Simulations for lifetime measurements

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What will I talk about...

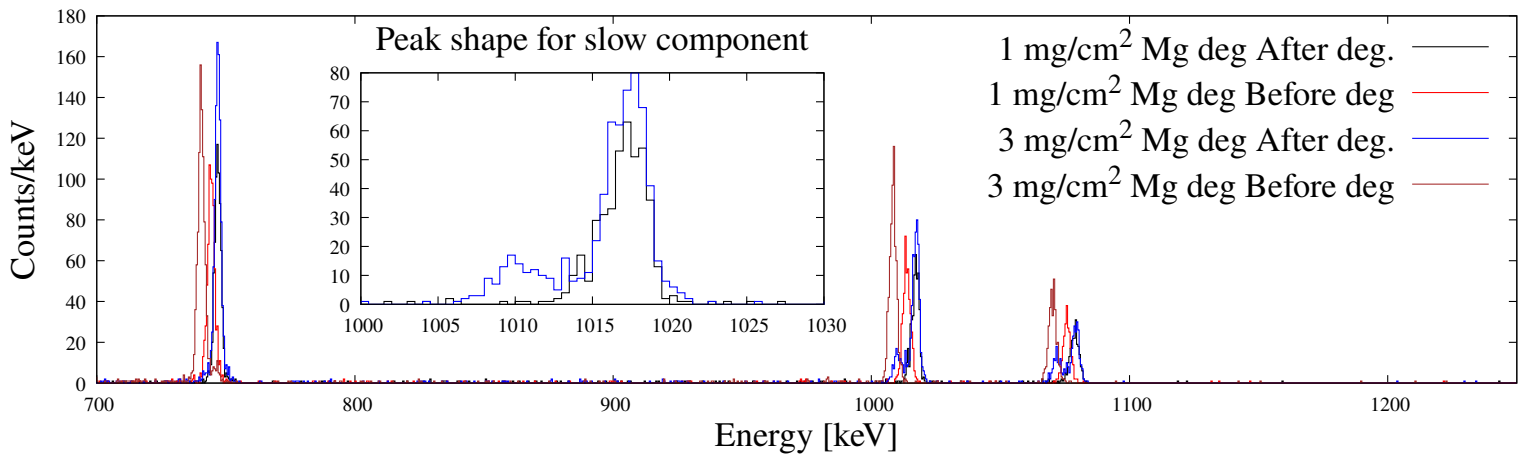
- A very short introduction to why simulate experiments aiming to measure lifetimes
- Then I get technical about how to do it...

Why do simulations for lifetime measurements?

Good simulations help planning experiments

- Requires one to think about the experiment
- Conceptually easier than analytical methods
- However, not magic. Many results shown today could be done with paper and pen.

