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**How the $\omega_0$ condensate can spike the speed of sound cold, quarkyonic matter**[1] ROBERT PISARSKI, Brookhaven National Laboratory — I consider the effects of a coupling $\sim +\omega_\mu^2 \vec{\phi}^2$ between the $\omega_\mu$ meson and the $O(4)$ chiral field, $\vec{\phi}$. A condensate for $\omega_0$ is automatically generated at nonzero baryon density. I assume that with increasing density, a decrease of the chiral condensate and the effective $\omega_0$ mass gives a stiff equation of state. In order to match that onto a soft equation of state for quarkyonic matter, I consider an $O(N)$ field at large $N$. At nonzero temperature, Tsvelik, Valgushev, and myself showed that at nonzero temperature quantum fluctuations disorder any putative pion "condensate" into a pion quantum spin liquid. Here I show that the pion quantum spin liquid persists at zero temperature. If valid qualitatively at $N = 4$, the $\omega_0$ mass goes up sharply and suppresses the $\omega_0$ condensate. This could generate a spike in the speed of sound at high density, which is strongly suggested by experimental data on neutron stars.

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Robert Pisarski
Brookhaven National Laboratory

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