Summary of DBCN Options in MCNP6

H. Grady Hughes

ABSTRACT

The functions of the DBCN card in MCNP6 have expanded considerably beyond their original uses for debugging and other low-level control of the code, and now include a variety of options affecting the general operation and physics of the transport process. In this document, we present a concise table summarizing the functions of this card. This document refers specifically to the first production release of MCNP6.

<table>
<thead>
<tr>
<th>DBCN Entry</th>
<th>Value</th>
<th>Function</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Obsolescent: Effect of &quot;RAND seed=&quot;</td>
<td>19073486328125</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>One-line debug print interval.</td>
<td>no debug prints.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>First history number for event log printing.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Last history number for event log printing.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Maximum number of events per history in the event log.</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Detector/DXTRAN underflow limit. (50 \leq \text{DBCN}(6) \leq 200)</td>
<td>80.0</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>\begin{align*} = 0 &amp; \quad \text{No print from volume and surface area calculations.} \ \neq 0 &amp; \quad \text{Generate a detailed print from these calculations.} \end{align*}</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Obsolescent: Effect of &quot;RAND hist=&quot;</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>A tolerance: distance between repeated-structures surfaces to be considered coincident.</td>
<td>(10^{-4}) cm.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>—</td>
<td>Not used.</td>
<td>—</td>
</tr>
<tr>
<td>11</td>
<td>\begin{align*} = 0 &amp; \quad \text{Collision events not printed in event logs for lost particles.} \ \neq 0 &amp; \quad \text{Print the collision events in these event logs.} \end{align*}</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Expected number of random numbers.</td>
<td>0 (test ignored)</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Obsolescent: Effect of &quot;RAND stride=&quot;</td>
<td>152917</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Description</td>
<td>Value</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Obsolescent: Effect of &quot;RAND gen=&quot;</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Normal selection of statistical quantities printed.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Also print shifted center and VOV for each bin.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Scale the history score grid for print tables 161 and 162.</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Developers only: study electron angular deflection methods</td>
<td>0: current best</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>New detailed logic for Landau electron energy straggling.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ITS (&quot;nearest group boundary&quot;) logic.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MCNP (&quot;bin centered&quot;) logic.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Developers only: study quadratic polynomial interpolation.</td>
<td>0: current model</td>
<td></td>
</tr>
<tr>
<td>20–22</td>
<td>Not used.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Use PHTVR trees if VR present, otherwise not.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Force PHTVR trees whether needed or not.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Do not use PHTVR trees.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24–26</td>
<td>Not used.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Do not promote anti-particles</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Promote anti-particles on MODE card and certain tallies.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Certain restrictions may apply.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Bank size</td>
<td>2048 … or …</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>128 criticality</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16384 hi-energy</td>
<td></td>
</tr>
<tr>
<td>29–31</td>
<td>Not used.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Normal GENXS behavior</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Use internal bremsstrahlung spectrum generation with CEM and LAQGSM models for GENXS.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Additional interpolation/smoothing for de/dx for ions.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Skip this extra manipulation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Status</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----------------</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Developers only: reproduce a bug in $\mu^-$ induced gammas.</td>
<td>0: corrected</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>$= 0$ Slight spreading of nuclear excitation during $\mu^-$ capture.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\neq 0$ Turn off this behavior.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>$= 0$ Use user-provided data for $\mu^-$ induced gammas if available.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\neq 0$ Use only older data hard-coded in MCNPX.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Set minimum of internal bremsstrahlung spectrum for CEM and LAQGSM in GENXS when $\text{dbcn}(32) \neq 0$.</td>
<td>30 MeV</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>$= 0$ Use Barashenkov/Polanski data file barpol2001.dat</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\neq 0$ Use older barpol.dat file from 1996.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>$= 0$ Use default $S(\alpha,\beta)$ sampling treatment (from MCNP5).</td>
<td>0.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\neq 0$ Use MacFarlane/Little treatment (from MCNPX).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Developers only: control writing of mcplib and xsdir lines.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>Developers only: for printing photon/electron data.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>$= 0$ Use default integrated method for model cross sections.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$&gt; 0$ Use original MCNPX model cross section method.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$&lt; 0$ Use earlier MCNP6 method (MARS coding).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Developers only: controls photon form factor interpolation.</td>
<td>2: best method</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Developers only: study coherent scattering in isolation.</td>
<td>0: all processes.</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>$= 0$ Use MCNP6 elastic scattering method.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\neq 0$ Use earlier MCNPX elastic scattering method.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>— Not used.</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>$= 0$ Use Clem model for cosmic ray spectra.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\neq 0$ Use Lal model.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>$= 0$ Allow MCNP to forbid threading when not suitable.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\neq 0$ Insist on threading if requested.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Option</td>
<td>Value</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>= 0</td>
<td>Normal input checking.</td>
<td>0</td>
</tr>
<tr>
<td>≠ 0</td>
<td>Skip some lattice input checks to save time in initialization.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>= 0</td>
<td>Normal printing of tally fluctuation charts.</td>
<td>0</td>
</tr>
<tr>
<td>≠ 0</td>
<td>More precision in error and variance of the variance.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>Developers only: turn off photon-induced fluorescence.</td>
<td>0: not turned off</td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>Developers only: turn off Compton-induced relaxation.</td>
<td>0: not turned off</td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>= 0</td>
<td>Use new ENDF photoelectric relaxation data if available.</td>
<td>0</td>
</tr>
<tr>
<td>≠ 0</td>
<td>Use traditional (limited) pre-ENDF/B VI.8 treatment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>= 0</td>
<td>Old sampling for ENDF Law 9 for $10^8$ tries, then new.</td>
<td>0</td>
</tr>
<tr>
<td>≠ 0</td>
<td>New, improved sampling method.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55–60</td>
<td>—</td>
<td>Not used.</td>
<td>—</td>
</tr>
<tr>
<td>61</td>
<td>Developers only: models of knock-on electron angles.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>Developers only: control single-event electron excitation.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>Developers only: control single-event elastic scattering.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>Developers only: control knock-on angular deflection.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>Developers only: control deflection of ionizing electron.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>Developers only: control single-event bremsstrahlung angle</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>NPS of first calculation of average contributions to point detectors and DXTRAN spheres.</td>
<td>NPS of first tally fluctuation report</td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>—</td>
<td>Not used.</td>
<td>—</td>
</tr>
<tr>
<td>69</td>
<td>Increase limits on certain arrays (after certain fatal errors).</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>Developers only: debug choice of some interaction models.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>71</td>
<td>= 0</td>
<td>Allow model photonuclear capability.</td>
<td>0</td>
</tr>
<tr>
<td>≠ 0</td>
<td>Prohibit model photonuclear capability.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>= 0</td>
<td>Explicit log-log interpolation in ELXS_MOD.</td>
<td>0</td>
</tr>
<tr>
<td>≠ 0</td>
<td>Random linear interpolation.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>