Experimental Proposal: *E073*

- Title "Electron Screening and Alpha-Decay"
- Spokesperson:

  A. Musumarra, INFN-LNS & University of Catania
- GSI Contact Person:

  C. Nociforo, GSI
- Year of Approval: June 2006
- Shifts: 41 approved (main)

  10 used (main, only FRS-S4)

  31 left (main)

Physical motivation

- Search for evidence of electron screening effects in alpha-decay by modifications in lifetimes and Q_α-values of fully stripped, H-like, He-like α-emitters → faced only theoretically !

Theory: *Z. Patyk et al. accepted for publication on PRC*

First step: test the technique for (re)measuring neutrals at FRS

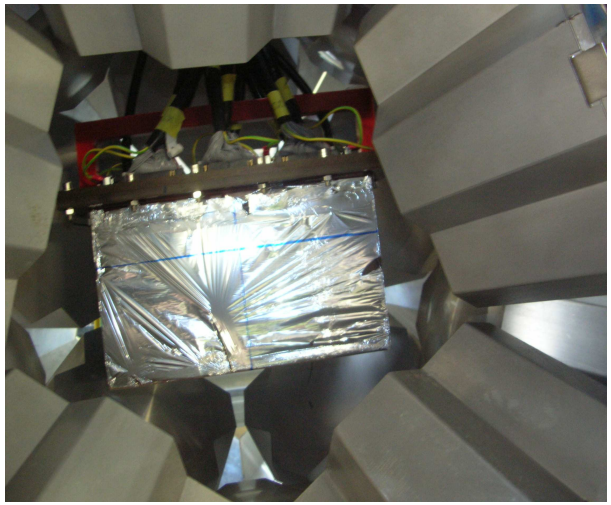
selected

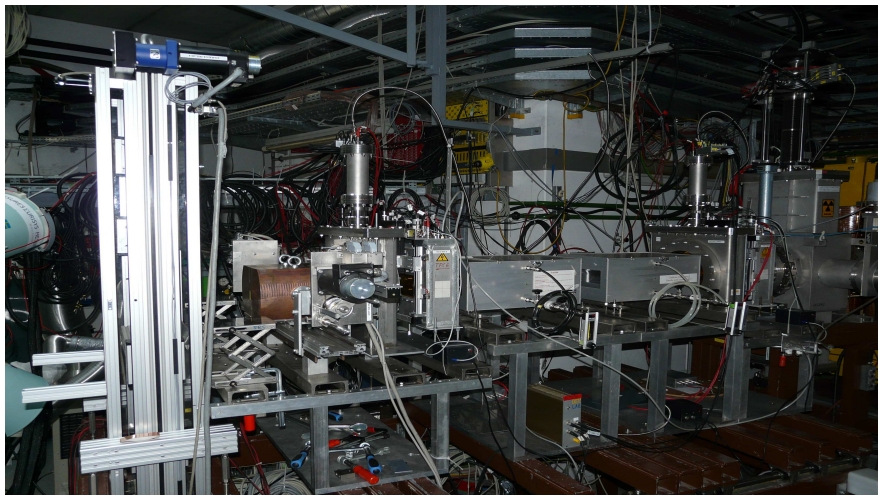
	$T_{1/2}$	α-branch	Q_α(MeV)
^{213}Fr	34.6 s (*3*)	99.45%	6.905

E073 Test beam (April 2008)

10 shifts @FRS-S4 ^{238}U@1GeV·A slow extraction

fully exploited





beam

* The FRS ID-setup was calibrated during the RISING S347 exp

* The equipment at S4 (RISING Implantation setup) was immediately available and calibrated !

