

E8 Physics from Cl(8) via Elementary Cellular Automata Bits

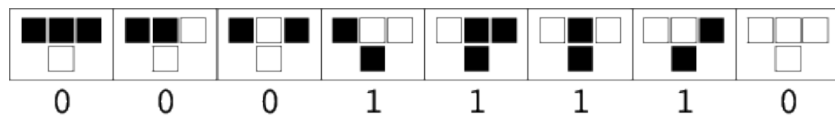
John C. Gonsowski*

Abstract

In this article, I describe E8 Physics from Cl(8) via pairing elementary cellular automata bits. Tony Smith relates the 256 dimensions of the Cl(8) Clifford Algebra to the 256 rules of Elementary Cellular Automata. The graded dimensions of Cl(8) correspond to graded dimensions of the E8 Lie Algebra used in Smith's physics model. Six Cellular Automata (CA) rules with four one-bits are related to Smith's 8-dim Primitive Idempotent bookended by the single rule with no one-bits and the single rule with all eight bits as ones. The 64 other four one-bit rules are related to E8's 64-dim vector representation used by Smith for Kaca Bradonjic's Unimodular Relativity. The two 28-dim D4 subalgebras of E8 are used for bosons and their ghosts and relate to the CA rules with two one-bits and six one-bits. The two remaining 64-dim spinor representations for E8 are used for eight component fermions/antifermions and relate to the CA rules with one, three, five and seven one-bits.

1. Introduction

Tony Smith [1] relates the 256 dimensions of the Cl(8) Clifford Algebra to the 256 rules of Elementary Cellular Automata [2]. The graded dimensions of Cl(8) correspond to graded dimensions of the E8 Lie Algebra used in Smith's physics model. An 8-dim Primitive Idempotent half spinor along with the 248-dim E8 are embedded in the 256-dim Cl(8). The grading of this Cl(8) is 1 8 28 56 70 56 28 8 1 which sum to the 256 dimensions. This grading gives the quantity of Cellular Automata (CA) rules that have a certain number of one-bits.



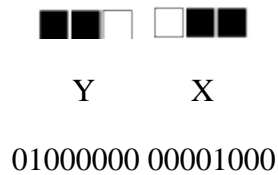
The rule above is called rule 30 because the 4 one-bits produce a binary $2+4+8+16=30$. The Cl(8) grading indicates there are 70 rules with 4 of the 8 bits being a one. In other words there are 70 ways to place 4 ones in the 8 bits to form a rule. The bits for the rule represent the next state value for the 8 possible values of the current state and the states to the left and right of the current state being evaluated. Via the Cl(8) grading there is one way to have 0 of 8 ones in the

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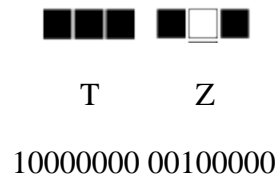
rule; 8 ways to have a single one; 28 ways to have two ones; 56 ways to have three ones; 70 ways to have four ones; 56 ways to have five ones; 28 ways to have six ones; 8 ways to have seven ones; and one way to have 8 ones.

2. Relating Basis Vectors to Cellular Automata Bits

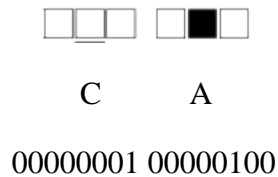
Two CA bits are related via Smith's model to the Y and X basis vectors of a YX spatial rotation [3].



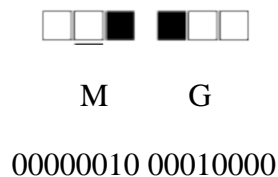
Two CA bits are related to the temporal T and spatial Z basis vectors of a Lorentz group TZ boost.



Two CA bits relate to the Conformal group (C) basis vector and an Anti-de Sitter/de Sitter group (A) translation basis vector to form a dilation (CA). This dilation is the Higgs VEV in Smith's physics model.

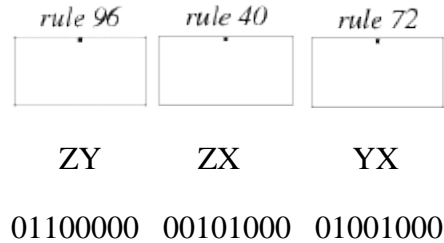


The final two CA bits allow Standard Model Ghosts in Smith's physics using basis vectors M (magenta/minus for strong force anticolor and weak force negative charge) and G (green/greater than zero for strong force color/weak force positive charge). The MG bivector is a propagator phase in Smith's model.

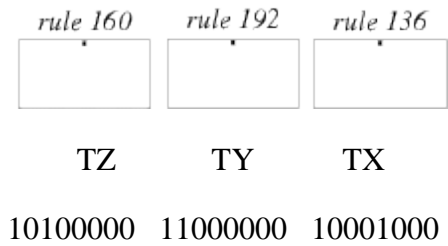


3. Rotations and Boosts

The grading of the 248-dim E8 in Smith's physics model is 28 64 64 64 28. The following bivectors are in the 28s of his E8 grading which match to the 28s in the Cl(8) grading. The E8 28s come from two D4 subalgebras which also relate to the four axes and 24 vertices of a 24-cell, D4's root vector polytope. The 28 Cellular Automata with 2 one-bits and the 28 CA with 6 one-bits will match to these two D4s. Here are the three Lorentz Group gravity spatial rotation [3] bivectors/double one-bits.

