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MIT Lie Groups Seminar, May 8, 2013

**Representation count, rational singularities of deformation varieties, and pushforward of smooth measures.**

We will present the following 3 results:

1. The number of  $n$ -dimensional irreducible representations of the pro-finite group  $SL(d, Z_p)$  is bounded by a polynomial on  $n$  whose degree does not depend on  $d$  and  $p$  (our current bound for the degree is 22).
2. Let  $\phi : X \rightarrow Y$  be a flat map of smooth algebraic varieties over a local field  $F$  of characteristic 0 and assume that all the fibers of  $\phi$  are of rational singularities. Then, the push-forward of any smooth compactly supported measure on  $X$  has continuous density.
3. Let  $X = \text{Hom}(\pi_1(S), SL_d)$  where  $S$  is a surface of high enough genus (our current bound for the genus is 12). Then  $X$  is of rational singularities.

We will also discuss the surprising relation between those results which allowed us to prove them.