STUDY OF POSITRON ANNIHILATION LIFETIME IN NON-CENTROSYMMETRIC MONOSILICIDES (B20) BY ^{48}V SOURCE

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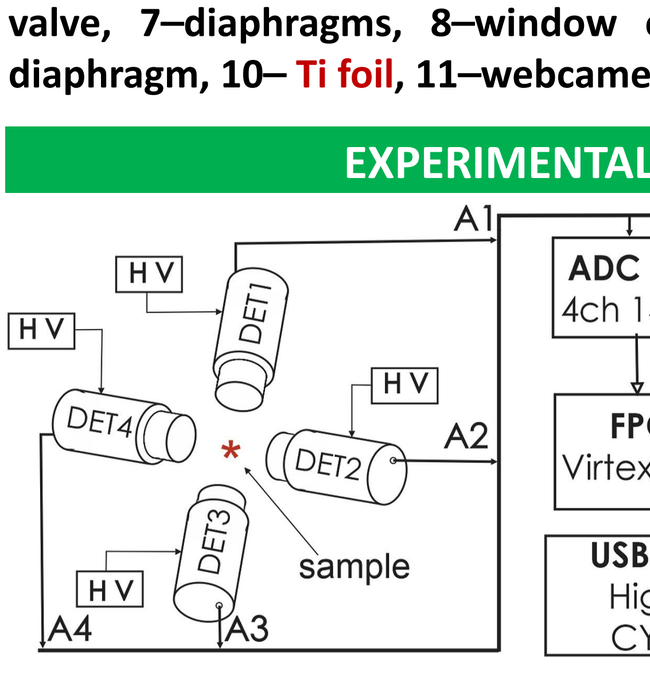
MOTIVATION

In the work we have studied single crystals of 3d transition metals B20 monosilicides (MnSi, FeSi and CoSi) and Si by the means of positron annihilation lifetime spectroscopy (PALS). The compounds have cubic noncentrosymmetric B20 crystal structure. Much research attention was devoted to studying these compounds because of some interesting phenomena observed in them: unusual magnetism in MnSi (long-period magnetic spirals induced by DMI, skirmion lattices), Kondo behaviour in FeSi, and CoSi is a Weyl semimetal.

^{48}V SOURCE



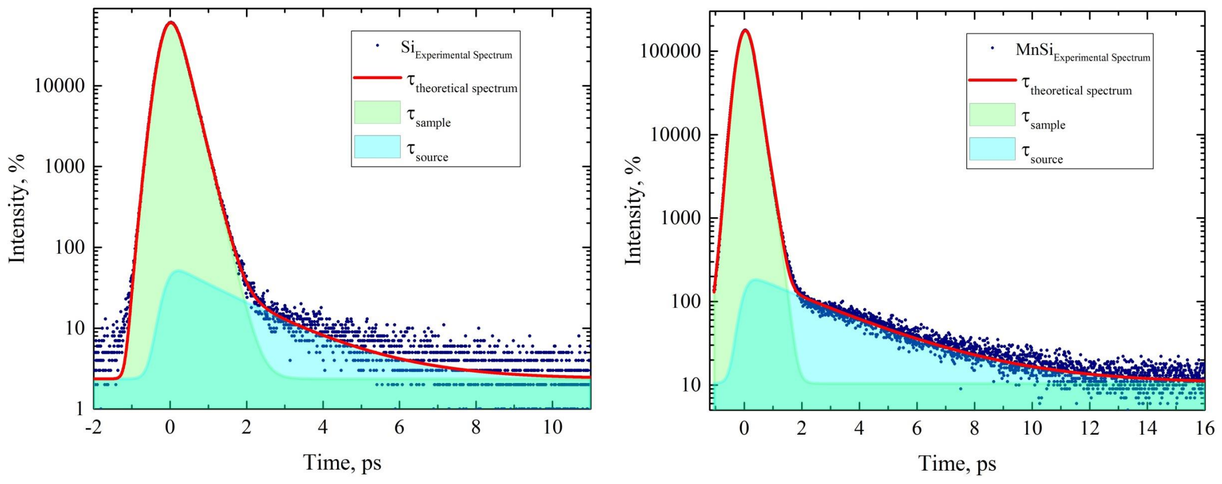
The isotope was produced in the ^{48}Ti(p,n)^{48}V reaction with 7 MeV protons at the Nuclear Physics Institute cyclotron (Moscow State University). The thin foil (50 μm) of natural titan was used as a target. The source has small positron self-absorption and in the PALS time spectra the long-lifetime component is absent. The short half-life ($T_{1/2}$ ≈ 16 d) makes this source suitable for environmentally friendly nuclear experiments.

Scheme of the U-120 Cyclotron: 1–cyclotron, 2–quadrupole lenses, 3–deflecting magnet, 4–ion guide, 5–protective wall, 6–vacuum valve, 7–diaphragms, 8–window of the ion guide, 9–accessory diaphragm, 10– Ti foil, 11–webcamera.

