
Supplementary information

Evidence for a significant Kuiper belt dust contribution to the zodiacal cloud

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EVIDENCE FOR A SIGNIFICANT KUIPER BELT DUST CONTRIBUTION TO THE ZODIACAL CLOUD

Supplemental Data

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Solar energetic particle (SEP) track densities were measured in thin sections of individual interplanetary dust particles (IDPs) using transmission electron microscopy (TEM) imaging techniques. For the data presented here, we counted the number of tracks (n) present in 100 nm^2 regions of uniform contrast in the TEM images determining the track density ($n/100 \text{ nm}^2$) in each square. Averaging the results from the individual squares we determined the track density per cm^2 . The errors on the track density measurements are estimated based on the following example (Fig. S1) where we have made multiple counts in 100 nm^2 regions from IDP L2005Q4. In this case we derive a track density of $6 (+/-1) \times 10^{10} \text{ tracks/cm}^2$, which we consider as a representative measurement error on our track density determinations.

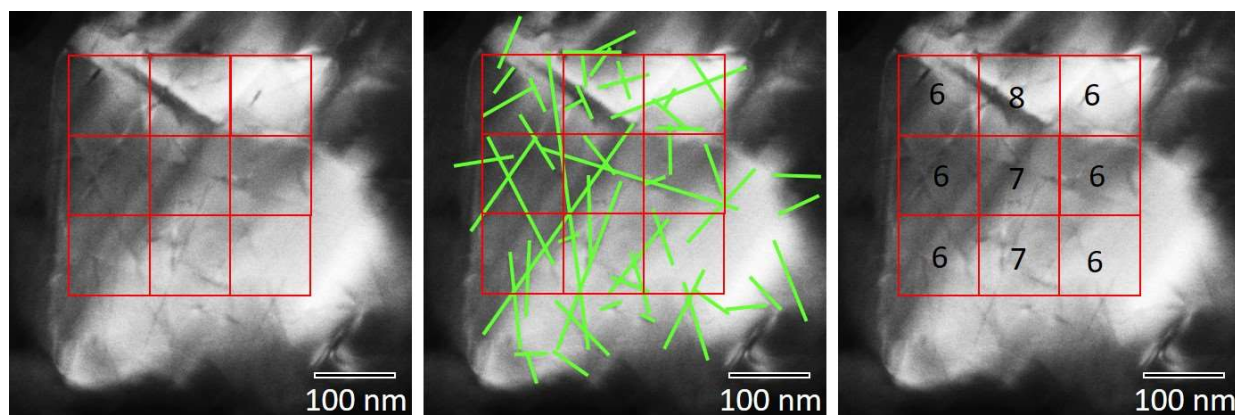


Fig. S1. Track counting procedure. A darkfield TEM image of a pyroxene grain from IDP L2005Q4 with an array of 100 nm^2 -sized boxes in red superimposed on the image (left). In the middle image, we have used green lines to highlight the positions of individual SEP tracks in the grain. The track counts in each 100 nm^2 box are given in the image on the right and results in an average measured SEP density of $6 (+/-1) \times 10^{10} \text{ tracks cm}^{-2}$.

We have collected our observations in this supplemental section where we show pairs of images for each IDP and the measured track density that is reported in Table 1. In all images, the red square is 100 nm^2 and we indicate the identified SEP tracks using green lines in the right-hand image of each pair.

