A CANCELLATION-FREE FORMULA FOR THE SCHUR ELEMENTS OF
THE ARIKI-KOIKE ALGEBRA

MARIA CHLOUVERAKI

1. Introduction

Schur elements play a powerful role in the representation theory of symmetric algebras. In the case of the Ariki-Koike algebra, Schur elements are Laurent polynomials whose factors determine when Specht modules are projective irreducible and whether the algebra is semisimple.

Formulas for the Schur elements of the Ariki-Koike algebra have been independently obtained first by Geck, Iancu and Malle [6], and later by Mathas [10]. The aim of this note is to give a cancellation-free formula for these polynomials (Theorem 5.1), so that their factors can be easily read and programmed.

2. Partitions: definitions and notation

A partition \( \lambda = (\lambda_1, \lambda_2, \lambda_3, \ldots) \) is a decreasing sequence of non-negative integers. We define the length of \( \lambda \) to be the smallest integer \( \ell(\lambda) \) such that \( \lambda_i = 0 \) for all \( i > \ell(\lambda) \). We write \( |\lambda| := \sum_{i \geq 1} \lambda_i \) and we say that \( \lambda \) is a partition of \( m \), for some \( m \in \mathbb{N} \), if \( m = |\lambda| \). We set \( n(\lambda) := \sum_{i \geq 1} (i - 1)\lambda_i \).

We define the set of nodes \([\lambda]\) of \( \lambda \) to be the set

\[
[\lambda] := \{(i, j) \mid i \geq 1, \ 1 \leq j \leq \lambda_i\}.
\]

A node \( x = (i, j) \) is called removable if \([\lambda] \setminus \{(i, j)\}\) is still the set of nodes of a partition. Note that if \((i, j)\) is removable, then \( j = \lambda_i \).

The conjugate partition of \( \lambda \) is the partition \( \lambda' \) defined by

\[
\lambda'_k := \#\{i \mid i \geq 1 \text{ such that } \lambda_i \geq k\}.
\]

Obviously, \( \lambda'_1 = \ell(\lambda) \). The set of nodes of \( \lambda' \) satisfies

\[
(i, j) \in [\lambda'] \Leftrightarrow (j, i) \in [\lambda].
\]

Note that if \((i, \lambda_i)\) is a removable node of \( \lambda \), then \( \lambda'_{\lambda_i} = i \). Moreover, we have

\[
n(\lambda) = \sum_{i \geq 1} (i - 1)\lambda_i = \frac{1}{2} \sum_{i \geq 1} (\lambda'_i - 1)\lambda'_i.
\]

I would like to thank Iain Gordon and Stephen Griffeth for the conversations which led to the discovery of this pretty formula. In particular, I am indebted to Stephen Griffeth for explaining to me the results of his paper [10], which inspired this note. I also gratefully acknowledge the support of the EPSRC through the grant EP/G04984X/1.
Now, if \( x = (i, j) \in [\lambda] \), we define the *content* of \( x \) to be the difference

\[
\text{cont}(x) = j - i.
\]

The following lemma, whose proof is an easy combinatorial exercise (with the use of Young diagrams), relates the contents of the nodes of (the “right rim” of) \( \lambda \) with the contents of the nodes of (the “lower rim” of) \( \lambda' \).

**Lemma 2.1.** Let \( \lambda = (\lambda_1, \lambda_2, \ldots) \) be a partition and let \( k \) be an integer such that \( 1 \leq k \leq \lambda_1 \). Let \( q \) and \( y \) be two indeterminates. Then we have

\[
\frac{1}{(q^\lambda_1 y - 1)} \cdot \left( \prod_{i=1}^{\lambda_1} \frac{q^\lambda_{i-1} + 1 y - 1}{q^\lambda_{i-1} y - 1} \right) = \frac{1}{(q^{-\lambda_1 + 1} y - 1)} \cdot \left( \prod_{j=k}^\lambda \frac{q^{-\lambda_j + 1} y - 1}{q^{-\lambda_j} y - 1} \right).
\]

Finally, if \( x = (i, j) \in [\lambda] \) and \( \mu \) is another partition, we define the *generalized hook length of \( x \) with respect to \( \mu \) to be the integer:

\[
h_{i,j}^\mu := \lambda_i - i + \mu'_j - j + 1.
\]

For \( \mu = \lambda \), the above formula becomes the classical hook length formula (giving us the length of the hook of \( \lambda \) that \( x \) belongs to).

