Towards a First Principles Model of Curling Ice Friction and Curling Stone Dynamics

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ABSTRACT

Scientific investigations to measure and explain the curl (lateral displacement) of a granite stone sliding on ice in the sport of curling go back almost 100 years (Harrington, 1924). Nevertheless, some prominent researchers in the field remain baffled as to the physical explanation of this lateral displacement. And no one has thus far been able to produce a quantitative model, from first principles, that predicts all the documented characteristics of the observed curl. In this paper, we describe our progress towards producing such a numerical model.

INTRODUCTION

Despite almost 100 years of scientific investigation, the answer to the question, “What puts the curl in a curling rock?” remains elusive. In this paper, we review the history of these scientific investigations and examine some previous explanations of the curl that don’t quite work. We also summarize the experimental observations that will need to be explained by any successful model. And we present our own initial steps towards developing, from first principles, a testable model of ice friction in curling, based in part on our earlier theoretical work on ice friction in the sports of speed skating, bobsleigh and skeleton (Penny et al., 2007; Lozowski and Szilder, 2013; Lozowski et al., 2013; Lozowski et al., 2014a; Lozowski et al., 2014b). In order to make some progress, we have simplified curling dynamics by ignoring everything but two essential elements. First, we examine the frictional interaction between a single pebble and the running band of a curling rock. Second, we derive a friction coefficient based on thermodynamic equilibrium, without considering the details of dry and wet friction.