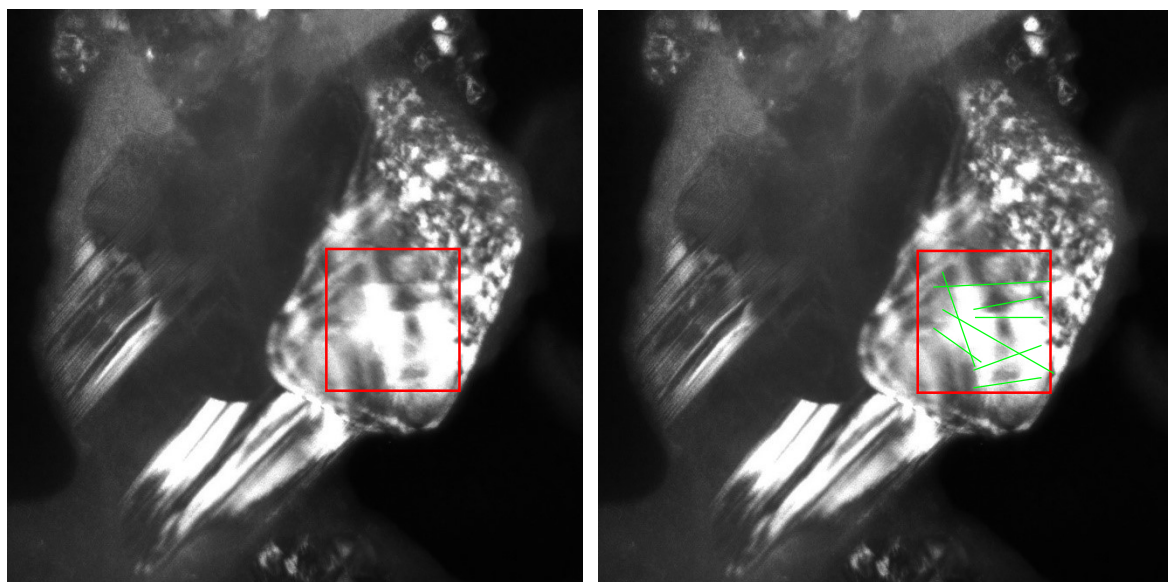


Figure S2. IDP L2005*A3 with a track density of $8 \times 10^{10} \text{ cm}^{-2}$.

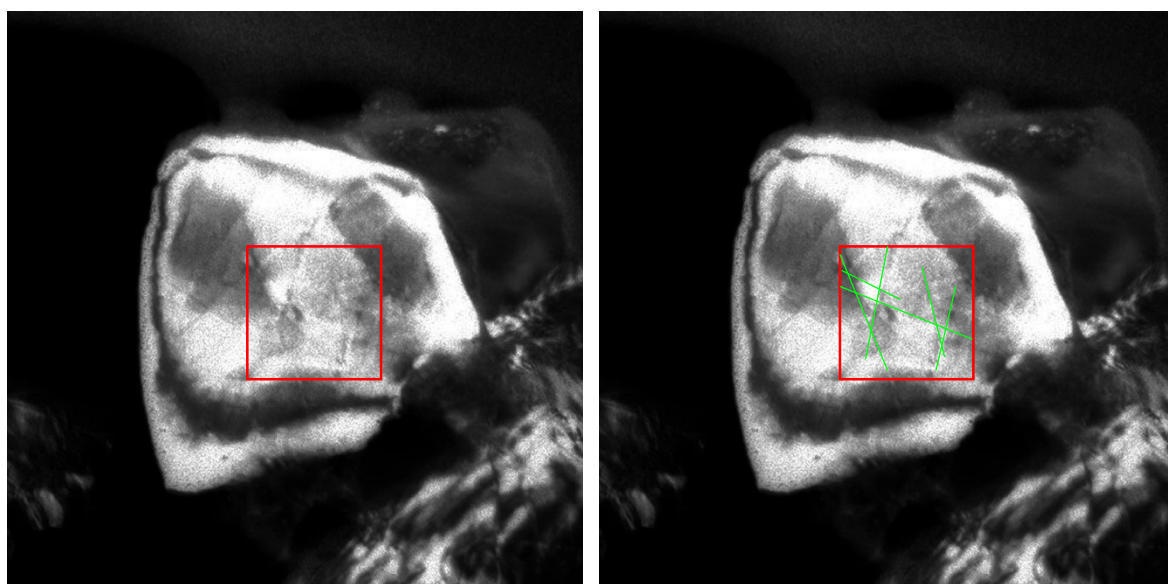


Figure S3. IDP L2036*C11 with a track density of $6 \times 10^{10} \text{ cm}^{-2}$.

