Title: Singularities of symplectic reductions

Abstract: Let $V$ be a unitary representation of the compact Lie group $K$ where $K$ has Lie algebra $\mathfrak{k}$. Then there is a canonical moment mapping $\mu: V \to \mathfrak{k}^*$ which is equivariant with respect to the $K$-actions on $V$ and $\mathfrak{k}^*$. Let $M$ denote the zero set of $\mu$ and let $M_0$ (the symplectic reduction) denote the quotient space $M/K$ which is a real semi-algebraic set. In most cases the algebra of regular functions $A$ on $M_0$ is isomorphic to the restriction of $\mathbb{R}[V]^K$ to $M$. Note that if $K$ is finite, then $\mu = 0$, $M_0 = V/K$ and often one has that $\mathbb{R}[V]^K$ is Gorenstein. We investigate algebraic properties of $A$ and $M_0$ and consider the following questions.

1. Is there a finite group $H$ and unitary $H$-module $W$ such that $M_0 \cong W/H$? In other words, when is $M_0$ an orbifold?

2. Let $X$ denote the complexification of $M_0$. When does $X$ have rational singularities? When does $X$ have symplectic singularities? When does $X$ have Gorenstein singularities?