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**C-A OPERATIONS PROCEDURES MANUAL**

**ATTACHMENT**

**9.1.11.c Examples of Beam Flux Corresponding to C-A Class and Dose Rate Guidelines for Beams 20 CM<sup>2</sup> in Size**

C-A-OPM Procedures in which this Attachment is used.		
9.1.11		

Hand Processed Changes

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Approved: \_\_\_\_\_ ***Signature on File*** \_\_\_\_\_  
 Collider-Accelerator Department Chairman                      Date

J.W. Glenn

9.1.11.c Examples of Beam Flux Rate Corresponding to C-A Class  
and Dose Rate Guidelines for Beams 20 cm<sup>2</sup> In Size

Protons or ions per hour	Dose Equivalent Rate or Absorbed Dose Rate <sup>d</sup>	C-A Class With Access	Brief Description of Access Control
$< 2.3 \times 10^8$ protons <sup>a</sup> $< 1.5 \times 10^7$ O ions <sup>b</sup> $< 7.2 \times 10^6$ Si ions <sup>b</sup> $< 4.3 \times 10^5$ Au ions <sup>c</sup>	$< 0.1$ rem/h	V	Radiation Warning Signs
$> 2.3 \times 10^8$ and $< 1.1 \times 10^{10}$ p $> 1.5 \times 10^7$ and $< 7.6 \times 10^8$ O $> 7.2 \times 10^6$ and $< 3.6 \times 10^8$ Si $> 4.3 \times 10^5$ and $< 2.1 \times 10^7$ Au	$> 0.1$ and $< 5$ rem/h	IV	Barriers, Locked Gates, Authorized Individual Access
$> 1.1 \times 10^{10}$ and $< 1.1 \times 10^{11}$ p $> 7.6 \times 10^8$ and $< 7.6 \times 10^9$ O $> 3.6 \times 10^8$ and $< 3.6 \times 10^9$ Si $> 2.1 \times 10^7$ and $< 2.1 \times 10^8$ Au	$> 5$ and $< 50$ rem/h	III	Barriers, Interlocked Gates, Health Physics Supervised Access
$> 1.1 \times 10^{11}$ and $< 3.9 \times 10^{12}$ p $> 7.6 \times 10^9$ and $< 1.4 \times 10^{11}$ O $> 3.6 \times 10^9$ and $< 5.1 \times 10^{10}$ Si $> 2.1 \times 10^8$ and $< 1.9 \times 10^9$ Au	$> 50$ rem/h and $< 500$ rad/h	II	Barriers, Interlocked Gates, Access By Special Procedure
$> 3.9 \times 10^{12}$ p $> 1.4 \times 10^{11}$ O $> 5.1 \times 10^{10}$ Si $> 1.9 \times 10^9$ Au	$> 500$ rad/h	I	Access Prohibited

<sup>a</sup> Protons are 28 GeV.

<sup>b</sup> Oxygen and silicon ions are 13.5 GeV/nucleon.

<sup>c</sup> Gold ions are 11 GeV/ nucleon.

<sup>d</sup> The actual in-beam dose rate is 50 times higher than the 'reduced' dose rate listed in the table above. The de-rating of dose rate for small beams accounts for the fact that only a small part of the body may be directly struck by the beam, leaving most of the body intact. However, significant deterministic effects may occur along the beam path as the beam penetrates the body (see Section 5.5).