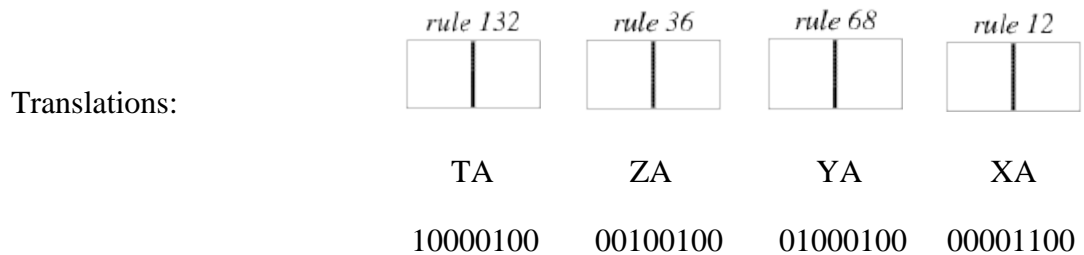


Here are the three Lorentz group gravity boost bivectors/double one-bits.

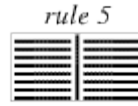


4. Translations, Dilation and Special Conformal Transformations

Here are the four Anti-de Sitter/de Sitter group gravity translation bivectors/double one-bits, the dilation (Smith's Higgs VEV), and the four special conformal transformations (dark energy related for Smith).



Dilation:



CA

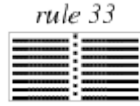
00000101

Conformal Transformations:



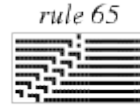
TC

10000001



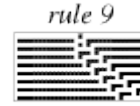
ZC

00100001



YC

01000001



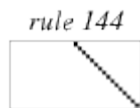
XC

00001001

5. Ghosts for the Standard Model Bosons and Propagator Phase

Here are the bivectors/double one-bits for the Standard Model ghosts and propagator phase of Smith's physics model.

rgb/rg/rb/gb "half" Gluons:



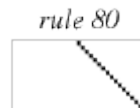
TG

10010000



ZG

00110000



YG

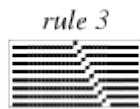
01010000



XG

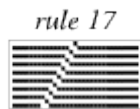
00011000

Photon/Z0/W-/W+/Phase:



CM

00000011



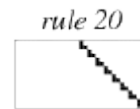
CG

00010001



AM

00000110



AG





00010100



MG

00010010

cmy/cm/cy/my “half” Gluons:

<i>rule 130</i>	<i>rule 34</i>	<i>rule 66</i>	<i>rule 10</i>
			
TM	ZM	YM	XM
10000010	00100010	01000010	00001010


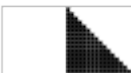
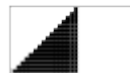
6. Ghosts for Rotations and Boosts

The above conformal gravity and Standard Model ghost bivectors fit with the 28 Cellular Automata rules with double one-bits. These 28 CA relate to the first 28 in the E8 and Cl(8) grading. The conformal gravity ghost and Standard Model bivectors fit with the 28 CA with six one-bits. These CA relate to the second 28 in the E8 and Cl(8) grading. The CA with six one-bits are also the CA with double zero-bits. These double zero-bits will be matched to Smith’s D4 conformal gravity ghost and Standard Model bivectors.

Besides using double zero-bits instead of double one-bits, this ghost boson-actual boson bivector mapping also exchanges XYZT vectors with GMAC vectors thus forming a negative transformation [4]. This may relate to how in Smith’s model, the XYZT physical spacetime interacts with the GMAC Kaluza-Klein internal symmetry space. Here are the three Lorentz Group gravity spatial rotation bivectors/double zero-bit ghosts.

<i>rule 249</i>	<i>rule 235</i>	<i>rule 237</i>
		
AM	AG	MG
11111001	11101011	11101101

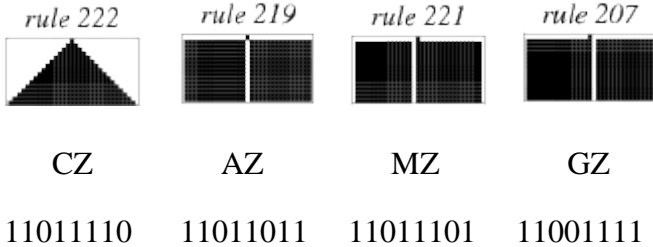
Here are the three Lorentz group gravity boost bivectors/double zero-bit ghosts.

<i>rule 250</i>	<i>rule 252</i>	<i>rule 238</i>
		
CA	CM	CG
11111010	11111100	11101110

7. Ghost Translation, Dilation and Special Conformal Transformations

Here are the four Anti-de Sitter/de Sitter group gravity translation bivectors/double zero-bit ghosts, the dilation ghost (for Smith's Higgs VeV), and the four special conformal transformation ghosts (dark energy related for Smith).

