Constraints on millicharged dark matter and axion-like particles from timing of radio waves

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After reviewing the status of dark matter constraints obtained from pulsar radio waves, we derive new constraints on millicharged dark matter and axion-like particles using pulsar timing and fast radio burst observations. For dark matter particles of charge ϵe, the constraint from time of arrival (TOA) of waves is $\epsilon/m_{\rm milli} \lesssim 10^{-8}{\rm eV}^{-1}$, for masses $m_{\rm milli} \gtrsim 10^{-6}\,{\rm eV}$. For axion-like particles, the polarization of the signals from pulsars yields a bound in the axial coupling $g/m_a \lesssim 10^{-13}{\rm GeV}^{-1}/(10^{-22}{\rm eV})$, for $m_a \lesssim 10^{-19}\,{\rm eV}$. Both bounds scale as $(\rho/\rho_{\rm dm})^{1/2}$ for fractions of the total dark matter energy density $\rho_{\rm dm}$. We make a precise study of these bounds using TOA from several pulsars, FRB 121102 and polarization measurements of PSR J0437−4715. Our results rule out a new region of the parameter space for these dark matter models.