miscellaneous Mössbauer topics

www. hyperfinecourse .org

miscellaneous Mössbauer topics

1. suitable isotopes

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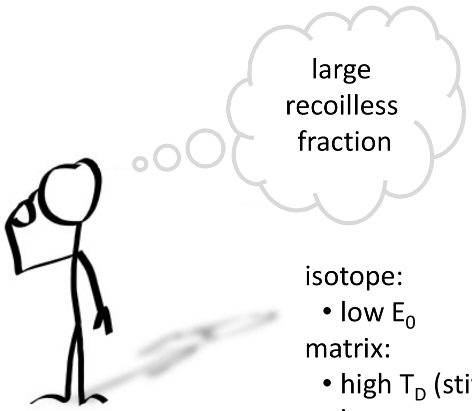
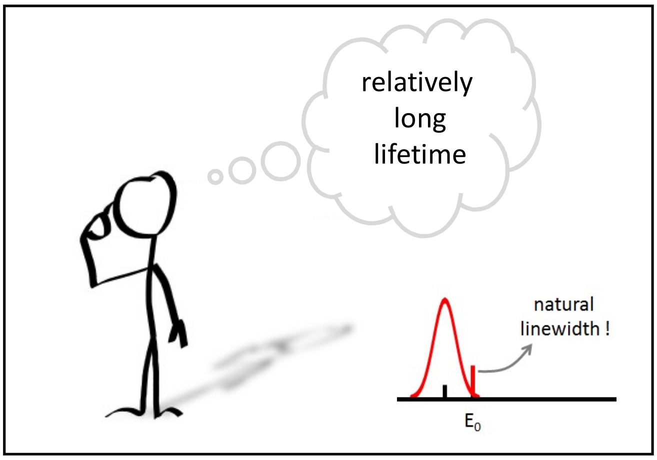


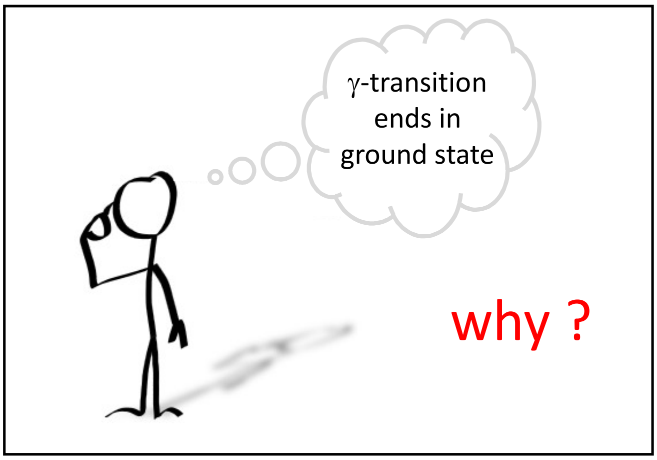
isotope:

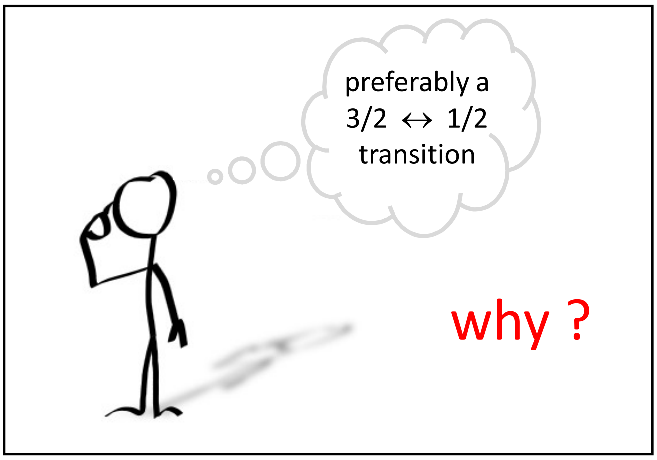
- low E_0

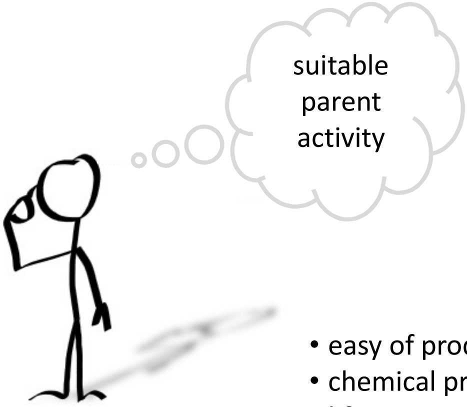
matrix:

