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The resolution of (13,10)/(1,1)

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Abstract

This research study the application of Weyl module and gain the elements of characteristic free for (13,10)/(1,1) by using the polarization and latter place-algebra with capelli-identities and contracting homological. Through this work R is a commutative ring with identity 1 and F be a free R-module with D_b the divided power of degree b.

Subject Classification (2020): *13D07.*

Keywords: *Weyl module, Resolution, Place polarization, Skew-partition.*

1. Introduction

Author in an earlier work use of letter place algebra to the resolution for $K_{\lambda/\mu}F$ in [1], [2].

As in [3], [4] we compute the elements of characteristic free for (13,10)/(1,1) and we can apply the same idea for $\mathcal{SL}(2,\mathfrak{U})$ where $\mathfrak{U}$ = 81, 729,

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125,3125,121, 196, [5-7], also the ideas in [8-11], Mxn-open sets and LC-Spaces, [12-15] and the idea in [16-22].

2. The elements of the case of skew-partition (13,10)/(1,1)

The elements for the skew-partition (13,10)/(1,1) as follows

$M_0 = \mathcal{D}_{12} \otimes \mathcal{D}_9$

$M_1 = Z_{21}^{(2)} \varkappa \mathcal{D}_{14} \otimes \mathcal{D}_7 \oplus Z_{21}^{(3)} \varkappa \mathcal{D}_{15} \otimes \mathcal{D}_6 \oplus Z_{21}^{(4)} \varkappa \mathcal{D}_{16} \otimes \mathcal{D}_5 \oplus Z_{21}^{(5)} \varkappa \mathcal{D}_{17} \otimes \mathcal{D}_4$
$\oplus Z_{21}^{(6)} \varkappa \mathcal{D}_{18} \otimes \mathcal{D}_3 \oplus Z_{21}^{(7)} \varkappa \mathcal{D}_{19} \otimes \mathcal{D}_2 \oplus Z_{21}^{(8)} \varkappa \mathcal{D}_{20} \otimes \mathcal{D}_1 \oplus Z_{21}^{(9)} \varkappa \mathcal{D}_{21} \otimes \mathcal{D}_0$

$M_2 = \oplus_{|b|=2}^{8} Z_{21}^{(1+b_1)} x Z_{21}^{(b_2)} x \mathcal{D}_{12+1+|b|} \otimes D_{9-1-|b|}$ where $|b| = b_1 + b_2$ and $2 \leq |b| \leq 8$.

$M_3 = \oplus_{|b|=3}^{8} Z_{21}^{(1+b_1)} x Z_{21}^{(b_2)} x Z_{21}^{(b_3)} x \mathcal{D}_{12+1+|b|} \otimes D_{9-1-|b|}$, where $|b| = b_1 + b_2 + b_3$ and $3 \leq |b| \leq 8$.

$M_4 = \oplus_{|b|=4}^{8} Z_{21}^{(1+b_1)} x Z_{21}^{(b_2)} x Z_{21}^{(b_3)} x Z_{21}^{(b_4)} x \mathcal{D}_{12+1+|b|} \otimes D_{9-1-|b|}$, where $|b| = b_1 + b_2 + b_3 + b_4$ and $4 \leq |b| \leq 8$.

$M_5 = \oplus_{|b|=5}^{8} Z_{21}^{(1+b_1)} x Z_{21}^{(b_2)} x Z_{21}^{(b_3)} x Z_{21}^{(b_4)} x Z_{21}^{(b_5)} x \mathcal{D}_{12+1+|b|} \otimes D_{9-1-|b|}$, where $|b| = b_1 + b_2 + b_3 + b_4 + b_5$ and $5 \leq |b| \leq 8$.

$M_6 = \oplus_{|b|=6}^{8} Z_{21}^{(1+b_1)} x Z_{21}^{(b2)} x Z_{21}^{(b3)} x Z_{21}^{(b_4)} x Z_{21}^{(b5)} x Z_{21}^{(b_6)} x \mathcal{D}_{12+1+|b|} \otimes D_{9-1-|b|}$, where $|b| = b_1 + b_2 + b_3 + b_4 + b_5 + b_6$ and $6 \leq |b| \leq 8$.

$M_7 = \oplus_{|b|=7}^{8} Z_{21}^{(1+b_1)} x Z_{21}^{(b_2)} x Z_{21}^{(b_3)} x Z_{21}^{(b_4)} x Z_{21}^{(b_5)} x Z_{21}^{(b_6)} x Z_{21}^{(b_7)} x \mathcal{D}_{12+1+|b|} \otimes D_{9-1-|b|}$, where $|b| = b_1 + b_2 + b_3 + b_4 + b_5 + b_6 + b_7$ and $7 \leq |b| \leq 8$.

