ISTITUTO NAZIONALE DI FISICA NUCLEARE

Sezione di Pisa

INFN/TC-83/5
24 Febbraio 1983

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FURTHER IMPROVEMENTS IN THE DESIGN OF A POSITRON CAMERA WITH DENSE DRIFT SPACE MWPC's

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Presented at the "Wire Chamber Conference", Vienna 16-18 February,1983
(to be published in Nuclear Instruments and Methods)

ABSTRACT

We describe the improvements achieved in the last three years towards the construction of a large solid angle Positron Camera with dense drift space MWPC's. A multiplane three-dimensional Tomograph is proposed, made of six MWPC modules (active area 45×45 cm^2 each), arranged to form the lateral surface of a hexagonal prism. Its expected performance is presented and is shown to be very competitive with the multiring scintillator Positron Camera.

In a previous paper[1] we presented the preliminary imaging performance of a two plane MWPC Positron Camera consisting of two MWPC modules equipped with converters made of lead corrugated banded strips.

TABLE I - Characteristics and Performance of the Proposed Tomograph.

Number of modules	6
Characteristics of each module:	
Active area	45×45 cm^2
Converter tubes diameter	0.48 mm
Total converter thickness	4 x 1 cm
Gas pressure	2 atm
Efficiency for 511 keV γ-rays	22.5%
Covered solid angle	2π
Performance of the tomograph in air:	
Coincidence efficiency for β^+ decay	2.2%
Coincidence resolving time	100 ns
Spatial resolution (point-like ^{18}F source)	$\lesssim$ 4.5 mm (FWHM)
True coincidence (T) to Accidental coincidence (A) ratio = T/A	3
Single rate per module	375 KHz
True coincidence rate per module pair	84 KHz
True coincidence rate for the tomograph	252 KHz
Total coincidence rate for the tomograph	336 KHz
Count rate for an uniform activity in a cylindrical water phantom (10 cm long x 10 cm radius):	
Source strength	$\sim$ 300 μCi
True coincidence rate for the tomograph	84 KHz
Number of simultaneous (1 cm thick) slices	10
Number of pixel (6×6 mm^2) per slice	$\sim$870
Statistical uncertainty of the signal per pixel in one minute (Accidental coincidences subtracted)	7%
Compton distributed noise	1/3

REFERENCES

(1) - V. Perez-Mendez, C. B. Lim, D. Ortendhal, R. Semper, A. Cheng, D. Chu, R. Hattner, L. Kaufman and D. C. Price, Nuclear Instr. and Meth. 156, 33 (1978).

(2) - G. K. Lum, M. I. Green, V. Perez-Mendez and K. C. Tam, IEEE Trans. Nucl. Sci. NS-27, 157 (1980).

(3) - G. K. Lum, V. Perez-Mendez and B. Sleaford, IEEE Trans. Nucl. Sci. NS-28, 821 (1981).

(4) - A. DelGuerra, V. Perez-Mendez, G. Schwartz and W. R. Nelson, IEEE Trans. Nucl. Sci. NS-30, vol. 1 (1983), in press.

(5) - T. Mulera, A. DelGuerra, V. Perez-Mendez and G. Schwartz, IEEE Trans. Nucl. Sci. NS-30, vol. 1 (1983), in press.

(6) - A. DelGuerra, C. B. Lim, G. K. Lum, D. Ortendhal and V. Perez-Mendez, IEEE Trans. Med. Imag. MI-1, 4 (1982).

(7) - V. Perez-Mendez, A. DelGuerra, W. R. Nelson and K. C. Tam, in Proceedings of the First IEEE Computer Society ISMIII '82, Berlin, October 26-28 (1982), p. 99.

(8) - T. F. Budinger, S. E. Derenzo, R. H. Huesman and J. L. Cahoon, in Proceedings of the Intern. Workshop on Physics and Engineering in Medical Physics, Pacific Grove, California, March 15-18 (1982), p. 3.