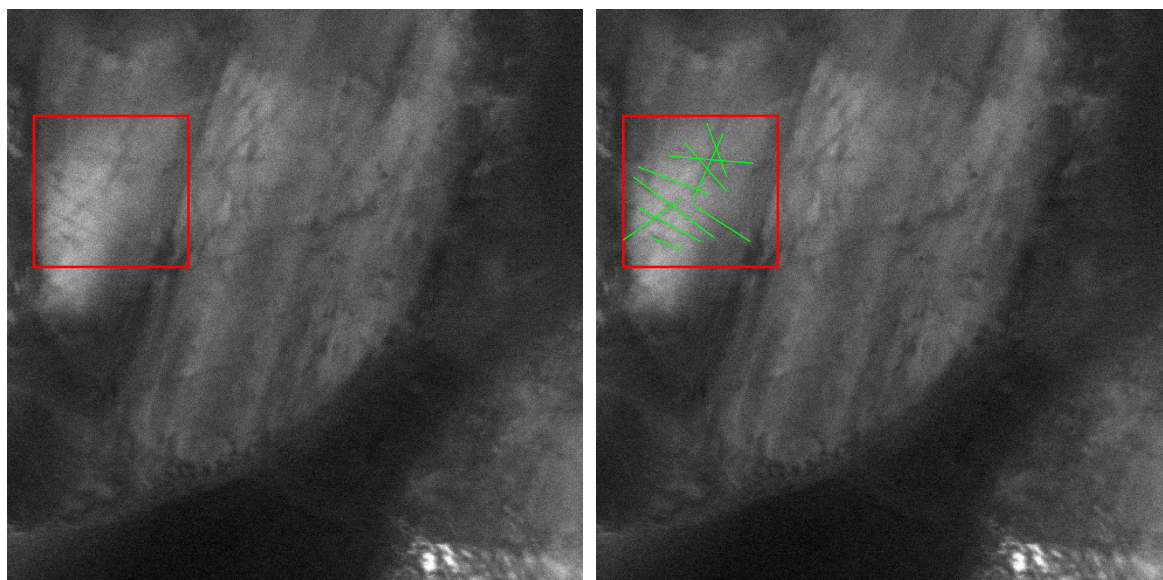


Figure S4. IDP L2036*B61 with a track density of $1 \times 10^{11} \text{ cm}^{-2}$.

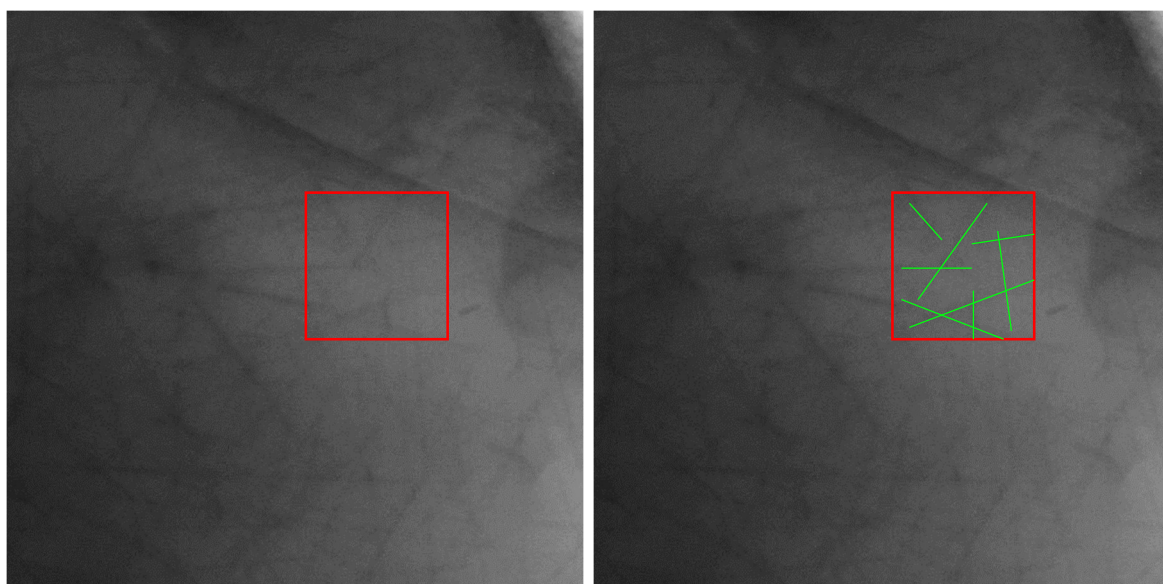


Figure S5. IDP L2036*C46 with a track density of $7 \times 10^{10} \text{ cm}^{-2}$.

