

MÖSSBAUER BACKSCATTER SPECTROMETER FOR MINERALOGICAL ANALYSIS OF THE MARS SURFACE FOR MARS-94 MISSION; E.N.Evlanov<sup>1</sup>, L.M.Mukhin<sup>1</sup>, O.F.Prilutski<sup>1</sup>, G.V.Smirnov<sup>2</sup>, J.Juchniewicz<sup>3</sup>, E.Kunkeleit<sup>4</sup>, D.Klingefelter<sup>4</sup>, J.M.Knudsen<sup>5</sup>, C.d'Uston<sup>6</sup>

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This experiment is proposed to be launched on board MARS-94 mission for Mars rover scientific payload. Mossbauer spectroscopy can be used for mineralogical analysis of Mars surface. This technique provides quantitative information on the iron distribution among its oxidation states, mineralogy of iron-bearing phases and relative proportion of those phases.

Viking observations showed that iron is the main element in the mineralogical composition of the martian soil. Mossbauer spectrometry can provide an effective possibility of iron mineral identification by direct measurements. Identification of the magnetic phase, investigation of the iron-bearing nonmagnetic phase, and determination of the state of the iron oxidation ( $\text{Fe}^{2+}$  or  $\text{Fe}^{3+}$ ) can solve the following problems:

- origin of magnetic particles,
- role of iron-containing clays,
- intensity of weathering processes.

Mossbauer spectrometer will be installed on Mars rover with special drilling device. This combination will allow to study the samples of martian soil in different places and different depth. The samples of martian soil will be driven to detector aperture by special device. There are alternative measuring possibility to push detector down to martian surface for on-site measurements.

The principal instrument scheme is given on Fig.1. Backscattered mossbauer photons are registered by solid-state detectors (p-i-n diodes). On the instrument axis a mechanical vibrator with the radioactive source  $\text{Co}^{57}$  is mounted. The source is collimated and shielded to avoid increasing of effective line width and to decrease nonresonance line intensities at 122,1 and 136,5 keV. The scattering geometry must be chosen for this experiment because there is no possibility of preparing thin uniform samples on board of Mars rover.

On board velocity scale calibration will be done by analysing the known material (iron foil) by additional source of low activity. Parameters of solid-state detectors allow to measure additional spectral information (fluorescent spectra of martian soil). On-board data treatment will be performed by event-by-event analysis with determination of photon energy and corresponding velocity of the source in the moment of registration with special microprocessor.

The calibration measurements have been done with the target sample of 5,4% iron abundance in the resonance backscattering mode. Source activity was equal to 100 mC, xenon proportional counter was used with effective area equal to 1.5 cm<sup>2</sup>. The velocity resolution was 0,03 mm/s, measurements showed that statistical accuracy of data were 0,5% with exposition time of 20 hours. A detector, source and geometry optimisation in flight unit will allow to decrease necessary exposition approximately by one order of magnitude.

Overall mass of the experiment should be no more than 600 grams, power consumption should be no more than 2 W, vibrator velocity range — 12 mm/s amplitude, velocity measurement accuracy — 0.01%.

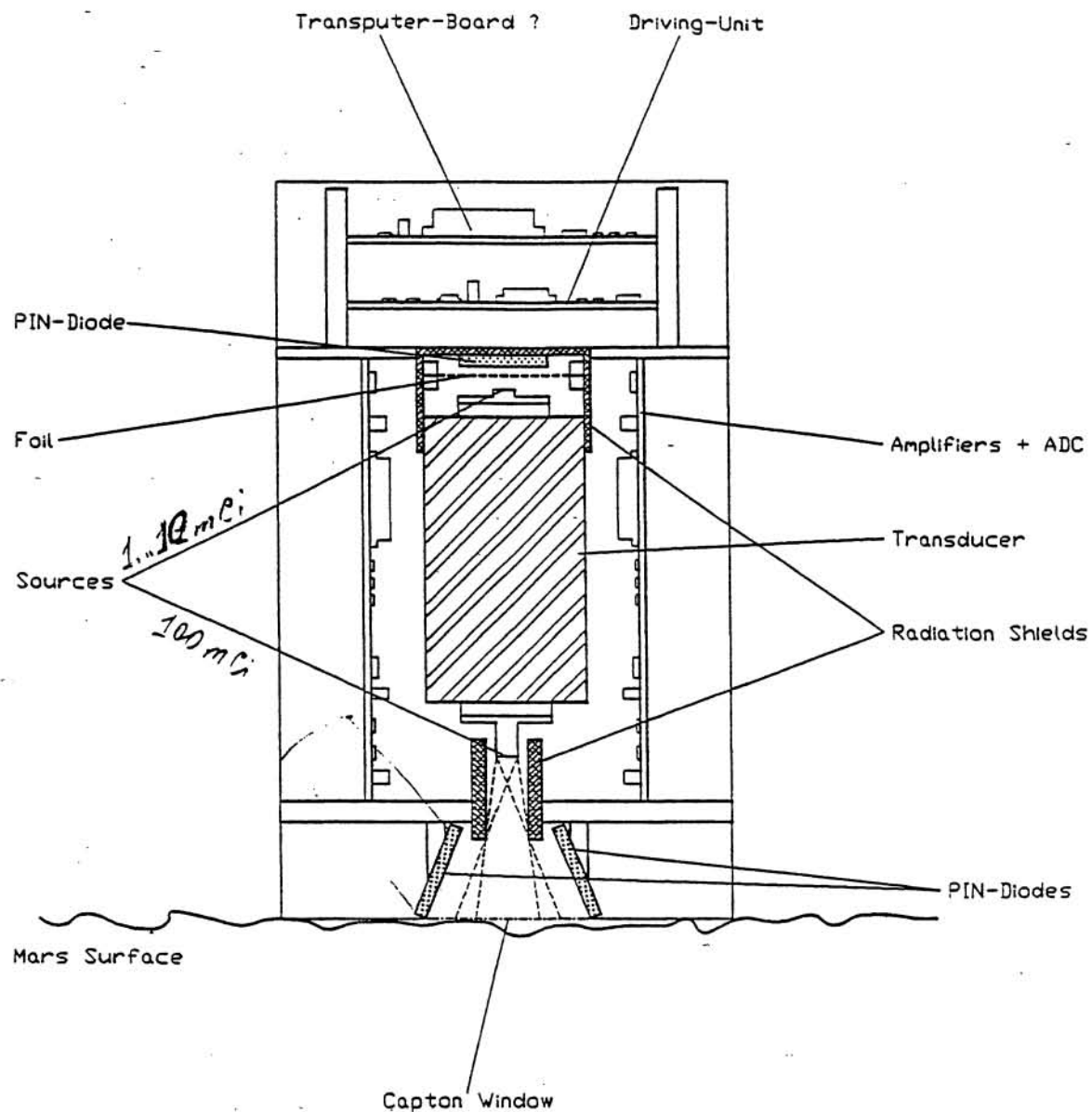


Figure 1. The outline of Mössbauer Spectrometer.