Translations:



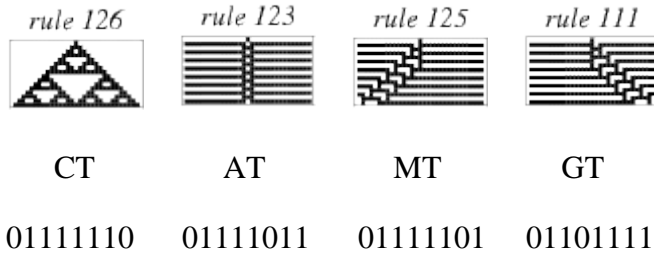
Dilation:



TZ

01011111

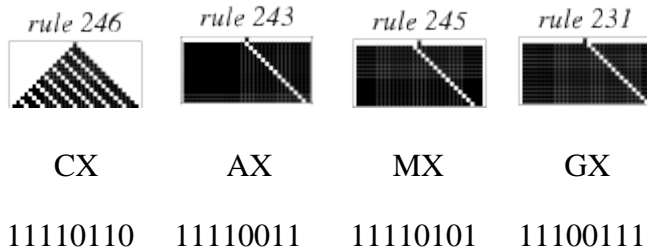
Conformal Transformations:




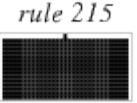


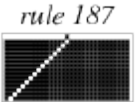

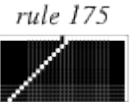


8. Standard Model Bosons and Propagator Phase Ghost

Here are the bivectors/double zero-bits for the Standard Model bosons and propagator phase ghost of Smith's physics model.

rgb/rg/rb/gb "half" Gluons:

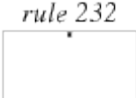
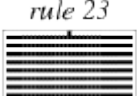


Photon/Z0/W-/W+/Phase:					
	TY	TX	ZY	ZX	YX
	00111111	01110111	10011111	11010111	10110111
cmY/cm/cy/my “half” Gluons:					
	CY	AY	MY	GY	
	10111110	10111011	10111101	10101111	

















There’s a pattern where rules (with G vs. M) that slant to the left vs. slanting to the right may relate to charge for the Standard Model bosons and direction change (X vs. Y) for gravity bosons. These reflection transformation [4] bits perhaps relate to how charge, mass, and change of direction are related in Smith’s 4-dim Feynman Checkerboard.

9. The Primitive Idempotent and Spacetime Position and Momentum
















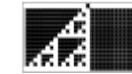

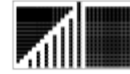


















The grading of the 8-dim Primitive Idempotent (PI) half spinor embedded with E8 in Cl(8) is 1 6 1. In Smith’s physics, the PI performs a Standard Model Higgs-like role. This 6-dim PI middle grade is the lower left to upper right diagonal of the 6x6 matrix below. Subtracting the 6 middle grade of the PI from the 70 Cl(8) middle grade gives the 64 middle grade for E8. This 64 middle grade is the position by momentum 8x8=64-dim vector part of Smith’s E8 physics model [5]. This 64-dim part of E8 thus relates to the 4-vector/four one-bit CA rules not used for the 6-dim PI middle grade though the upper left to lower right diagonals of the two 4x4 matrices below form another PI half spinor that is part of the E8 middle grade. Both PI half spinors fit with the 16 Pertti Lounesto terms using basis vectors MGCATYZX [6]. The position and momentum are 8-dim due to the GMAC Kaluza-Klein internal symmetry space added to the XYZT physical spacetime in Smith’s model.

	0	15-GMAC
15-TZYX		
	TZYX	GMAC
	11101000	00010111











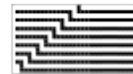


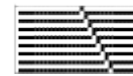

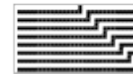
Smith relates his spacetime structure to Kaca Bradonjic's Unimodular Relativity [7]. The two rules above would relate to 4-volumes [8] for physical spacetime and internal symmetry space. The rule thumbnails below closely match the ones for gluon ghosts, translations, and special conformal transformations described earlier. Here they represent an SU(3) Yang-Mills connection [9] and part of a conformal connection [8].

	1-G	2-M	4-A	8-C
	<i>rule 240</i>	<i>rule 226</i>	<i>rule 228</i>	<i>rule 225</i>
14-TZY				
	TZYG	TZYM	TZYA	TZYC
	11110000	11100010	11100100	11100001
	<i>rule 184</i>	<i>rule 170</i>	<i>rule 172</i>	<i>rule 169</i>
13-TZX				
	TZXG	TZXM	TZXA	TZXC
	10111000	10101010	10101100	10101001
	<i>rule 216</i>	<i>rule 202</i>	<i>rule 204</i>	<i>rule 201</i>
11-TYX				
	TYXG	TYXM	TYXA	TYXC
	11011000	11001010	11001100	11001001
	<i>rule 120</i>	<i>rule 106</i>	<i>rule 108</i>	<i>rule 105</i>
7-ZYX				
	ZYXG	ZYXM	ZYXA	ZYXC
	01111000	01101010	01101100	01101001


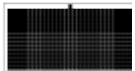
The lower left to upper right diagonal below is the Primitive Idempotent Higgs related structure mentioned earlier. This diagonal splits the 6x6 block into two copies of a 15-dim Unimodular SL(4,R) projective structure [8]. The SL(4,R) aka SO(3,3) structures include a 3x3 block (upper left and lower right) with translations, special conformal transformations, and a dilation plus three each from the adjacent blocks for rotations and boosts. The two copies of SL(4,R) are one each for physical spacetime and the internal symmetry space.

