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The formation and stability of a cold disc made out of stellar winds in the Galactic Centre

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The discovery of a cold (~10,000 K) disc-like structure around the super-massive black hole at the centre of the Milk Way, Sagittarius A*(Sgr A)*, has challenged our understanding of the gas dynamics and thermodynamic state of the plasma in its immediate vicinity. State-of-the-art simulations do not agree whether or not such a disc can indeed be a product of the multiple stellar wind interactions taking place in the region. This work aims to constrain the conditions for the formation of a cold disc as a natural outcome of the system of mass-losing stars orbiting around Sgr A, *and to investigate if such a disc is a transient or a long-lasting structure. We conduct a set of hydrodynamic simulations of the observed Wolf-Rayet (WR) stars feeding Sgr A* using the adaptive mesh-refinement grid-based code Ramses. We focus on the impact of the unusual, H-poor composition of the plasma emanating from the WR stars. The simulations show that more realistic chemical compositions of the plasma affect the radiative cooling enough to impact the properties of the medium and, as a consequence the rate at which material inflows onto Sgr A. *We have identified that the formation of a cold disc due to the action of the stellar winds is possible only for certain chemical compositions that are consistent with the current observational constraints. However, it is not possible to reproduce all the properties of the observed disc, since the inclination of the observed and simulated discs do not align perfectly. We conclude that the hypothesis of the stellar winds forming a cold disc around Sgr A* is feasible but might require additional ingredients that have not been included in the model yet (e.g. inflow material from the mini-spiral).

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