## Using simulations to inform μSR data analysis

STFC ISIS Muon Department

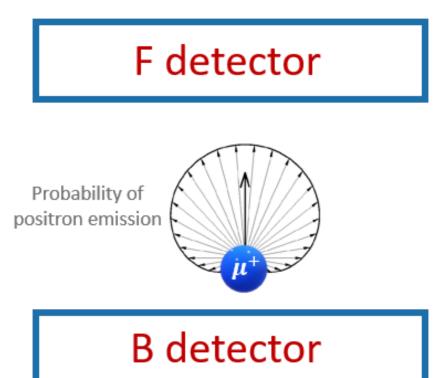
#### Introduction

$$A(t) = \frac{F - \alpha B}{F + \alpha B}$$

The experimental data is obtained by the asymmetric emission of positron on the decay of muon.

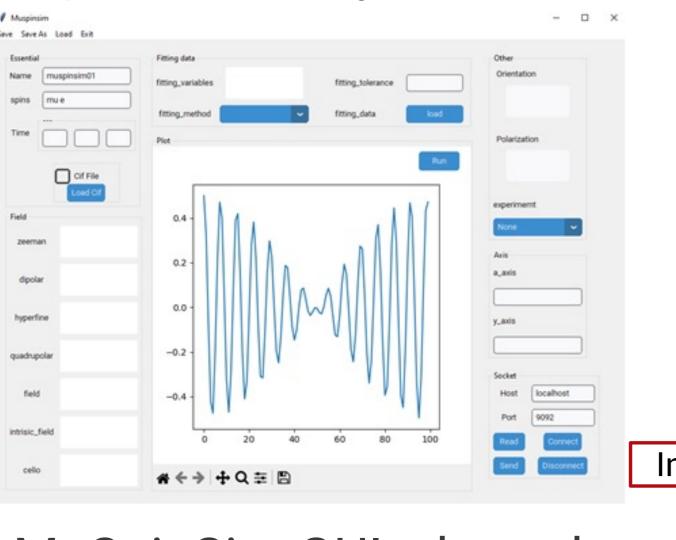
A(t) -Asymmetry

F, B-counts on the forward backward detectors



### Method

The Hamiltonian and its physical components in the simulation can be tuned to represent closely the experimental system.



MuSpinSim GUI where the physical parameters such as dipolar distances are defined