### 3. The Ariki-Koike algebra

Let \( d \) and \( r \) be positive integers and let \( R \) be a commutative domain with 1. Fix elements \( q, Q_0, \ldots, Q_{d-1} \) of \( R \), and assume that \( q \) is invertible in \( R \). Set \( q := (q; Q_0, \ldots, Q_{d-1}) \). The *Ariki-Koike algebra* \( \mathcal{H}_{d,r} \) is the unital associative \( R \)-algebra with generators \( T_0, T_1, \ldots, T_{r-1} \) and relations:

\[
(T_0 - Q_0)(T_0 - Q_1) \cdots (T_0 - Q_{d-1}) = 0,
\]

\[
(T_i - q)(T_i + 1) = 0 \quad \text{for } 1 \leq i \leq r - 1,
\]

\[
T_0T_1T_0T_1 = T_1T_0T_1T_0,
\]

\[
T_iT_{i+1}T_i = T_{i+1}T iT_{i+1} \quad \text{for } 1 \leq i \leq r - 2,
\]

\[
T_iT_j = T_jT_i \quad \text{for } 0 \leq i < j \leq r - 1 \text{ with } j - i > 1.
\]

The Ariki-Koike algebra \( \mathcal{H}_{d,r} \) is a deformation of the group algebra of the complex reflection group \( G(d,1,r) = (\mathbb{Z}/d\mathbb{Z}) \wr \mathfrak{S}_r \). Ariki and Koike \([2]\) have proved that \( \mathcal{H}_{d,r} \) is a free \( R \)-module of rank \( d^r r! = |G(d,1,r)| \). Moreover, Ariki \([1]\) has shown that, when \( R \) is a field, \( \mathcal{H}_{d,r} \) is (split) semisimple if and only if

\[
P(q) = \prod_{i=1}^r (1 + q + \cdots + q^{i-1}) \prod_{0 \leq s < t \leq d-1} \prod_{-r < k < r} (q^k Q_s - Q_t)
\]

is a non-zero element of \( R \).

A *d-partition* of \( r \) is an ordered \( d \)-tuple \( \lambda = (\lambda^{(0)}, \lambda^{(1)}, \ldots, \lambda^{(d-1)}) \) of partitions \( \lambda^{(s)} \) such that \( \sum_{s=0}^{d-1} |\lambda^{(s)}| = r \). Let us denote by \( P(d,r) \) the set of \( d \)-partitions of \( r \). In the semisimple case,
Ariki and Koike [2] constructed an irreducible $H_{d,r}$-module $S^\lambda$, called a Specht module, for each $d$-partition $\lambda$ of $r$. Further, they showed that $\{S^\lambda | \lambda \in P(d, r)\}$ is a complete set of pairwise non-isomorphic irreducible $H_{d,r}$-modules. We denote by $\chi^\lambda$ the character of the Specht module $S^\lambda$.

Now, there exists a linear form $\tau : H_{d,r} \to R$ which was introduced by Bremke and Malle in [3], and was proved to be symmetrizing by Malle and Mathas in [8] whenever all $Q_i$'s are invertible in $R$. An explicit description of this form can be found in any of these two articles. Following Geck’s results on symmetrizing forms [5], we obtain the following definition for the Schur elements associated to the irreducible representations of $H_{d,r}$.

**Definition 3.1.** Suppose that $R$ is a field and that $P(q) \neq 0$. The Schur elements of $H_{d,r}$ are the elements $s_\lambda(q)$ of $R$ such that

$$\tau = \sum_{\lambda \in P(d, r)} \frac{1}{s_\lambda(q)} \chi^\lambda.$$ 

Schur elements play a powerful role in the representation theory of $H_{d,r}$, as illustrated by the following result (cf. [7, Theorem 7.4.7], [9, Lemme 2.6]).

**Theorem 3.2.** Suppose that $R$ is a field. If $s_\lambda(q) \neq 0$, then the Specht module $S^\lambda$ is irreducible. Moreover, the algebra $H_{d,r}$ is semisimple if and only if $s_\lambda(q) \neq 0$ for all $\lambda \in P(d, r)$.

