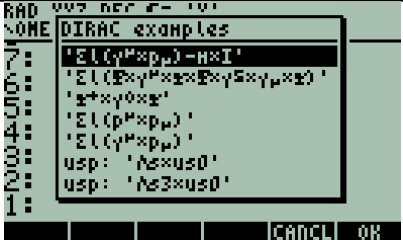
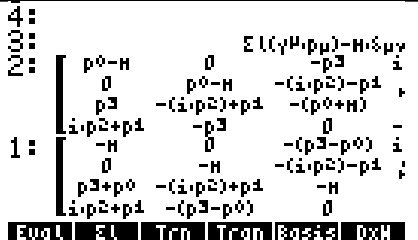
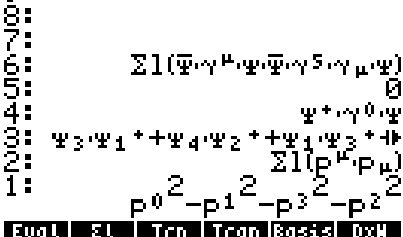
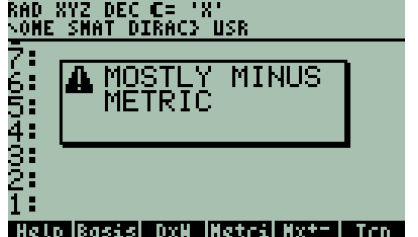

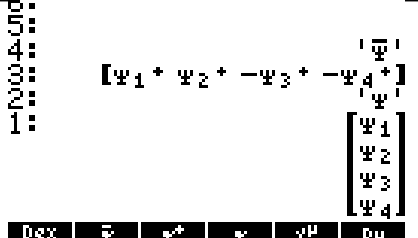
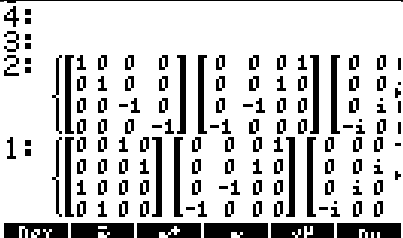
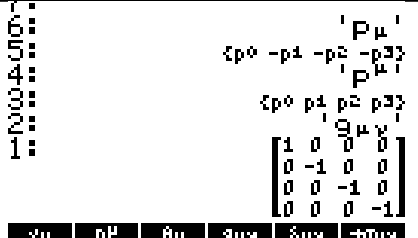
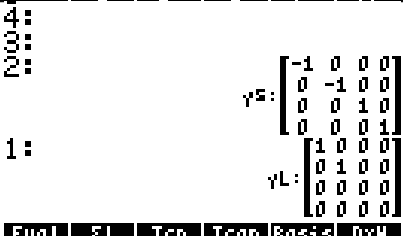
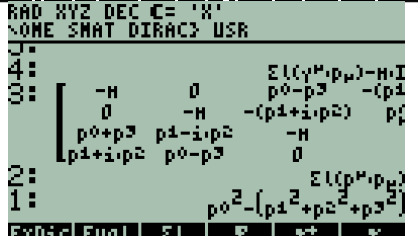
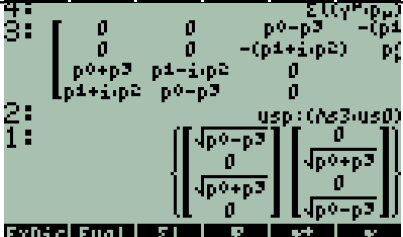
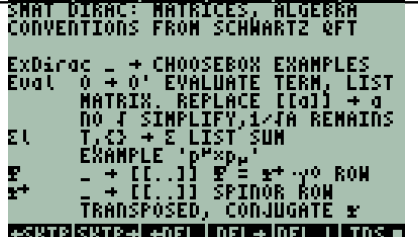

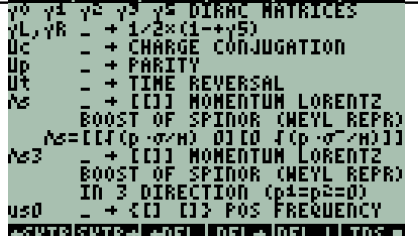

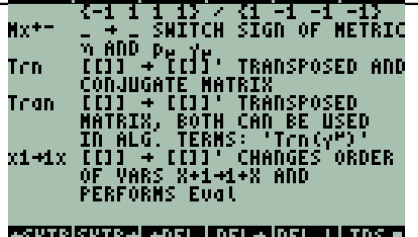


# SMAT

DIRAC: Dex: examples (1s)		
Eval: matrix $\gamma.p-m$ in Dirac basis, Weyl basis (1s)		
DIRAC: Eval various expressions (1s)		
Metric?		