	3-GM	5-GA	6-MA	9-GC	10-MC	12-AC
	<i>rule 178</i>	<i>rule 180</i>	<i>rule 166</i>	<i>rule 177</i>	<i>rule 163</i>	<i>rule 165</i>
12-TZ						
	TZGM	TZGA	TZMA	TZGC	TZMC	TZAC
	10110010	10110100	10100110	10110001	10100011	10100101
	<i>rule 210</i>	<i>rule 212</i>	<i>rule 198</i>	<i>rule 209</i>	<i>rule 195</i>	<i>rule 197</i>
10-TY						
	TYGM	TYGA	TYMA	TYGC	TYMC	TYAC
	11010010	11010100	11000110	11010001	11000011	11000101
	3-GM	5-GA	6-MA	9-GC	10-MC	12-AC
	<i>rule 154</i>	<i>rule 156</i>	<i>rule 142</i>	<i>rule 153</i>	<i>rule 139</i>	<i>rule 141</i>
9-TX						
	TXGM	TXGA	TXMA	TXGC	TXMC	TXAC
	10011010	10011100	10001110	10011001	10001011	10001101
	<i>rule 114</i>	<i>rule 116</i>	<i>rule 102</i>	<i>rule 113</i>	<i>rule 99</i>	<i>rule 101</i>
6-ZY						
	ZYGM	ZYGA	ZYMA	ZYGC	ZYMC	ZYAC
	01110010	01110100	01100110	01110001	01100001	01100101
	<i>rule 58</i>	<i>rule 60</i>	<i>rule 46</i>	<i>rule 57</i>	<i>rule 43</i>	<i>rule 45</i>
5-ZX						
	ZXGM	ZXGA	ZXMA	ZXGC	ZXMC	ZXAC
	00111010	00111100	00101110	00111001	00101011	00101101
	<i>rule 90</i>	<i>rule 92</i>	<i>rule 78</i>	<i>rule 89</i>	<i>rule 75</i>	<i>rule 77</i>
3-YX						
	YXGM	YXGA	YXMA	YXGC	YXMC	YXAC
	01011010	01011100	01001110	01011001	01001011	01001101

The 4x4 block below has an upper left to lower right diagonal for a conformal metric [8] that splits the block into the Lorentz structure group part of the conformal connection and the $SU(2) \times U(1)$ Yang-Mills connection [9]. This Electroweak half of the block also has the dilation part of the conformal connection (Smith's Higgs VeV related) plus a propagator phase related rule.

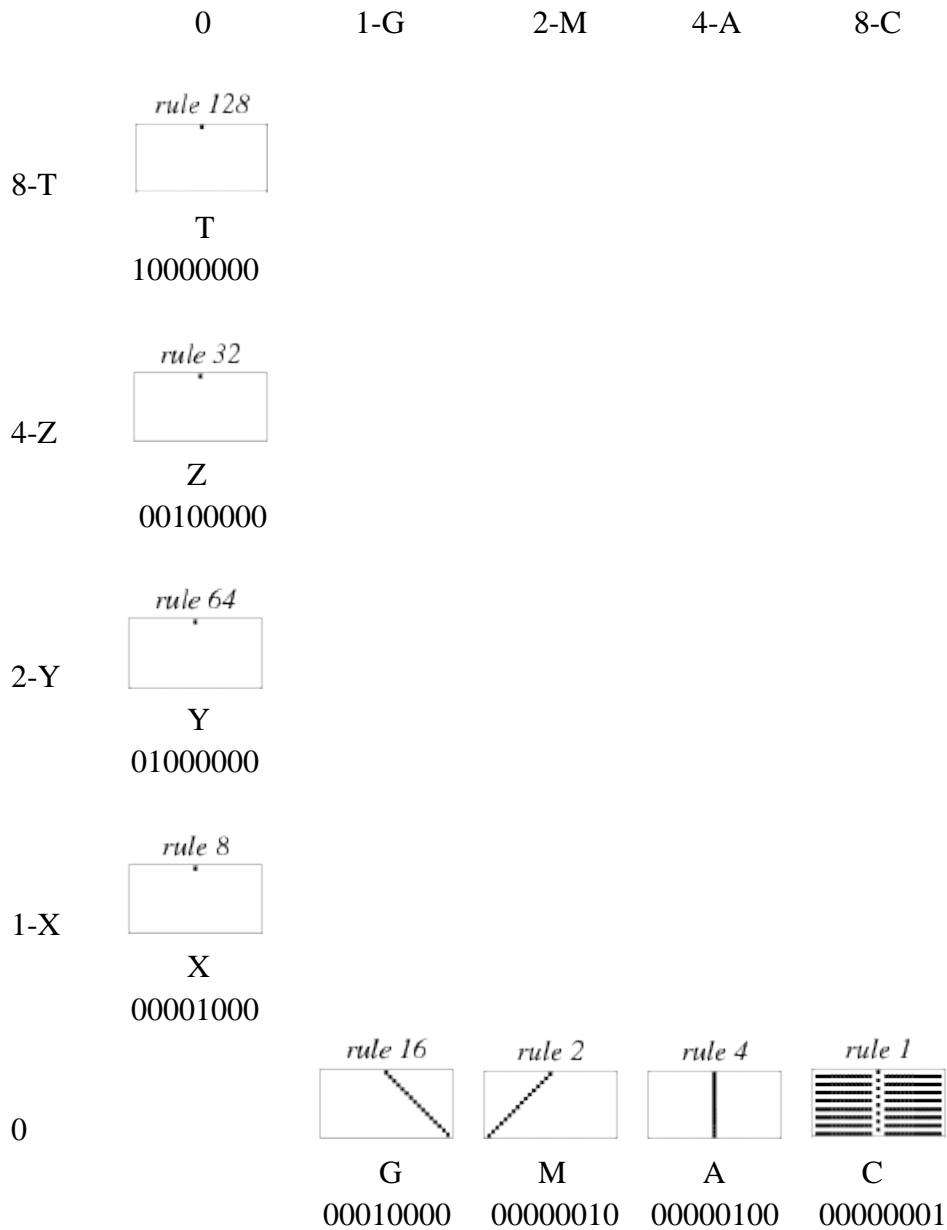
	7-GMA	11-GMC	13-GAC	14-MAC
	<i>rule 150</i>	<i>rule 147</i>	<i>rule 149</i>	<i>rule 135</i>
8-T				
	TGMA	TGMC	TGAC	TMAC
	10010110	10010011	10010101	10000111
	<i>rule 54</i>	<i>rule 51</i>	<i>rule 53</i>	<i>rule 39</i>
4-Z				
	ZGMA	ZGMC	ZGAC	ZMAC
	00110110	00110011	00110101	00100111
	7-GMA	11-GMC	13-GAC	14-MAC
	<i>rule 86</i>	<i>rule 83</i>	<i>rule 85</i>	<i>rule 71</i>
2-Y				
	YGMA	YGMC	YGAC	YMAC
	01010110	01010011	01010101	01000111
	<i>rule 30</i>	<i>rule 27</i>	<i>rule 29</i>	<i>rule 15</i>
1-X				
	XGMA	XGMC	XGAC	XMAC
	00011110	00011011	00011101	00001111

