# The Spectrum of Heavy-Quark Exotics

R. Lebed, Arizona State University

- $> \mathbf{40}$ candidates $X, Y, Z, P_c$ observed to date
- Likely $> \mathbf{100}$ more await discovery
- Most first observed through $e^+e^-$, but several through $B, \Lambda_b$ or even directly in $pp$
- WHAT ARE THEY? No consensus even on this simple fact! *Not* just hadronic molecules
- Experiment: Need to uncover *full spectrum*, use ideal modes ($J/\psi \to \mu^+\mu^-, \eta_c \to p\bar{p}$), systematically explore each $J^{PC}$, look for *transitions* between exotics, as for quarkonium
  Make lots of high $\Upsilon$ states for $b\bar{b}$ exotics; hidden- and open-strangeness exotics
- Theory: Need unifying scheme to say where exotics occur & *where they should not*
  *e.g.*, Why doesn't *every* hadronic threshold exhibit strong threshold effects?
  *e.g.*, Are there exactly 12 *S*-wave & 28 *P*-wave isomultiplets, as in diquark models?