DIRAC: Basis: displays current basis, DxW: switches from Dirac to Weyl and back (1s)		
wavefunctions (1s)		
DIRAC: matrices $\gamma$ in Dirac, Weyl basis (0.1s)		
$p_\mu, p^\mu, g_{\mu\nu}$ (1s)		
DIRAC: matrices $\gamma^5, \gamma^L$ in Weyl basis (0.1s)		
Evaluate expressions		
DIRAC: Evaluate expressions		
Help		
DIRAC: Help		
Help		
DIRAC: Help		
Help		

WEYL: Examples	WEYL examples p <sup>μ</sup> x <sup>μ</sup> 'Σ1(p <sup>μ</sup> x <sup>μ</sup> )' 'Σ1(p <sup>μ</sup> x <sup>μ</sup> )' 'Σ1(p <sup>μ</sup> x <sup>μ</sup> )' f(p·σ)/H: 'Σ1(p <sup>μ</sup> x <sup>μ</sup> )' f(p·σ)/H: 'Σ1(p <sup>μ</sup> x <sup>μ</sup> )' 'Σ1(p <sup>μ</sup> x <sup>μ</sup> )x <sup>μ</sup> -Hx <sup>μ</sup> 'Σ1(p <sup>μ</sup> x <sup>μ</sup> )x <sup>μ</sup> -Hx <sup>μ</sup>	Σ1(p <sup>μ</sup> x <sup>μ</sup> ) p <sup>0</sup> -p <sup>3</sup> -(p <sup>1</sup> -ip <sup>2</sup> ) -(p <sup>1</sup> +ip <sup>2</sup> ) p <sup>0</sup> +p <sup>3</sup> Σ1(p <sup>μ</sup> x <sup>μ</sup> ) p <sup>0</sup> +p <sup>3</sup> p <sup>1</sup> -ip <sup>2</sup> p <sup>1</sup> +ip <sup>2</sup> p <sup>0</sup> -p <sup>3</sup> Σ1(p <sup>μ</sup> x <sup>μ</sup> ) p <sup>0</sup> <sup>2</sup> -(p <sup>1</sup> <sup>2</sup> +p <sup>2</sup> <sup>2</sup> +p <sup>3</sup> <sup>2</sup> ) H <sup>2</sup>
Evaluate	CANCEL OK	ExMeyl Eval Σ1 p <sup>2</sup> +m <sup>2</sup> n I <sub>2</sub>
WEYL: Examples	p <sup>μ</sup> p <sup>μ</sup> p <sup>μ</sup> p <sup>μ</sup> p <sup>μ</sup> p <sup>μ</sup> p <sup>μ</sup> p <sup>μ</sup> (1 0) (0 1) (0 -i) (1 0) (0 1) (1 0) (i 0) (0 -1) (1 0) (0 -1) (0 i) (-1 0) (0 1) (-1 0) (-i 0) (0 1)	σ <sub>2</sub> : (0 -i) (i 0) (1+i 1+i) (2 2) (1+i 1+i) (2 2)
