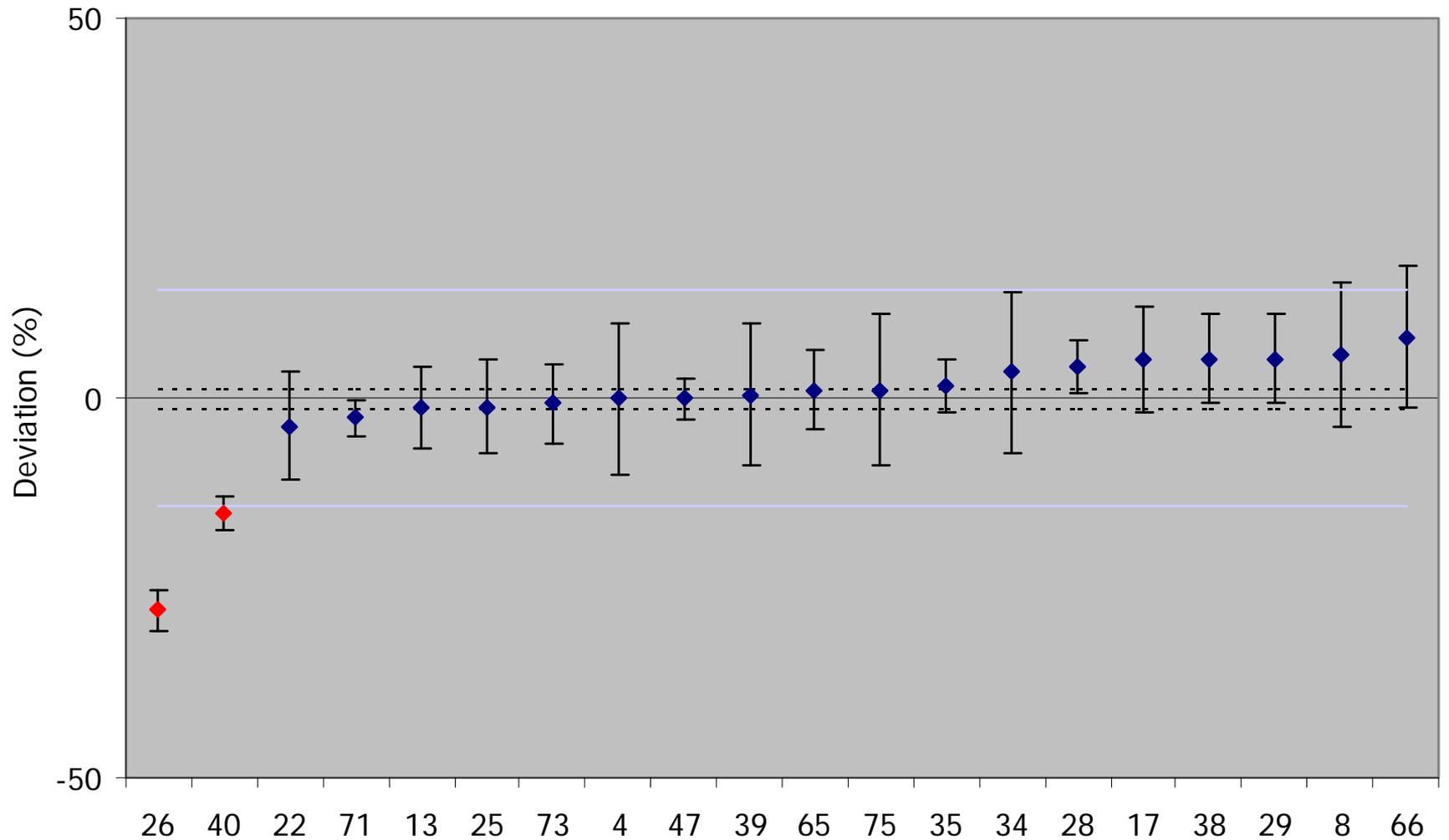
90% of the results 'in agreement'