The two ones of the PI and CI(8) grading fit with the CA rules having 0 of 8 ones and 8 of 8 ones and as mentioned earlier are Higgs related:

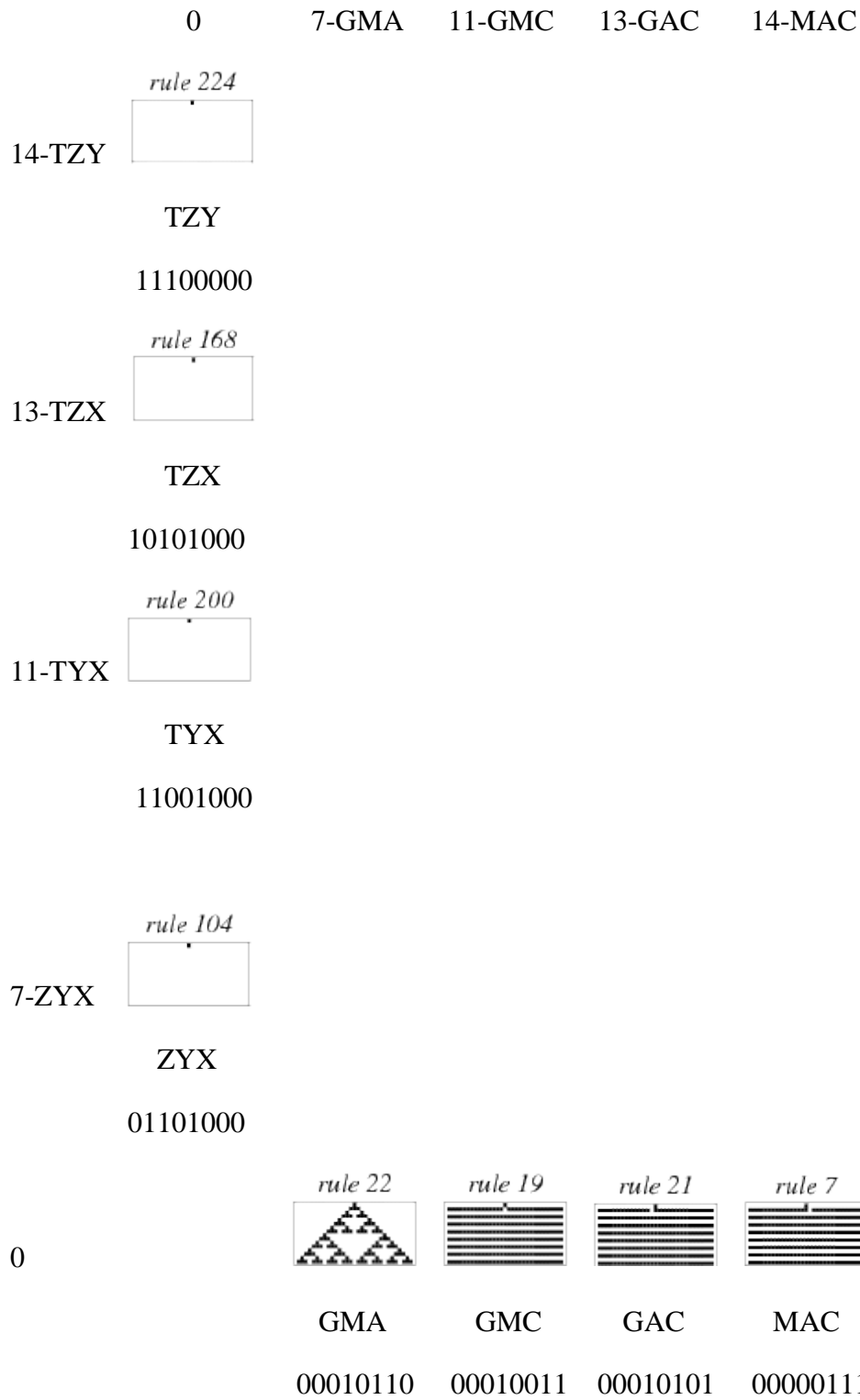
<i>rule 0</i>	<i>rule 255</i>
	
	TZYXGMAC
00000000	11111111

10. Spacetime Components of Fermion Creation Operators










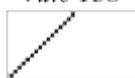


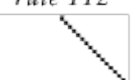
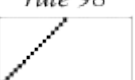
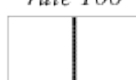


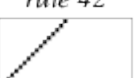
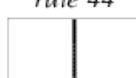
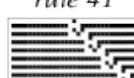
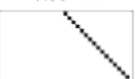
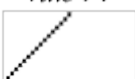


The two remaining 64s in the E8 grading of Smith's model are for 8 spacetime components of fermion creation operators and 8 spacetime components of antifermion creation operators. The E8 64 grading for fermions comes from the 8 Cl(8) vectors plus the 56 Cl(8) 3-vectors. Thus the fermions relate to the Cellular Automata rules with a single one-bit and the rules with three one-bits. Here are the rules for the neutrino creation operator [10].





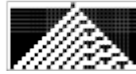






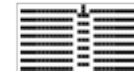














Here are the rules for the electron creation operator.



Here are the rules for quark creation operators.





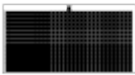



	1-G	2-M	4-A	8-C
12-TZ	<i>rule 176</i> 	<i>rule 162</i> 	<i>rule 164</i> 	<i>rule 161</i> 
	TZG 10110000	TZM 10100010	TZA 10100100	TZC 10100001
10-TY	<i>rule 208</i> 	<i>rule 194</i> 	<i>rule 196</i> 	<i>rule 193</i> 
	TYG 11010000	TYM 11000010	TYA 11000100	TYC 11000001
9-TX	<i>rule 152</i> 	<i>rule 138</i> 	<i>rule 140</i> 	<i>rule 137</i> 