Msqrt: squareroot of matrix	p <sup>μ</sup> p <sup>μ</sup> σ <sup>μ</sup> σ <sup>μ</sup> σ <sub>i</sub> σ <sub>i</sub>	σ <sub>i</sub> Msqrt Mfct xL xR xL+
WEYL: Mfct: exponential of matrix	σ <sub>1</sub> : (1 0) (0 1) EXP (e <sup>1</sup> +1) (e <sup>1</sup> -1) 2e <sup>1</sup> 2e <sup>1</sup> (e <sup>1</sup> -1) (e <sup>1</sup> +1) 2e <sup>1</sup> 2e <sup>1</sup>	SHAT: WEYL MATRICES WEYL REPRESENTATION, METRIC +--- ExMeyl - + EXAMPLES Eval 0 + 0' EVALUATE TERM, LIST MATRIX, REPLACE [1d] + a DO J SIMPLIFY, 1/JA REMAINS Σ1 T, C3 + Σ LIST SUM EXAMPLE 'p <sup>μ</sup> x <sup>μ</sup> ' p <sup>2</sup> +m <sup>2</sup> T + T' USES p <sup>0</sup> <sup>2</sup> -p <sup>1</sup> <sup>2</sup> -p <sup>2</sup> <sup>2</sup> -p <sup>3</sup> <sup>2</sup> =H <sup>2</sup> n - + C1 -1 -1 -13 METRIC
Help	σ <sub>i</sub> Msqrt Mfct xL xR xL+	+SKIP SKIP+ +DEL DEL+ DEL L INS =
WEYL: Help	n - + C1 -1 -1 -13 METRIC DIAGONALS σ <sup>μ</sup> x <sup>μ</sup> =σ <sub>μ</sub> p <sup>μ</sup> x <sup>μ</sup> =p <sup>μ</sup> I <sub>2</sub> - + 2x2 IDENTITY MATRIX p <sup>μ</sup> p <sup>μ</sup> - + C3 MOMENTA σ <sup>μ</sup> - + C1 σ <sub>13</sub> σ <sup>μ</sup> - + C1 -σ <sub>13</sub> σ <sub>i</sub> - + C3 PAULI-MATRICES σ <sub>i</sub> - + C3 RAPIDITIES BOOST σ <sub>i</sub> - + C3 ANGLES ROTATION Msqrt [11] + [11]' SQUAREROOT OF QUADRATIC MATRIX Mfct [11] xL xR + [11]' FUNCTION OF QUADRATIC MATRIX EXAMPLES: * EXP * * J *	σ <sub>i</sub> - + C1 -σ <sub>13</sub> σ <sub>i</sub> - + C3 PAULI-MATRICES σ <sub>i</sub> - + C3 RAPIDITIES BOOST σ <sub>i</sub> - + C3 ANGLES ROTATION Msqrt [11] + [11]' SQUAREROOT OF QUADRATIC MATRIX Mfct [11] xL xR + [11]' FUNCTION OF QUADRATIC MATRIX EXAMPLES: * EXP * * J * xL, xR - + [11] WEYL SPINORS xL+, xR+ L-LEFT, R-RIGHT xL... - + [1] LORENTZ TRANSF.
