

FDG 가

## Shielding Calculations of Accelerator Facility for FDG Production

17

FDG

가

. MCNPX

1

가 가  
가 140cm 가  
가

### Abstract

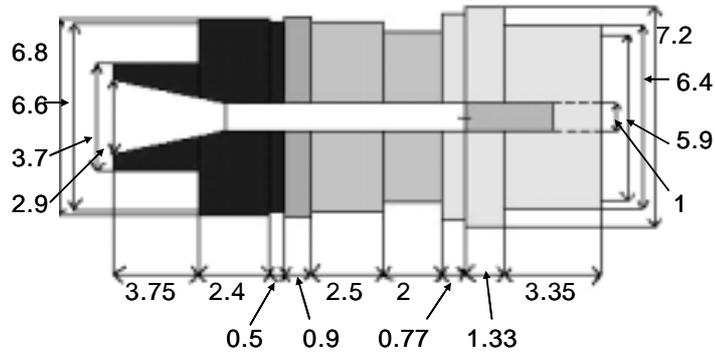
Secondary photons are generated and emitted from the concrete shielding wall of the PET cyclotron since the proton-generated neutrons are thermalized and absorbed in the concrete wall and emit secondary radiations, i.e., photons. This study calculated the ratio of the neutron dose to photon dose varying the thickness of the concrete shielding wall. It was found that the ratio decreases continuously with the thickness of the shielding wall. The ratio was less than one when the concrete wall thickness is greater than 140cm. When we consider it is not easy to measure the absorbed dose from thermal neutrons, this study suggests a methodology to measure photon dose and then estimate neutron dose, based on the result in this study, to calculate the total radiation dose from the neutrons and photons.



Bare target Full target

void

Units : cm

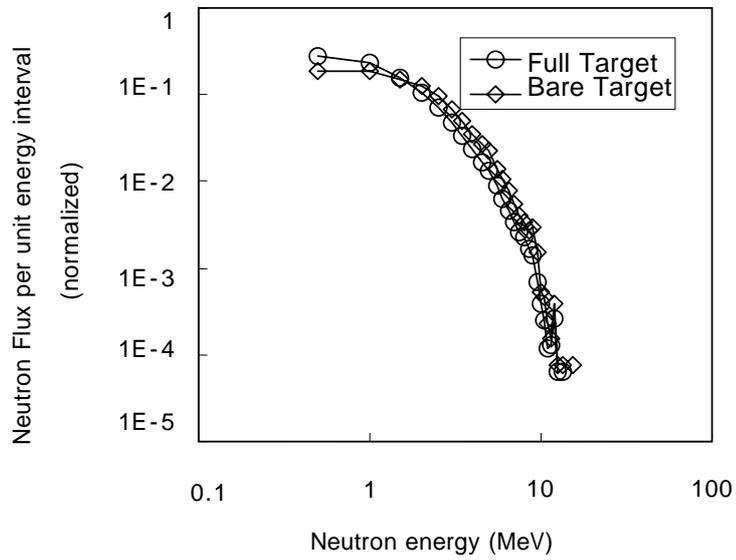


1. Large target

가 , Large target (95% enriched H<sub>2</sub><sup>18</sup>O)  
 가 , Large target  
 17.5 MeV 가 (Cyclotron 18/19 Product Description, Version 2000-Revision F, IBA).  
 H<sub>2</sub><sup>18</sup>O 가  
 95% enriched H<sub>2</sub><sup>18</sup>O  
 , SRIM 2003 17.5 MeV H<sub>2</sub><sup>18</sup>O  
 3.28 mm H<sub>2</sub><sup>18</sup>O 3 cm  
 H<sub>2</sub><sup>18</sup>O 가

1. Full Taget Bare Target

(Scattering angle)	(neutrons/cm <sup>2</sup> - sec)			(MeV)		
	Bare target	Full target		Bare target	Full target	
0-30	1.69E-06	1.41E-06	-19%	3.53	2.76	-28%
30-60	1.51E-06	1.29E-06	-17%	2.60	2.08	-25%
60-90	1.27E-06	1.29E-06	2%	2.30	1.86	-24%
90-120	1.05E-06	1.24E-06	15%	2.12	1.71	-24%
120-150	9.09E-07	9.92E-07	10%	2.00	1.62	-23%
150-180	8.36E-07	5.93E-07	-48%	1.94	1.67	-16%



## 2. Full target Bare target

1 Bare target Full target . 17.5 MeV  
가 가

30~60 , 60~90 , 90~120 , 120~180 , 0~30 ,  
가 가 . , Bare target Full  
target , 150-180 20% 가 ,  
, 150-180 30% 가 .