### 4. Formulas for the Schur Elements of the Ariki-Koike Algebra

The Schur elements of the Ariki-Koike algebra $H_{d,r}$ have been independently calculated first by Geck, Iancu and Malle [9], and later by Mathas [10]. From now on, for all $m \in \mathbb{N}$, let $[m]_q := (q^m - 1)/(q - 1) = q^{m-1} + q^{m-2} + \cdots + q + 1$. The formula given by Mathas does not demand extra notation and is the following:

**Theorem 4.1.** Let $\lambda = (\lambda^{(0)}, \lambda^{(1)}, \ldots, \lambda^{(d-1)})$ be a $d$-partition of $r$. Then

$$s_\lambda(q) = (-1)^{r(d-1)}(Q_0Q_1 \cdots Q_{d-1})^{-r}q^{-\alpha(\lambda')} \prod_{s=0}^{d-1} \prod_{(i,j) \in [\lambda(s)]} Q_s[h_{i,j}^{\lambda(s)}]_q \cdot \prod_{0 \leq s < t \leq d-1} X^\lambda_{st},$$

where

$$\alpha(\lambda') = \frac{1}{2} \sum_{s=0}^{d-1} \sum_{i \geq 1} (\lambda_i^{(s)' - 1}) \lambda_i^{(s)'},$$

and

$$X_{st}^\lambda = \prod_{(i,j) \in [\lambda^{(t)}]} (q^{j-i}Q_t - Q_s) \cdot \prod_{(i,j) \in [\lambda^{(t)}]} \left( (q^{j-i}Q_s - q^{\lambda_i^{(t)}}Q_t) \prod_{k=1}^{\lambda_i^{(t)}} q^{j-i}Q_s - q^{k-1-\lambda_i^{(t)}'}Q_t \right).$$

The formula by Geck, Iancu and Malle is more symmetric, and describes the Schur elements in terms of beta numbers. If $\lambda = (\lambda^{(0)}, \lambda^{(1)}, \ldots, \lambda^{(d-1)})$ is a $d$-partition of $r$, then the length of $\lambda$ is $\ell(\lambda) = \max \{ \ell(\lambda^{(s)}) | 0 \leq s \leq d - 1 \}$. Fix an integer $L$ such that $L \geq \ell(\lambda)$. The $L$-beta
numbers for $\lambda^{(s)}$ are the integers $\beta_i^{(s)} = \lambda_i^{(s)} + L - i$ for $i = 1, \ldots, L$. Set $\mathcal{B} = \{\beta_1^{(s)}, \ldots, \beta_L^{(s)}\}$ for $s = 0, \ldots, d - 1$. The matrix $B = (B(s))_{0 \leq s \leq d - 1}$ is called the $L$-symbol of $\lambda$.

**Theorem 4.2.** Let $\lambda = (\lambda^{(0)}, \lambda^{(1)}, \ldots, \lambda^{(d-1)})$ be a $d$-partition of $r$ with $L$-symbol $B = (B(s))_{0 \leq s \leq d - 1}$, where $L \geq \ell(\lambda)$. Let $a_L := r(d - 1) + \binom{d}{2} \frac{L^2}{2}$ and $b_L := dL(L - 1)(2dL - d - 3)/12$. Then

$$s_\lambda(q) = (-1)^{a_L} x^{b_L} (q - 1)^{-r}(Q_0 Q_1 \ldots Q_{d - 1})^{-r} \nu_\lambda / \delta_\lambda,$$

where

$$\nu_\lambda = \prod_{0 \leq s < t \leq d - 1} (Q_s - Q_t)^L \prod_{0 \leq s, t \leq d - 1} \prod_{b_s \in B(s)} \prod_{1 \leq k \leq b_s} (q^k Q_s - Q_t)$$

and

$$\delta_\lambda = \prod_{0 \leq s < t \leq d - 1} \prod_{(b_s, b_t) \in B(s) \times B(t)} (q^{b_s} Q_s - q^{b_t} Q_t) \prod_{0 \leq s \leq d - 1} \prod_{1 \leq i < j \leq L} (q^{x(s)} Q_s - q^{y(s)} Q_s).$$

As the reader may see, in both formulas above, the factors of $s_\lambda(q)$ are not obvious. Hence, it is not obvious for which values of $q$ the Schur element $s_\lambda(q)$ becomes zero.

5. **A cancellation-free formula**

In this section, we will give a cancellation-free formula for the Schur elements of $\mathcal{H}_{d,r}$. This formula is also symmetric.

