Optical Pumping Simulations of Copper and Magnesium Isotopes

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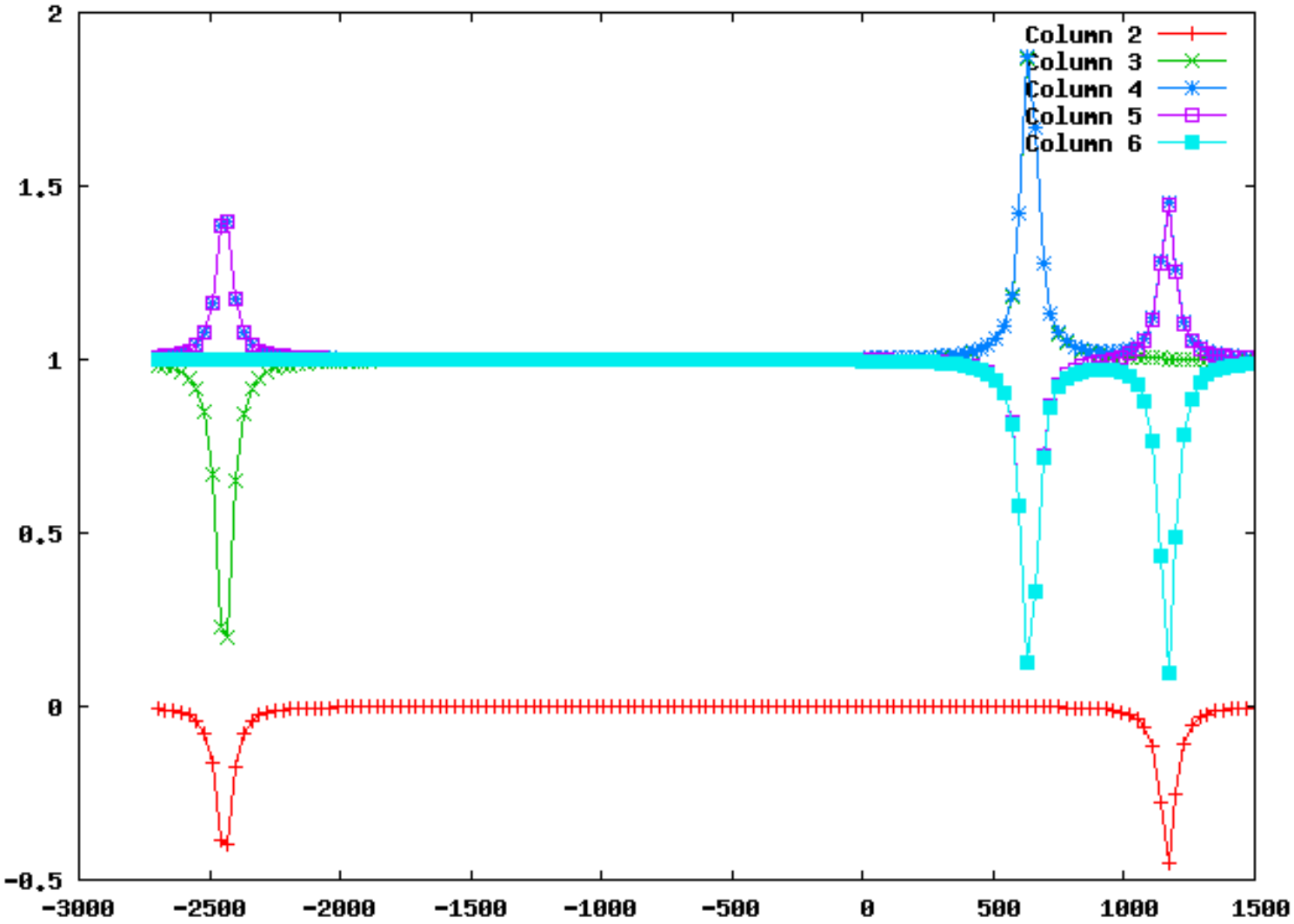
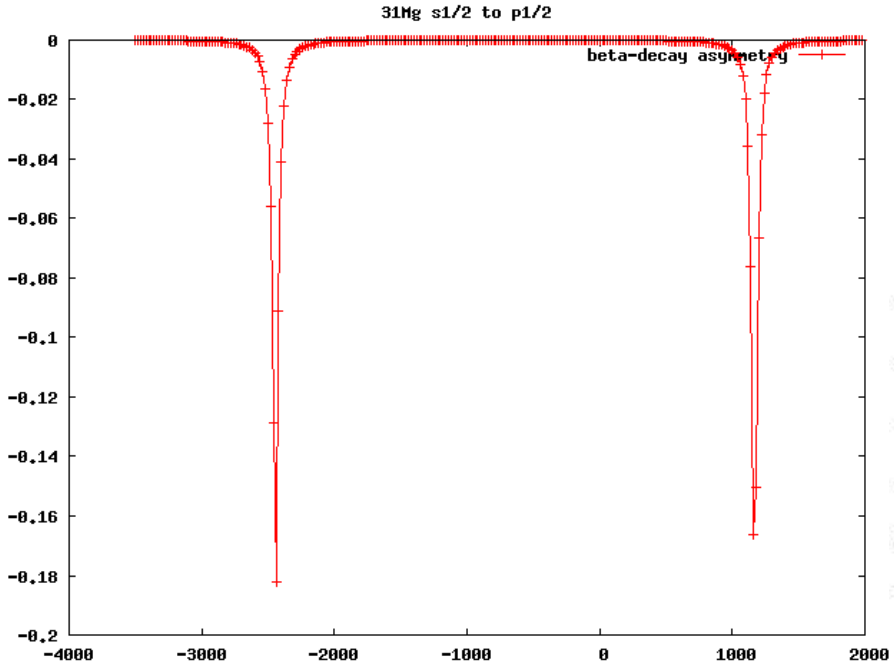
ISOLDE CERN
11.5.14

