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Reply to Tietz' Letter: "Approximate Analytic Solution of the Thomas-Fermi Equation for Atoms"

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IN a recent letter to the editor, Tietz[1] gives a modification of my method of solving the Thomas-Fermi equation[2] applied to atoms. The following remarks may serve to compare the relative positions of Tietz' modification and my original method for atoms:

		Approximations	
	Exact	Brinkman	Tietz
Equation	$d^2\varphi/d\chi^2=\chi^{-\frac{1}{2}}\varphi^{\frac{3}{2}}$	$d^2\varphi/d\chi^2=(\chi\varphi)^{\frac{1}{2}}\dfrac{\varphi}{\chi}$	$d^2\varphi/d\chi^2=\dfrac{\varphi^2}{(\chi\varphi)^{\frac{1}{2}}}$
		$(\chi\varphi)^{\frac{1}{2}}=c_1=0.64$	$(\chi\varphi)^{\frac{1}{2}}=c_2=0.576$
Solution	numerical	$\varphi=c\chi^{\frac{1}{2}}k_1(2c_1^{\frac{1}{2}}\chi^{\frac{1}{2}})$	$\varphi=\dfrac{6c_2}{\{\chi+(6c_2)^{\frac{1}{2}}\}^2}$
Asymptotic behavior	$\chi\rightarrow\infty$, $\varphi\rightarrow 144/\chi^3$	exponential	$\varphi\rightarrow 6c_2/\chi^2$

The approximate solutions do not differ much numerically for intermediate values of χ, while Tietz' solution has a simpler form. For $\chi\rightarrow\infty$ my solution decreases too fast and Tietz' solution too slowly.

However, the essential difference lies in the fact that my equation is linear, while Tietz' equation is not. Linearity greatly facilitates the application of the method to molecules, as was shown in my treatment of the H_2O molecule.[3] On the other hand, the extension of Tietz' method to molecules seems to be hardly possible.

[1] T. Tietz, J. Chem. Phys. **22**, 2094 (1954).
[2] H. C. Brinkman, Physica **20**, 44 (1954).
[3] H C. Brinkman and B. Peperzak, Physica **21**, 48 (1955).