Hiroshi Naruse

Summary of previous works

[1] Representation theory of Hecke algebras and Weyl groups, calculation of W-graphs.

For representation theory type C_n, I made character formula for irreducible representations as a generating function, and got recursive formulas such as Murnaghan–Nakayama type ([23]). Computations of Kazhdan–Lusztig's W-graph for type A $n = 7$ case are done in [21]. In the early 1990s, I made general algorithm to compute W-graph. At the time, Ochiai and Kako of Nara Woman's University were searching W-graph of S_n for calculating knot invariant. They did not find the case of $n = 14$, $\lambda = (44321)$, dim $= 48048$, and asked me to calculate. Then I calculated by large computer about one week, and sent the data to them. They analyzed the data and found an empirical algorithm[1] , but it did no work for $n = 16$. Recently, I calculated W-graph for $n = 16$, $\lambda = (44422)$, dim $= 171600$, by using the C-program of that time and checked the existence of 5-folded edge.

[2] Construction of equivariant Schubert basis for flag varieties of classical Lie types

We generalized the known Billey–Haiman Schubert polynomials of type B,C,D, to equivariant version by adding another variables and studied their fundamental properties [19]. Further more, we defined K-theory analogue of Schur's P-,Q- functions and studied their fundamental properties [17]. We also constructed these polynomials via degeneracy loci, from which the Pfaffian formula follows naturally [11,7]. On the other hand, using the id-Coxeter algebra, we constructed double Grothendieck polynomials of classical types.

[3] Generalization of Schur P-Q-functions and Hall–Littlewood function

We generalized the fact that the Schur P-,Q-functions can be seen as cohomology basis of loop space of infinite classical groups of type B,C, to the generalized cohomology case, defined their factorial analogue and studied their properties such as vanishing and GKM condition [13]. We followed the work of Pragacz to construct Hall–Littlewood function using Gysin map, and extended to the case of generalized cohomology [10]. I formulated and proved the generating function algebraically [9]. We generalized the Darondeau–Pragacz formula to the case of generalized cohomology [6]. We also defined equivariant version of Hall–Littlewood functions for generalized cohomology and studied their fundamental properties [4].

[4] Proof and extension of hook formula using equivariant cohomology

I realized that one can get a new hook formula for counting standard tableaux of skew shape, by using recurrence relations of localization of equivariant cohomology of the Grassmannians, and gave a talk at the Seminair Lotharingien de Combinatoire in 2014. After that, we get K-theory skew diagram version, which gives a generalization of Peterson–Proctor's hook formula [8]. Using the Chern–Schwartz–MacPherson classes of Schubert cells, we found that these give Nakada's colored hook formula geometrically [2]. Using the twisted group algebra, we proved Nakada's colored hook formula and its generalization for even infinite Coxeter groups [3]. To generalize these to K-theory, we made a Chevalley rule for the motivic Chern classes of Schubert cells [1]. The left Demazure–Lusztig operators give crucial role in the process, so we wrote a paper on this theme [5].

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[1] H.Ochiai–F.Kako (1995) "Computational construction of W-graphs of Hecke algebra H(q,n) for n up to 15", Experimental Math. 4(1), 61–67.