31Mg s1/2 to p1/2

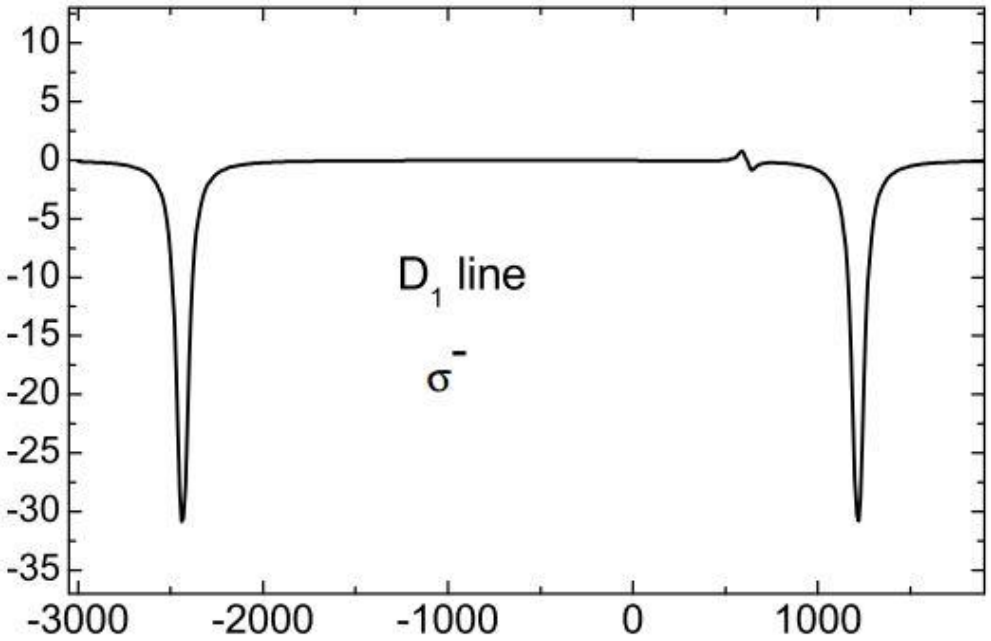


(Asymmetry factor in red;
other lines correspond to populations.)