3. The contracting homotopy of the homological mapping

The homological mapping $S_0, S_1, S_2, S_3, S_4, S_5, S_6, S_7$ in the case of skew-partition (13,10)/(1,1) as follows:

$$S_0\left(\left(\begin{matrix} w \\ w' \end{matrix}\middle| \begin{matrix} 1^{(12)} 2^{(b)} \\ 2^{(9-b)} \end{matrix}\right)\right) = \begin{cases} Z_{21}^{(b+1)} \varkappa \left(\begin{matrix} w \\ w' \end{matrix}\middle| \begin{matrix} 1^{(12+b)} \\ 2^{(9-b)} \end{matrix}\right) ; if\ 1 \leq b \leq 8 \\ 0 ;\ if\ b < 1 \end{cases}$$

$$S_1\left(Z_{21}^{(b+1)} \varkappa \left(\begin{matrix} w \\ w' \end{matrix}\middle| \begin{matrix} 1^{(12+b)} 2^{(m)} \\ 2^{(9-b-m)} \end{matrix}\right)\right) =$$
$$\begin{cases} Z_{21}^{(b+1)} \varkappa Z_{21}^{(m)} \varkappa \left(\begin{matrix} w \\ w' \end{matrix}\middle| \begin{matrix} 1^{(12+b+m)} \\ 2^{(9-b-m)} \end{matrix}\right) ; if\ m = 1,2,\dots,7 \\ 0 ; if\ m = 0 \end{cases} ;\ \text{where } |b| = b_1 + b_2$$

$$S_2\left(Z_{21}^{(b_1+1)} \varkappa Z_{21}^{(b_2)} \varkappa \left(\begin{matrix} w \\ w' \end{matrix}\middle| \begin{matrix} 1^{(12+|b|)} 2^{(m)} \\ 2^{(9-|b|-m)} \end{matrix}\right)\right) =$$

$$\begin{cases} Z_{21}^{(b_1+1)}\varkappa Z_{21}^{(b_2)}\varkappa Z_{21}^{(m)}\varkappa \begin{pmatrix} w \\ w' \end{vmatrix} \begin{matrix} 1^{(12+|b|+m)} \\ 2^{(9-|b|-m)} \end{pmatrix} ; if\ m = 1,2,\dots,6 \\ 0; if\ m = 0 \end{cases};$$

where $|b| = b_1+b_2$

$$S_3\left(Z_{21}^{(b_1+1)}\varkappa Z_{21}^{(b_2)}\varkappa Z_{21}^{(b_3)}\varkappa \begin{pmatrix} w \\ w' \end{vmatrix} \begin{matrix} 1^{(12+|b|)}2^{(m)} \\ 2^{(9-|b|-m)} \end{pmatrix}\right) =$$

$$\begin{cases} Z_{21}^{(b_1+1)}\varkappa Z_{21}^{(b_2)}\varkappa Z_{21}^{(b_3)}\varkappa Z_{21}^{(m)}\varkappa \begin{pmatrix} w \\ w' \end{vmatrix} \begin{matrix} 1^{(12+|b|+m)} \\ 2^{(9-|b|-m)} \end{pmatrix} ; if\ m = 1,2 \dots,5 \\ 0 ; if\ m = 0 \end{cases};$$

where $|b| = b_1+b_2 + b_3$

$$S_4\left(Z_{21}^{(b_1+1)}\varkappa Z_{21}^{(b_2)}\varkappa Z_{21}^{(b_3)}\varkappa Z_{21}^{(b_4)}\varkappa \begin{pmatrix} w \\ w' \end{vmatrix} \begin{matrix} 1^{(12+|b|)}2^{(m)} \\ 2^{(9-|b|-m)} \end{pmatrix}\right) =$$

$$\begin{cases} Z_{21}^{(b_1)}\varkappa Z_{21}^{(b_2)}\varkappa Z_{21}^{(b_3)}\varkappa Z_{21}^{(b_4)}\varkappa Z_{21}^{(m)}\varkappa \begin{pmatrix} w \\ w' \end{vmatrix} \begin{matrix} 1^{(12+|b|+m)} \\ 2^{(9-|b|-m)} \end{pmatrix} ; if\ m = 1,2,3,4 \\ 0 ; if\ m = 0 \end{cases};$$

where $|b| = b_1+ b_2+b_3+b_4$

$$S_5\left(Z_{21}^{(b_1+1)}\varkappa Z_{21}^{(b)}\varkappa Z_{21}^{(b_3)}\varkappa Z_{21}^{(b_4)}\varkappa Z_{21}^{(b_5)}\varkappa \begin{pmatrix} w \\ w' \end{vmatrix} \begin{matrix} 1^{(12+|b|)}2^{(m)} \\ 2^{(9-|b|-m)} \end{pmatrix}\right) =$$

