

We introduce a new orbit parametrization for square roots of the class of the inverse different in rings cut out by binary forms. This parametrization has many applications to studying class groups of orders in number fields, as well as rational/integral points on varieties/stacks. As an example, in joint work with Bhargava and Shankar, we apply the parametrization to prove that the second moment of the size of the 2-Selmer group of elliptic curves is at most 15, and that the average size of the 2-Selmer group is at most 6 in natural families of hyperelliptic Jacobians of any given dimension. These results confirm conjectures of Poonen and Rains.