Recent Activities in Neutron Metrology at NIM

Zhang Hui

Division of Metrology in Ionizing Radiation and Medicine

National Institute of Metrology

1. Introduction

This report describes recent work in neutron metrology at National Institute of Metrology from 2007 to present. After our standard equipment of reference neutron irradiation field had been rebuilt in 2006, we're engaged in research for the primary standard of neutron source strength. We also carry out routine calibration for the neutron survey meter.

2. The standard equipment of reference neutron irradiation field and Routine calibration

Since the environment protection and security have been regarded increasingly the requirement of calibration for neutron survey meter are getting more and more. The amount of neutron survey meter calibrated in 2007 and 2008 are more than 140. We use neutron ambient dose equivalent which was calculated from the strength of Am-Be source according to ISO 8529-1 to calibrate the meter generally, sometime we use fluence also. Because of limitation of our source we have to change the distance from the source to detector so that the calibration points can cover the range of meter as full as possible. The range of ambient

equivalent dose rate for calibration is about (9～360) μSv/h .During the calibration we found that most of neutron detectors are lack of sign for calibrating on their surface, we can't find information from correlative accompanying documents also. We have to assume the center of detector as the calibrating point.

The new standard equipment of reference neutron irradiation field was finished in 2006. It locates in a irradiation room with the size 6000 mm(W) × 9000 mm(L) × 6000 mm(H). The equipment has four positions for the neutron sources, but only two sources were used. Both of these source are Am-Be neutron source calibrated by our primary standard source. (The parameter of two sources see Table 1).

Table 1 Parameter of the sources used for calibrating neutron survey meter

Source No.	Content of ^{241}Am	Strength	Size	Reference date
1#	100 GBq	8.243×10^6 n/s	φ23 mm × 48 mm	June 1983
2#	20 GBq	1.03×10^6 n/s	φ16 mm ×19 mm	June 1993

3. Research work for the primary standard of neutron source strength (Neutron emission rate)

In 2008 we begin to work on the primary standard of neutron source strength. We plan to use a new Am-Be source to replace the present Ra-Be source as the primary source and establish a new manganese sulfate bath system (Fig. 1. the sketch map of new manganese sulfate bath system). The main work is to confirm the parameters and correct factors

of manganese sulfate bath system for our new primary standard. Some 5 or 7 batches of highly pure ^{55}Mn powder will be irradiated at CIAE reactor to get ^{56}Mn, the activity of ^{56}Mn is determined by $4\pi\beta$-γ coincidence method using our primary standard for radioactivity. The ^{56}Mn solution of known activity was mixed with the $MnSO_4$ solution in the bath to determine the counting efficiency of the bath. We plan to find other factors which will effect the measurement e.g. position of source in the bath, flow rate, temperature. The new manganese sulfate bath and associated measuring system were finished. To protect the operator we designed a set of equipment used for transmitting the source between container and the center of the bath automatically at same time. We're cooperating with CIAE on this work. Most of experiments are made in CIAE.

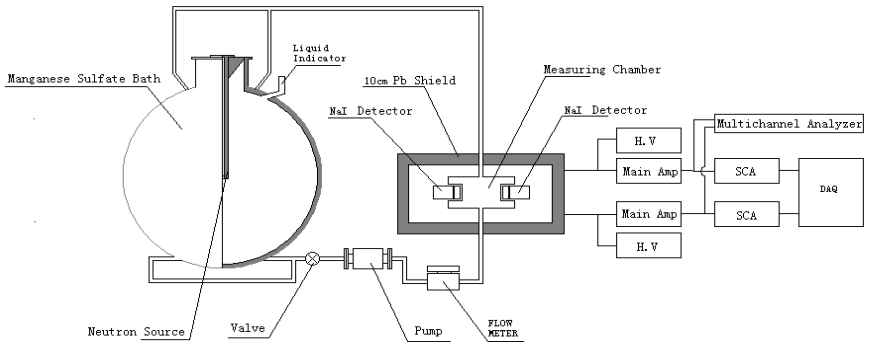

Fig.1. The manganese sulfate bath system

4. Plans in the future

4.1 The neutron spectrum measurement

We plan to purchase a set of bonner spheres for studying the neutron spectrum if we can get budget. We also want to use another set of neutron spectrometer with two surface-barrier detectors mounted in face to face sandwich geometry plus a quantity of He-3 as neutron sensitive material to carry out the neutron spectrum measuring although it has low efficiency.

4.2 Taking part in the international comparisons

We have never attended the international comparisons. In the future we plan to take part in the comparisons as possible as we can.