$$\begin{cases} Z_{21}^{(b_1)}\varkappa Z_{21}^{(b_2)}\varkappa Z_{21}^{(b_3)}\varkappa Z_{21}^{(b_4)}\varkappa\ Z_{21}^{(b_5)}\varkappa Z_{21}^{(m)}\varkappa \begin{pmatrix} w \\ w' \end{vmatrix} \begin{matrix} 1^{(12+|b|+m)} \\ 2^{(9-|b|-m)} \end{pmatrix}; if\ m = 1,2,3 \\ 0 ; if\ m = 0 \end{cases};$$

where $|b| = b_1+b_2+b_3+b+b_5$

$$S_6\left(Z_{21}^{(b_1+1)}\varkappa Z_{21}^{(b_2)}\varkappa Z_{21}^{(b_3)}\varkappa Z_{21}^{(b_4)}\varkappa Z_{21}^{(b_5)}\varkappa\ Z_{21}^{(b_6)}\varkappa \begin{pmatrix} w \\ w' \end{vmatrix} \begin{matrix} 1^{(12+|b|)}2^{(m)} \\ 2^{(9-|b|-m)} \end{pmatrix}\right) =$$

$$\begin{cases} Z_{21}^{(b_1)}\varkappa Z_{21}^{(b_2)}\varkappa Z_{21}^{(b_3)}\varkappa Z_{21}^{(b_4)}\varkappa\ Z_{21}^{(b_5)}\ Z_{21}^{(b_6)}\varkappa Z_{21}^{(m)}\varkappa \begin{pmatrix} w \\ w' \end{vmatrix} \begin{matrix} 1^{(12+|b|+m)} \\ 2^{(9-|b|-m)} \end{pmatrix}; if\ m = 1,2 \\ 0 ; if\ m = 0 \end{cases};$$

where $|b| = b_1+b_2+b_3+b_4+b_5\ + b_6$

$$S_7\left(Z_{21}^{(b_1+1)}\varkappa Z_{21}^{(b_2)}\varkappa Z_{21}^{(b_3)}\varkappa Z_{21}^{(b_4)}\varkappa Z_{21}^{(b_5)}\varkappa\ Z_{21}^{(b_6)}\varkappa\ Z_{21}^{(b_7)}\varkappa \begin{pmatrix} w \\ w' \end{vmatrix} \begin{matrix} 1^{(12+|b|)}2^{(m)} \\ 2^{(9-|b|-m)} \end{pmatrix}\right) =$$

$$\begin{cases} Z_{21}^{(b_1)}\varkappa Z_{21}^{(b_2)}\varkappa Z_{21}^{(b_3)}\varkappa Z_{21}^{(b_4)}\varkappa\ Z_{21}^{(b_5)}\ Z_{21}^{(b_6)}\varkappa\ Z_{21}^{(b_7)}\varkappa Z_{21}^{(m)}\varkappa \begin{pmatrix} w \\ w' \end{vmatrix} \begin{matrix} 1^{(12+|b|+m)} \\ 2^{(9-|b|-m)} \end{pmatrix}; if\ m = 1 \\ 0 ; if\ m = 0 \end{cases}$$

Where $|b| = b_1+b_2+b_3+b_4+b_5\ + b_6\ + b_7$.

Now,

$$S_0\partial_\varkappa\left(Z_{21}^{(b+1)}\varkappa \begin{pmatrix} w \\ w' \end{vmatrix} \begin{matrix} 1^{(12+b)}2^{(m)} \\ 2^{(9-b-m)} \end{pmatrix}\right) = S_0\binom{b+1+m}{m}\begin{pmatrix} w \\ w' \end{vmatrix} \begin{matrix} 1^{(12)}2^{(b+1+m)} \\ 2^{(9-b-m)} \end{pmatrix}$$

$$= \binom{b+1+m}{m} Z_{21}^{(b+1+m)}\varkappa \begin{pmatrix} w \\ w' \end{vmatrix} \begin{matrix} 1^{(12+b+m)} \\ 2^{(9-b-m)} \end{pmatrix}, \text{ and}$$

$$\partial_{\varkappa} S_1\left(Z_{21}^{(b+1)}\varkappa\begin{pmatrix}w\\w'\end{pmatrix}\begin{matrix}1^{(12+b)}2^{(m)}\\2^{(9-b-m)}\end{pmatrix}\right)=\partial_{\varkappa}\left(Z_{21}^{(b+1)}\varkappa Z_{21}^{(m)}\varkappa\begin{pmatrix}w\\w'\end{pmatrix}\begin{matrix}1^{(12+b+m)}\\2^{(9-b-m)}\end{pmatrix}\right)$$