31Mg $S_{1/2}$ to $P_{1/2}$ negatively circularly polarized light

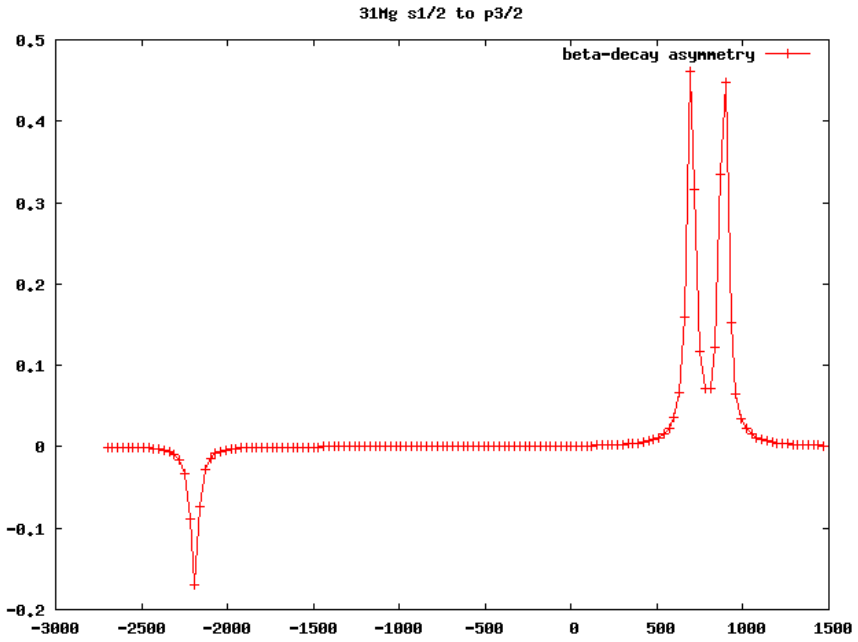


Trial simulation

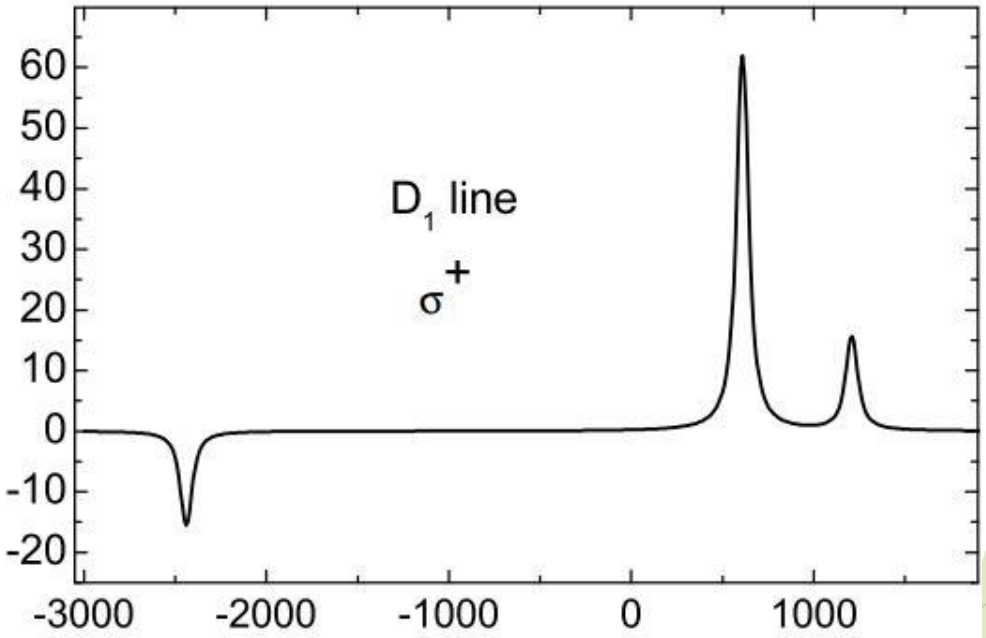


Published simulation, for comparison

31Mg $S_{1/2}$ to $P_{3/2}$ positively circularly polarized light

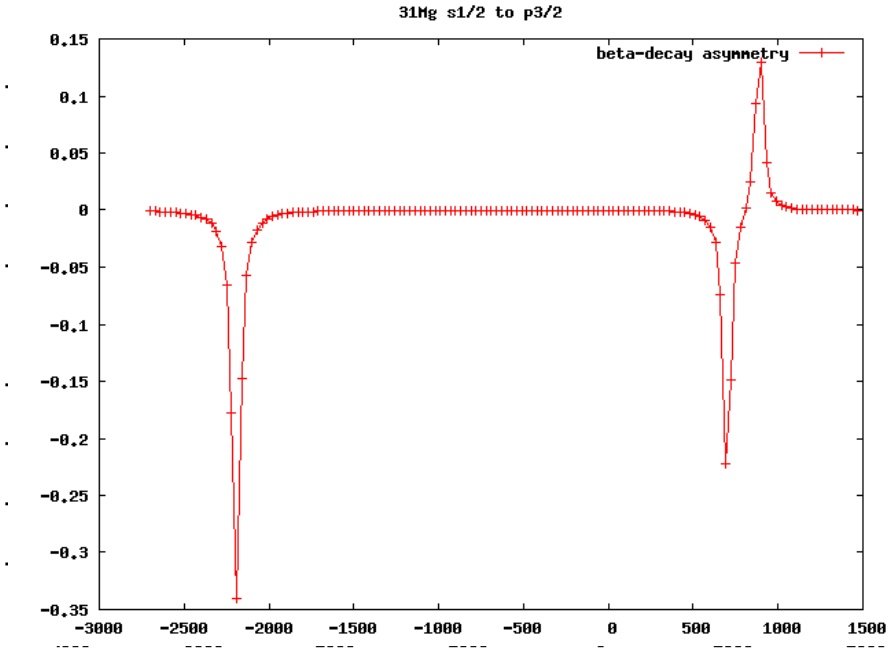


Trial simulation

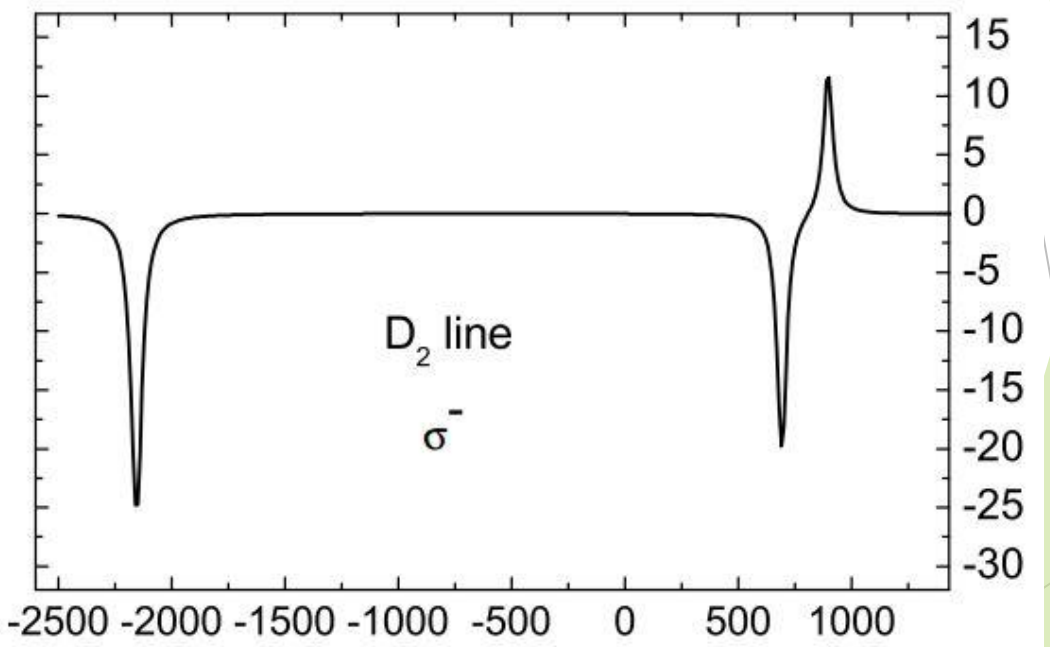


Published simulation, for comparison

31Mg $S_{1/2}$ to $P_{3/2}$ negatively circularly polarized light