	TXG 10011000	TXM 10001010	TXA 10001100	TXC 10001001
6-ZY	<i>rule 112</i> 	<i>rule 98</i> 	<i>rule 100</i> 	<i>rule 97</i> 
	ZYG 01110000	ZYM 01100010	ZYA 01100100	ZYC 01100001
5-ZX	<i>rule 56</i> 	<i>rule 42</i> 	<i>rule 44</i> 	<i>rule 41</i> 
	ZXG 00111000	ZXM 00101010	ZXA 00101100	ZXC 00101001
3-YX	<i>rule 88</i> 	<i>rule 74</i> 	<i>rule 76</i> 	<i>rule 73</i> 
	YXG 01011000	YXM 01001010	YXA 01001100	YXC 01001001

	3-GM	5-GA	6-MA	9-GC	10-MC	12-AC
	<i>rule 146</i>	<i>rule 148</i>	<i>rule 134</i>	<i>rule 145</i>	<i>rule 131</i>	<i>rule 133</i>
8-T						
	TGM	TGA	TMA	TGC	TMC	TAC
	10010010	10010100	10000110	10010001	10000011	10000101
	<i>rule 50</i>	<i>rule 52</i>	<i>rule 38</i>	<i>rule 49</i>	<i>rule 35</i>	<i>rule 37</i>
4-Z						
	ZGM	ZGA	ZMA	ZGC	ZMC	ZAC
	00110010	00110100	00100110	00110001	00100011	00100101
	<i>rule 82</i>	<i>rule 84</i>	<i>rule 70</i>	<i>rule 81</i>	<i>rule 67</i>	<i>rule 69</i>
2-Y						
	YGM	YGA	YMA	YGC	YMC	YAC
	01010010	01010100	01000110	01010001	01000011	01000101
	<i>rule 26</i>	<i>rule 28</i>	<i>rule 14</i>	<i>rule 25</i>	<i>rule 11</i>	<i>rule 13</i>
1-X						
	XGM	XGA	XMA	XGC	XMC	XAC
	00011010	00011100	00001110	00011001	00001011	00001101





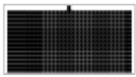
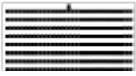

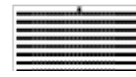
11. Spacetime Components of Antifermion Creation Operators

The E8 64 grading for antifermions comes from the 8 Cl(8) 7-vectors plus the 56 Cl(8) 5-vectors. Thus the related Cellular Automata rules for the spacetime components of each antifermion creation operator have five one-bits or seven one-bits. Like with the ghost boson to actual boson mapping done earlier, the fermion to antifermion mapping is a negative transformation [4].