AH

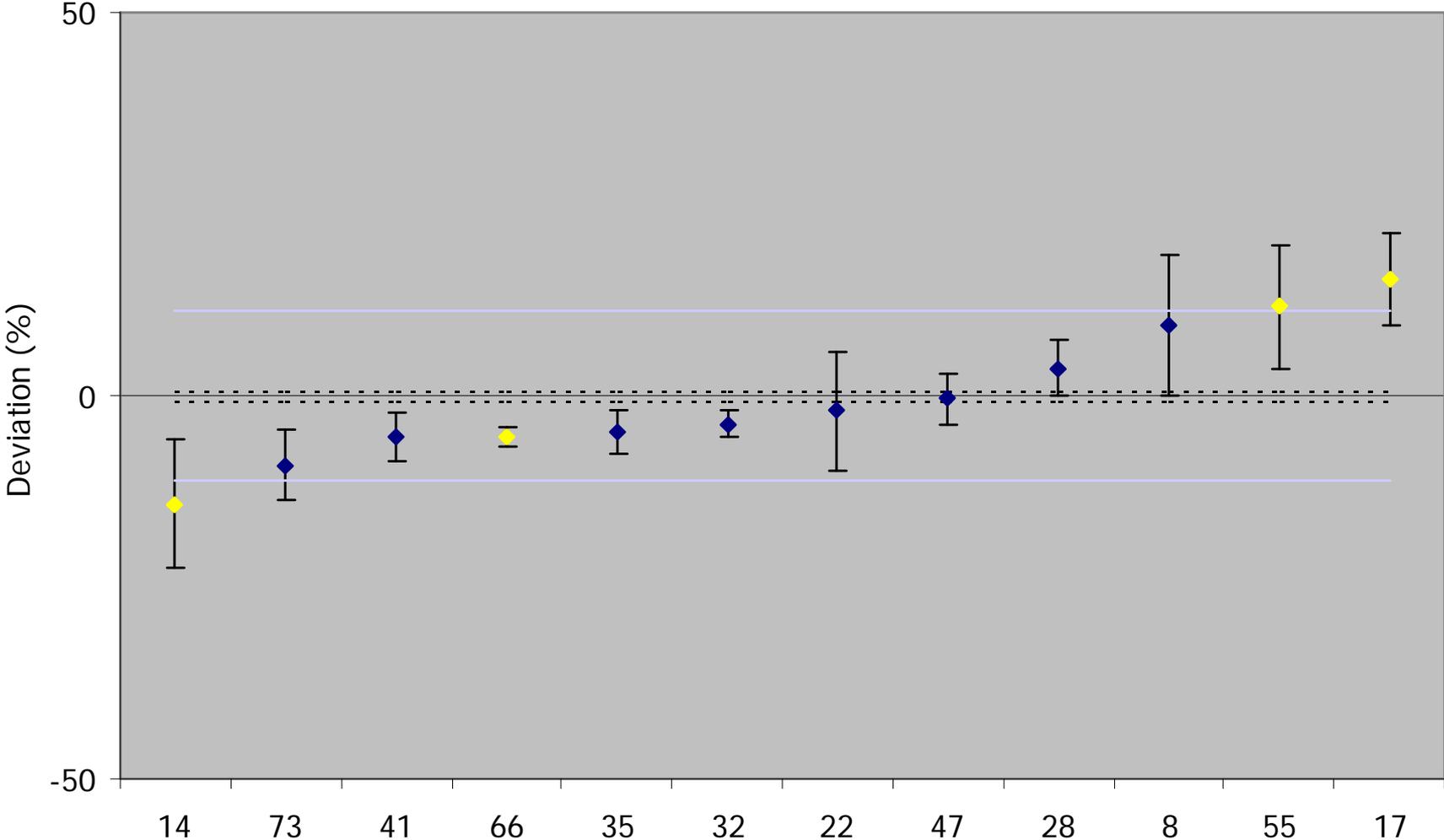
12 results

66% of the results 'in agreement'

Deviation Pu-238 AL



Deviation Pu-238 AH



AL

20 results

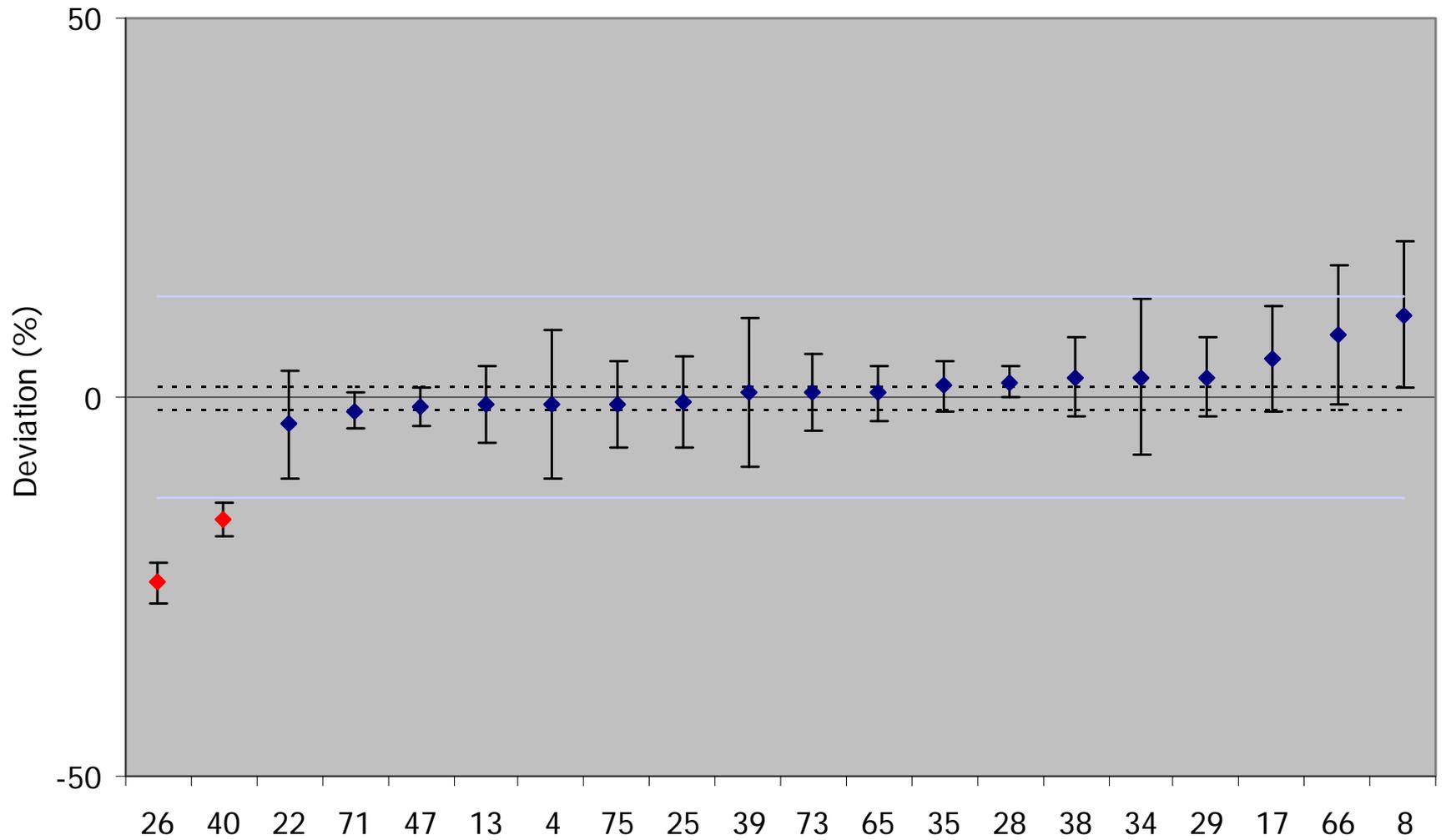
90% of the results 'in agreement'