Help	+SKIP SKIP+ +DEL DEL+ DEL L INS =	+SKIP SKIP+ +DEL DEL+ DEL L INS =
SWEYL: Weyl matrices in Spherical coordinates	RAD SWEYL examples p <sup>μ</sup> x <sup>μ</sup> 'Σ1(p <sup>μ</sup> x <sup>μ</sup> )' 'Σ1(p <sup>μ</sup> x <sup>μ</sup> )' 'Σ1(p <sup>μ</sup> x <sup>μ</sup> )' f(p·σ): 'Σ1(p <sup>μ</sup> x <sup>μ</sup> )'+Hx <sup>μ</sup> f(p·σ): II 'sxsx*f(E+P f(p·σ): 'Σ1(p <sup>μ</sup> x <sup>μ</sup> )'+ f(p·σ): II 'sxsx*f(E-	Σ1(p <sup>μ</sup> x <sup>μ</sup> ) E-(c <sup>2</sup> -sxsx).p -(2.Pxs.c) -(2.Pxs.c) E+(c <sup>2</sup> -sxsx).p Σ1(p <sup>μ</sup> x <sup>μ</sup> ) E+(c <sup>2</sup> -sxsx).p 2.Pxs.c 2.Pxs.c E-(c <sup>2</sup> -sxsx).p
SWEYL:	CANCEL OK	ExSwe EvalS Σ1 p <sup>2</sup> +m <sup>2</sup> cs2+1 Expan
SWEYL: Help	f(p·σ): Σ1(p <sup>μ</sup> x <sup>μ</sup> )'+Hx <sup>μ</sup> √2.(E+H) 1: [H+E-(c <sup>2</sup> -sxsx).p -(2.Pxs.c) √2.E+2.H √2.E+2.H -(2.Pxs.c) H+E+(c <sup>2</sup> -sxsx).p √2.E+2.H √2.E+2.H	f(p·σ): Σ1(p <sup>μ</sup> x <sup>μ</sup> )'+Hx <sup>μ</sup> √2.(E+H) 1: [H+E-(c <sup>2</sup> -sxsx).p 2.Pxs.c √2.E+2.H √2.E+2.H 2.Pxs.c H+E-(c <sup>2</sup> -sxsx).p √2.E+2.H √2.E+2.H
SWEYL: Help	SWEYL: SPHERICAL WEYL MATRICES METRIC +--- p <sup>μ</sup> =CE 'P×SIN(θ)×COS(φ)' 'P×SIN(θ)×SIN(φ)' 'P×COS(θ)' 'c=COS(θ/2)' 's=SIN(θ/2)×EXP(i×φ)' 's'=SIN(θ/2)×EXP(-i×φ)' ExSweyl - + EXAMPLES EvalS 0 + 0' EVALUATE TERM, LIST MATRIX, USE 'c <sup>2</sup> +sxsx=1' REPLACE [1d] + a Σ1 T, C3 + Σ LIST SUM	+SKIP SKIP+ +DEL DEL+ DEL L INS =
Help	OBJ+ +ARRY+LIST+STR+TAG+UNIT	+SKIP SKIP+ +DEL DEL+ DEL L INS =
SWEYL: Help	p <sup>μ</sup> p <sup>μ</sup> T + T' USE 'c <sup>2</sup> -p <sup>2</sup> =H <sup>2</sup> cs2+1 T + T' USE 'c <sup>2</sup> +sxsx=1' Expand T + T' EvalS + EXPAND Msqrt [11] + [11]' SQUAREROOT OF QUADRATIC MATRIX EX: Σ1(p <sup>μ</sup> x <sup>μ</sup> ) THEN EvalS Mfct [11] xL xR + [11]' FUNCTION OF QUADRATIC MATRIX EX: * EXP * * J * Mtrh [11] + [11]' EXPONENTIAL TO TRIG HYP. EX: ixp <sup>μ</sup> σ <sub>i</sub> * EXP * Mfct Mtrh	p <sup>μ</sup> p <sup>μ</sup> - + C3 MOMENTA σ <sup>μ</sup> - + C1 σ <sub>13</sub> σ <sup>μ</sup> - + C1 -σ <sub>13</sub> σ <sub>i</sub> - + C3 PAULI-MATRICES σ <sub>i</sub> - + C3 RAPIDITIES BOOST σ <sub>i</sub> - + C3 ANGLES ROTATION  p>,  p  - + [1] SPINOR NEGATIVE, POSITIVE HELICITY  p> <sub>0</sub> ,  p  <sub>0</sub> - + [1] RESTFRAME SPINOR NEGATIVE, POSITIVE HELICITY 'f(p·σ)/4H'× p> <sub>0</sub> = p> 'f(p·σ)/4H'× p  <sub>0</sub> = p