2 90-120  
가 가

Full target 가

가 . Full target , Bare target 가 ,

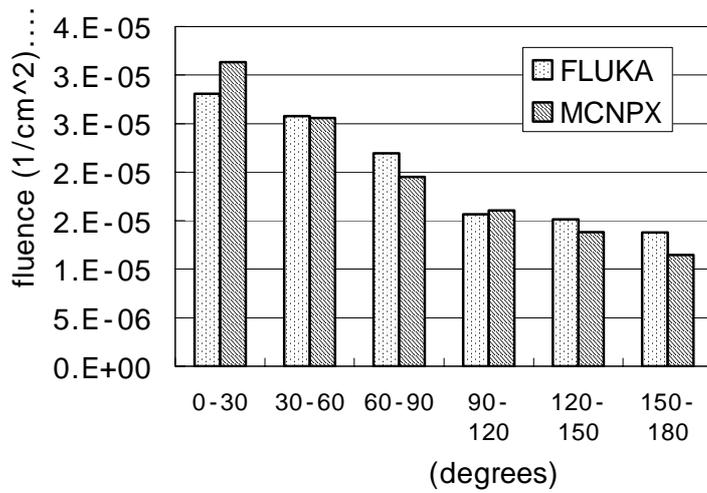
가 가 . Large target Bare target  
Full target 가 가 , 가 Bare  
target 가 가 , 가 가  
가 가 . ( %  
).

Bare target

$2 \times 10^8$  (WSSA)  
 $1.2 \times 10^6$  WSSA  
 iTRSstar 40- 98  
 WSSA 120 MB

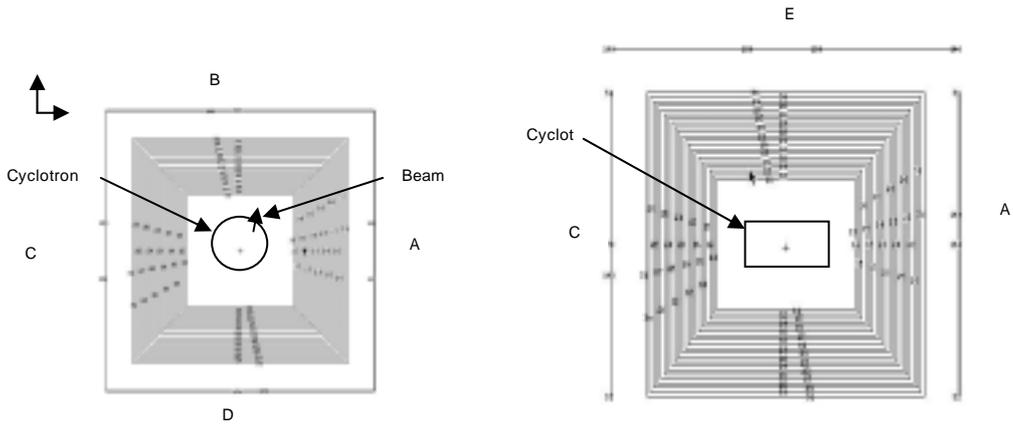
3.

MCMPX FLUKA  
 Bare target geometry  
 history, tally MCNPX track length estimator F4 tally, FLUKA  
 (Ref. 5) MCNPX F4 tally fluence estimator USRTRACK(Ref. 5)  
 FLUKA  $^{18}\text{O}$  Experimental total cross section data  
 3  
 (p,n)



3. MCNPX FLUKA fluence

가 variance reduction technique (VRT) (Ref. 3)  
 importance particle splitting Russian Roulette  
 concrete 20 10cm  
 ( 4 ).



4.