AH

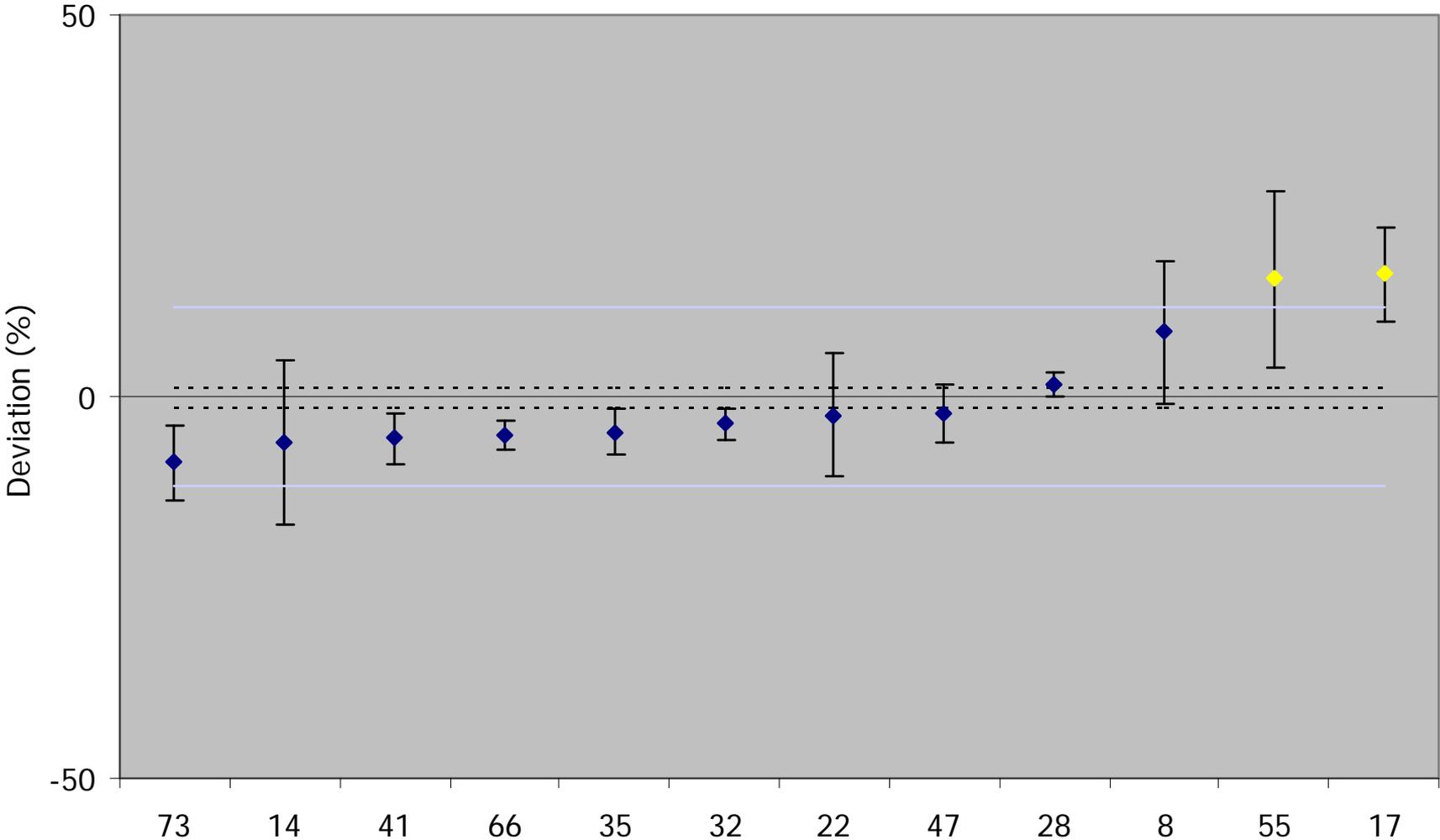
12 results

86% of the results 'in agreement'

Deviation Pu-239 AL



Deviation Pu-239 AH



AL

21 results

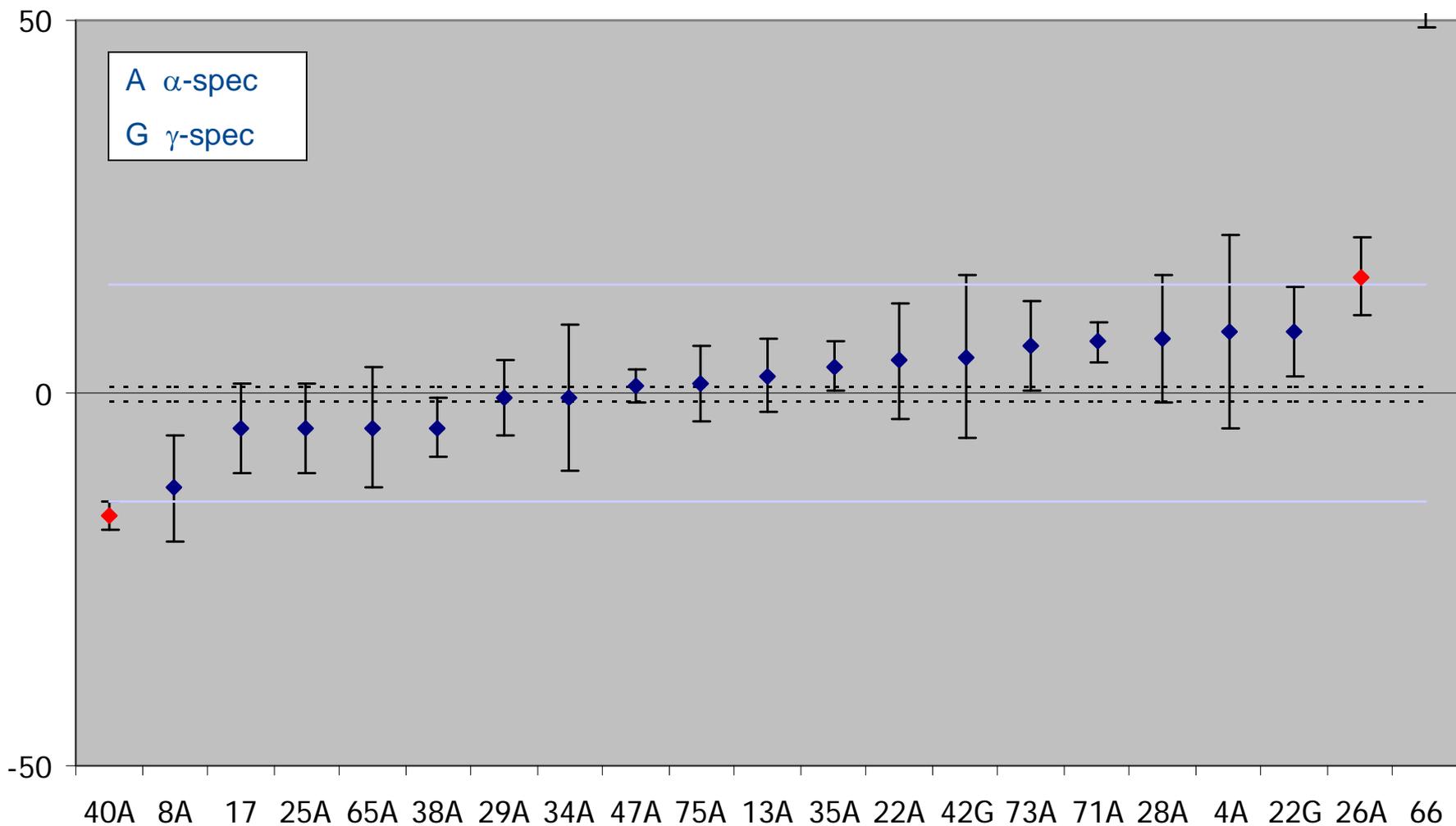
86% of the results 'in agreement'