- high T_D (stiff)
- large atom masses

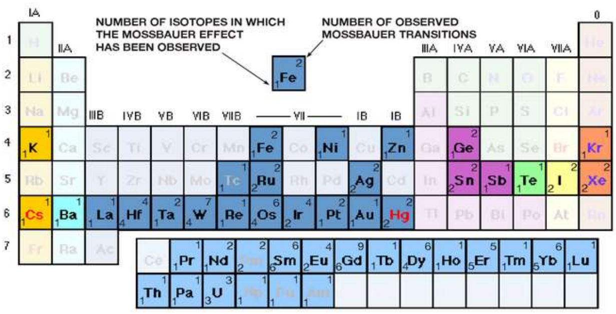

relatively long lifetime
natural linewidth !
E_0


γ-transition ends in ground state
why ?


preferably a 3/2 ↔ 1/2 transition
why ?

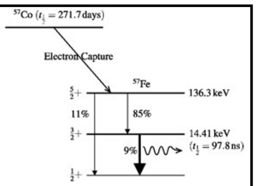


- easy of production
- chemical properties
- life-time



click on element to see details :

http://www.medc.dicp.ac.cn/Resources.php



Isotopic abundance 2.14(1)%

Ground state properties:
μ = 0.09062(3) nm

Excited state properties:
E = 14.412497(3) keV
E_R = 1.95883310(4) 10^{-3} eV
α_{IC} =8.20
σ = 2.56 10^{-18}cm^2
μ = -0.1549 nm
Q = 0.21(2)b
$T_{1/2}$ = 98.3(3) ns
W = 0.194(2) mm/s

E = 136.4785 keV
E_R = 1.755939(6) 10^{-1} eV
α_{IC} =0.14
σ = 3.45 10^{-19}cm^2
μ = 0.935(10) nm
$T_{1/2}$ = 8.7(3) ns
W = 0.23(5) mm/s

Source Production:
^{56}Fe(p,γ)
^{55}Mn(α,2n)
^{57}Fe(n,p)
^{54}Cr(α,p)

Unit Conversion:
1mm/s = 11.6248 MHz
1mm/s = 4.80766 10^{-8}eV

1mm/s = 110.076 MHz
1mm/s = 4.55243 10^{-7}eV

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2. on-line techniques

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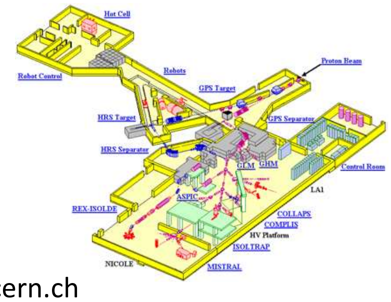
ISOLDE

The Radioactive Ion Beam facility



http://isolde.web.cern.ch

Hyperfine Interactions 129 (2000) 371–390 371

Mössbauer spectroscopy at ISOLDE

G. Weyer [a] and the ISOLDE Collaboration [b]

[a] *Institute of Physics and Astronomy, University of Aarhus, DK-8000 Aarhus C, Denmark*
[b] *EP Division, CERN, CH-1211 Geneva 23, Switzerland*

Applications of radioactive ion beams produced at the ISOLDE facility for Mössbauer studies of probe atoms in solids are presented. Examples are given for a site-selective incorporation on different substitutional sites in compound semiconductors by ion implantation and thermal annealing of the radiation damage resulting from the implantation. The interactions of the probe atoms with lattice defects created in the implantation process have been studied to elucidate likely causes for the site-selective implantation mechanism. The technique has enabled to determine the electronic densities at electrically active substitutional probe atoms, having shallow donor or acceptor states as well as states deeper in the band gap. The results are in good agreement with theoretical results from local density calculations. Methodological aspects of the Mössbauer emission techniques employed at ISOLDE are compared to alternative accelerator based techniques and the consequences of the application of different precursor isotopes to the ^{57}Fe Mössbauer isotope are treated in detail for ^{57}Fe in silicon. Finally, results obtained for the magnetic hyperfine interactions of 5 sp impurities associated with vacancies in ferromagnetic metals are discussed.

http://dx.doi.org/10.1023/A:1012693229011

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3. CEMS

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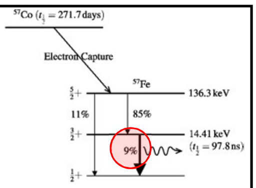

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Q = 0.21(2)b
$T_{1/2}$ = 98.3(3) ns
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E = 136.4785 keV
E_R = 1.755939(6) 10^{-1} eV
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^{55}Mn(α,2n)
^{57}Fe(n,p)
^{54}Cr(α,p)