( / )

(WSSA) 1

statistical error) 가

40

DBCN

random number

(standard error) 40

<sup>18</sup>F

0.511MeV

MicroShield v5.05

가  $3 \times 10^{-11}$  mrem/hr

가

가

( 가

)

F4 Tally(Ref. 4)

Belogrolov

Fluence-to-

dose-equivalent

(Ref. 6)

MCNPX

F6 Tally

A, B, C, D, E , 5

( 4 )

Tally

1m

, A, B, C, D

, E

가

( = 0.02)

가 (normal dose equivalent TVL) 280-330

g/cm<sup>2</sup> (Bernard Shleien et. al, "Handbook of Health and Radiological Health," 3rd edition, 1998, p.7-27, Table 7.26).(Ref. 7) , 305 g/cm<sup>2</sup>

39 cm가 가

66cm

0.02

90

(1.71-1.86 MeV)가

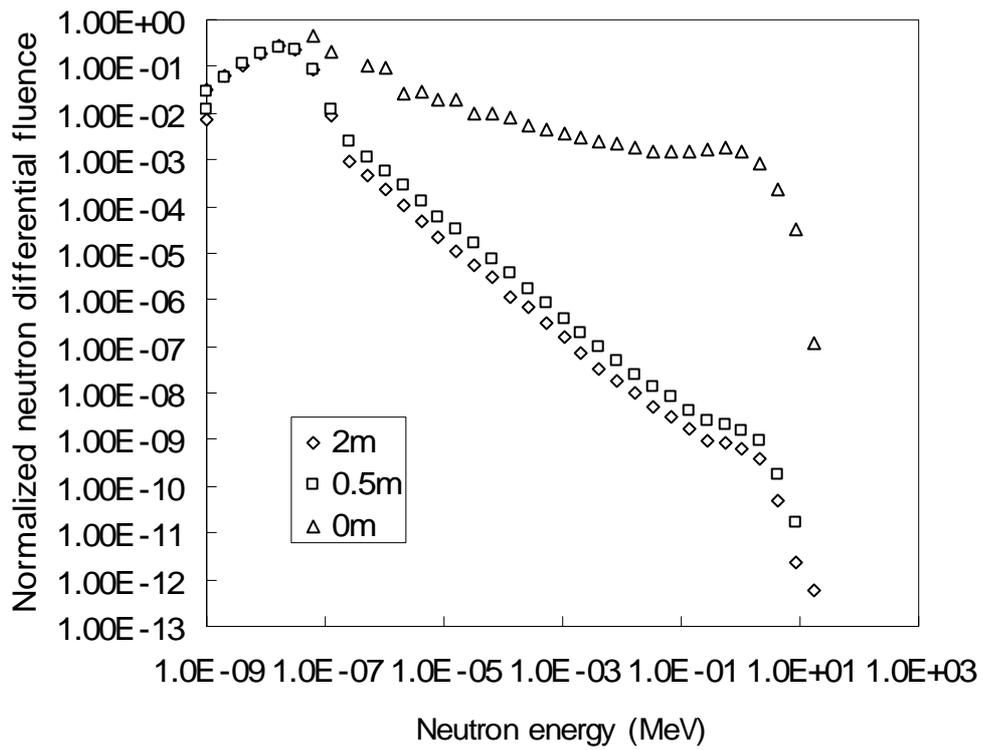
(1.98 MeV)