$$=-\binom{b+1+m}{m}Z_{21}^{(b+1+m)}\varkappa\left(\begin{matrix}w\\w'\end{matrix}\middle|\begin{matrix}1^{(12+b+m)}\\2^{(9-b-m)}\end{matrix}\right)+Z_{21}^{(b+1)}\varkappa\left(\begin{matrix}w\\w'\end{matrix}\middle|\begin{matrix}1^{(12+b)}2^{(m)}\\2^{(9-b-m)}\end{matrix}\right),$$

Then $S_0\partial_{\varkappa}+\partial_{\varkappa}S_1=id_{M_1}$.

$$S_1\partial_{\varkappa}\left(Z_{21}^{(b_1+1)}\varkappa Z_{21}^{(b_2)}\varkappa\left(\begin{matrix}w\\w'\end{matrix}\middle|\begin{matrix}1^{(12+|b|)}2^{(m)}\\2^{(9-|b|-m)}\end{matrix}\right)\right)$$

$$=S_1\left(-\binom{|b|+1}{b_2}Z_{21}^{|b|+1}\varkappa\left(\begin{matrix}w\\w'\end{matrix}\middle|\begin{matrix}1^{(12+|b|)}2^{(m)}\\2^{(9-|b|-m)}\end{matrix}\right)+Z_{21}^{(b_1+1)}\varkappa\,\partial_{21}\left(\begin{matrix}w\\w'\end{matrix}\middle|\begin{matrix}1^{(12+|b|)}2^{(m)}\\2^{(9-|b|-m)}\end{matrix}\right)\right)$$

$$=-\binom{|b|+1}{b_2}Z_{21}^{|b|+1}\varkappa Z_{21}^{(m)}\varkappa\left(\begin{matrix}w\\w'\end{matrix}\middle|\begin{matrix}1^{(12+|b|+m)}\\2^{(9-|b|-m)}\end{matrix}\right)+$$

$$\binom{b_2+m}{m}Z_{21}^{(b_1+1)}\varkappa Z_{21}^{(b_2+m)}x\left(\begin{matrix}w\\w'\end{matrix}\middle|\begin{matrix}1^{(12+|b|+m)}\\2^{(9-|b|-m)}\end{matrix}\right),\text{ and}$$

$$\partial_{\varkappa}S_2\left(Z_{21}^{(b_1+1)}\varkappa Z_{21}^{(b_2)}\varkappa\left(\begin{matrix}w\\w'\end{matrix}\middle|\begin{matrix}1^{(12+|b|)}2^{(m)}\\2^{(9-|b|-m)}\end{matrix}\right)\right)=$$

$$\partial_{\varkappa}\left(Z_{21}^{(b_1+1)}\varkappa Z_{21}^{(b_2)}\varkappa Z_{21}^{(m)}\varkappa\left(\begin{matrix}w\\w'\end{matrix}\middle|\begin{matrix}1^{(12+b+m)}\\2^{(9-b-m)}\end{matrix}\right)\right)$$

$$=\binom{|b|+1}{b_2}Z_{21}^{|b|+1}\varkappa Z_{21}^{(m)}\varkappa\left(\begin{matrix}w\\w'\end{matrix}\middle|\begin{matrix}1^{(12+|b|+m)}\\2^{(9-|b|-m)}\end{matrix}\right)-$$

$$\binom{b_2+m}{m}Z_{21}^{(b_1+1)}\varkappa Z_{21}^{(b_2+m)}\varkappa\left(\begin{matrix}w\\w'\end{matrix}\middle|\begin{matrix}1^{(12+|b|+m)}\\2^{(9-|b|-m)}\end{matrix}\right)+Z_{21}^{(b_1+1)}\varkappa\,Z_{21}^{(b_2)}\left(\begin{matrix}w\\w'\end{matrix}\middle|\begin{matrix}1^{(12+|b|)}2^{(m)}\\2^{(9-|b|-m)}\end{matrix}\right),$$

So that $S_1\partial_{\varkappa}+\partial_{\varkappa}S_2=id_{M_2}$.

By that same way, we can get that, $\mathcal{S}_{i-1}\partial_x+\partial_x\mathcal{S}_i=\mathrm{id}_{\mathcal{M}_i}$, i = 3, 4, …, 7.

Thus $\{\mathcal{S}_i\}$; i = 0,1,2, …, 7 is a contracting homotopy [5], which implies the exactness of the following complex.

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