Deriving E8 from Cl(8) through Pairing up Elementary Cellular Automata Bits

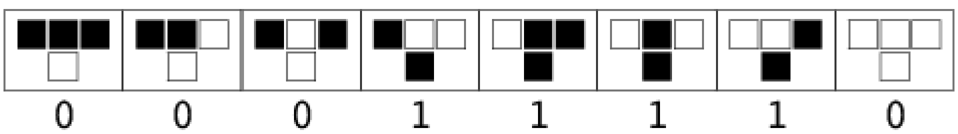
By John C. Gonsowski

Abstract

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 a spacetime 8-dim position by 8-dim momentum. 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. Paired up CA bits are related to the Cartan subalgebras of these D4s. 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.

Introduction

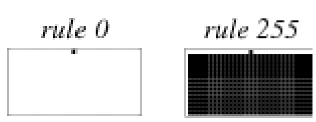
Tony Smith [1] relates the 256 dimensions of the Cl(8) Clifford Algebra to the 256 rules of Elementary Cellular Automata [2]. The graded dimensions of Cl(8) correspond to graded dimensions of the E8 Lie Algebra used in Smith's physics model. An 8-dim Primitive Idempotent half spinor along with the 248-dim 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 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.

The Primitive Idempotent and Paired Up Cellular Automata

The grading of the 248-dim E8 in Smith's physics model is 28 64 64 64 28. 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. The two ones of the PI grading fit with the rules having 0 of 8 ones and 8 of 8 ones:



00000000 11111111

The middle 6 of the PI grading adds to the middle 64 of the E8 grading to get the middle 70 of the Cl(8) grading. This middle 6 grading thus fits with 6 rules having four one-bits. It specifically fits with the 3+2+1=6 rules that have two pairs of bits that can pair up to form the Cartan subalgebra bivectors of Smith’s model. The first two bits that pair up form the Y and X of an YX spatial rotation.

Y X

01000000 00001000

The next two bits to pair up form the temporal T and spatial Z of a Lorentz group TZ boost.

T Z

10000000 00100000

The next two bits to pair up use a Conformal group (C) basis vector and an Anti-DeSitter group (A) translation basis vector to form a dilation (CA). This dilation is the Higgs VEV in Smith’s physics model.

C A

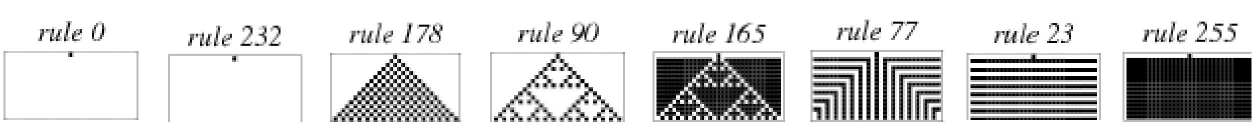
00000001 00000100

The final two bits to pair up 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).

M G

00000010 00010000

Using these paired up bits gives the following rules with four one-bits for the middle 6 grading of the 8-dim Primitive Idempotent bookended by the single rule with no one-bits and the single rule with all eight bits as ones.



	TZYX	TZGM	YXGM	TZAC	YXAC	GMAC	TZYXGMAC
00000000	11101000	10110010	01011010	10100101	01001101	00010111	11111111

Rotations and Boosts

As mentioned earlier, these paired up bits (TZ, YX, GM, and AC) are to be used for the Cartan subalgebra in Smith's physics model. Smith uses the Cartan subalgebra bivectors for the 28s in his E8 grading which match to the 28s in the Cl(8) grading. The E8 28s come from two D4 subalgebras. The Cartan subalgebra bivectors thus also relate to the axes of a 24-vertex, 4-dim 24-cell, D4's root vector polytope. The 28 Cellular Automata with 2 one-bits and the 28 CA with 6 one-bits will contain the Cartan subalgebra bivectors. Here are the three Lorentz Group gravity spatial rotation bivectors/double one-bits including the YX Cartan subalgebra one.

ZY ZX YX

01100000 00101000 01001000

Here are the three Lorentz group gravity boost bivectors/double one-bits including the TZ Cartan subalgebra one.