AH

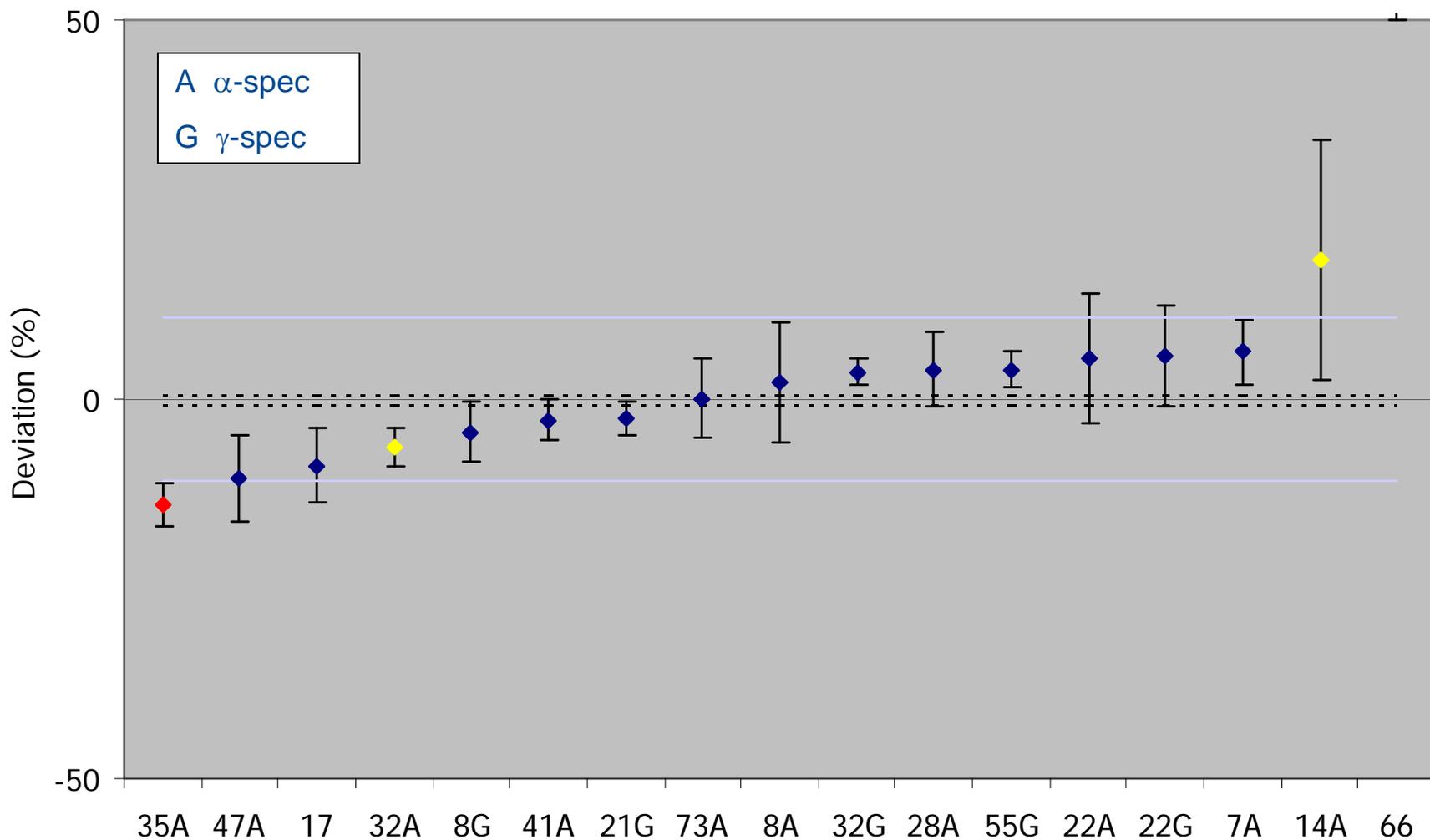
17 results

76% of the results 'in agreement'

