Comment on "Emergence of a Superconducting State from an Antiferromagnetic Phase in Single Crystals of the Heavy Fermion Compound Ce$_2$PdIn$_8$"

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A recently published Letter [1] has reported on the antiferromagnetism (AF) and ambient-pressure superconductivity (SC) in a Ce$_2$PdIn$_8$ single crystal with $T_N \sim 10$ K and $T_c = 0.68$ K, respectively. Although we very much appreciate the effort exerted to prepare and characterize this new heavy fermion (HF) superconductor (SC), we would like to add a cautionary note that the reported Néel temperature coincides remarkably with $T_N = 10.2$ K of CeIn$_3$ [2]. It therefore leads us to consider the possible presence of CeIn$_3$ in the samples that were investigated. In other Ce$_n$TIn$_{3n+2}$($n = 1, 2$) compounds [3–5] the AF is either absent ($T$=Co, Ir) or remarkably limited to much lower temperatures ($T$=Rh). These compounds form a quasi-two-dimensional tetragonal structure with the CeIn$_3$ and TIn$_2$ layers alternating along the (001) direction. Hence one might expect that the AF correlations develop within the CeIn$_3$ layers while the interaction between the layers will be weaker as reported for CeRhIn$_5$, an incommensurate AF ($T_N = 3.8$ K) [6]. The remarkable agreement of the $T_N$ values in the reported Ce$_2$PdIn$_8$ with the well-known CeIn$_3$ is not discussed in the Letter [1]. Neither the striking discrepancy between their own results on single crystals [1] and polycrystals (reported paramagnetic down to 0.35K [7]) has been explained. The absence of SC in the polycrystalline sample is explained by an unconventional coupling sensitive to structural planar defects, which were also observed in Ce$_2$RhIn$_8$ [10]. In agreement with [1], the SC has a HF character and it is a bulk property of the compound but it does not emerge out of a long-range AF state below the Néel temperature of 10 K because the reported AF was due to presence of an impurity phase.

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FIG. 1: EDX element mapping (Ce-red, Pd-green, In-blue) of a typical polished sample. CeIn$_3$ (red region) is covered by a layer of Ce$_2$PdIn$_8$ and Ce$_{1.5}$Pd$_{1.5}$In$_7$ (thin dark green).
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