Let $\lambda = (\lambda^{(0)}, \lambda^{(1)}, \ldots, \lambda^{(d-1)})$ be a $d$-partition of $r$. The multiset $(\lambda_i^{(s)})_{0 \leq s \leq d - 1, i \geq 1}$ is a composition of $r$ (i.e., a multiset of non-negative integers whose sum is equal to $r$). By reordering the elements of this composition, we obtain a partition of $r$. We denote this partition by $\bar{\lambda}$. (e.g., if $\lambda = ((4, 1), \emptyset, (2, 1))$, then $\bar{\lambda} = (4, 2, 1, 1))$.

**Theorem 5.1.** Let $\lambda = (\lambda^{(0)}, \lambda^{(1)}, \ldots, \lambda^{(d-1)})$ be a $d$-partition of $r$. Then

$$s_\lambda(q) = (-1)^{r(d - 1)} q^{-n(\bar{\lambda})} (q - 1)^{-r} \prod_{s=0}^{d-1} \prod_{(i,j) \in \lambda(s)} \prod_{t=0}^{d-1} (q^{\lambda_i^{(t)}} Q_s Q_t^{-1} - 1).$$

(1)

Since the total number of nodes in $\lambda$ is equal to $r$, the above formula can be rewritten as follows:

$$s_\lambda(q) = (-1)^{r(d - 1)} q^{-n(\bar{\lambda})} \prod_{0 \leq s \leq d - 1} \prod_{(i,j) \in \lambda^{(s)}} \left[ h_{i,j}^{\lambda(s)} q \prod_{0 \leq t \leq d - 1, t \neq s} (q^{h_{i,j}^{\lambda(t)}} Q_s Q_t^{-1} - 1) \right].$$

(2)

We will now proceed to the proof of the above result. Following Theorem 4.1, we have that

$$s_\lambda(q) = (-1)^{r(d - 1)} (Q_0 Q_1 \cdots Q_{d-1})^{-r} q^{-\alpha(\lambda)} \prod_{s=0}^{d-1} \prod_{(i,j) \in \lambda^{(s)}} Q_s h_{i,j}^{\lambda(s)} q \prod_{0 \leq s < t \leq d - 1} X_{st}^\lambda,$$

where

$$\alpha(\lambda) = \frac{1}{2} \sum_{s=0}^{d-1} \sum_{i \geq 1} (\lambda_i^{(s)})^r - 1) \lambda_i^{(s)} q.$$
and
\[ X_{st}^\lambda = \prod_{(i,j) \in [\lambda^{(t)}]} \left( q^{j-i}Q_t - Q_i ight) \cdot \prod_{(i,j) \in [\lambda^{(s)}]} \left( q^{j-i}Q_s - q^{\lambda_i^{(s)}} Q_t \right) \cdot \prod_{k=1}^{\lambda_i^{(t)}} \frac{q^{j-i}Q_s - q^{k-1-\lambda_i^{(t)}} Q_t}{q^{j-i}Q_s - q^{k-\lambda_k^{(t)}} Q_t} . \]

The following lemma relates the terms \( q^{-\alpha(\lambda)} \) and \( q^{-\alpha(\lambda')} \).

**Lemma 5.2.** Let \( \lambda \) be a \( d \)-partition of \( r \). We have that
\[ \alpha(\lambda') + \sum_{0 \leq s < t \leq d-1} \sum_{i \geq 1} \lambda_i^{(s)} \lambda_i^{(t)' - 1} = n(\lambda). \]

**Proof.** Following the definition of the conjugate partition, we have \( \bar{\lambda}'_i = \sum_{s=0}^{d-1} \lambda_i^{(s)'}, \) for all \( i \geq 1 \). Therefore,
\[ n(\bar{\lambda}) = \frac{1}{2} \sum_{i \geq 1} (\bar{\lambda}'_i - 1) \bar{\lambda}'_i = \frac{1}{2} \sum_{i \geq 1} \left( \left( \sum_{s=0}^{d-1} \lambda_i^{(s)' - 1} \right) \cdot \sum_{s=0}^{d-1} \lambda_i^{(s)'} \right) \]
\[ = \frac{1}{2} \sum_{i \geq 1} \left( \sum_{0 \leq s < t \leq d-1} 2 \cdot \lambda_i^{(s)' - 1} + \sum_{s=0}^{d-1} \lambda_i^{(s)'} - \sum_{s=0}^{d-1} \lambda_i^{(s)'} \right) \]
\[ = \sum_{0 \leq s < t \leq d-1} \sum_{i \geq 1} \lambda_i^{(s)' - 1} + \frac{1}{2} \sum_{s=0}^{d-1} \sum_{i \geq 1} (\lambda_i^{(s)' - 1}) \lambda_i^{(s)'} = \sum_{0 \leq s < t \leq d-1} \sum_{i \geq 1} \lambda_i^{(s)' - 1} + \alpha(\lambda') \]