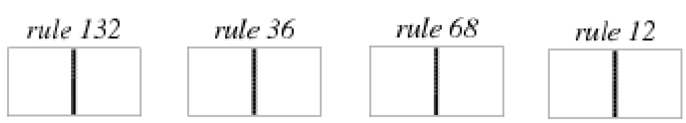
TZ TY TX

10100000 11000000 10001000

Translations, Dilation and Special Conformal Transformations

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

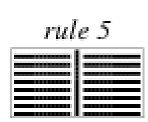
Anti-DeSitter Translations:



TA ZA YA XA

10000100 00100100 01000100 00001100

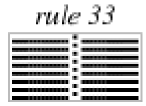
Cartan subalgebra Dilation:

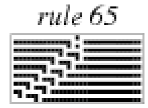


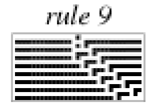
CA

00000101

Conformal Transformations:







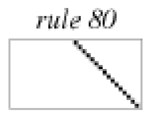
TC ZC YC XC

10000001 00100001 01000001 00001001

Ghosts for the Standard Model Bosons

Here are the bivectors/double one-bits for the Standard Model Ghosts of Smith's physics model plus the MG Cartan subalgebra propagator phase.

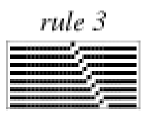
rgb/rg/rb/gb "half" Gluons:

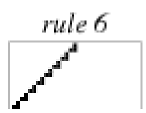


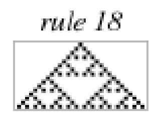
TG ZG YG XG

10010000 00110000 01010000 00011000

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



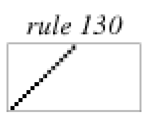


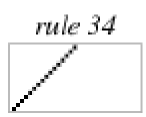


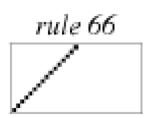
CM CG AM AG MG

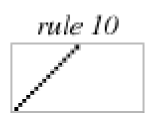
00000011 00010001 00000110 00010100 00010010

cmy/cm/cy/my "half" Gluons:









TM ZM YM XM

10000010 00100010 01000010 00001010

Ghosts for Rotations and Boosts

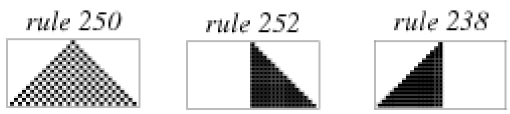
The above conformal gravity and Standard Model ghost bivectors fit with the 28 Cellular Automata rules with double one-bits. These 28 CA relate to the first 28 in the E8 and Cl(8) grading. The conformal gravity ghost and Standard Model bivectors fit with the 28 CA with six one-bits. These CA relate to 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 including the four Cartan subalgebra 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 [3]. 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 including the MG Cartan subalgebra one.

AM AG MG

11111001 11101011 11101101

Here are the three Lorentz group gravity boost bivectors/double zero-bit ghosts including the CA Cartan subalgebra one.



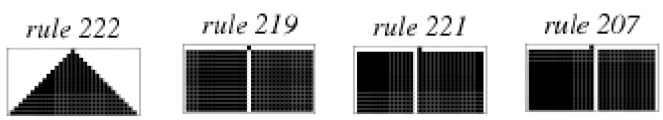
CA CM CG

11111010 11111100 11101110

Ghosts for the Translations, Dilation and Special Conformal Transformations

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

Anti-DeSitter Translations:



CZ AZ MZ GZ

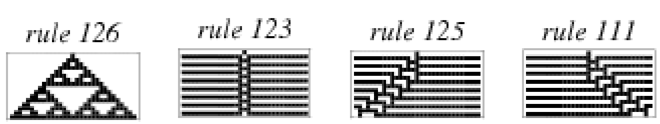
11011110 11011011 11011101 11001111

Cartan subalgebra Dilation:

TZ

01011111

Conformal Transformations:



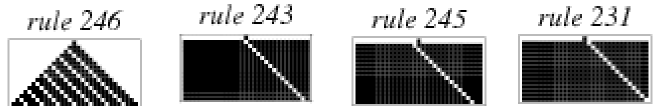
CT AT MT GT

01111110 01111011 01111101 01101111

Standard Model Bosons

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

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

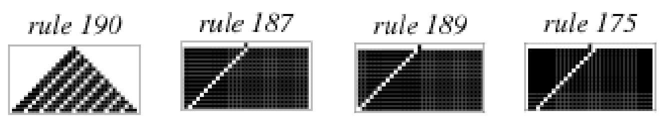


CX	AX	MX	GX
11110110	11110011	11110101	11100111

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

TY	TX	ZY	ZX	YX
00111111	01110111	10011111	11010111	10110111

cmy/cm/cy/my "half" Gluons:

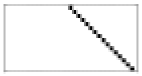
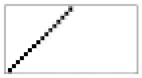
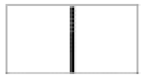
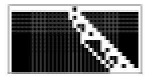
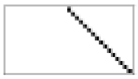
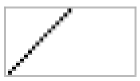
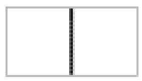
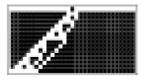
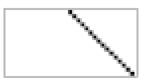
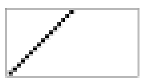
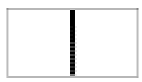
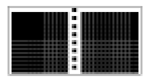
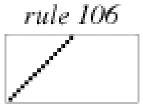
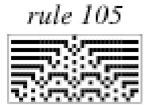


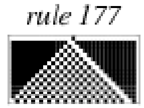
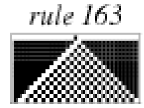
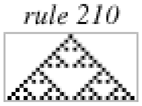
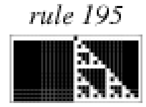
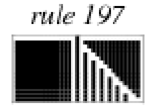
CY	AY	MY	GY
10111110	10111011	10111101	10101111

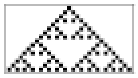
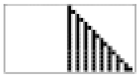
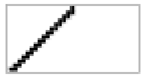
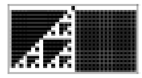
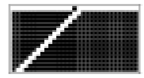
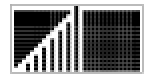
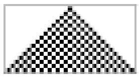
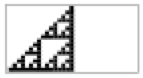
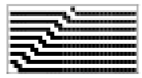
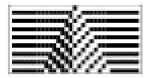
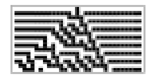
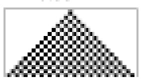
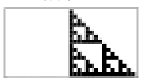
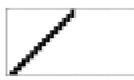
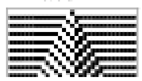
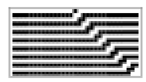
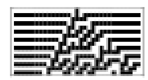
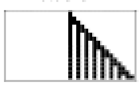
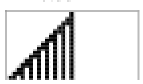
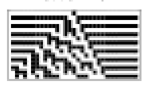
There's a pattern where rules (with G vs. M) that slant to the left vs. slanting to the right may relate to charge for the Standard Model bosons and direction change (X vs. Y) for gravity bosons. These reflection transformation [3] bits perhaps relate to how charge, mass, and change of direction are related in Smith's 4-dim Feynman Checkerboard.

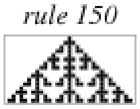
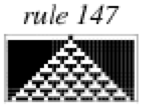
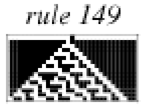
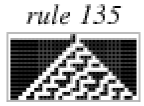
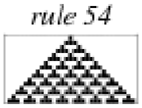
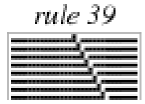
Spacetime Position and Momentum

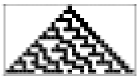
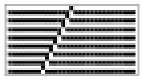
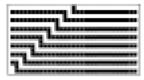
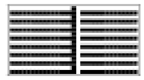
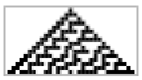
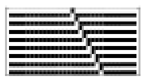
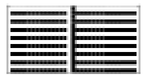
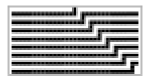
Subtracting the 6 middle grade of the Primitive Idempotent from the 70 Cl(8) middle grade gives the 64 middle grade for E8. This 64 middle grade is the position by momentum 8x8=64-dim vector part of Smith's E8 physics model. This 64-dim part of E8 thus relates to the 4-vector/four one-bit Cellular Automata rules not used for the Primitive Idempotent. The position and momentum are 8-dim due to the GMAC Kaluza-Klein internal symmetry space added to the XYZT physical spacetime.