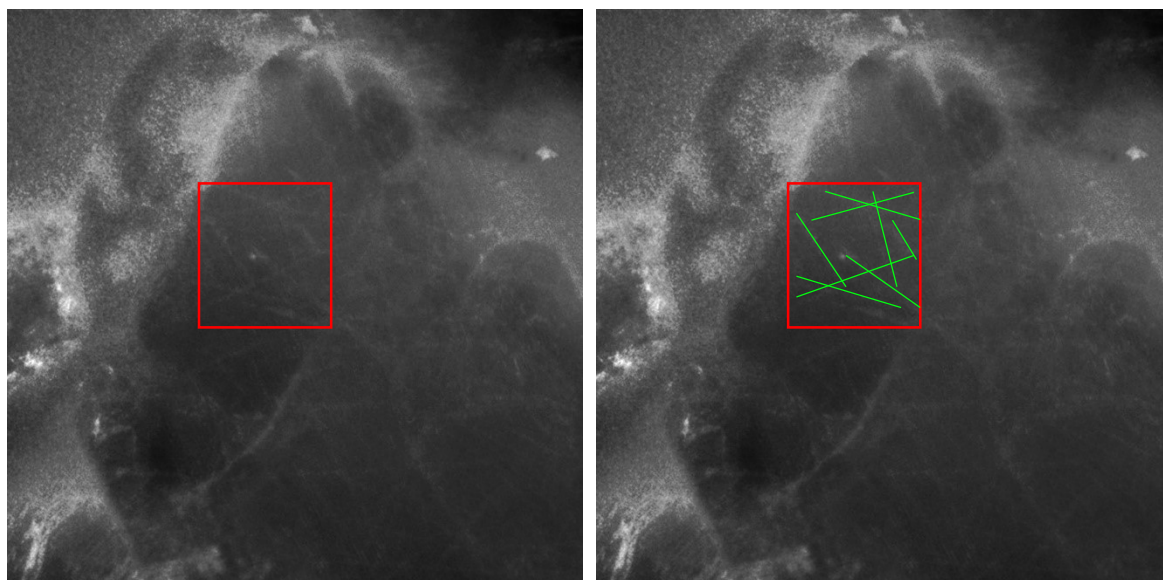


Figure S6. IDP L2036*C41 with a track density of $8 \times 10^{10} \text{ cm}^{-2}$.

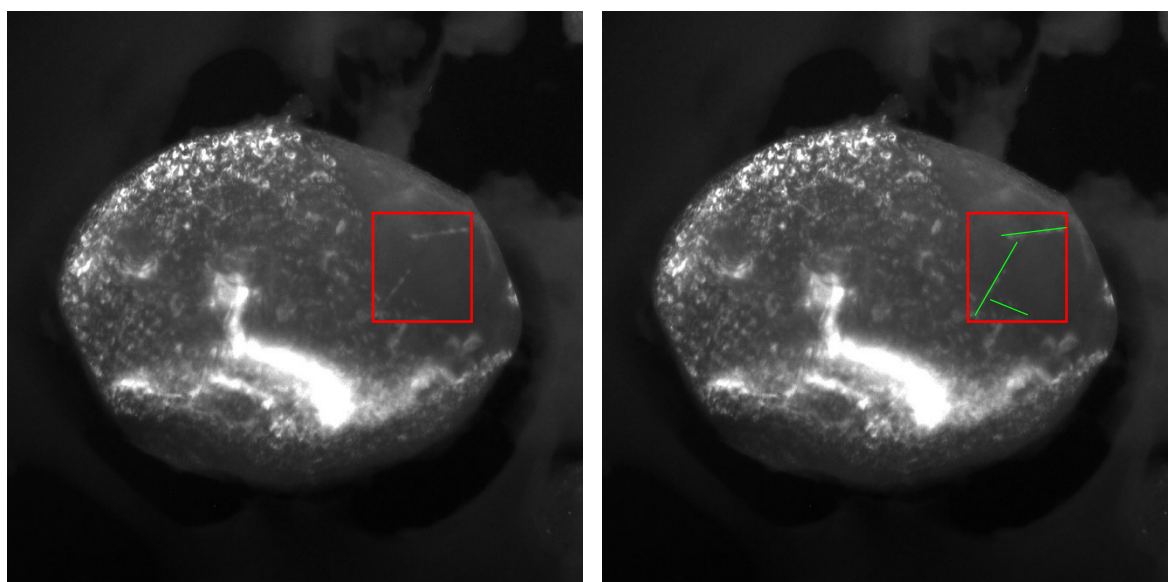


Figure S7. IDP L2011B10 with a track density of $3 \times 10^{10} \text{ cm}^{-2}$.