Hence, to prove Equality (2), it is enough to show that, for all \( 0 \leq s < t \leq d-1 \),
\[ X_{st}^\lambda = q^{-\sum_{i \geq 1} \lambda_i^{(s)' - 1}} \prod_{(i,j) \in [\lambda^{(t)}]} (q^{h_{i,j}^{(t)}} Q_s Q_t^{-1} - 1) \cdot \prod_{(i,j) \in [\lambda^{(s)}]} (q^{h_{i,j}^{(s)}} Q_t Q_s^{-1} - 1) . \]

We will proceed by induction on the number of nodes of \( \lambda^{(s)} \). We do not need to do the same for \( \lambda^{(t)} \), because the symmetric formula for the Schur elements given by Theorem 4.2 implies the following: if \( \mu \) is the multipartition obtained from \( \lambda \) by exchanging \( \lambda^{(s)} \) and \( \lambda^{(t)} \), then
\[ X_{st}^\lambda(Q_s, Q_t) = X_{st}^\mu(Q_t, Q_s). \]

If \( \lambda^{(s)} = \emptyset \), then
\[ X_{st}^\lambda = \prod_{(i,j) \in [\lambda^{(t)}]} (q^{j-i}Q_t - Q_i) = Q_s^{\lambda^{(t)}} \prod_{(i,j) \in [\lambda^{(t)}]} (q^{j-i}Q_t Q_s^{-1} - 1) = Q_s^{\lambda^{(t)}} \prod_{i=1}^{\lambda_i^{(t)}} \prod_{j=1}^{\lambda_j^{(t)}} (q^{j-i}Q_t Q_s^{-1} - 1) \]
\[ = Q_s^{\lambda^{(t)}} \prod_{i=1}^{\lambda_i^{(t)}} \prod_{j=1}^{\lambda_j^{(t)}} (q^{j-i}Q_t Q_s^{-1} - 1) = Q_s^{\lambda^{(t)}} \prod_{(i,j) \in [\lambda^{(t)}]} (q^{h_{i,j}^{(s)}} Q_t Q_s^{-1} - 1) , \]
as required.
Now, assume that our assertion holds when \( \#[\lambda^{(s)}] \in \{0, 1, 2, \ldots, N - 1\} \). We want to show that it also holds when \( \#[\lambda^{(s)}] = N \geq 1 \). If \( \lambda^{(s)} \neq \emptyset \), then there exists \( i \) such that \((i, \lambda_i^{(s)})\) is a removable node of \( \lambda^{(s)} \). Let \( \nu \) be the multipartition defined by

\[
\nu_i^{(s)} := \lambda_i^{(s)} - 1, \quad \nu_j^{(s)} := \lambda_j^{(s)} \quad \text{for all } j \neq i, \quad \nu^{(t)} := \lambda^{(t)} \quad \text{for all } t \neq s.
\]

Then \( [\lambda^{(s)}] = [\nu^{(s)}] \cup \{(i, \lambda_i^{(s)})\} \). Since Equality (3) holds for \( X_{st}^{\nu} \) and

\[
X_{st}^{\lambda} = X_{st}^{\nu} \cdot \left( (q^{\lambda_i^{(s)} - i} Q_s - q^{\lambda_i^{(t)}} Q_t) \prod_{k=1}^{\lambda_i^{(s)}} q^{\lambda_i^{(s)} - i} Q_s - q^{k - 1 - \lambda_k^{(t)}} Q_t \right),
\]

it is enough to show that (to simplify notation, from now on set \( \lambda := \lambda^{(s)} \) and \( \mu := \lambda^{(t)} \):