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

	3-GM	5-GA	6-MA	9-GC	10-MC	12-AC
12-TZ		*rule 180*  TZGA 10110100	*rule 166*  TZMA 10100110	*rule 177*  TZGC 10110001	*rule 163*  TZMC 10100011	
10-TY	*rule 210*  TYGM 11010010	*rule 212*  TYGA 11010100	*rule 198*  TYMA 11000110	*rule 209*  TYGC 11010001	*rule 195*  TYMC 11000011	*rule 197*  TYAC 11000101

	3-GM	5-GA	6-MA	9-GC	10-MC	12-AC
9-TX	*rule 154*  TXGM 10011010	*rule 156*  TXGA 10011100	*rule 142*  TXMA 10001110	*rule 153*  TXGC 10011001	*rule 139*  TXMC 10001011	*rule 141*  TXAC 10001101
6-ZY	*rule 114*  ZYGM 01110010	*rule 116*  ZYGA 01110100	*rule 102*  ZYMA 01100110	*rule 113*  ZYGC 01110001	*rule 99*  ZYMC 01100001	*rule 101*  ZYAC 01100101
5-ZX	*rule 58*  ZXGM 00111010	*rule 60*  ZXGA 00111100	*rule 46*  ZXMA 00101110	*rule 57*  ZXGC 00111001	*rule 43*  ZXMC 00101011	*rule 45*  ZXAC 00101101
3-YX		*rule 92*  YXGA 01011100	*rule 78*  YXMA 01001110	*rule 89*  YXGC 01011001	*rule 75*  YXMC 01001011	

	7-GMA	11-GMC	13-GAC	14-MAC
8-T	*rule 150*  TGMA 10010110	*rule 147*  TGMC 10010011	*rule 149*  TGAC 10010101	*rule 135*  TMAC 10000111
4-Z	*rule 54*  ZGMA 00110110	*rule 51*  ZGMC 00110011	*rule 53*  ZGAC 00110101	*rule 39*  ZMAC 00100111

	7-GMA	11-GMC	13-GAC	14-MAC
2-Y	*rule 86*  YGMA 01010110	*rule 83*  YGMC 01010011	*rule 85*  YGAC 01010101	*rule 71*  YMAC 01000111
1-X	*rule 30*  XGMA 00011110	*rule 27*  XGMC 00011011	*rule 29*  XGAC 00011101	*rule 15*  XMAC 00001111

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.

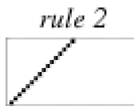
	0	1-G	2-M	4-A	8-C
8-T	*rule 128*  T 10000000				
4-Z	*rule 32*  Z 00100000				
2-Y	*rule 64*  Y 01000000				

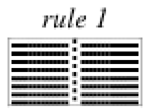
1-X 

X

00001000

0





1-G	2-M	4-A	8-C
00010000	00000010	00000100	00000001

Here are the rules for the electron creation operator.

0	7-GMA	11-GMC	13-GAC	14-MAC

14-TZY 

TZY

11100000

13-TZX 

TZX

10101000

11-TYX 

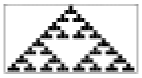
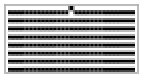
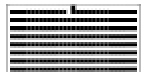
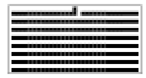
TYX

11001000

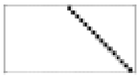
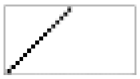
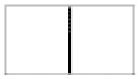
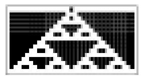
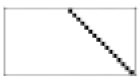
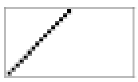
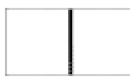
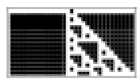
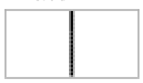
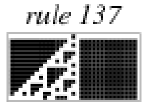
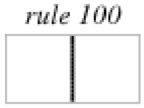
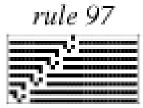
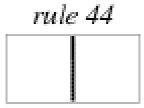
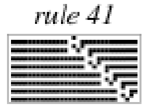
7-ZYX 

ZYX

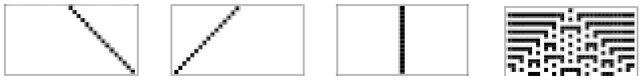
01101000

0	*rule 22* 	*rule 19* 	*rule 21* 	*rule 7* 
	7-GMA	11-GMC	13-GAC	14-MAC
	00010110	00010011	00010101	00000111

Here are the rules for quark creation operators.