Example, degrader thickness for ^{64}Fe

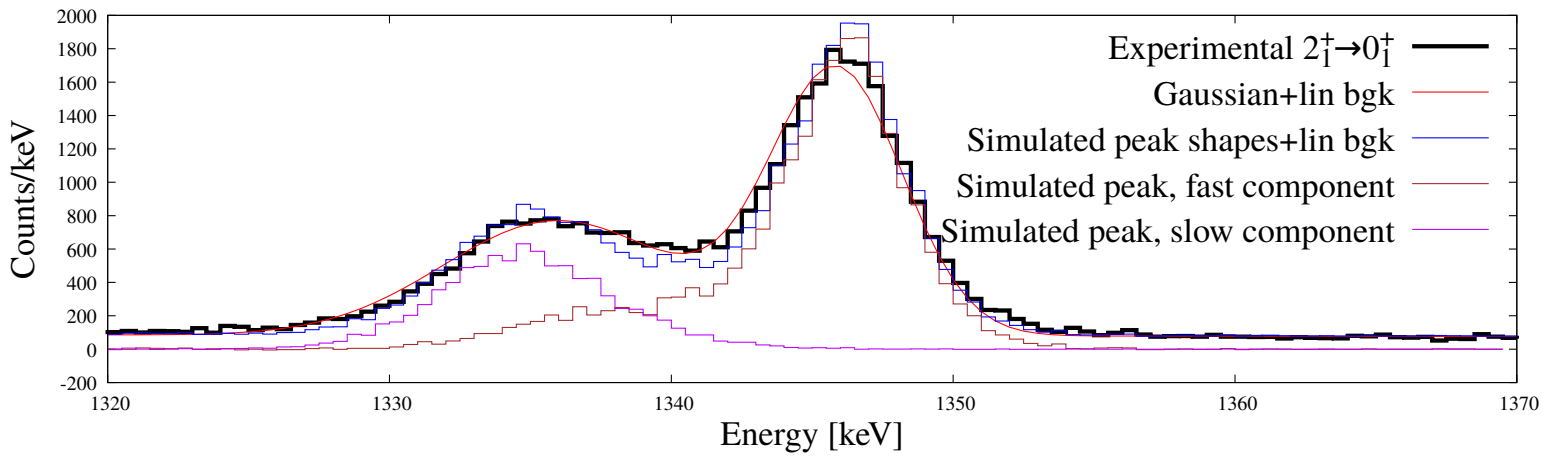


Why do simulations for lifetime measurements?

To help fit oddly shaped peaks

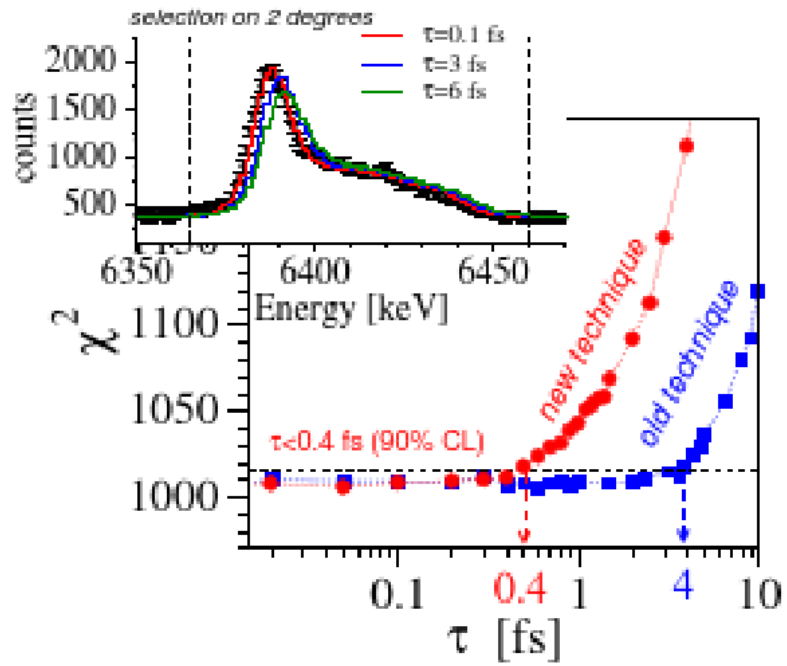
- We can get correct shape of a peak
- But also see how shapes varies with feeding pattern

Example, 2^+ ^{64}Ni



Why do simulations for lifetime measurements?

DSAM in ^{15}O

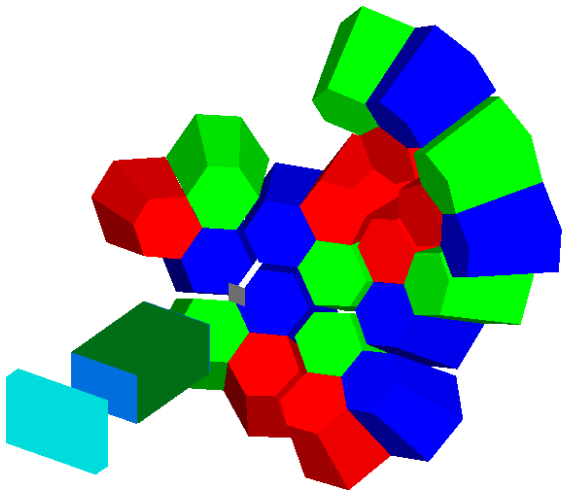


Determination of τ via lineshape analysis over a **continuous angular distribution**

How to we do this?

