

3b. Basis for the complex Lie algebra

Definitions in Table 3.2

```
In[ ]:= Clear[Z13, Z31, Z12, Z21, Z23, Z32]
Zlist = {Z13, Z23, Z12, CKi, WW0, Z21, Z32, Z31};
Liesub0b = {Z12 → WW1 - I WW2, Z21 → WW1 + I WW2,
  Z13 → (1 / 2) HHR + I (XX0 - (1 / 4) WW0 - (1 / 4) CKi),
  Z31 → (1 / 2) HHR - I (XX0 - (1 / 4) WW0 - (1 / 4) CKi),
  Z23 → (1 / 2) (XX1 - WW1 + I (XX2 - WW2)),
  Z32 → (1 / 2) (XX1 - WW1 - I (XX2 - WW2))};
```

```
In[ ]:= setlb[CKi, WW0, nul]
setlb[WW0, Z12, 2 I Z12]
setlb[WW0, Z21, -2 I Z21]
setlb[CKi, Z12, nul]
setlb[CKi, Z21, nul]
```

Out[]:= True

Out[]:= True

Out[]:= True

Out[]:= True

Out[]:= True

```
In[ ]:= setlb[CKi, Z23, 3 I Z23]
setlb[WW0, Z23, -I Z23]
setlb[CKi, Z32, -3 I Z32]
setlb[WW0, Z32, I Z32]
```

Out[]:= True

Out[]:= True

Out[]:= True

Out[]:= True

```
In[ ]:= setlb[CKi, Z13, 3 I Z13]
        setlb[WW0, Z13, I Z13]
        setlb[CKi, Z31, -3 I Z31]
        setlb[WW0, Z31, -I Z31]
```

Out[]:= True

Out[]:= True

Out[]:= True

Out[]:= True

```

In[ * ]:= setlb[Z32, Z31, nul]
          setlb[Z21, Z31, nul]
          setlb[Z21, Z32, 2 Z31]
          setlb[Z13, Z31, -(I / 2) CKi - (I / 2) WW0]
          setlb[Z13, Z32, (1 / 2) Z12]
          setlb[Z13, Z21, 2 Z23]
          setlb[Z23, Z31, -(1 / 2) Z21]
          setlb[Z23, Z32, -(I / 2) (CKi - WW0)]
          setlb[Z23, Z21, nul]
          setlb[Z23, Z13, nul]
          setlb[Z12, Z31, -2 Z32]
          setlb[Z12, Z21, 4 I WW0]
          setlb[Z12, Z13, nul]
          setlb[Z12, Z23, 2 Z13]
          setlb[Z12, Z32, nul]

```

Out[*]= True

Out[*]= True

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Out[*]= True

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Out[*]= True

Out[*]= True

Transition between bases.

With the substitution **Liesub0** we express the Z-basis in the real basis. For the other direction the following routine **XWtoZsub** can be used.

In[*]:=

```
Clear[a1, co, mt, mti]
mt = Table[Coefficient[Zlist[[j]] /. Liesub0, XWlist[[k]], {j, 1, 8}, {k, 1, 8}];
mti = Inverse[mt];
Table[XWlist[[j]] → Sum[mti[[j, k]] × Zlist[[k]], {k, 1, 8}], {j, 1, 8}];
XWtoZsub = Delete[%, 6];
```

Check

In[*]:= XWlist /. XWtoZsub /. Liesub0 // Expand

% == XWlist

Zlist /. Liesub0 /. XWtoZsub // Expand

% == Zlist

Out[*]:= {XX0, XX1, XX2, HHr, HHi, WW0, WW1, WW2}

Out[*]:= True

Out[*]:= {Z13, Z23, Z12, CKi, WW0, Z21, Z32, Z31}

Out[*]:= True