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# A combinatorial approach to Macdonald $q$ , $t$ -symmetry via the Carlitz bijection

Maria Monks Gillespie<sup>\*1</sup>

<sup>1</sup>University of California [Berkeley] – Berkeley, CA, United States

## Abstract

We investigate the combinatorics of the symmetry relation  $H_{\mu}(x; q, t) = H_{\mu^{\star}}(x; t, q)$  on the transformed Macdonald polynomials, from the point of view of the combinatorial formula of Haglund, Haiman, and Loehr in terms of the  $\text{inv}$  and  $\text{maj}$  statistics on Young diagram fillings. By generalizing the Carlitz bijection on permutations, we provide a purely combinatorial proof of the relation in the case of Hall-Littlewood polynomials ( $q = 0$ ) for the coefficients of the square-free monomials in the variables  $x$ . Our work in this case relates the Macdonald  $\text{inv}$  and  $\text{maj}$  statistics to the monomial basis of the modules  $R\mu$  studied by Garsia and Procesi. We also provide a new proof for the full Macdonald relation in the case when  $\mu$  is a hook shape.

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<sup>\*</sup>Speaker