Search for Physics Beyond the Standard Model...

...with $\beta$-\$ correlation in nuclear $\beta$ decay

![Diagram of nuclear recoil measurement with $^{32}$Ar](image)

**Proton peak shift measurement**
- $p$ and $p'$ are detected in coincidence
- $p'$ upwards, $p$ nuclear recoil downwards

![Diagram of angular correlation coefficient](image)

**Statistics:**
- Higher beam intensity
- Better transmission through HBL and VBL
- Higher $p$ detection sensitivity
- Larger solid angle

**Systematics:**
- Higher $p$ detection resolution
- Thinner catcher foil
- Lower $\beta$ detection threshold
- Systematics studies of backscattering

**References:**
1. [Adelberger et al., 1995, Phys. Rev. Lett. 75, 1390.](#)
2. [Savard et al., 2005, Phys. Rev. Lett. 94, 142501.](#)

**Proof of Principle Experiment**

**Set up**
- ISOLDE exp. Hall
- $30$ keV $^{40}$Ar
- $7$ cm molybdenum catcher foil
- $8$ $\times$ $300$ $\mu$m Si detectors for $p$
- Plastic scintillator + PMT
- $8$ to $4$ $\times$
- $3$h of beam time

**Measured proton spectrum**

**Extraction of the angular correlation coefficient**

**Success of the proof-of-principle experiment:** 3rd most precise measurement of $a_{\beta}$.

**Short term: by 2021**

**Error budget: how to go to the 1% level**

**Long term**

**Funding:**
- [AR: ER233-3249/32]
- [European Union’s 7th Framework Programme, Contract No. 262010 (ENSAR)]
- [Fermilab for Scientific Research F902]