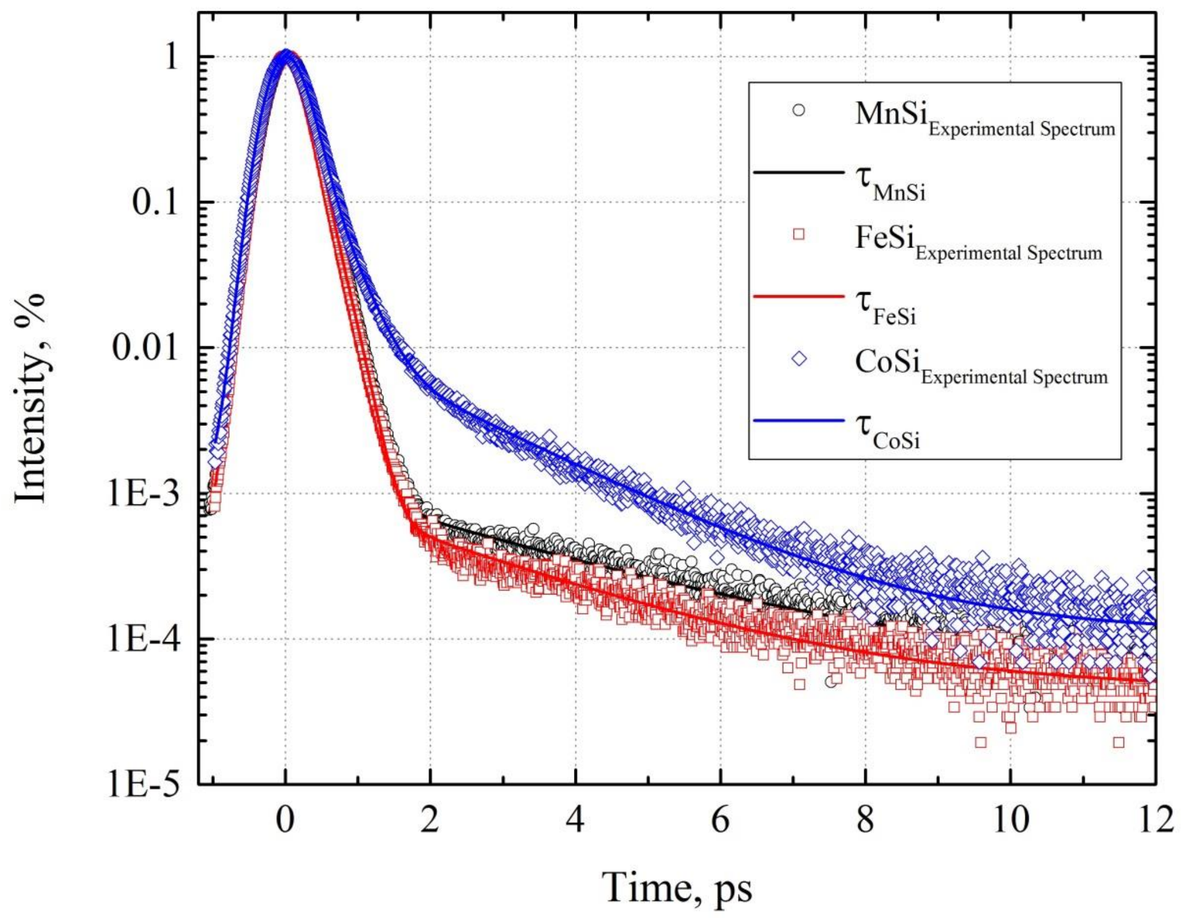
EXPERIMENTAL TECHNIQUE

The PALS measurements have been performed with compact spectrometer «VUKAP» equipped with four $LaBr_3$ detectors. The time resolution (FWHM) is equal to 380 ps at ^{60}Co. It should be note that this spectrometer can perform the measurements even with low activity radioactive sources. The contribution from the source was less than 4 %.

RESULTS



PALS spectra of B20 monosilicides by ^{48}V source



	τ_{exp}, ps	LITERATURE DATA, ps
Si	218(1)	τ_b = 218
CoSi	168(1)	τ_b = 115(2), $\tau_{V\text{-}Co}$ = 168, $\tau_{V\text{-}Si}$ = 173
MnSi	111(1)	τ_b = 111-119(3), $\tau_{V\text{-}Mn}$ = 185(4)
FeSi	114(1)	τ_b = 108-130

CONCLUSIONS

- ❑ **The use of a ^{48}V source can greatly simplify the technique of experimental work with promising materials (e.g. B20 compounds).**
- ❑ **The source used can also be used under different measurement conditions (liquids, vacuum, low or high temperature, high pressures).**
- ❑ **The use of a compact spectrometer enables environmentally friendly nuclear experiments.**

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