Keys of a successfull run

E073 test: main achievements in April

* Test of the implantation/decay technique on Silicon (^{213}Fr , ^{214}Ra)

* High precision α–decay lifetime measurement achieved (error less than 1%)

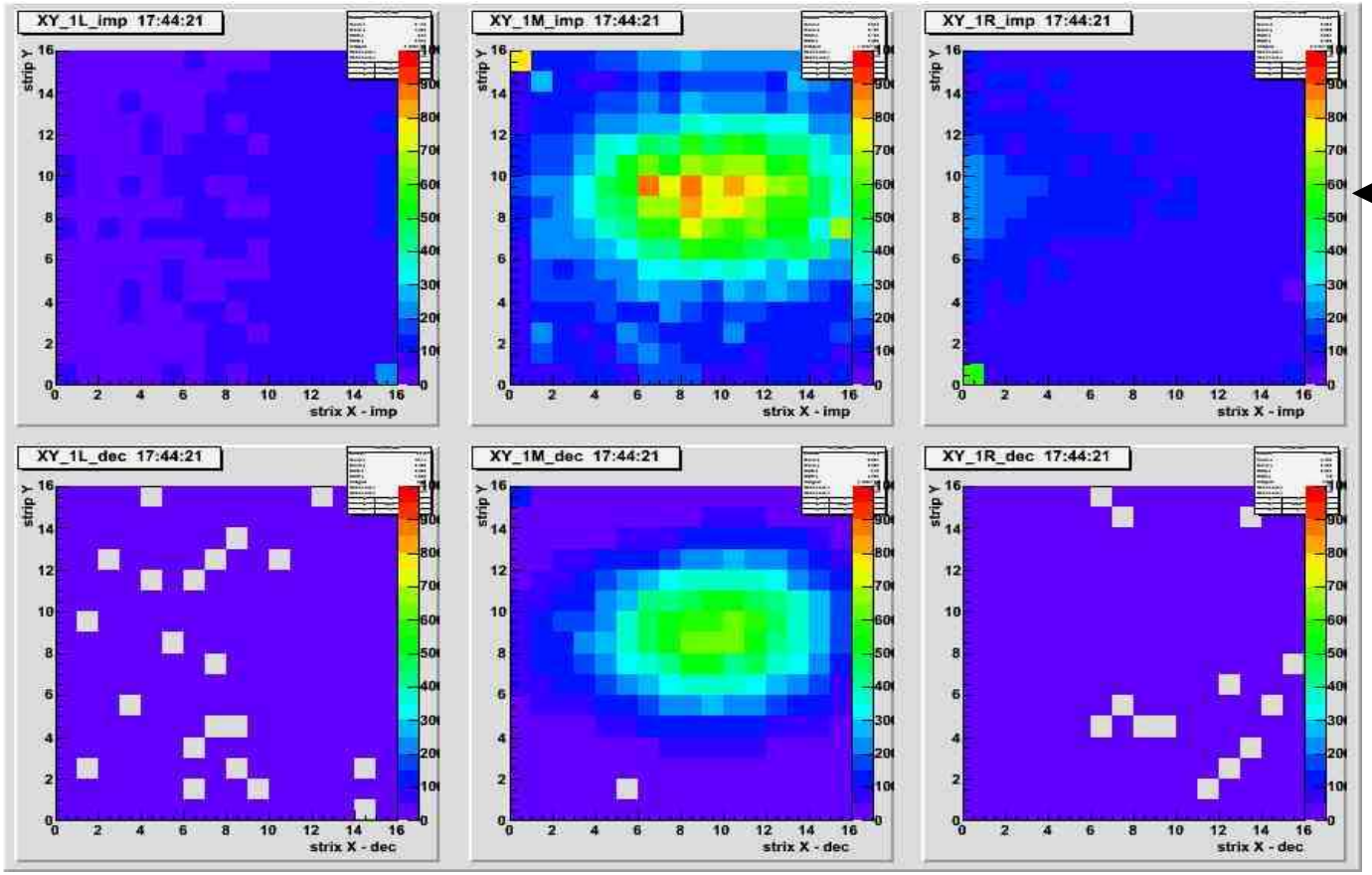
* Reliability and effectiveness of γ-decay tagging for nuclide identification

* By product: contemporary gamma measurement during the run (RISING Ge-Array)