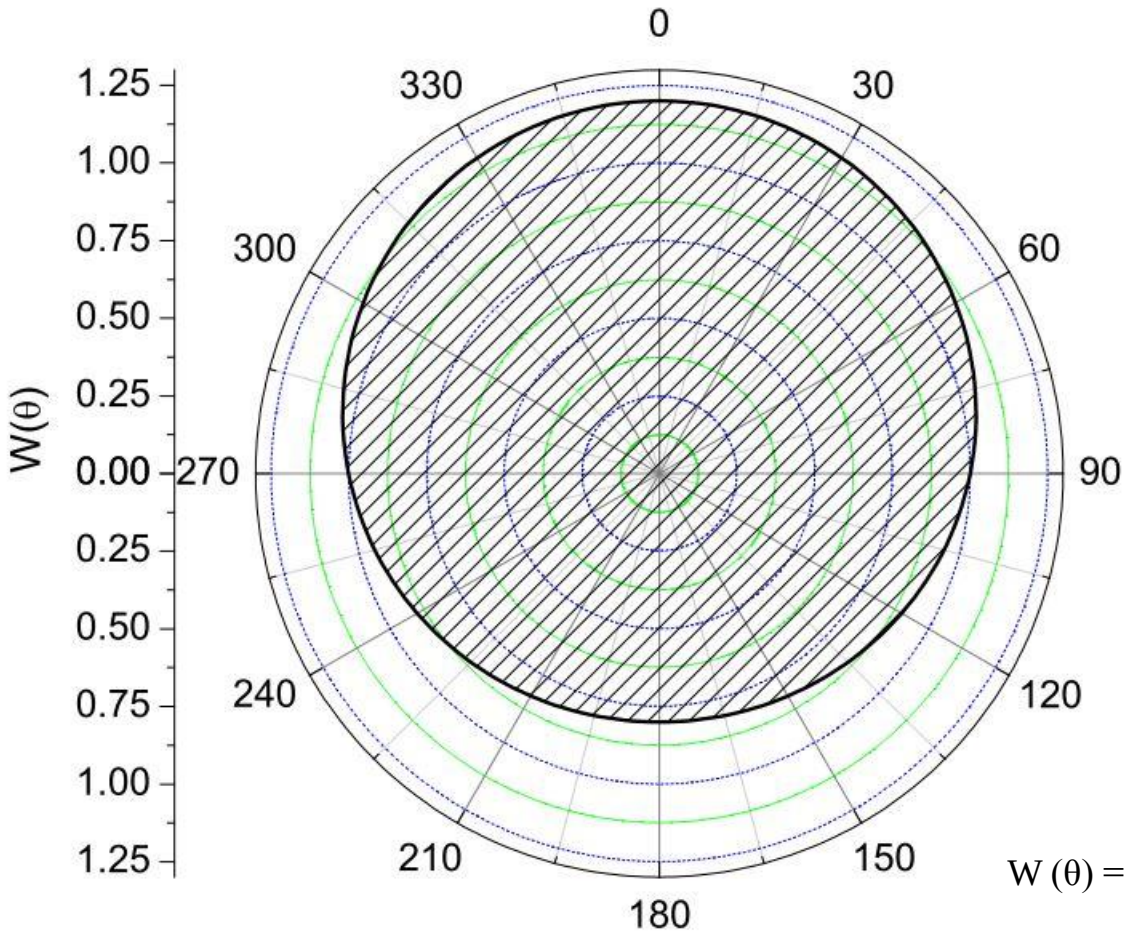


Trial simulation



Published simulation, for comparison

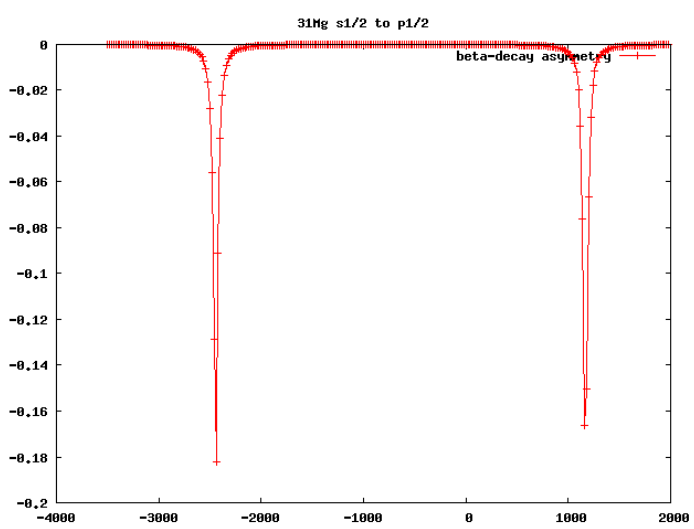
A Visual Representation of the Asymmetry Factor



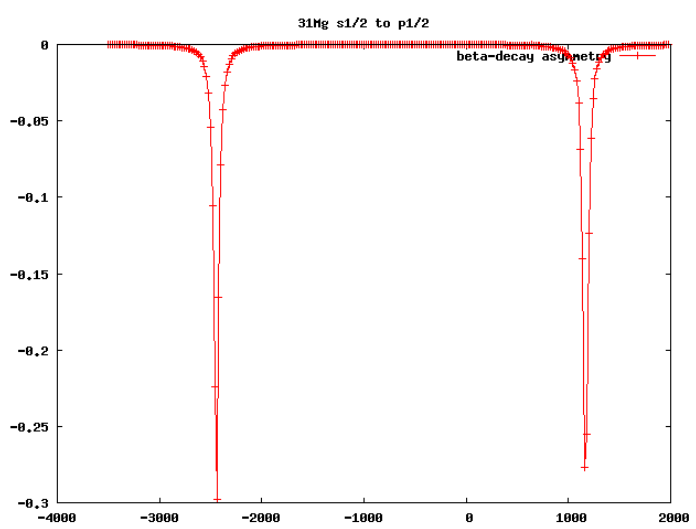
$W(\theta) = 1 + a * (v/c) * P_I * \cos(\theta)$

Figure 4.5: Angular distribution of β particles from allowed transitions, on the example of ^{29}Mg.

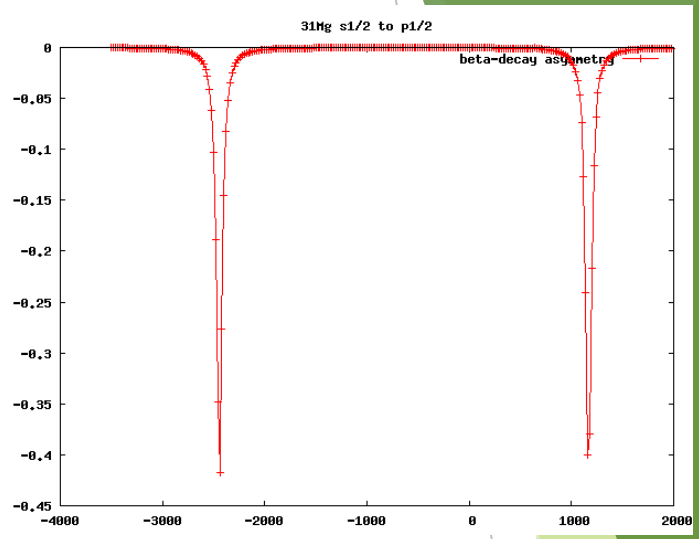
Asymmetry factor of 31Mg as a function of laser intensity