Deviation Am-241 AL



Deviation Am-241 AH



AL

16 results

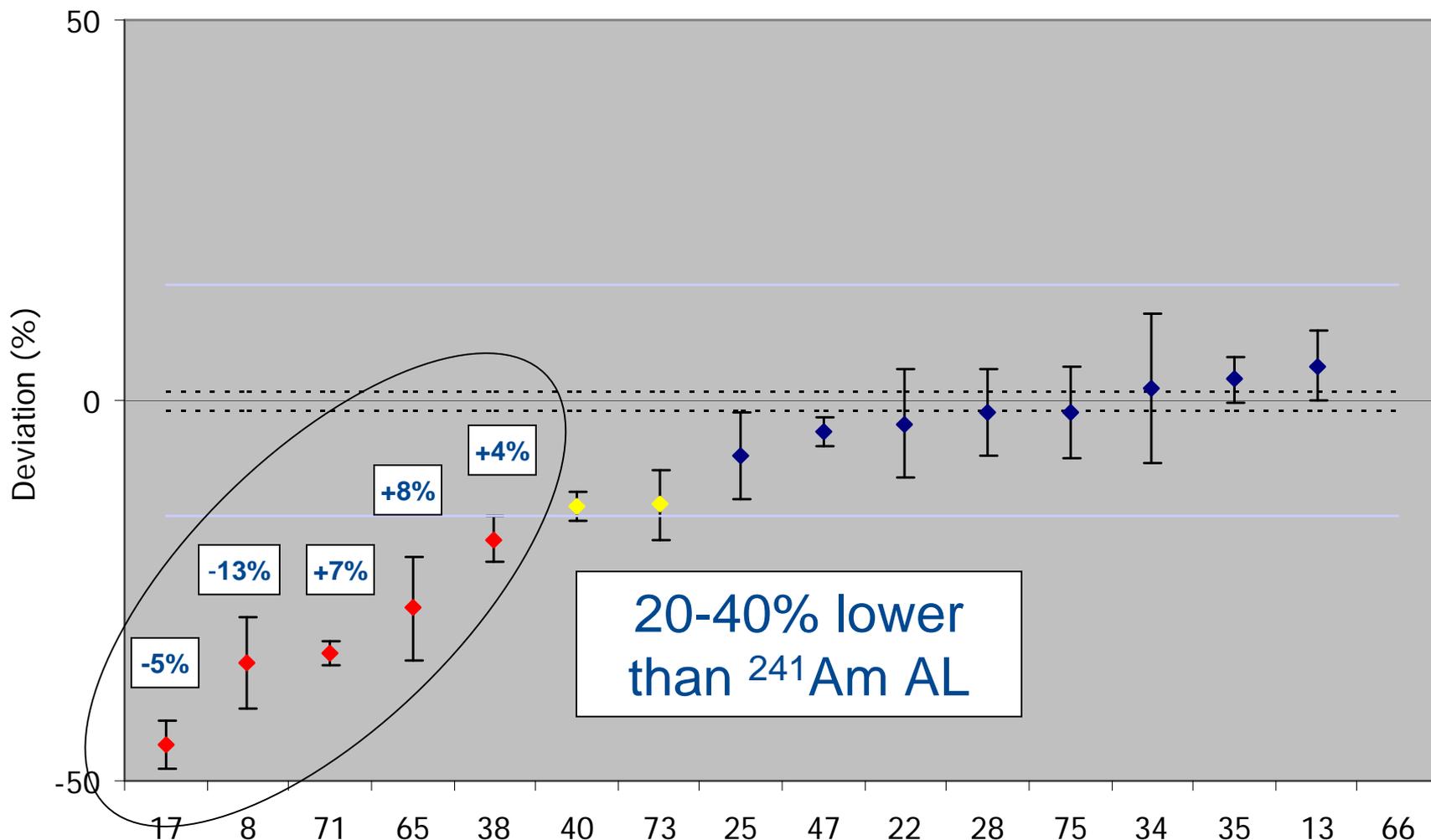
50% of the results 'in agreement'