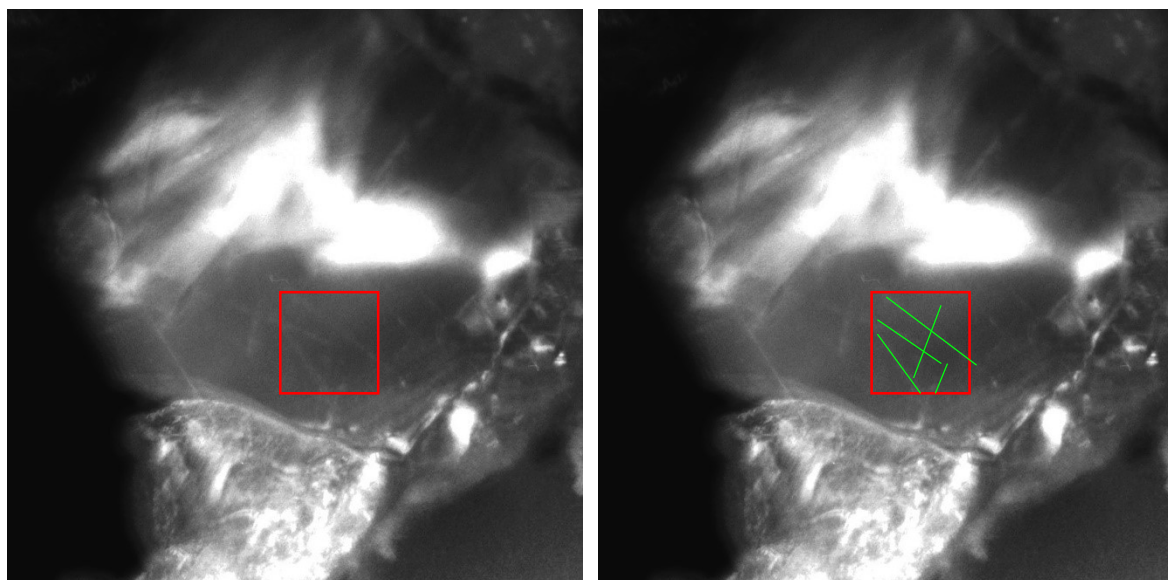


Figure S8. IDP L2005F31 with a track density of $5 \times 10^{10} \text{ cm}^{-2}$.