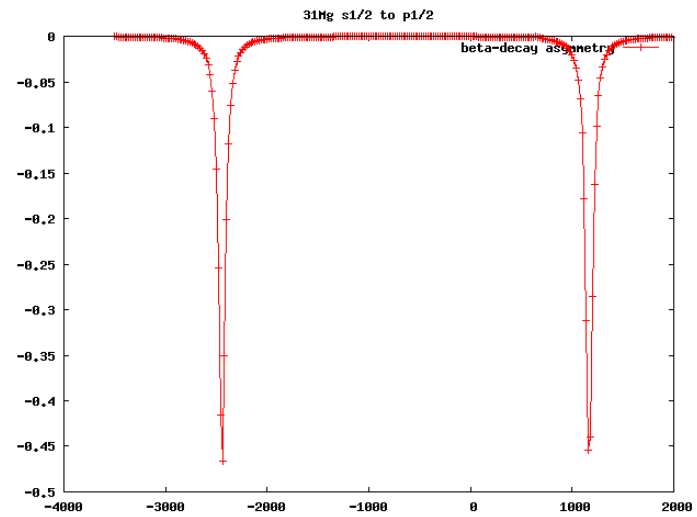
20 W/m^2; a = -0.182



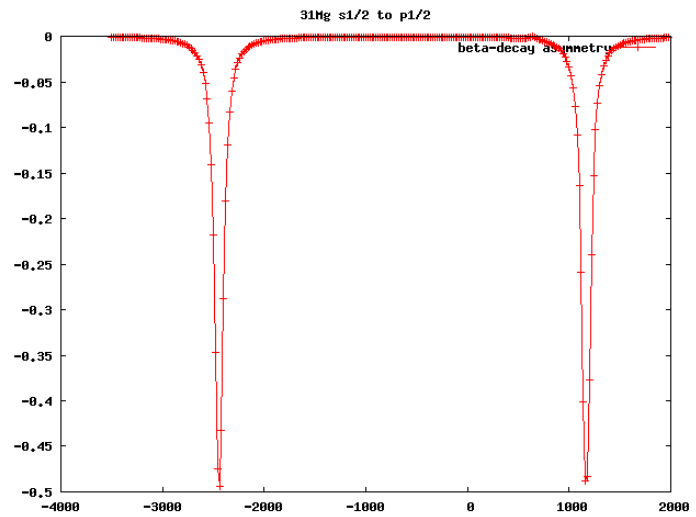
40 W/m^2; a = -0.0.298



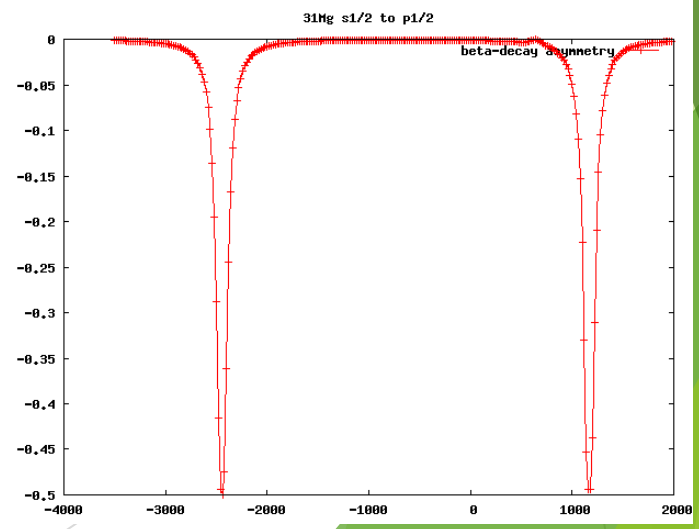
80 W/m^2; a = -0.419



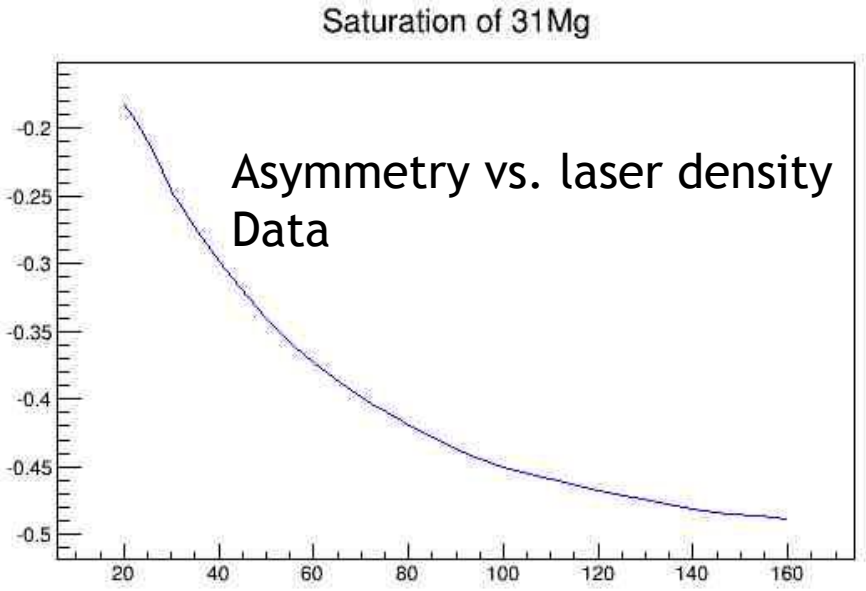
120 W/m^2; a = -0.467



200 W/m^2; a = -0.495



300 W/m^2; a = -0.498

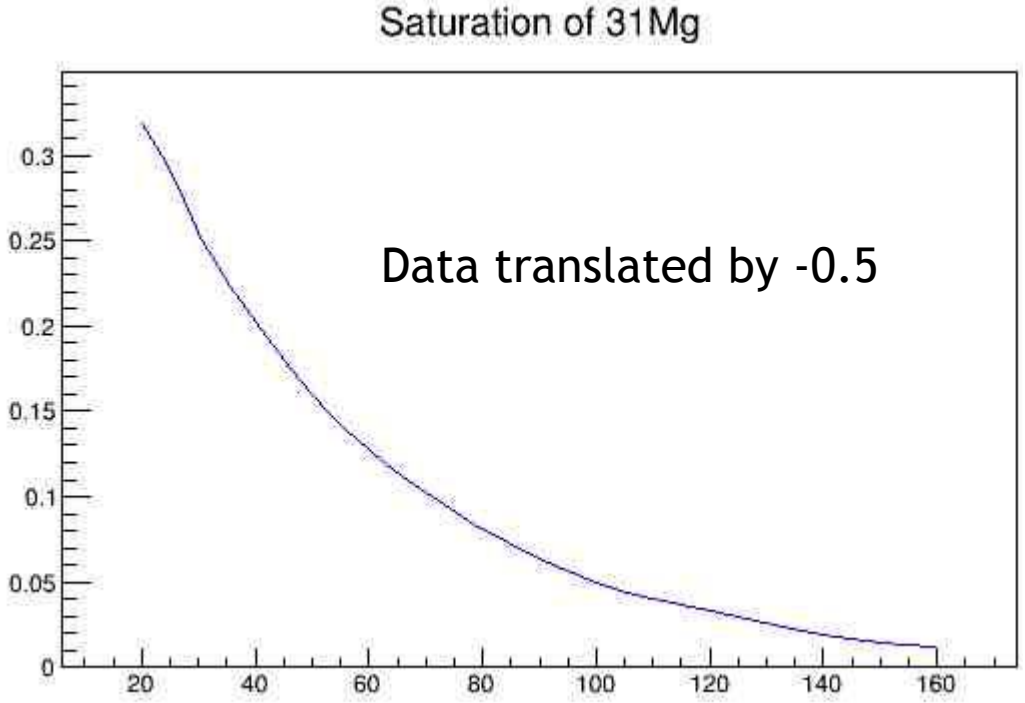


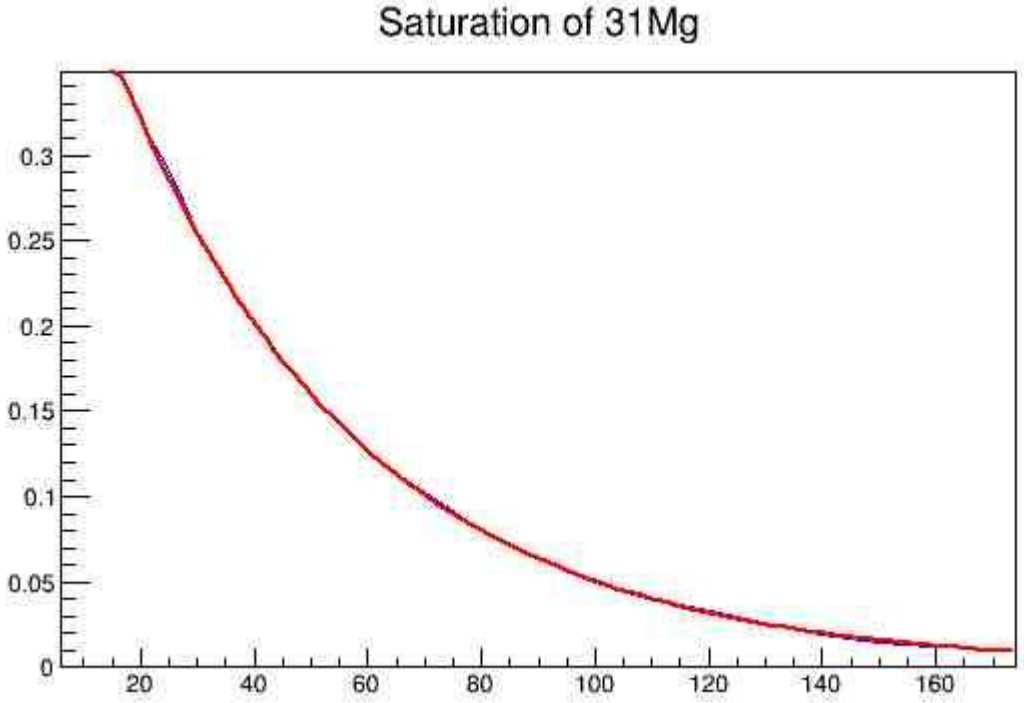