Implanted and Decay events on Rising Stopper for ^{213}Fr setting

First layer DSSSD

L1 M1 R1

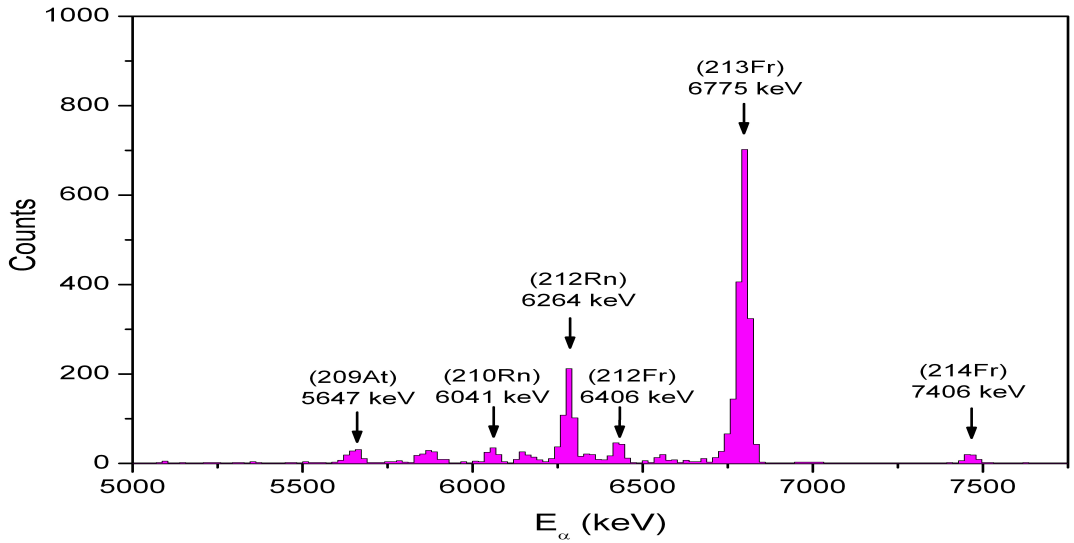


← Impl.

← Decay

Analysis in progress …

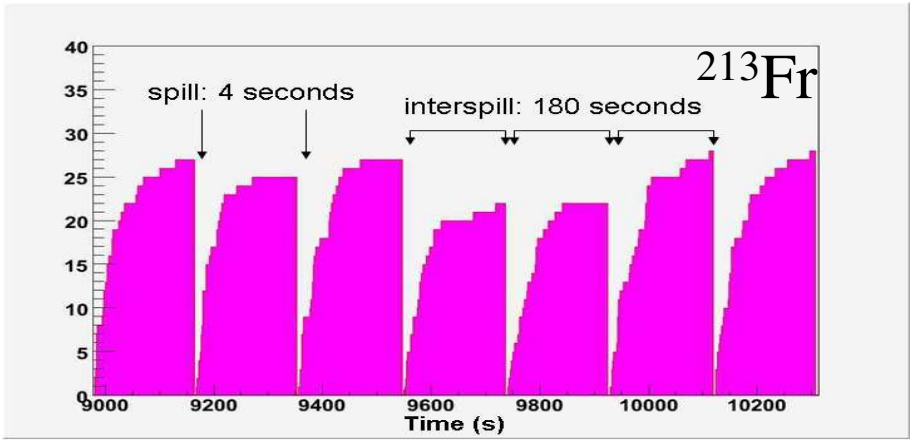
1) No contamination of Q-alpha spectra, full inclusive measurement, no correlation analysis needed.
(optimal choice
of the candidates,
good selectivity)



2) Statistics:

^{213}Fr($T_{1/2}$=34.6 s) ~$2\cdot10^4$ decays
interspill 180 s
interspill 60 s

^{214}Ra ($T_{1/2}$=2.46 s) ~$3.5\cdot10^4$ decays
interspill 12 s



Next: Bare nuclide measurement in the ESR

31 shifts remain

Will ^{238}**U** be available on 2009 ?

We ask *18 shifts* for FRS settings and **Schottky** measurements.

ESR Electron and Stochastic cooling required.

1) FRS setting (^{213}**Fr**$^{87+}$**@400 MeV/u**) : high purity required

2) ESR setting : count how many α–daughter (^{209}**At**) remain after decay in ESR

Many particles decay measurement

Single particle decay measurement by daughter decay tagging

Summary E073

- *Beam time required in 2009:*

18 shifts of U^{238} @600-400 MeV/u

intensity 10^9 pps

– *4 shift:* FRS tuning for ^{213}Fr.

– *14 shifts:* for **Schottky** measurements in the ESR.