AH

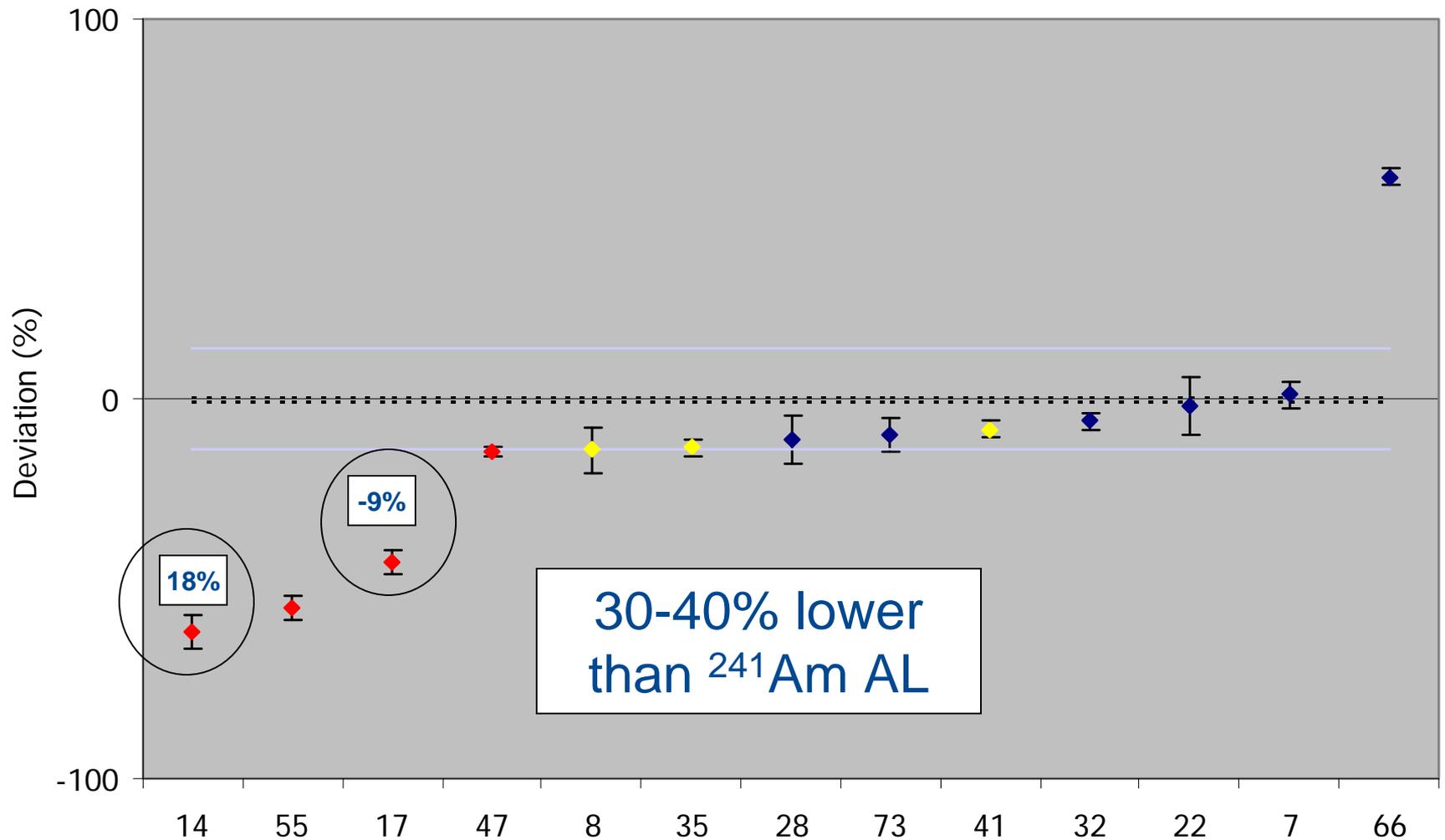
13 results

38% of the results 'in agreement'

Deviation Cm-244 AL



Deviation Cm-244 AH



Gross alpha results

AL

5 results

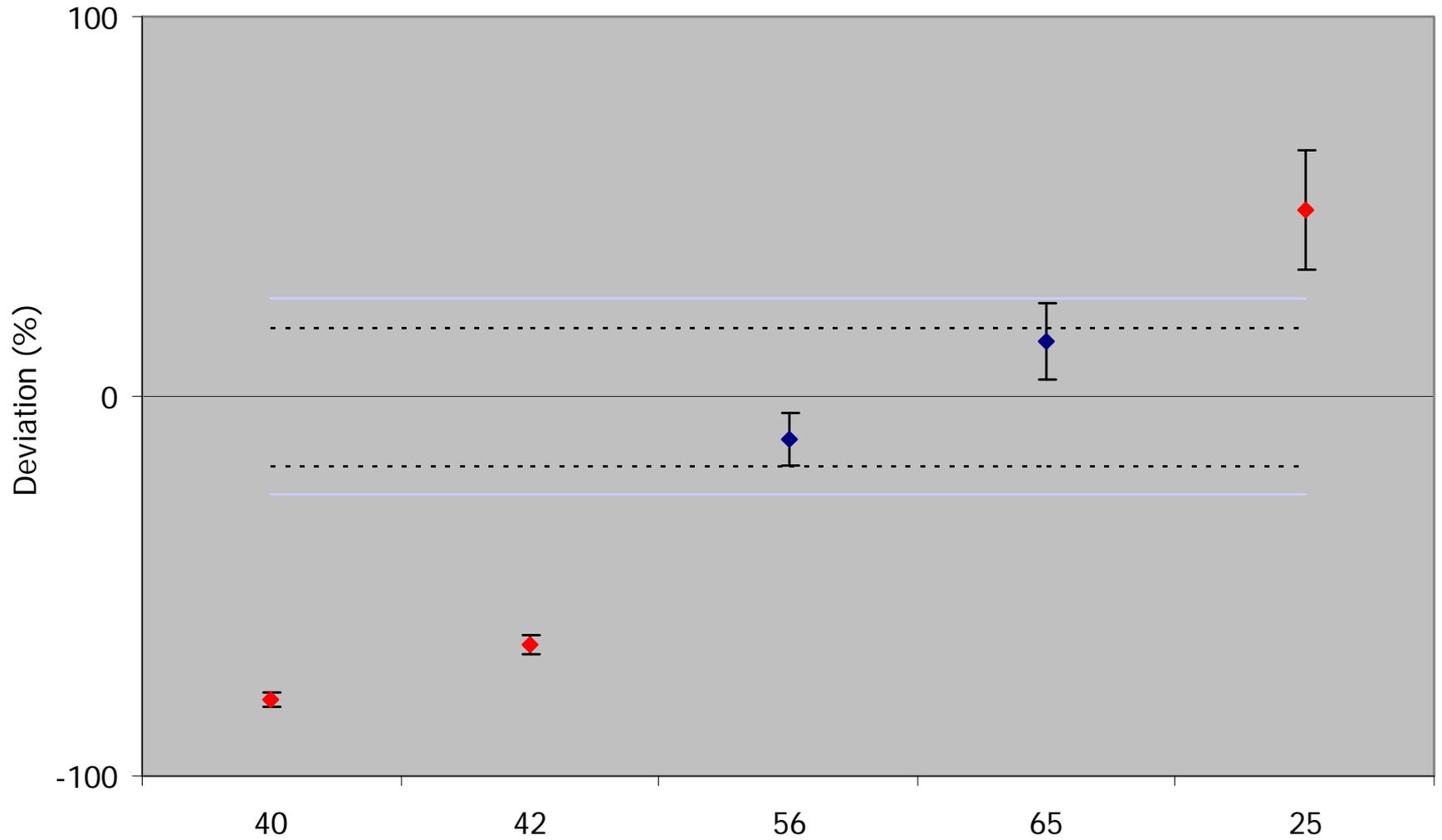
40% of the results 'in agreement'