Results:

$a = 0.5e^{-0.023x} - 0.5$

Where a is the asymmetry factor and x is the laser intensity.

x-axes are given in MHz laser densities and y-axes correspond to asymmetry factors.





Another variable: Time of Interaction

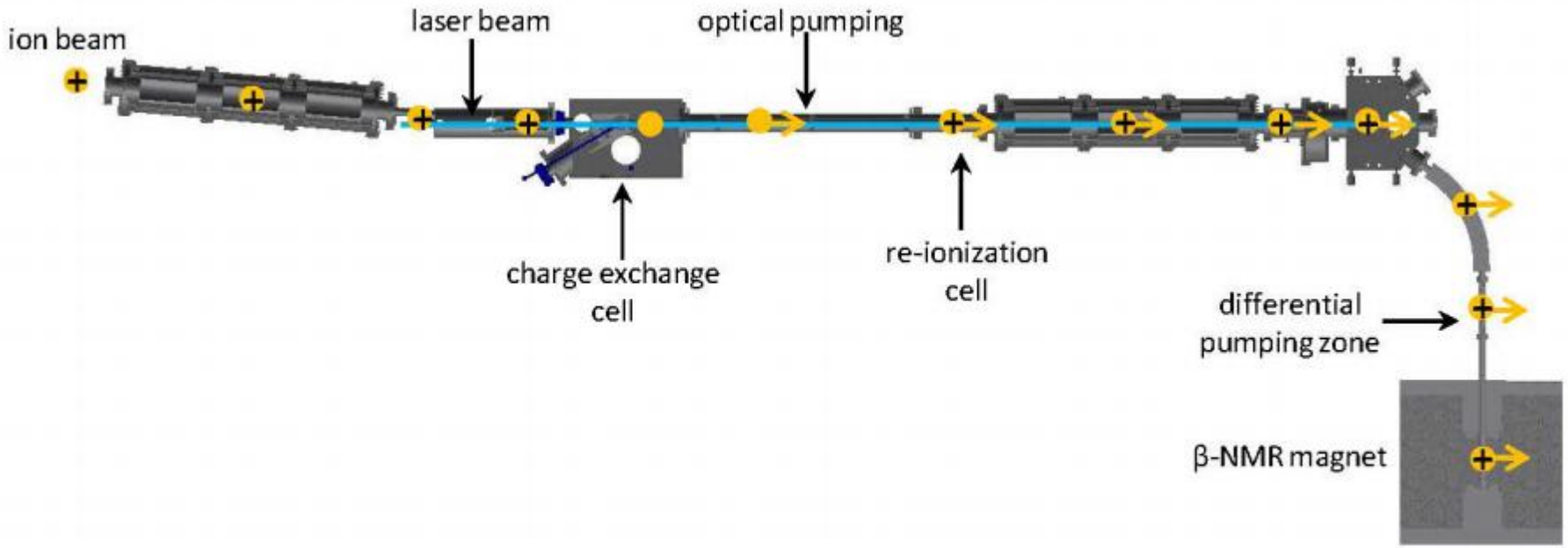


Fig. 2. Elements of the VITO beam line relevant for β-NMR studies on liquid samples.