Lets look at AGATA+VAMOS+Plunger MNT reaction

- 6.5 MeVA ^{238}U beam, 1.5 mg/cm^2 ^{64}Ni target, 3.3 mg/cm^2 Mg degrader
- VAMOS at 45°
- 19(21) AGATA crystals at 180°, 23.5 cm distance



How to do this

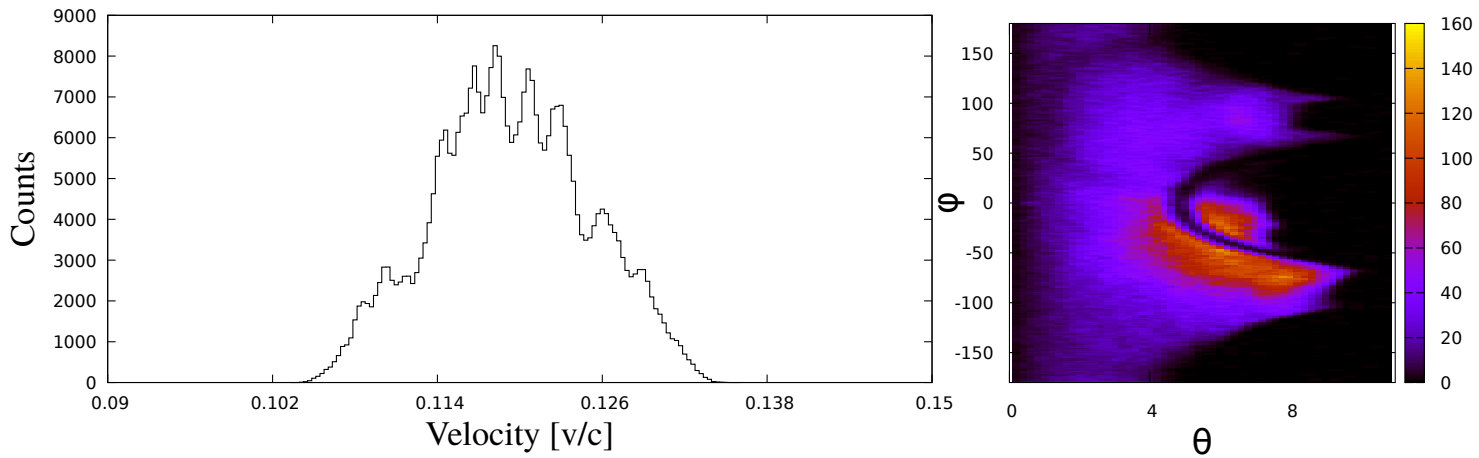
To set it up looks about like this

```
/Agata/generator/emitter/BeamIn/Z 92
/Agata/generator/emitter/BeamIn/A 238
/Agata/generator/emitter/BeamIn/KE 1547 MeV
/Agata/generator/emitter/BeamIn/fcZ -5 cm
/Agata/generator/emitter/BeamIn/bDir 45 0
/Agata/generator/emitter/BeamOut/DZ -64
/Agata/generator/emitter/BeamOut/DA -174
#target in the following
/Agata/generator/emitter/BeamOut/Z 28
/Agata/generator/emitter/BeamOut/A 64
/Agata/detector/targetMaterial G4_Ni
/Agata/detector/targetSize 20 20 0.00001 #!!
/Agata/detector/degraderMaterial G4_Mg
/Agata/detector/degraderSize 20 20 3.3
/Agata/detector/SetBuildSpectrometer true
/Agata/detector/angleFile euler_e663.list
/Agata/detector/enableCapsules
/Agata/detector/enablePassive
/Agata/detector/rotateArray 0 -33.9 0
```

How do we do this?