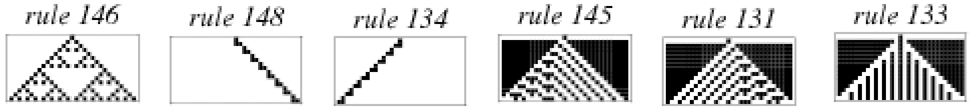
	1-G	2-M	4-A	8-C
12-TZ	*rule 176* 	*rule 162* 	*rule 164* 	*rule 161* 
	TZG	TZM	TZA	TZC
	10110000	10100010	10100100	10100001
10-TY	*rule 208* 	*rule 194* 	*rule 196* 	*rule 193* 
	TYG	TYM	TYA	TYC
	11010000	11000010	11000100	11000001
9-TX	*rule 152* 	*rule 138* 	*rule 140* 	*rule 137* 
	TXG	TXM	TXA	TXC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

	1-G	2-M	4-A	8-C
	rule 88	rule 74	rule 76	rule 73

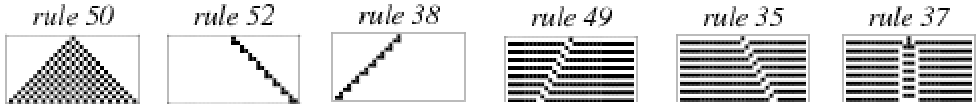
3-YX 

YXG	YXM	YXA	YXC
01011000	01001010	01001100	01001001

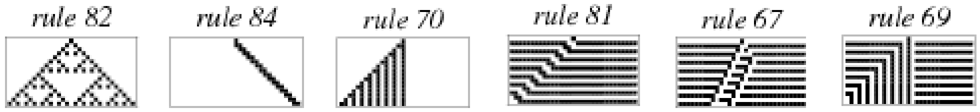
	3-GM	5-GA	6-MA	9-GC	10-MC	12-AC
	rule 146	rule 148	rule 134	rule 145	rule 131	rule 133

8-T 

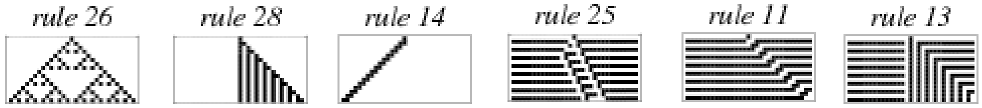
TGM	TGA	TMA	TGC	TMC	TAC
10010010	10010100	10000110	10010001	10000011	10000101
rule 50	rule 52	rule 38	rule 49	rule 35	rule 37

4-Z 

ZGM	ZGA	ZMA	ZGC	ZMC	ZAC
00110010	00110100	00100110	00110001	00100011	00100101
rule 82	rule 84	rule 70	rule 81	rule 67	rule 69

2-Y 

YGM	YGA	YMA	YGC	YMC	YAC
01010010	01010100	01000110	01010001	01000011	01000101
rule 26	rule 28	rule 14	rule 25	rule 11	rule 13

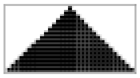
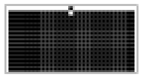
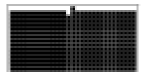
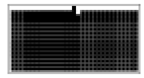
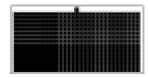
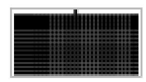
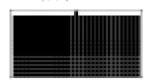
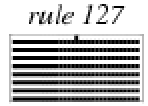
1-X 

XGM	XGA	XMA	XGC	XMC	XAC
00011010	00011100	00001110	00011001	00001011	00001101

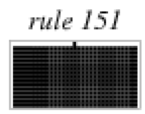
Spacetime Components of Antifermion Creation Operators

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 [3].

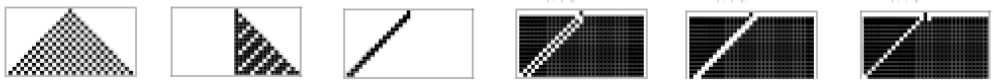
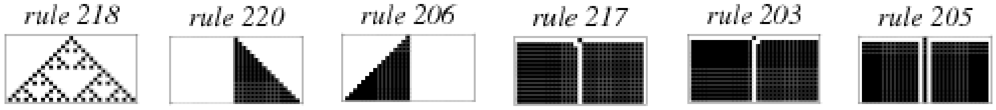
Here are the rules for the antineutrino creation operator.