Another variable: Time of Interaction

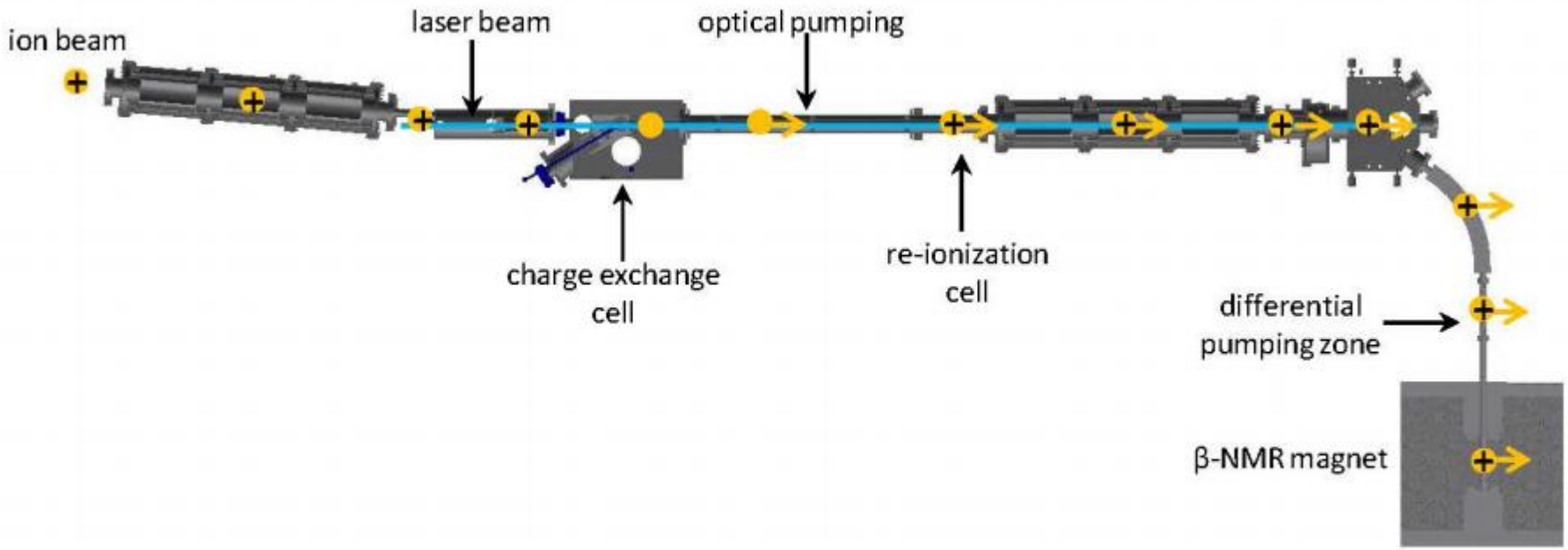


Fig. 2. Elements of the VITO beam line relevant for β-NMR studies on liquid samples.

Constraints: 60keV beam, 2m optical pumping length

=> interaction time is given:

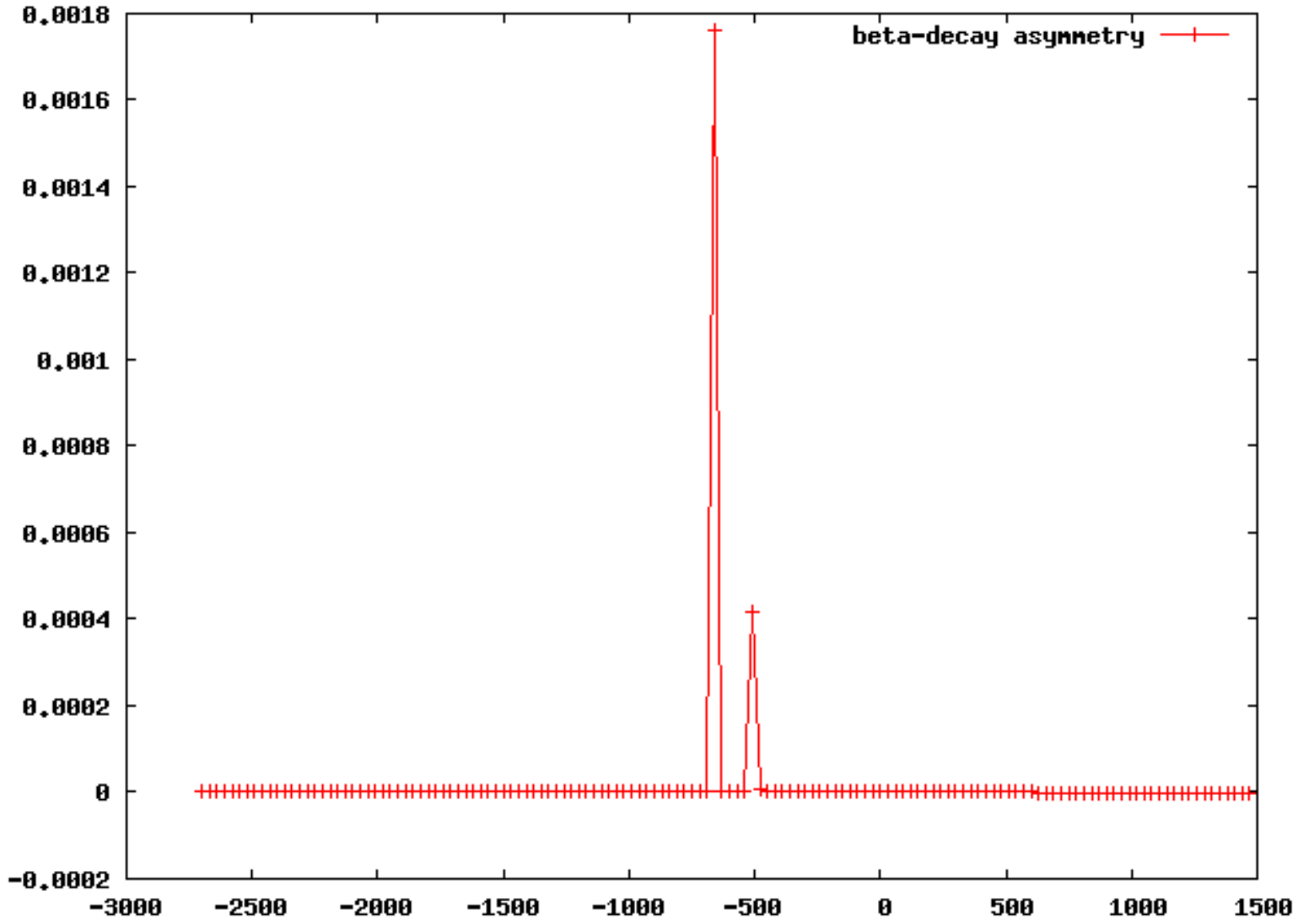
31Mg: 3.28 μs

58Cu: 4.49 μs

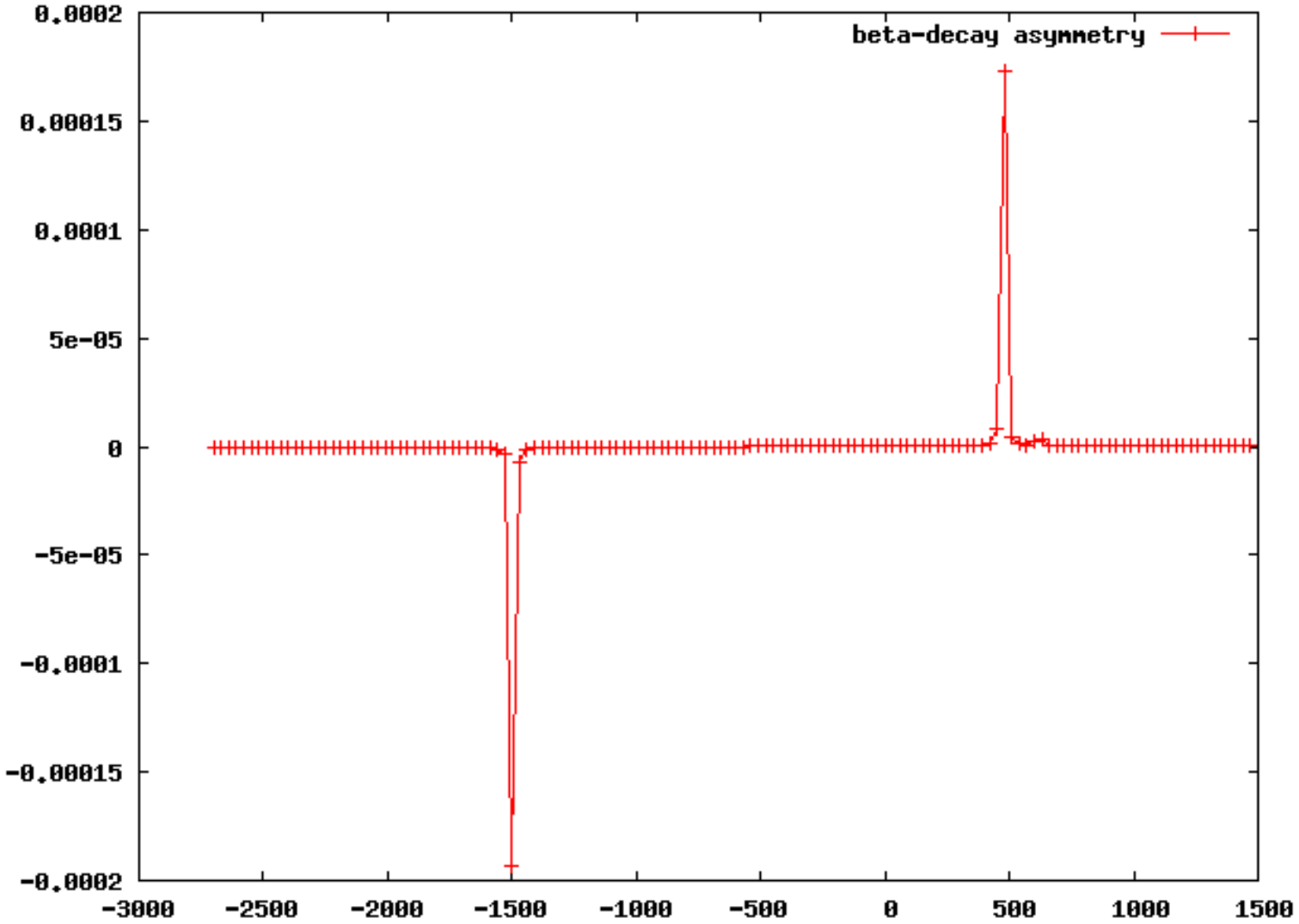
74Cu: 5.07 μs

75Cu: 5.11 μs

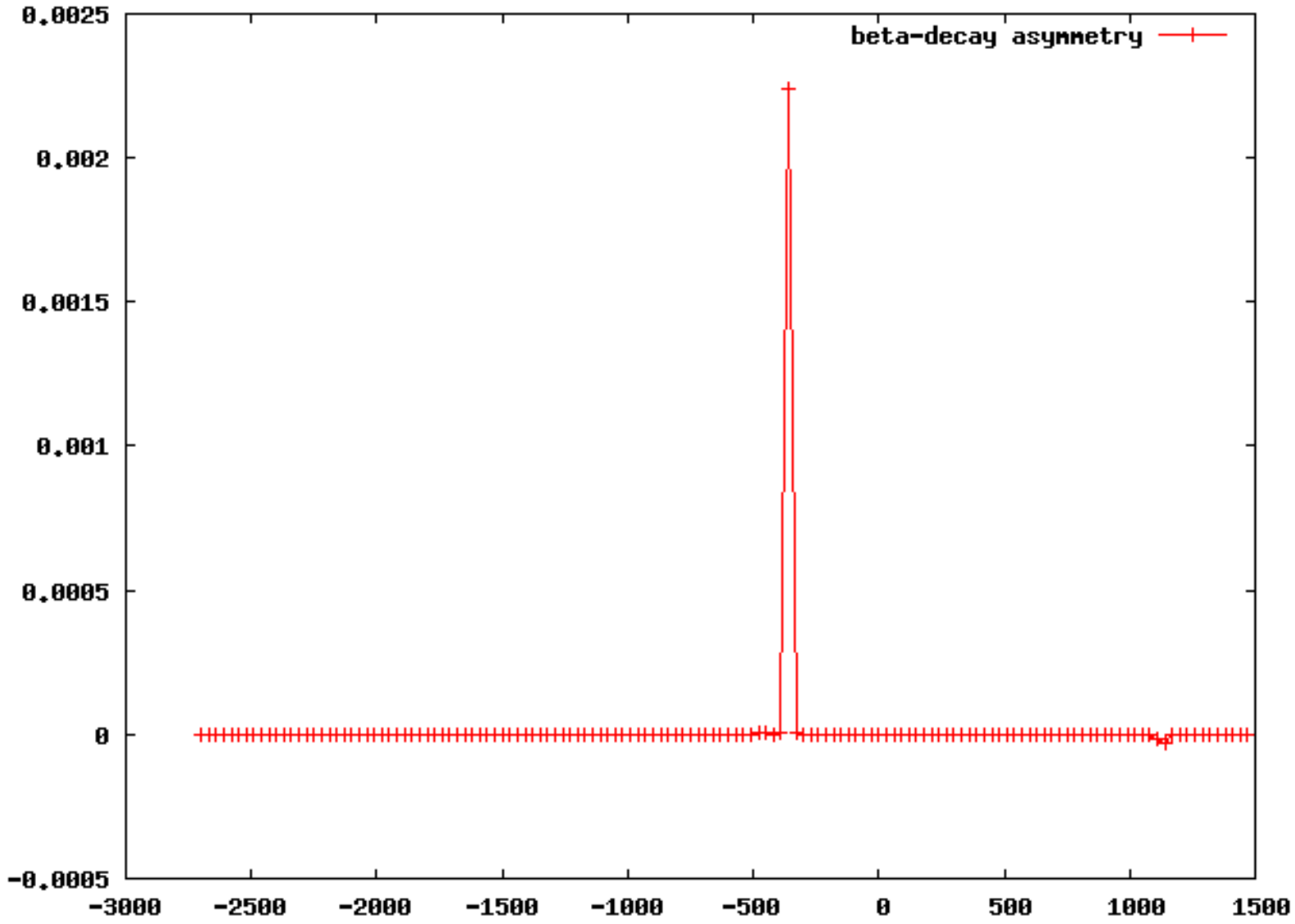
Asymmetry Factor for 58Cu



Asymmetry factor for 74Cu



Asymmetry factor for 75Cu



Questions?