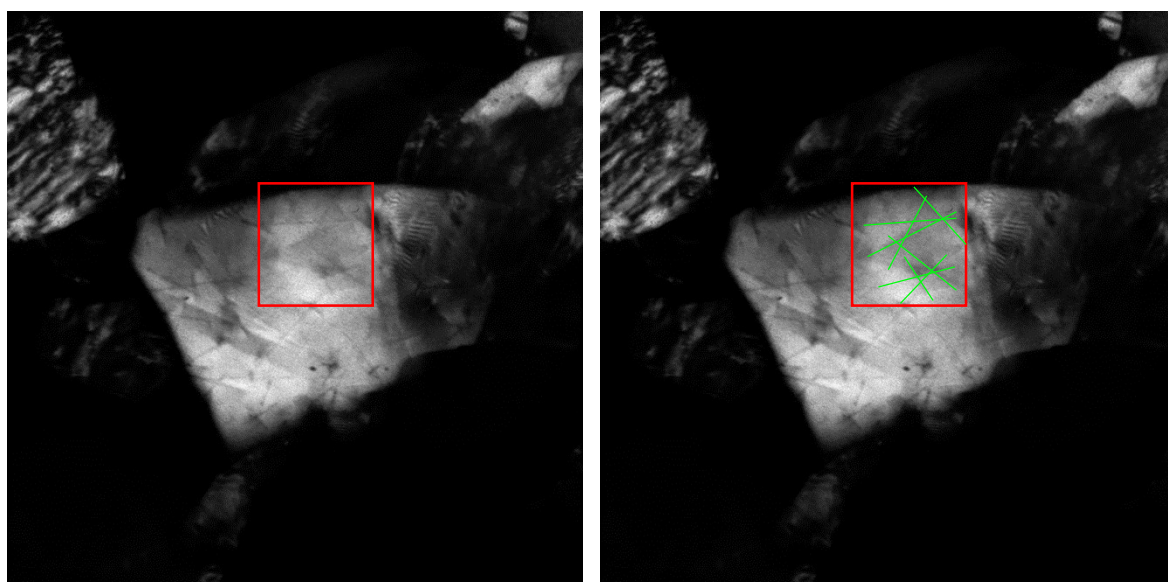


Figure S9. IDP L2009H11 with a track density of $8 \times 10^{10} \text{ cm}^{-2}$.

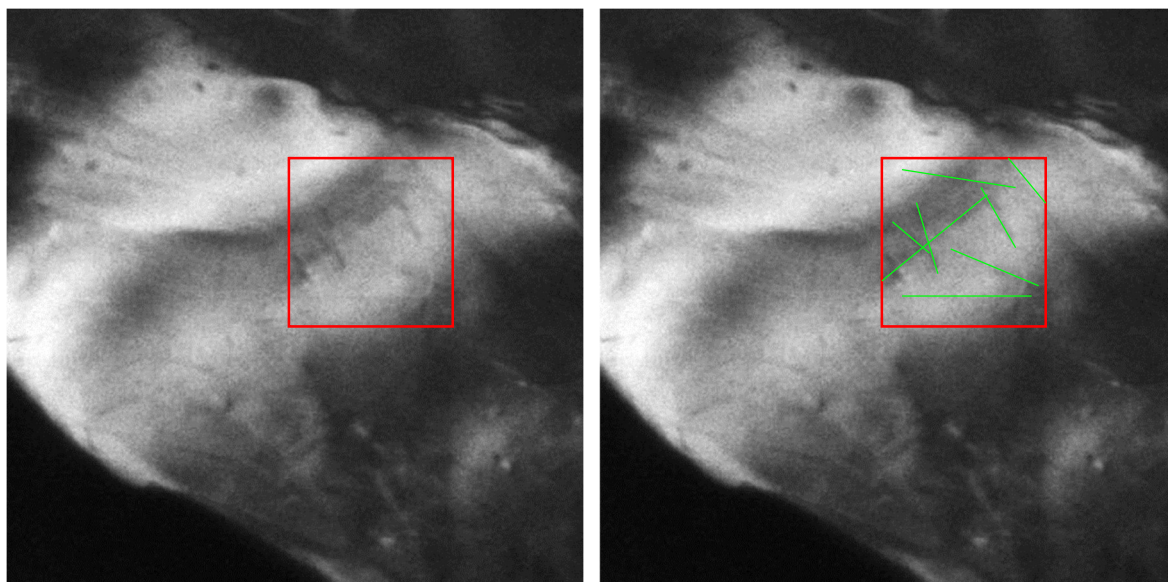


Figure S10. IDP L2036AW1 with a track density of $8 \times 10^{10} \text{ cm}^{-2}$.

