

1154-13-648

**Zach Greif** and **Jason McCullough\*** (jmccullo@iastate.edu). *Green-Lazarsfeld condition for toric edge ideals of bipartite graphs.*

Previously, Ohsugi and Hibi gave a combinatorial description of bipartite graphs  $G$  whose toric edge ideal  $I_G$  is generated by quadrics, showing that every cycle of  $G$  of length at least 6 must have a chord. This corresponds to the Green-Lazarsfeld condition  $\mathbf{N}_1$ . In this paper, we investigate the higher syzygies of  $I_G$  and give combinatorial descriptions of the Green-Lazarsfeld conditions  $\mathbf{N}_p$  of toric edge ideals of bipartite graphs for all  $p \geq 1$ . In particular, we show that  $I_G$  is linearly presented (i.e. satisfies condition  $\mathbf{N}_2$ ) if and only if the bipartite complement of  $G$  is a tree of diameter at most 3. We also investigate the regularity of linearly presented toric edge ideals and give criteria for polyomino ideals to satisfy the Green-Lazarsfeld conditions. (Received September 09, 2019)