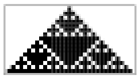
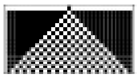
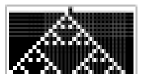
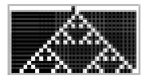
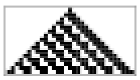
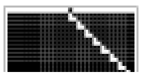
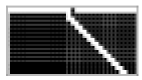
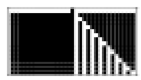
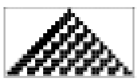
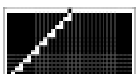
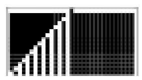
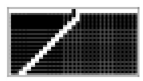
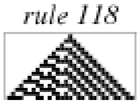
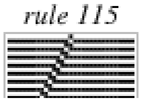
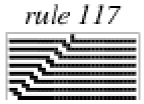
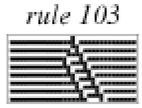
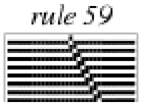
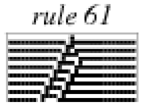
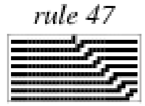
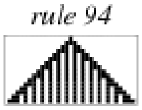
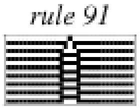
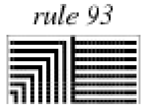
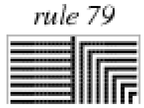
	7-GMA	11-GMC	13-GAC	14-MAC	15-GMAC
15-TZYX	rule 254  TZYXGMA 11111110	rule 251  TZYXGMC 11111011	rule 253  TZYXGAC 11111101	rule 239  TZYXMAC 11101111	
14-TZY					rule 247  TZYGMAC 11110111
13-TZX					rule 191  TZXGMAC 10111111
11-TYX					rule 223  TYXGMAC 10111111
7-ZYX					rule 127  ZYXGMAC 01111111

Here are the rules for the positron creation operator.

	1-G	2-M	4-A	8-C	15-GMAC
15-TZYX	 TZYXG 11111000	 TZYXM 11101010	 TZYXA 11101100	 TZYXC 11101001	
8-T					 TGMAC 10010111
4-Z					 ZGMAC 00110111
2-Y					 YGMAC 01010111
1-X					 XGMAC 00011111

Here are the rules for antiquark creation operators.

	3-GM	5-GA	6-MA	9-GC	10-MC	12-AC
	rule 242	*rule 244*	*rule 230*	*rule 241*	*rule 227*	*rule 229*
14-TZY						
	TZYGM	TZYGA	TZYMA	TZYGC	TZYMC	TZYAC
	11110010	11110100	11100110	11110001	11100011	11100101
	rule 186	*rule 188*	*rule 174*	*rule 185*	*rule 171*	*rule 173*
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
	rule 218	*rule 220*	*rule 206*	*rule 217*	*rule 203*	*rule 205*
11-TYX						
	TYXGM	TYXGA	TYXMA	TYXGC	TYXMC	TYXAC
	11011010	11011100	11001110	11011001	11001011	11001101
	rule 122	*rule 124*	*rule 110*	*rule 121*	*rule 107*	*rule 109*
7-ZYX						
	ZYXGM	ZYXGA	ZYXMA	ZYXGC	ZYXMC	ZYXAC
	01111010	01111100	01101110	01111001	01101011	01101101

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

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 effect 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 [4] associated with this mapping of Cl(8), E8 [5], and Elementary Cellular Automata.

	0	1 G	2 M	4 A	8 C	3 GM	5 GA	6 MA	9 GC	10 MC	12 AC	7 GMA	11 GMC	13 GAC	14 MAC	15 GMAC
15 TZYX	232 PI	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	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	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	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	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 PI	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 PM	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 PM	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 PM	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 PM	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 PI	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	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	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	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	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 PI

PI: Primitive Idempotent	RO: Rotation boson/ghost	BO: Boost boson/ghost	TR: Translation boson/ghost
CO: Conformal boson/ghost	DI: Dilation boson/ghost	EW: Electroweak boson/ghost	GL: Gluon boson/ghost
PR: Propagator Phase	Q: Quark creation	E: Electron creation	N: Neutrino creation
AQ: Antiquark creation	P: Positron creation	AN: Antineutrino creation	PM: Position-Momentum
Wolfram Class 1 Rule	Wolfram Class 2 Rule	Wolfram Class 3 Rule	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 [6] 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 [3].

References

1. http://vixra.org/pdf/1602.0319v3.pdf
2. http://mathworld.wolfram.com/ElementaryCellularAutomaton.html
3. http://vixra.org/pdf/0907.0040v4.pdf
4. http://tony5m17h.net/PureSpinorZD.pdf
5. http://vixra.org/pdf/0910.0023v4.pdf
6. http://www.complex-systems.com/pdf/24-1-2.pdf