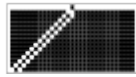
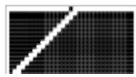
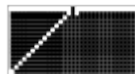


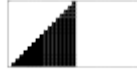









Here are the rules for the antineutrino creation operator.


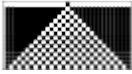



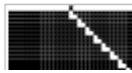

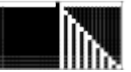

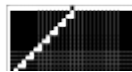
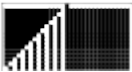













	7-GMA	11-GMC	13-GAC	14-MAC	15-GMAC
	<i>rule 254</i>	<i>rule 251</i>	<i>rule 253</i>	<i>rule 239</i>	
15-TZYX					
	TZYXGMA	TZYXGMC	TZYXGAC	TZYXMAC	
	11111110	11111011	11111101	11101111	
					<i>rule 247</i>
14-TZY					
					TZYGMAC
					11110111
					<i>rule 191</i>
13-TZX					
					TZXGMAC
					10111111
					<i>rule 223</i>
11-TYX					
					TYXGMAC
					10111111
					<i>rule 127</i>
7-ZYX					
					ZYXGMAC
					01111111

Here are the rules for the positron creation operator.

	1-G	2-M	4-A	8-C	15-GMAC
15-TZYX	<i>rule 248</i> 	<i>rule 234</i> 	<i>rule 236</i> 	<i>rule 233</i> 	
	TZYXG	TZYXM	TZYXA	TZYXC	
	11111000	11101010	11101100	11101001	
8-T					<i>rule 151</i> 
					TGMAC
					10010111
4-Z					<i>rule 55</i> 
					ZGMAC
					00110111
2-Y					<i>rule 87</i> 
					YGMAC
					01010111
1-X					<i>rule 31</i> 
					XGMAC
					00011111

Here are the rules for antiquark creation operators.

	3-GM	5-GA	6-MA	9-GC	10-MC	12-AC
	<i>rule 242</i>	<i>rule 244</i>	<i>rule 230</i>	<i>rule 241</i>	<i>rule 227</i>	<i>rule 229</i>
14-TZY						
	TZYG M	TZYGA	TZYMA	TZYG C	TZYMC	TZYAC
	11110010	11110100	11100110	11110001	11100011	11100101
	<i>rule 186</i>	<i>rule 188</i>	<i>rule 174</i>	<i>rule 185</i>	<i>rule 171</i>	<i>rule 173</i>
13-TZX						
	TZXGM	TZXGA	TZXMA	TZXGC	TZXMC	TZXAC
	10111010	10111100	10101110	10111001	10101011	10101101
	3-GM	5-GA	6-MA	9-GC	10-MC	12-AC
	<i>rule 218</i>	<i>rule 220</i>	<i>rule 206</i>	<i>rule 217</i>	<i>rule 203</i>	<i>rule 205</i>
11-TYX						
	TYXGM	TYXGA	TYXMA	TYXGC	TYXMC	TYXAC
	11011010	11011100	11001110	11011001	11001011	11001101
	<i>rule 122</i>	<i>rule 124</i>	<i>rule 110</i>	<i>rule 121</i>	<i>rule 107</i>	<i>rule 109</i>
7-ZYX						
	ZYXGM	ZYXGA	ZYXMA	ZYXGC	ZYXMC	ZYXAC
	01111010	01111100	01101110	01111001	01101011	01101101

	7-GMA	11-GMC	13-GAC	14-MAC
12-TZ	<i>rule 182</i>  TZGMA 10110110	<i>rule 179</i>  TZGMC 10110011	<i>rule 181</i>  TZGAC 10110101	<i>rule 167</i>  TZMAC 10100111
10-TY	<i>rule 214</i>  TYGMA 11010110	<i>rule 211</i>  TYGMC 11010011	<i>rule 213</i>  TYGAC 11010101	<i>rule 199</i>  TYMAC 11000111
9-TX	<i>rule 158</i>  TXGMA 10011110	<i>rule 155</i>  TXGMC 10011011	<i>rule 157</i>  TXGAC 10011101	<i>rule 143</i>  TXMAC 10001111
6-ZY	<i>rule 118</i>  ZYGMA 01110110	<i>rule 115</i>  ZYGMC 01110011	<i>rule 117</i>  ZYGAC 01110101	<i>rule 103</i>  ZYMAC 01100111
5-ZX	<i>rule 62</i>  ZXGMA 00111110	<i>rule 59</i>  ZXGMC 00111011	<i>rule 61</i>  ZXGAC 00111101	<i>rule 47</i>  ZXMAC 00101111
3-YX	<i>rule 94</i>  YXGMA 01011110	<i>rule 91</i>  YXGMC 01011011	<i>rule 93</i>  YXGAC 01011101	<i>rule 79</i>  YXMAC 01001111

12. Discussion

The reflection transformation bits mentioned earlier, G vs. M or X vs. Y, may relate to color (with neither/both bits making up the third color) for quarks and antiquarks. The bits may affect slant patterns in general (along with A/Z straight line and C/T periodicity/chaos) for bosons, position-momentum, and fermions/antifermions. Here is the partitioning of rule space [11] associated with this mapping of Cl(8), E8 [12], and Elementary Cellular Automata.

