Effects of Lovelock gravity on the Joule-Thomson expansion

Effects of Lovelock gravity on the Joule-Thomson expansion are probed from various perspectives. The well-known Joule-Thomson coefficient is derived with both the explicit expression and intuitive image presented. Moreover, the inversion curves showing the relation between the inversion temperature and the inversion pressure are studied. It is shown that for given inversion pressure, the inversion temperature of the case $\alpha \neq 0$ (α is the Lovelock parameter) is much lower than that of the case $\alpha = 0$. And the inversion temperature tends to decrease with α, in contrast to the effect of the electric charge. It is also shown that the ratio between the minimum inversion temperature and the critical temperature decreases with α for $\alpha \neq 0$. Furthermore, the isenthalpic curves are investigated with rich physics revealed. The intersection point between the isenthalpic curve and the inversion curve is exactly the inversion point discriminating the heating process from cooling process. It is shown that both the inversion temperature and the inversion pressure for $\alpha \neq 0$ are much lower for the same given mass of the black hole, showing the effect of Lovelock gravity. Last but not the least, we discuss the case of uncharged Lovelock AdS black holes with interesting feature found. It is shown that the Joule-Thomson coefficient is always positive, suggesting the expansion is always in the regime of cooling process. And no inversion temperature exists, in contrast to the case $Q \neq 0$. Isenthalpic curves are also quite different since the temperature increases monotonically with the pressure when the mass is specified.