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$$A(t) = a_0 P_Z(t)$$

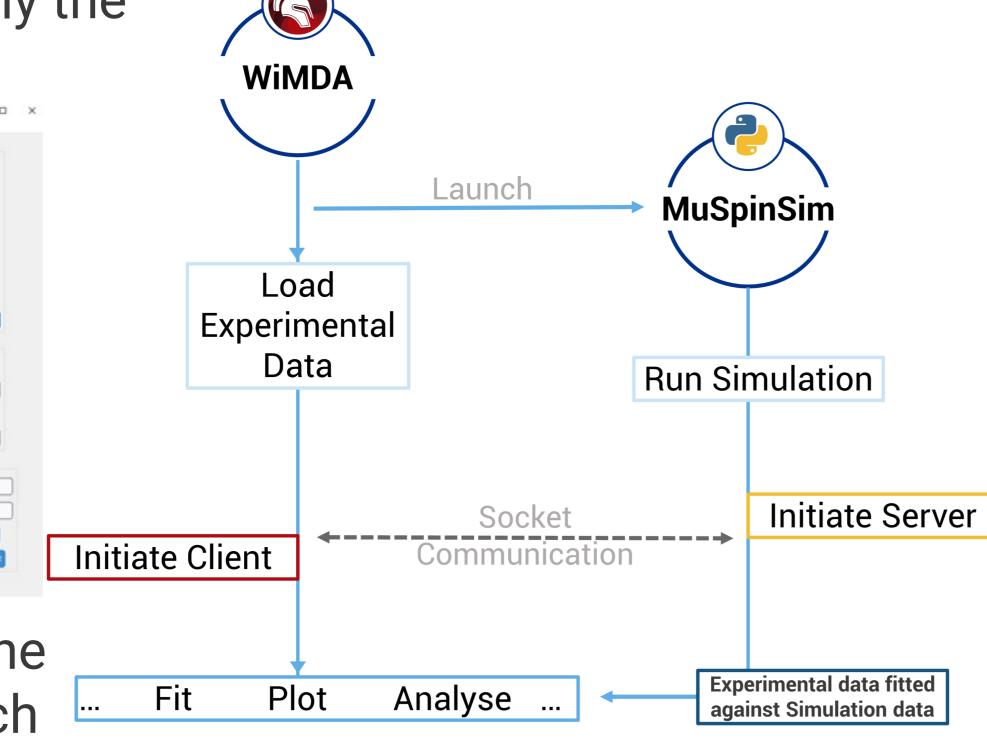
$$P_a(t) = \text{Tr}(\rho(t)\sigma^a)$$

$$\rho(t) = \hat{u}(t)\rho(0) \hat{u}^{\dagger}(t)$$

$$\hat{u}(t) = e^{-\frac{i\hat{H}t}{\hbar}}$$

The simulation is a result of the Hamiltonian, which characterises the system, calculate asymmetry A(t).

> $P_{a}(t)$  -Polarization function  $\rho(t)$  -Density function  $\widehat{u}(t)$  -Unitary operator -Hamiltonian



Flowchart of the code structure showing interaction between the experimental data in WiMDA and the Simulation data generated on MuSpinSim.

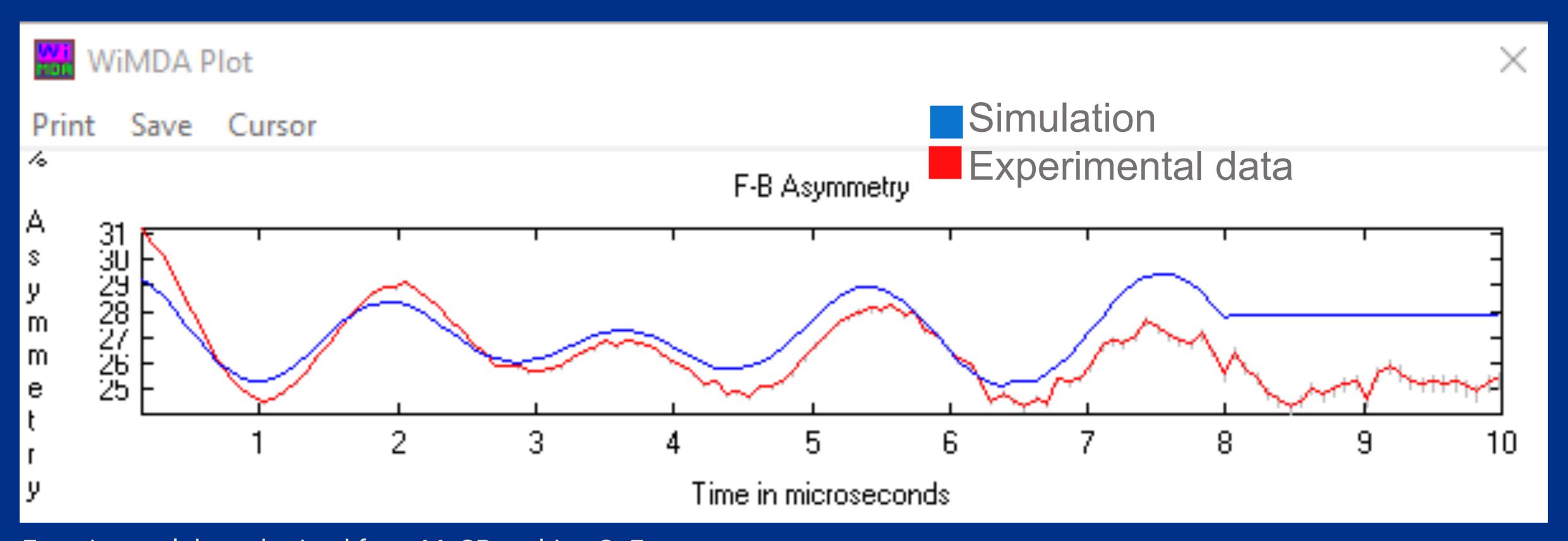
#### Results

The physical component that acts as fitting parameters are defined (using the fitting algorithm to find the local minimum) and they describe the real physical characteristics of the system being studied! ©

Using simulations, we have defined the real physical characteristics of the system being probed by the muon.



# parameters to fit experimental data?



Experimental data obtained from MuSR probing CaF<sub>2</sub>



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Original design by Mike Morrison