AH

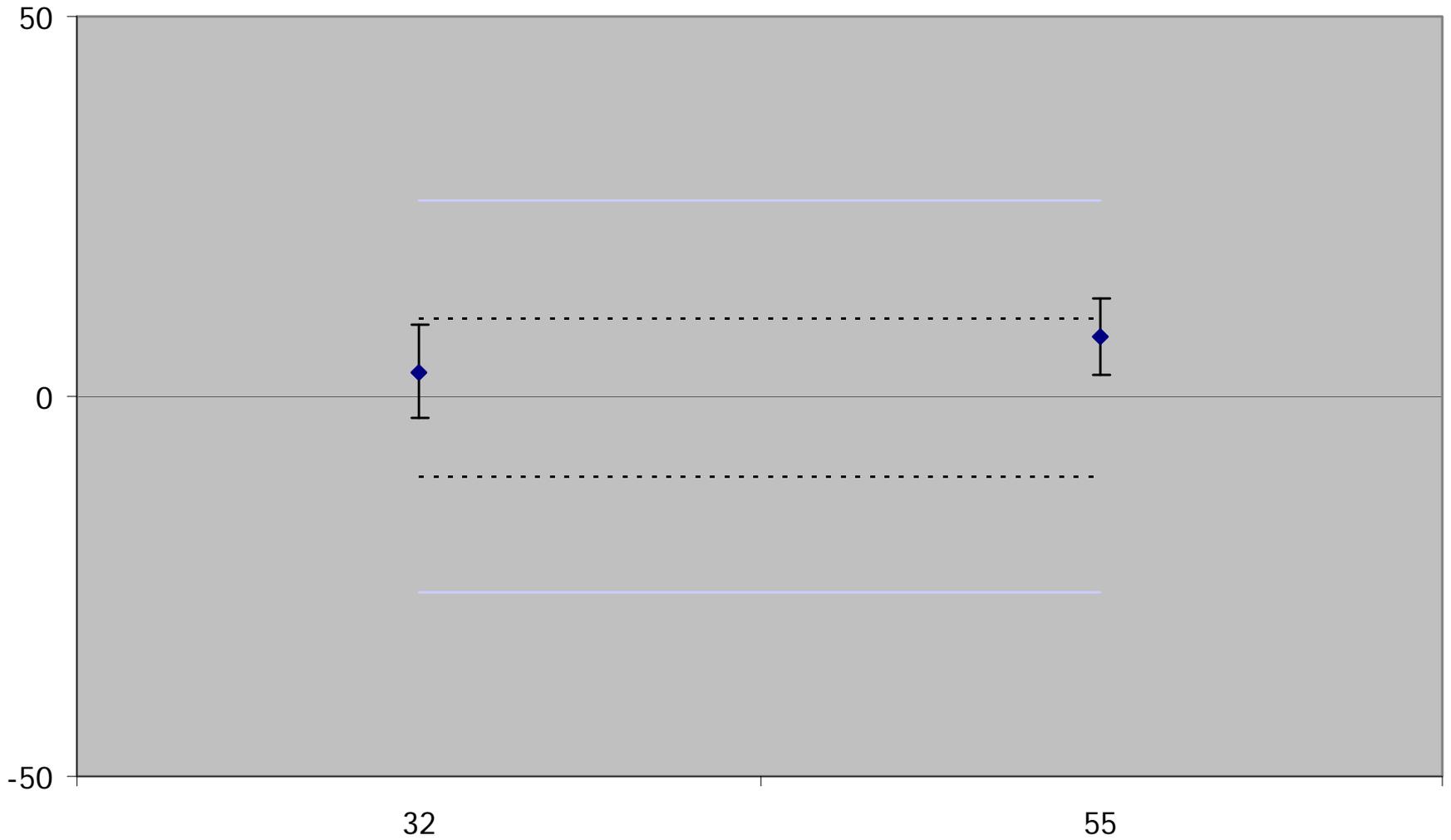
2 results

100% of the results 'in agreement'