\[
(q^{\lambda_i - i} Q_s - q^{\mu_k} Q_t) \prod_{k=1}^{\lambda_i} q^{\lambda_i - i} Q_s - q^{k - \mu_k} Q_t = q^{-\mu_i} Q_t (q^{\lambda_i - i + \mu_i} Q_s Q_t^{-1} - 1) \cdot A \cdot B,
\]

where

\[
A := \prod_{k=1}^{\lambda_i - 1} \frac{q^{\lambda_i - i + \mu_k - k + 1} Q_s Q_t^{-1} - 1}{q^{\lambda_i - i + \mu_k - k} Q_s Q_t^{-1} - 1}
\]

and

\[
B := \prod_{k=1}^{\mu_i} \frac{q^{\mu_k - k + \lambda_i - \lambda_i + 1} Q_t Q_s^{-1} - 1}{q^{\mu_k - k + \lambda_i - \lambda_i} Q_t Q_s^{-1} - 1}.
\]

Note that, since \((i, \lambda_i)\) is a removable node of \( \lambda \), we have \( \lambda_i' = i \). We have that

\[
A = q^{\lambda_i - 1} \prod_{k=1}^{\lambda_i - 1} \frac{q^{\lambda_i - i} Q_s - q^{k - 1 - \mu_k} Q_t}{q^{\lambda_i - i} Q_s - q^{k - \mu_k} Q_t}.
\]

Moreover, by Lemma 2.1 for \( y = q^{i - \lambda_i} Q_t Q_s^{-1} \), we obtain that

\[
B = \frac{(q^{\mu_i + i - \lambda_i} Q_t Q_s^{-1} - 1)}{(q^{-\mu_i - i + \lambda_i} Q_t Q_s^{-1} - 1)} \cdot \left( \prod_{k=\lambda_i}^{\mu_i} \frac{q^{\mu_k - k + i - \lambda_i} Q_t Q_s^{-1} - 1}{q^{-\mu_k - k + i - \lambda_i} Q_t Q_s^{-1} - 1} \right),
\]

i.e.,

\[
B = Q_t^{-1} \frac{q^{\lambda_i - i} Q_s - q^{\mu_i} Q_t}{(q^{\mu_i} - \lambda_i + 1 - \lambda_i) Q_s Q_t^{-1} - 1} \cdot \left( \prod_{k=\lambda_i}^{\mu_i} \frac{q^{\lambda_i - i} Q_s - q^{k - 1 - \mu_k} Q_t}{q^{\lambda_i - i} Q_s - q^{k - \mu_k} Q_t} \right).
\]

Hence, Equality (4) holds.
References

[1] S. Ariki, On the semi-simplicity of the Hecke algebra of \((\mathbb{Z}/r\mathbb{Z}) \wr \mathfrak{S}_n\), J. Algebra 169 (1994) 216–225.

[2] S. Ariki, K. Koike, A Hecke algebra of \((\mathbb{Z}/r\mathbb{Z}) \wr \mathfrak{S}_n\) and construction of its irreducible representations, Adv. Math. 106 (1994) 216–243.

[3] K. Bremke, G. Malle, Reduced words and a length function for \(G(e, 1, n)\), Indag. Math. 8 (1997) 453–469.

[4] C. Dunkl, S. Griffeth, Generalized Jack polynomials and the representation theory of rational Cherednik algebras, arXiv:1002.4607

[5] M. Geck, Beiträge zur Darstellungstheorie von Iwahori-Hecke-Algebren, RWTH Aachen, Habilitationsschrift, 1993.

[6] M. Geck, L. Iancu, G. Malle, Weights of Markov traces and generic degrees, Indag. Math. 11 (2000), 379-397.

[7] M. Geck, G. Pfeiffer, Characters of finite Coxeter groups and Iwahori-Hecke algebras. London Mathematical Society Monographs. New Series, 21. The Clarendon Press, Oxford University Press, New York, 2000.

[8] G. Malle, A. Mathas, Symmetric cyclotomic Hecke algebras, J. Algebra 205 (1998) 275–293.

[9] G. Malle, R. Rouquier, Familles de caractères de groupes de réflexions complexes, Representation theory 7 (2003), 610-640.

[10] A. Mathas, Matrix units and generic degrees for the Ariki-Koike algebras, J. Algebra 281 (2004), 695-730.

(M. Chlouveraki) University of Edinburgh, School of Mathematics, JCMB, King’s Buildings, Edinburgh, EH9 3JZ, UK

E-mail address: maria.chlouveraki@ed.ac.uk