Use as much information as possible from experiment

- Use velocities and angles from experimentally identified ions, here ^{64}Ni



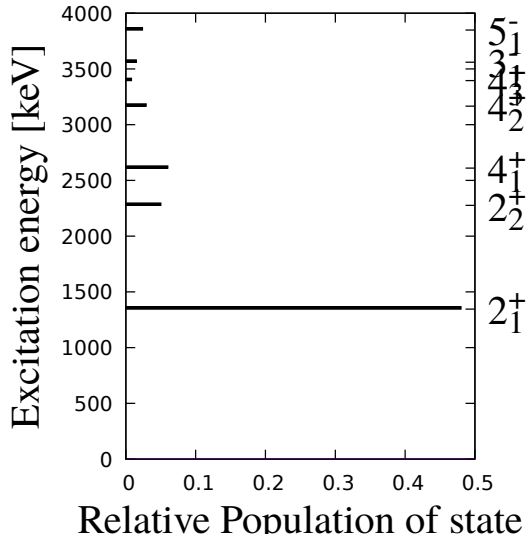
- And we need to tell simulations to use it

/Agata/generator/emitter/SetRecoilFile recoildata64Ni.txt

How do we do this?

Use as much information as possible from experiment

- We use efficiency and total intensities to put in feeding pattern



- Simulation command

/Agata/generator/emitter/BeamOut/ProjectileExcitation 1345.75 48.2 2276.56 5.3 2610.1 6.5 3166.1 2.9 3395.7 0.79 3560.4 1.48 3848.9 2.37

- And also some first guess of lifetimes

/grdm/setRadioactiveDecayFile 28 64 decay64Ni

How do we do this?

And the datafile for decay

```
P        1345.75   8.8e-13
                         IT       1345.75      100.
P        2276.56   1e-12
                         IT       2276.56      100.
P         2610.1   3.1e-13
                         IT        2610.1      100.
P         2867.3   4e-14
                         IT        2867.3      100.
P        2972.08   1.3e-13
                         IT       2972.08      100.
P        3025.83   0
                         IT       3025.83      100.
P         3166.1   1.3e-13
                         IT        3166.1      100.
P        3275.98   2.1e-13
                         IT       3275.98      100.
P         3395.7   0
                         IT        3395.7      100.
P        3463.61   0
                         IT       3463.61      100.
P         3560.4   2.8e-12
                         IT        3560.4      100.
P        3647.98   0
                         IT       3647.98      100.
P           3749   0
                         IT          3749      100.
P         3749.4   0
                         IT        3749.4      100.
P         3848.9   5e-12
```

