Refrigerant Properties for Particle Physics: Replacing R-12 in Cherenkov Detectors

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Dichlorodifluoromethane (R-12) has frequently been used as a radiating gas in pressure threshold Cherenkov detectors for high-energy particle physics. However, that ozone-depleting compound is becoming unavailable due to the Montreal Protocol. To find a replacement gas with suitably high refractive index, we use a combination of theoretical calculations and high-accuracy gas-phase refractive-index measurements to examine the polarizability and refractivity of several non-ozone-depleting compounds. Our measurements show that the third-generation refrigerants R-1234yf and R-1234ze(E) have sufficient refractivity to replace R-12. If the slight flammability of these compounds is a problem, an alternative is R-218 (octafluoropropane), which is non-flammable but has a high Global Warming Potential.