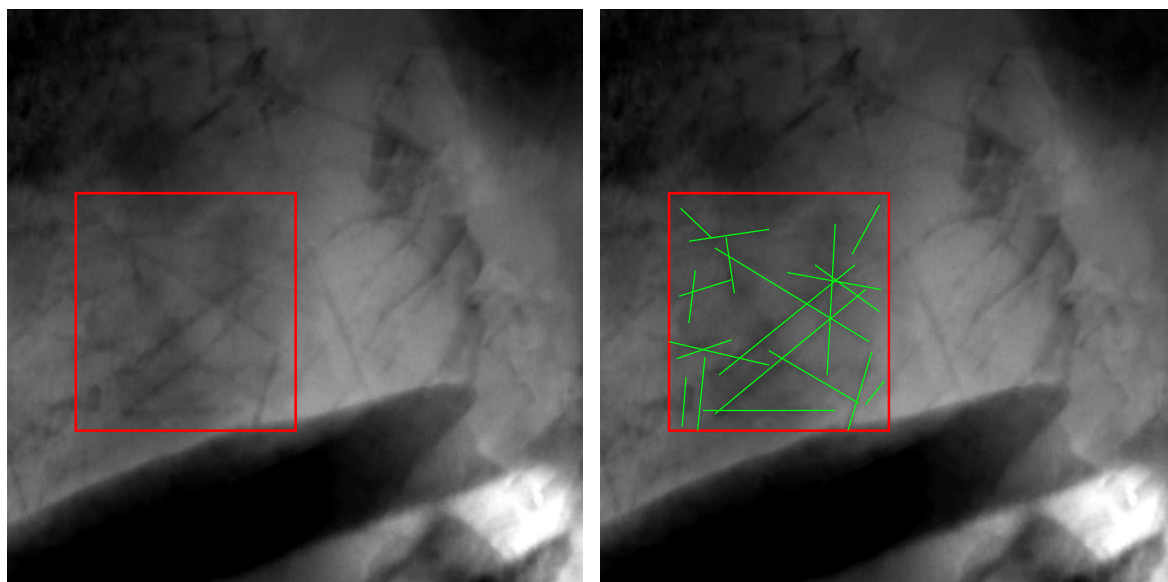


Figure S11. IDP L2036AA*4 with a track density of $2 \times 10^{11} \text{ cm}^{-2}$.

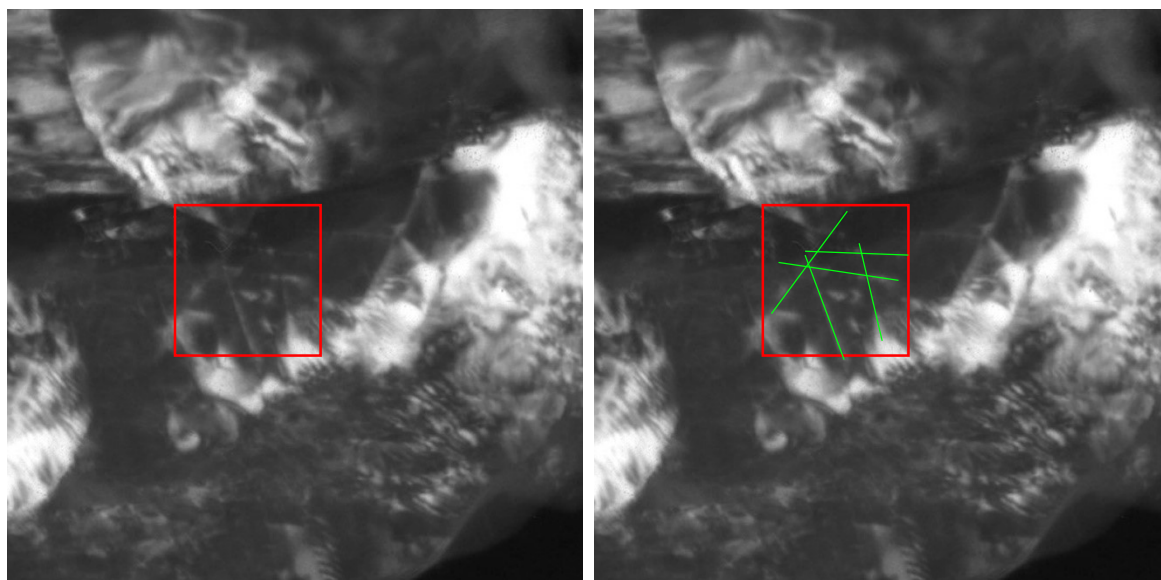


Figure S12. IDP L2009*E2 with a track density of $5 \times 10^{10} \text{ cm}^{-2}$.