4

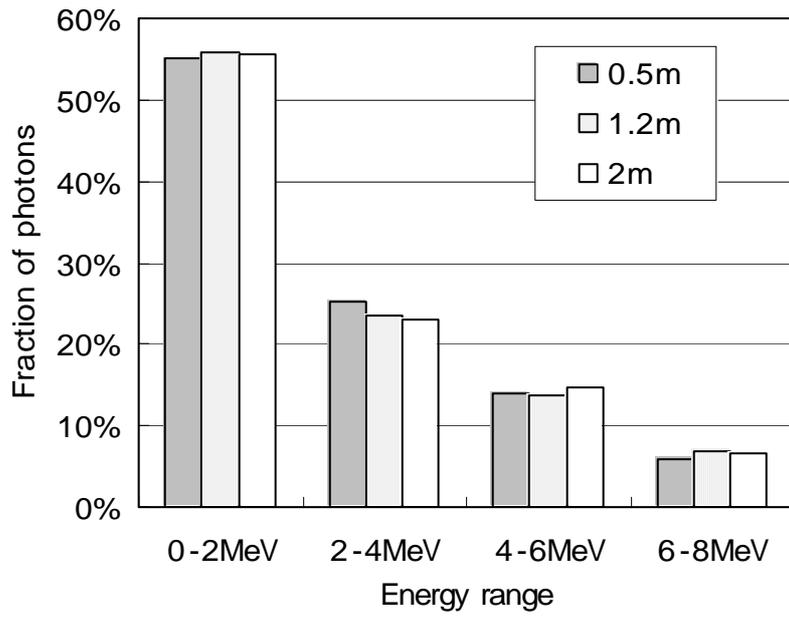


5 , 가 가 가  
 , 140cm  
 , 가 140cm

6 7  
 F4 tally 1E-9MeV 17.2MeV  $2^{(2n-1)}$   
 34 , F4 tally 0MeV 15MeV  
 24 , 0m ( )  
 2m 0.5m ,  
 가 10%  
 가 1%

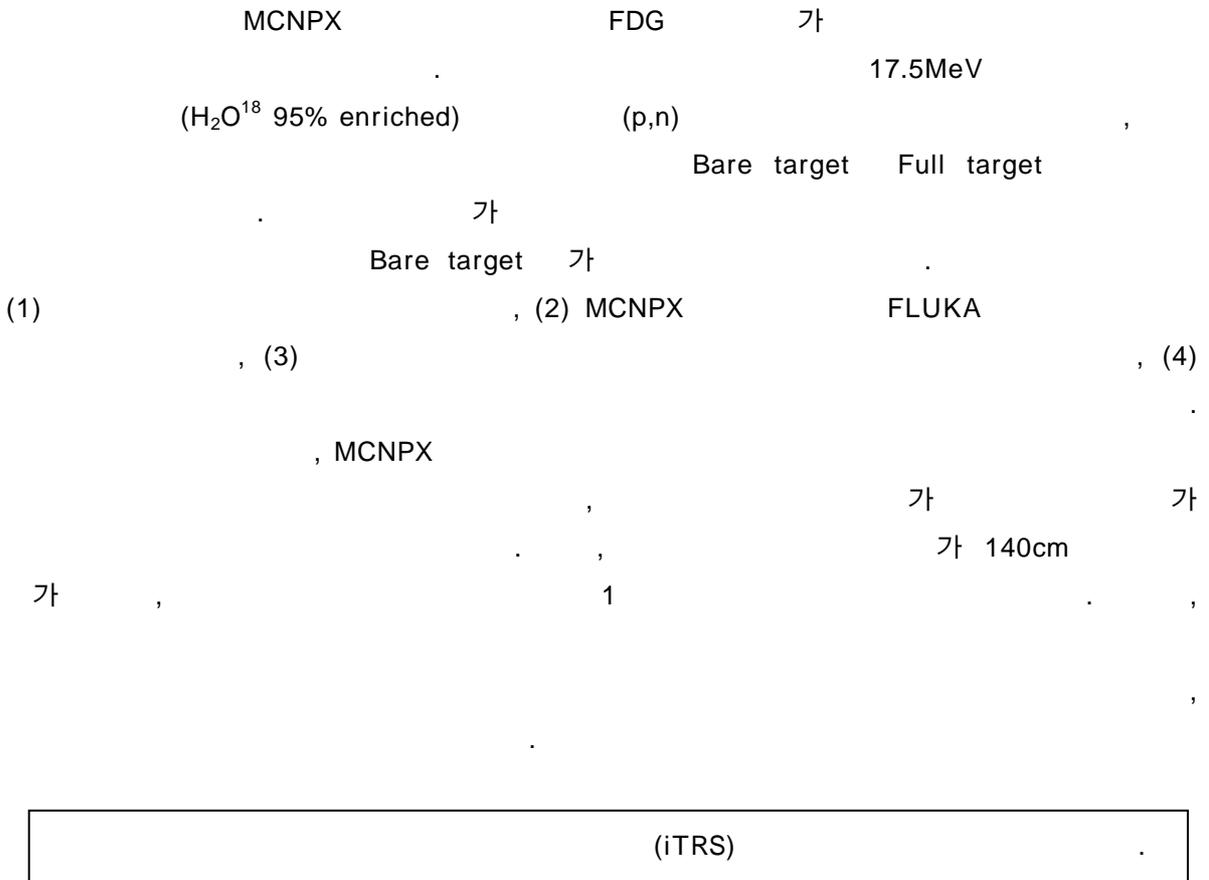


6.



7.

4.



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