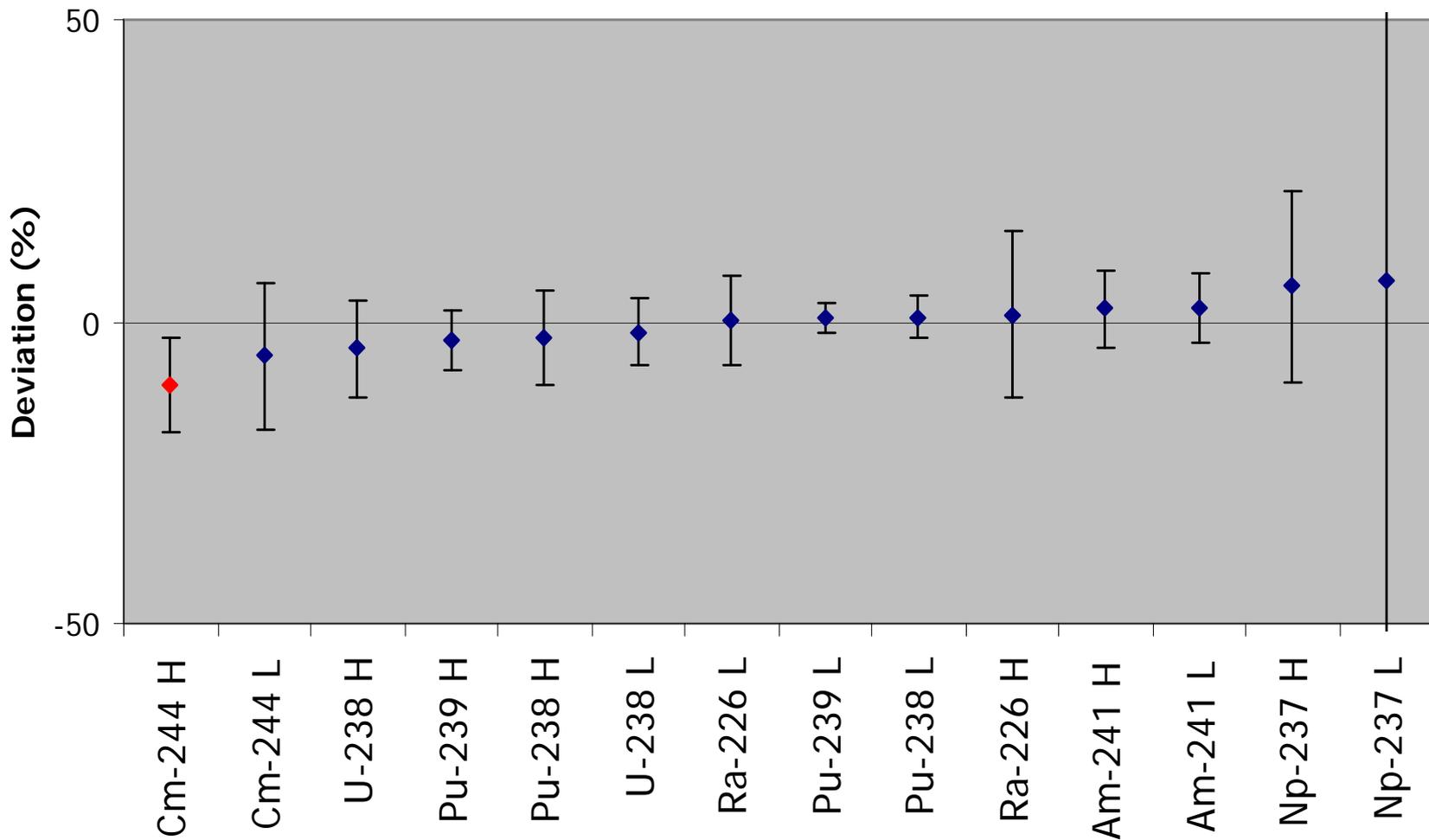
Deviation gross alpha AL



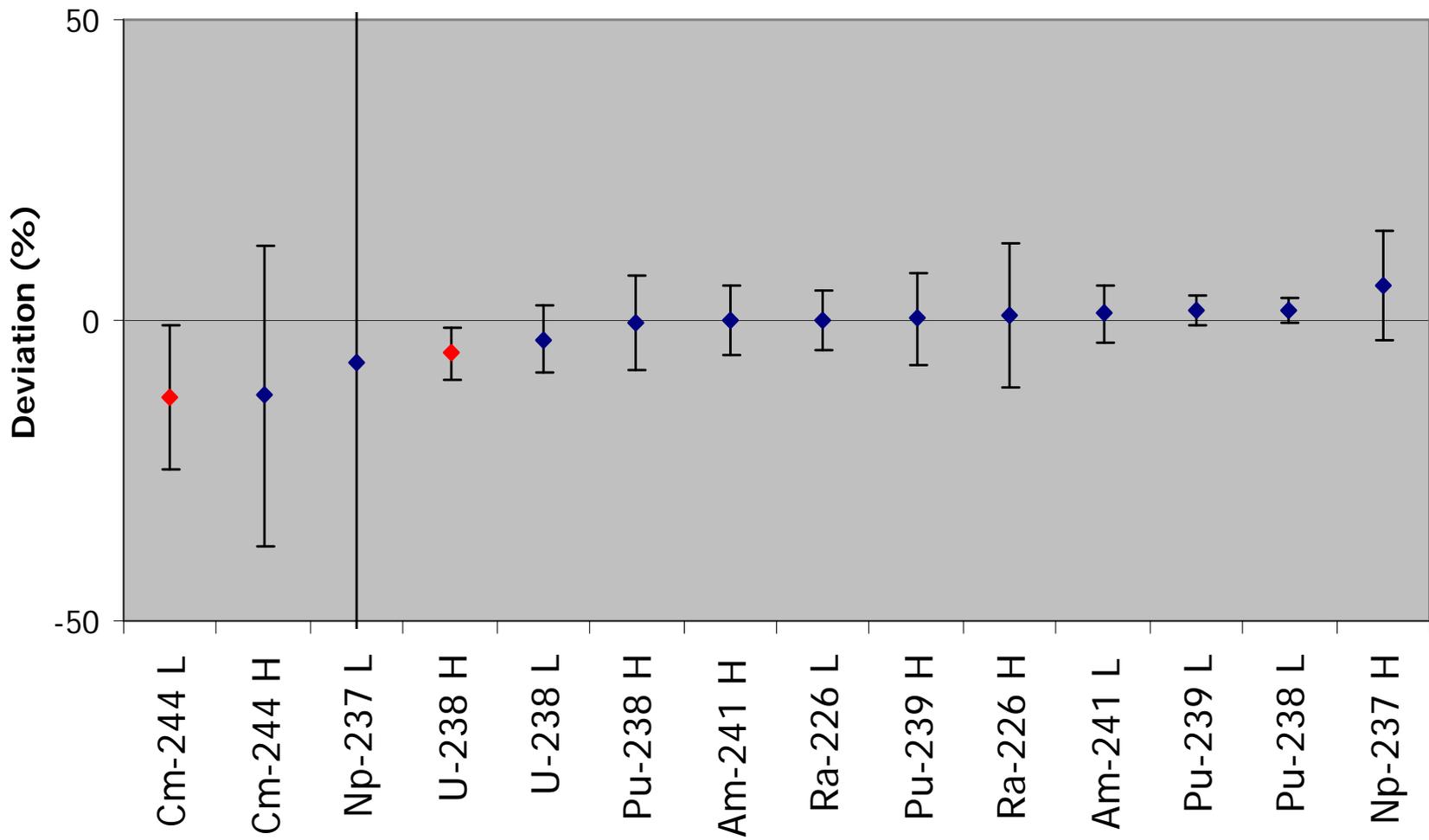
Deviation gross alpha AH



Median deviation AL and AH with 99% confidence limits



Mean deviation AL and AH with 99% confidence limits



Results

| | |
|-----|----------------|
| 74% | 'in agreement' |
| 8% | 'questionable' |
| 18% | 'discrepant' |

Problematic nuclides: ^{244}Cm , ^{237}Np (4 results)

Less problematic: ^{226}Ra , ^{238}U , ^{238}Pu , ^{239}Pu & ^{241}Am

Results

| | |
|-----|----------------|
| 69% | 'in agreement' |
| 18% | 'questionable' |
| 13% | 'discrepant' |

Problematic nuclides: ^{244}Cm , (^{238}U)

Less problematic: ^{226}Ra , ^{237}Np , ^{238}Pu , ^{239}Pu & ^{241}Am

Thank you

${}_{92}\text{U}$

${}_{93}\text{Np}$

${}_{94}\text{Pu}$

${}_{95}\text{Am}$

${}_{96}\text{Cm}$

