Abstract for an Invited Paper
for the DAMOP06 Meeting of
The American Physical Society

Positronic Atoms — Understanding a Sticky (Few-Body) Situation[1]

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It has been known for about a decade that positrons definitely bind to neutral atoms and, at last count, 11 different atoms are theoretically known to bind positrons, of which none have yet been demonstrated experimentally [1]. We have revisited the application of the configuration interaction (CI) method to the study of various positronic atoms [2]. The accurate representation of electron-positron clustering using only single particle orbitals centered on the nucleus requires the inclusion of orbitals with much higher angular momenta than a roughly equivalent electron-only calculation. Given that helium is described as slowly convergent [3], one struggles to find an adjective that could characterize the CI convergence properties of positronic systems! And this says nothing of the additional radial convergence induced horrors involved in calculating annihilation rates to even within 5%. However, armed with convergence patterns, we have obtained reliable estimates of various positronic atom structures and annihilation properties. Our CI calculations, for example, have shown that positronic calcium is the strongest positron binding system yet found, binding a positron much more strongly than it does an extra electron [4]. Recent progress on understanding the role of the p-wave in low-energy positron-atom interactions using a hybrid CI-Kohn scattering method will also be discussed.

[1] J.Mitroy, M.W.J.Bromley and G.G.Ryzhikh J.Phys.B **35** R81 (2002)
[2] J.Mitroy and M.W.J.Bromley Phys. Rev. A (under review)
[3] C.Schwartz Phys. Rev. **126** 1015 (1962)
[4] M.W.J.Bromley and J.Mitroy Phys. Rev. A (under review)

[1]This research was partially supported by the Australian Research Council.