How do we to this

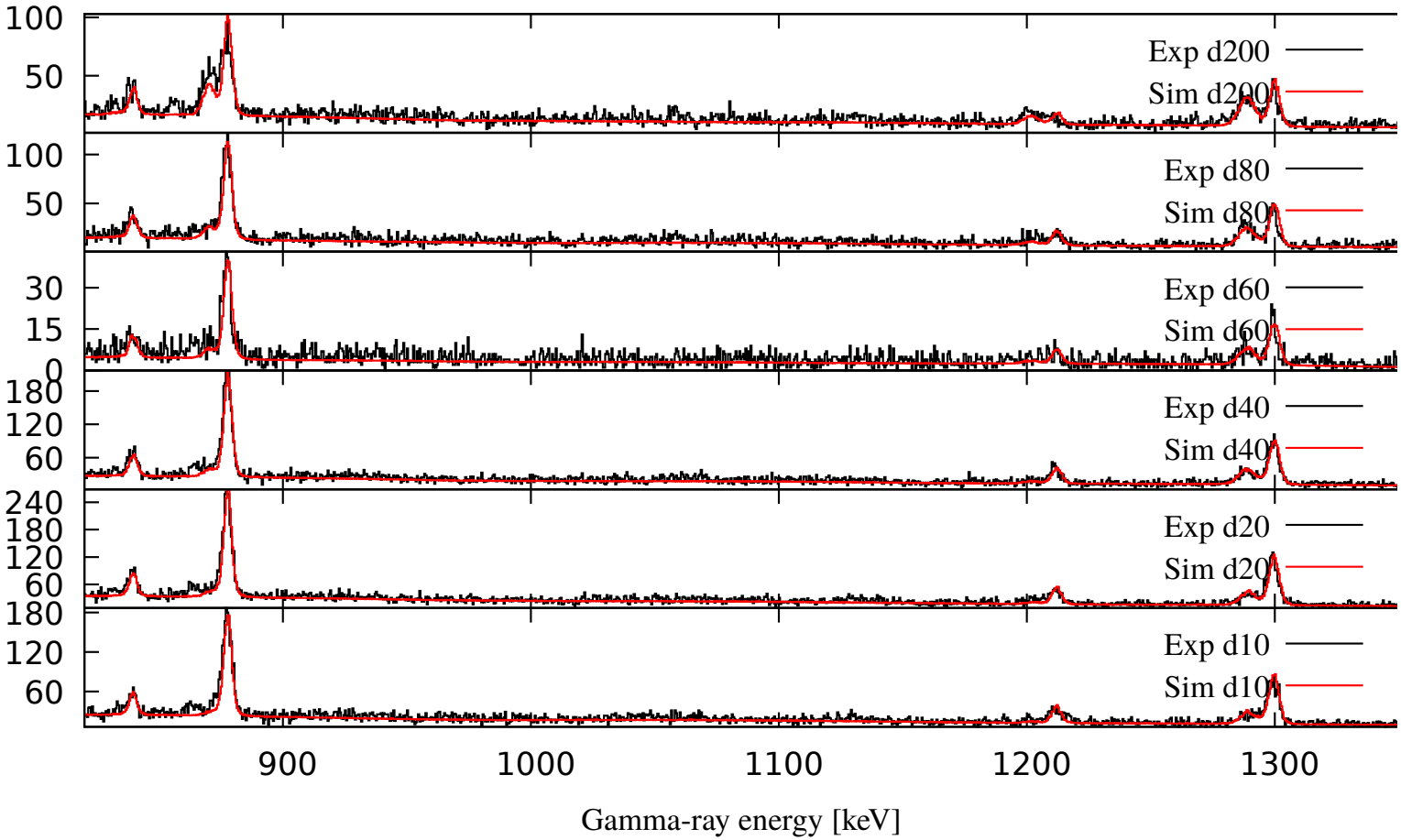
We then run the simulation and track the output

```
bash> G4AGATAGANILCHAMBERGDMLPATH=/data2/joa/agataganil/gdml-files/AGATA/GanilChamb/ \
G4AGATAVACUUMINWORLD=yes\
 ~/Mercurial/Ljungvall/AgataSimCode/RunRunsInParallel.py -i\
 64Ni_first.mac -c "Agata -a 1 27\
 -AddOn\
/raiddata/joa/e663/E663/geant4sim/SimEff152Eu/libCupperAddOn.so\
 -Gen -SN -seed"
bash> tracking_EmissionCode=-8 POSRESFACTOR=2.5\
 ~/Mercurial/Ljungvall/AgataSimCode/SortRuns 00[456][01]
```

And analyze the result using root

```
root [0] .L ~/Mercurial/Ljungvall/AgataSimCode/VamosAcc.cpp+O
root [1] .L ~/Mercurial/Ljungvall/AgataSimCode/HistoAGATAEXOGAM.cxx+O
root [2] BetaFactor=1.034
root [3] LoopOverFiles("tracked_energies_004[01]","","",.92)
```

An example of work in progress ^{62}Fe



Emacs 26.0.50.1 (Org mode 8.3.6)