	0	1	2	4	8	3	5	6	9	10	12	7	11	13	14	15
		G	M	A	C	GM	GA	MA	GC	MC	AC	GMA	GMC	GAC	MAC	GMAC
15 TZYX	232 PM	248 P	234 P	236 P	233 P	250 BO	252 BO	238 BO	249 RO	235 RO	237 RO	254 AN	251 AN	253 AN	239 AN	255 PI
14 TZY	224 E	240 PM/PI	226 PM	228 PM	225 PM	242 AQ	244 AQ	230 AQ	241 AQ	227 AQ	229 AQ	246 GL	243 GL	245 GL	231 GL	247 AN
13 TZX	168 E	184 PM	170 PM/PI	172 PM	169 PM	186 AQ	188 AQ	174 AQ	185 AQ	171 AQ	173 AQ	190 GL	187 GL	189 GL	175 GL	191 AN
11 TYX	200 E	216 PM	202 PM	204 PM/PI	201 PM	218 AQ	220 AQ	206 AQ	217 AQ	203 AQ	205 AQ	222 TR	219 TR	221 TR	207 TR	223 AN
7 ZYX	104 E	120 PM	106 PM	108 PM	105 PM/PI	122 AQ	124 AQ	110 AQ	121 AQ	107 AQ	109 AQ	126 CO	123 CO	125 CO	111 CO	127 AN
12 TZ	160 BO	176 Q	162 Q	164 Q	161 Q	178 PM	180 PM	166 PM	177 PM	163 PM	165 PI	182 AQ	179 AQ	181 AQ	167 AQ	183 PR
10 TY	192 BO	208 Q	194 Q	196 Q	193 Q	210 PM	212 PM	198 PM	209 PM	195 PI	197 PM	214 AQ	211 AQ	213 AQ	199 AQ	215 EW
9 TX	136 BO	152 Q	138 Q	140 Q	137 Q	154 PM	156 PM	142 PM	153 PI	139 PM	141 PM	158 AQ	155 AQ	157 AQ	143 AQ	159 EW
6 ZY	96 RO	112 Q	98 Q	100 Q	97 Q	114 PM	116 PM	102 PI	113 PM	99 PM	101 PM	118 AQ	115 AQ	117 AQ	103 AQ	119 EW
5 ZX	40 RO	56 Q	42 Q	44 Q	41 Q	58 PM	60 PI	46 PM	57 PM	43 PM	45 PM	62 AQ	59 AQ	61 AQ	47 AQ	63 EW
3 YX	72 RO	88 Q	74 Q	76 Q	73 Q	90 PI	92 PM	78 PM	89 PM	75 PM	77 PM	94 AQ	91 AQ	93 AQ	79 AQ	95 DI
8 T	128 N	144 GL	130 GL	132 TR	129 CO	146 Q	148 Q	134 Q	145 Q	131 Q	133 Q	150 PM/PI	147 PM	149 PM	135 PM	151 P
4 Z	32 N	48 GL	34 GL	36 TR	33 CO	50 Q	52 Q	38 Q	49 Q	35 Q	37 Q	54 PM	51 PM/PI	53 PM	39 PM	55 P
2 Y	64 N	80 GL	66 GL	68 TR	65 CO	82 Q	84 Q	70 Q	81 Q	67 Q	69 Q	86 PM	83 PM	85 PM/PI	71 PM	87 P
1 X	8 N	24 GL	10 GL	12 TR	9 CO	26 Q	28 Q	14 Q	25 Q	11 Q	13 Q	30 PM	27 PM	29 PM	15 PM/PI	31 P
0	0 PI	16 N	2 N	4 N	1 N	18 PR	20 EW	6 EW	17 EW	3 EW	5 DI	22 E	19 E	21 E	7 E	23 PM

PI: Primitive Idempotent
CO: Conformal boson/ghost
PR: Propagator Phase
AQ: Antiquark creation
Wolfram Class 1 Rule

RO: Rotation boson/ghost
DI: Dilation boson/ghost
Q: Quark creation
P: Positron creation
Wolfram Class 2 Rule

BO: Boost boson/ghost
EW: Electroweak boson/ghost
E: Electron creation
AN: Antineutrino creation
Wolfram Class 3 Rule

TR: Translation boson/ghost
GL: Gluon boson/ghost
N: Neutrino creation
PM: Position-Momentum
Wolfram Class 4 Rule

The line of symmetry for the Wolfram Rule Classes (diagonal line from rule 232 to rule 23) has the same rules as the line of symmetry for Rodrigo Obando's [13] rule space partitioning. However, the two lines of symmetry have the rules in different locations on the line. These line of symmetry rules are the rules that are their own negative transformation [4].

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