	+SKIP SKIP+ +DEL DEL+ DEL L INS =	+SKIP SKIP+ +DEL DEL+ DEL L INS =

<p>LORENTZ: vector boosts vector rotations</p> <p>spinor boosts (Weyl repr.)</p>		
<p>LORENTZ: spinor rotations</p> <p>infinitesimal spinor boosts</p>		
<p>LORENTZ: infinitesimal spinor rotations</p> <p>example for matrix exponential</p>		
<p>LORENTZ: Mexp: matrix exponential</p> <p>Mtrhyp: to hyperbolic</p>		
<p>LORENTZ: Mexp rotation</p> <p>ExMexp: examples</p>		
<p>LORENTZ: help</p>		
<p>LORENTZ: help</p>		
<p>SPIN: spin matrix -&gt; Sxyz (s=1/2)</p> <p>spin matrix -&gt; Sxyz (s=1)</p>		

SPIN: spin matrix ->Sxyz (s=2)  ->S2 (s=2)	<pre> 2: 1: [0 t 0 0 0] [0 -ci] [t 0 sqrt(6).t/2 0 0] [i.t 0] [0 sqrt(6).t/2 0 sqrt(6).t/2 0] [0 i.sqrt(6).t/2] [0 0 sqrt(6).t/2 0 t] [0 0] [0 0 0 t 0] [0 0] +sx yz +s2 +s- +s+ +xs z Help </pre>	<pre> RAD XYZ DEC C= 'H' CHOME SMAT SPIN&gt; USR 1: [6.t^2 0 0 0 0] [0 6.t^2 0 0 0] [0 0 6.t^2 0 0] [0 0 0 6.t^2 0] [0 0 0 0 6.t^2] +sx yz +s2 +s- +s+ +xs z Help </pre>
SPIN: spin matrix ->Sxyz (s=2)  ->S2 (s=2)	<pre> 2: 1: [0 t 0 0 0] [0 -ci] [t 0 sqrt(6).t/2 0 0] [i.t 0] [0 sqrt(6).t/2 0 sqrt(6).t/2 0] [0 i.sqrt(6).t/2] [0 0 sqrt(6).t/2 0 t] [0 0] [0 0 0 t 0] [0 0] +sx yz +s2 +s- +s+ +xs z Help </pre>	<pre> RAD XYZ DEC C= 'H' CHOME SMAT SPIN&gt; USR 1: [6.t^2 0 0 0 0] [0 6.t^2 0 0 0] [0 0 6.t^2 0 0] [0 0 0 6.t^2 0] [0 0 0 0 6.t^2] +sx yz +s2 +s- +s+ +xs z Help </pre>
SPIN: spin matrix ->Sxyz (s=2)  ->S2 (s=2)	<pre> 2: 1: [0 t 0 0 0] [0 -ci] [t 0 sqrt(6).t/2 0 0] [i.t 0] [0 sqrt(6).t/2 0 sqrt(6).t/2 0] [0 i.sqrt(6).t/2] [0 0 sqrt(6).t/2 0 t] [0 0] [0 0 0 t 0] [0 0] +sx yz +s2 +s- +s+ +xs z Help </pre>	<pre> RAD XYZ DEC C= 'H' CHOME SMAT SPIN&gt; USR 1: [6.t^2 0 0 0 0] [0 6.t^2 0 0 0] [0 0 6.t^2 0 0] [0 0 0 6.t^2 0] [0 0 0 0 6.t^2] +sx yz +s2 +s- +s+ +xs z Help </pre>
SPIN: spin matrix ->Sxyz (s=2)  ->S2 (s=2)	<pre> 2: 1: [0 t 0 0 0] [0 -ci] [t 0 sqrt(6).t/2 0 0] [i.t 0] [0 sqrt(6).t/2 0 sqrt(6).t/2 0] [0 i.sqrt(6).t/2] [0 0 sqrt(6).t/2 0 t] [0 0] [0 0 0 t 0] [0 0] +sx yz +s2 +s- +s+ +xs z Help </pre>	<pre> RAD XYZ DEC C= 'H' CHOME SMAT SPIN&gt; USR 1: [6.t^2 0 0 0 0] [0 6.t^2 0 0 0] [0 0 6.t^2 0 0] [0 0 0 6.t^2 0] [0 0 0 0 6.t^2] +sx yz +s2 +s- +s+ +xs z Help </pre>
