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Why nature never makes chiral twins – insights from cometary ice analogues and extra-terrestrial sample analyses

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'*How did life choose its handedness?*' While amino acids and sugars can exist in left- or right-handed forms, life on Earth predominantly uses *left-handed* amino acids and *right-handed* sugars. This homochirality is necessary for building functional proteins and RNA/DNA, but the reason for this preference remains unclear. Some evidence suggests that the asymmetric interaction of chiral organics with stellar ultraviolet circularly polarized light (UV CPL) may be responsible (Fig. 1)[1]. The astrophysical origin of homochirality is strengthened by *i*) the detection of l-enriched amino and d-enriched sugar acids in meteoritic samples[2], *ii*) the detection of CPL in star-forming regions[3], and *iii*) experiments studying the interaction of UV CPL with prebiotic chiral species[4]. I will therefore highlight a few significant results on our on-going cometary ice simulation experiments[5], newly recorded anisotropy spectra as a key tool to decipher the response of chiral molecules to UV CPL[6] and present future strategies towards furthering understanding the origin of asymmetric prebiotic molecules. Moreover, I will present our major findings on recent asymmetric photolysis experiments using laser and synchrotron CPL sources to critically discuss whether stellar UV CPL could have induced a common chiral bias across molecular families. These will be complemented by long-awaited first asymmetric photolysis experiments on isovaline using our newly built tunable laser set-up.

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Figure 1 Stellar circular polarization may have enriched the L-enantiomer of amino acids in meteorites.