I. INTRODUCTION

The Bayesian approach [1] to inference plays an increasingly important role in particle physics research. This is due, in part, to a better understanding of Bayesian reasoning within the field and the concomitant abating of the frequentist/Bayesian debate. Moreover, the small but growing number of successful applications provide concrete examples of how the Bayesian approach fares in practice.

In spite of these successes the specification of priors in a principled way remains a conceptual and practical hurdle. In the so-called subjective Bayesian approach [2], one is invited to elicit the prior based on one's actual beliefs about the unknown parameters in the problem. If one has well-understood information, for example based on subsidiary measurements or simulation studies, one can encode this partial information in an evidence-based prior [3]. Such priors generally occasion little or no controversy. On the other hand, if one knows little about a given parameter, or if one prefers to act as if one knows little, then it is far from clear how one ought to encode this minimal information in a prior probability.

Since there is, in fact, no unique way to model prior ignorance, a viewpoint has evolved in which this lack of knowledge is represented by one's willingness to *adopt* a standard prior for certain parameters [4], just as one has adopted a standard for quantities such as length and weight. In this spirit, our field adopted as a convention a uniform (flat) prior for unknown cross sections and other parameters (see for example Ref. [5]), mainly because this prescription is simple to implement and seems to embody Laplace's principle of insufficient reason. Unfortunately, uniform priors are both conceptually and practically flawed. The conceptual difficulty is with their justification: lack of knowledge about a parameter σ implies lack of knowledge about any one-to-one transform σ' of σ, and yet a prior distribution that is uniform in σ will not be so in σ' if the transform is non-linear. The practical problem is that careless use of uniform priors can lead to improper posteriors, that is, posteriors whose integrals are infinite and which can therefore not be used to assign meaningful probabilities to subsets of parameter space. An example of this pathology is found in a common method for reporting the exclusion of a new physics signal, where one estimates an upper limit from a posterior distribution for the signal's production cross section. When constructed from a Poisson probability mass function for the observations, a flat prior for the signal cross section, and a truncated Gaussian prior for the signal acceptance, this posterior is actually