SPIN: spin matrix ->Sxyz (s=2)  ->S2 (s=2)	<pre> 2: 1: [0 t 0 0 0] [0 -ci] [t 0 sqrt(6).t/2 0 0] [i.t 0] [0 sqrt(6).t/2 0 sqrt(6).t/2 0] [0 i.sqrt(6).t/2] [0 0 sqrt(6).t/2 0 t] [0 0] [0 0 0 t 0] [0 0] +sx yz +s2 +s- +s+ +xs z Help </pre>	<pre> RAD XYZ DEC C= 'H' CHOME SMAT SPIN&gt; USR 1: [6.t^2 0 0 0 0] [0 6.t^2 0 0 0] [0 0 6.t^2 0 0] [0 0 0 6.t^2 0] [0 0 0 0 6.t^2] +sx yz +s2 +s- +s+ +xs z Help </pre>
SPIN: help	<pre> 4MAT SPIN: SPIN MATRICES BASIS EUS2 = EIGENVECTORS OF S2 SPIN: s(s+1)/2, 1/2, 3/2, 5/2, ... SPIN in 2-DIR: H(s, -s) S^2 s m&gt;= h^2 s(s+1)  s m&gt; S2 s m&gt;= h^2 m  s m&gt;, S^+ s m&gt;= h^2 sqrt(s(s+1)-m(m+1))  s m+1&gt; +sx yz s + (sx sy sz) SPIN MATRICES IN x,y,z +s2 s + s2 = sx2+sy2+sz2 +s+- s + (s+ s-) = sx+-isy +eus2 s + {1,1,1} LIST OF EIGENVECTORS OF S2 sgen s + {3} LIST WITH GENERAL FORMULAS s12: SPIN 1/2, s1: SPIN 1 s32: SPIN 3/2, s2: SPIN 2 +SKIP SKIP+ +DEL DEL+ DEL L INS= </pre>	<pre> +sx yz s + (sx sy sz) SPIN MATRICES IN x,y,z +s2 s + s2 = sx2+sy2+sz2 +s+- s + (s+ s-) = sx+-isy +eus2 s + {1,1,1} LIST OF EIGENVECTORS OF S2 sgen s + {3} LIST WITH GENERAL FORMULAS s12: SPIN 1/2, s1: SPIN 1 s32: SPIN 3/2, s2: SPIN 2 +SKIP SKIP+ +DEL DEL+ DEL L INS= </pre>
SUN: InfoSUN	<pre> 4ie groups: U=group element, Ta=generators fabc=antisymm. structure const. dabc=symm. structure const. COMM(A,B)=A*B-B*A commutator ACOMM(A,B)=A*B+B*A anticommutator Trace(Aab)=Aaa trace sum over equal indices implicit I=unit matrix SU(n) group: R=Representation +SKIP SKIP+ +DEL DEL+ DEL L INS= </pre>	<pre> SU(N) group: R=Representation F=Fundamental representation A=Adjoint representation C2R=quadratic Casimir (TaxTa, sum over a) TR=index of Repr (Trace(TaxTa), no sum over a) dR=din of Repr (dRxdR matrices) dG=din of group (nr generators) 4 +SKIP SKIP+ +DEL DEL+ DEL L INS= </pre>
SUN: InfoSUN	<pre> 4: C2R: { C2F= n(n+1)/2 } 3: C2A= n(n-1)/2 2: TR: { TF= 1/2 } 1: TA= n dF= n dR= n^2-1 dG= n^2-1 SUNre Ta2 Ta3 Ta4 Ta5 +fabc </pre>	<pre> 8: product: { TaTb= 1/2(n+1)deltaab + 1/2(dabc) } 7: Jacobi identity: (fabd)fdce+fbde+fdce=0 6: antisymm. structure const: (fab) 5: symm. structure const: (dabc)=0 4: fabcfdcd=n*deltaab 3: TaTa=C2R*I 2: Trace(TaTb)=TR*deltaab 1: dR*C2R=TR*dG SUNre Ta2 Ta3 Ta4 Ta5 +fabc </pre>