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1mm/s = 110.076 MHz
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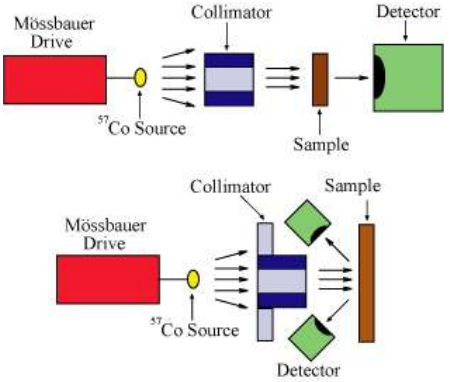
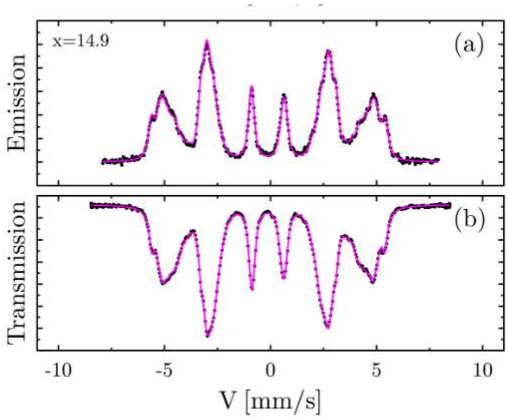
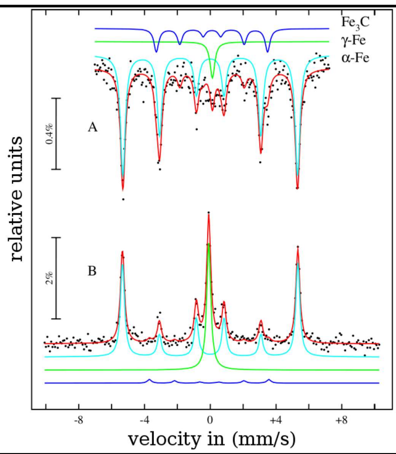


http://serc.carleton.edu/research_education/geochemsheets/techniques/mossbauer.html





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4. Mössbauer on Mars

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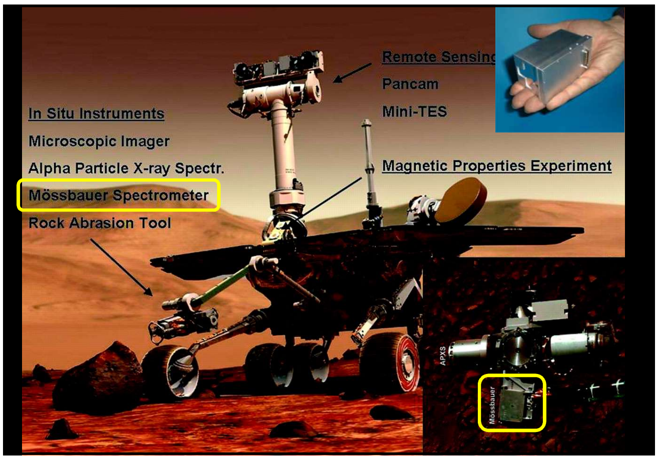
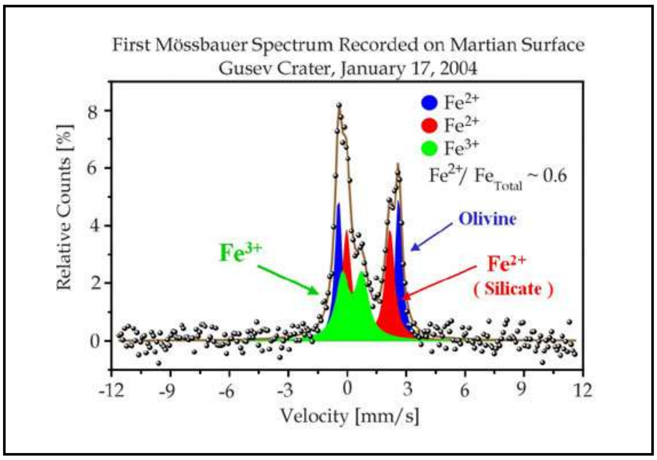

Remote Sensing
Pancam
Mini-TES
In Situ Instruments
Microscopic Imager
Alpha Particle X-ray Spectr.
Mössbauer Spectrometer
Rock Abrasion Tool
Magnetic Properties Experiment
APXS
Mössbauer


First Mössbauer Spectrum Recorded on Martian Surface
Gusev Crater, January 17, 2004
Relative Counts [%]
Velocity [mm/s]
Fe^{2+}
Fe^{2+}
Fe^{3+}
$Fe^{2+}/Fe_{Total} \sim 0.6$
Olivine
Fe^{3+}
Fe^{2+}
(Silicate)