SUN: Ta2: generators SU(2)	<pre> 56: 55: 54: 53: 52: 51: 1:       [ [ 0  1/2 ] [ 0 -i/2 ] [ 1/2  0 ] ]       [ [ 1/2  0 ] [ i/2  0 ] [ 0 -1/2 ] ] </pre>	<pre> 56: 55: 54: 53: 52: 51: 1:       [ [ 0  1/2  0 ] [ 0 -i/2  0 ] [ 1/2  0  0 ] ]       [ [ 1/2  0  0 ] [ i/2  0  0 ] [ 0 -1/2  0 ] ]       [ [ 0  0  0 ] [ 0  0  0 ] [ 0  0  0 ] ] </pre>
Ta3: generators SU(3)	SUNrel Ta2 Ta3 Ta4 Ta5 +fabc	SUNrel Ta2 Ta3 Ta4 Ta5 +fabc
SUN: ->fijk: antisymmetric structure coefficient (1s)  ->dijk: symmetric structure coefficient (1s)	<pre> 4:       [ 0 1 0 ]       [ 1 0 0 ]       [ 0 0 0 ] 3:       [ 0 -i 0 ]       [ i 0 0 ]       [ 0 0 0 ] 2:       [ 1 0 0 ]       [ 0 -1 0 ]       [ 0 0 0 ] 1:       -i </pre>	<pre> 4:       [ 0 1 0 ]       [ 1 0 0 ]       [ 0 0 0 ] 3:       [ 0 -i 0 ]       [ i 0 0 ]       [ 0 0 0 ] 2:       [ 1 0 0 ]       [ 0 -1 0 ]       [ 0 0 0 ] 1:       0 </pre>
SUN: fijk: antisymmetric structure coefficients of SU(3)  dijk: symmetric structure coefficients of SU(3)	<pre> 4 :f123: 1 :f147: '1/2' :f156: ' -(1/2)' :f246: '1/2' :f257: '1/2 ' :f345: '1/2' :f367: '-(1/2)' :f458: '1/2' :f678: '1/2' } +SKIP SKIP+ +DEL DEL+ DEL L INS= SMART SUN SU(3) GROUP </pre>	<pre> 4 :d112: '1/3' :d146: '1/2' :d157: '1/2' :d228: '1/3' :d247: '-(1/2)' :d256: '1/2' :d338: '1/3' :d344: '1/2' :d355: '1/2' :d366: '-(1/2)' :d377: '1/2' :d448: '1/2' :d552: '1/2' :d568: '1/2' :d578: '1/2' :d668: '1/2' :d778: '1/2' :d888: '1/2' </pre>
SUN: help	<pre> SUNrel = + {} LIST WITH SUN RELATIONS AND DEFINITIONS Ta2..5 = + Tan={1..11} LIST OF GENERATORS Ta OF THE FUNDAMENTAL REPRESENTATION 'Tan(a)' EVAL + {} WHERE a=1..N^2-1, NORMALISATION: ITa,Tb1=i*fabc*Tc' +fabc Ta(a) Ta(b) Ta(c) + fabc ANTISYM. STRUCTURE CONST. +SKIP SKIP+ +DEL DEL+ DEL L INS= </pre>	<pre> GENERATORS Ta OF THE FUNDAMENTAL REPRESENTATION 'Tan(a)' EVAL + {} WHERE a=1..N^2-1, NORMALISATION: ITa,Tb1=i*fabc*Tc' +fabc Ta(a) Ta(b) Ta(c) + fabc ANTISYM. STRUCTURE CONST. +dabc Ta(a) Ta(b) Ta(c) + dabc SYM. STRUCTURE CONST. fabcSU3 = + NONVANISHING CONST. OF SU(3) +SKIP SKIP+ +DEL DEL+ DEL L INS= </pre>