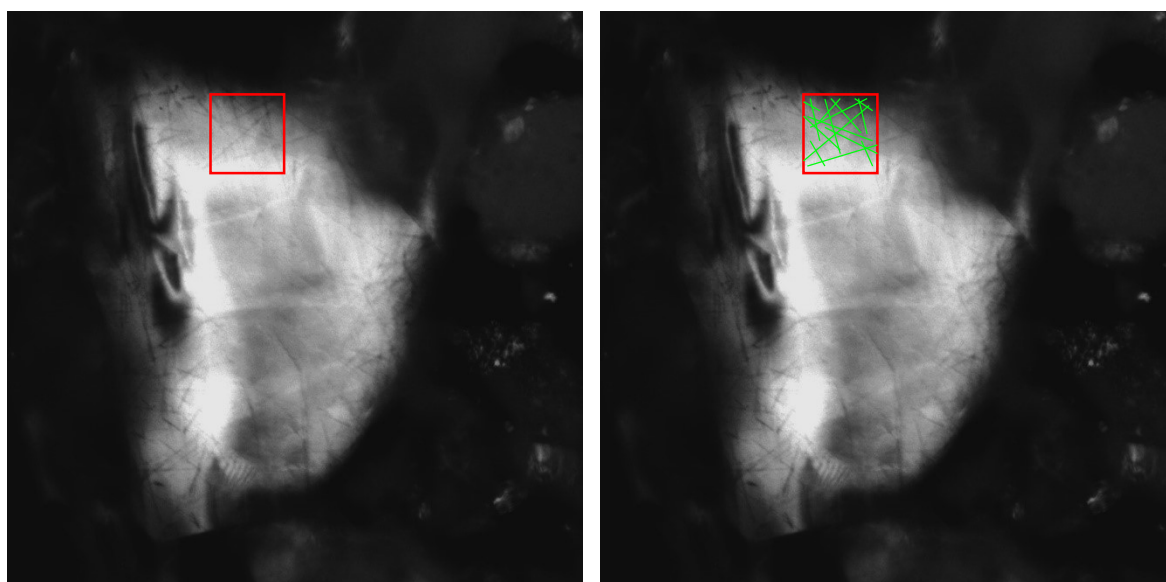


Figure S13. IDP L2009D11 with a track density of $15 \times 10^{10} \text{ cm}^{-2}$.

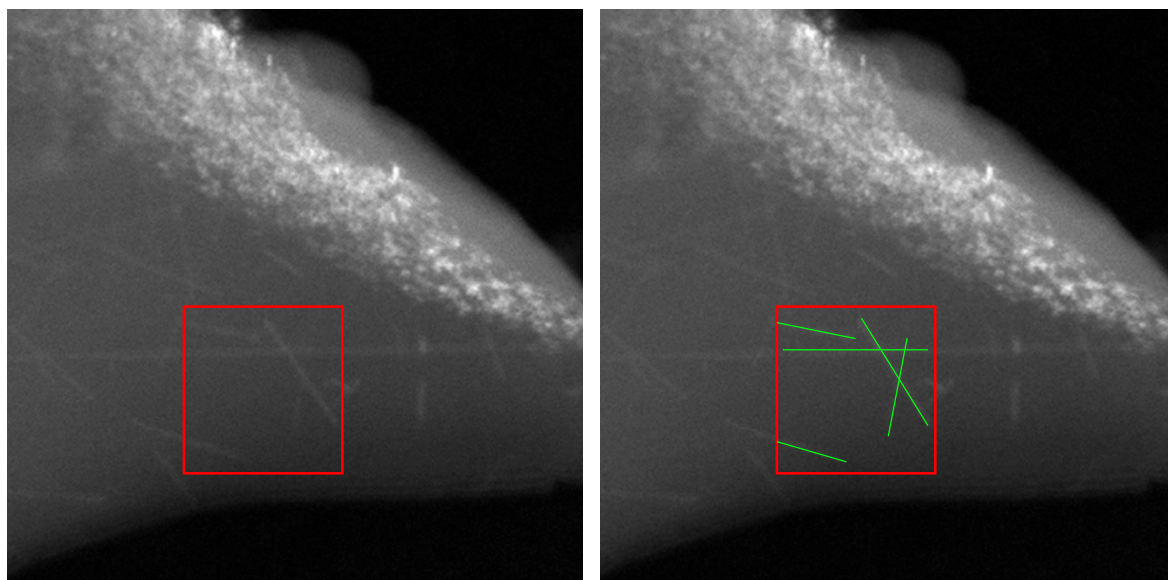


Figure S14. IDP L2036AY1 with a track density of $5 \times 10^{10} \text{ cm}^{-2}$.

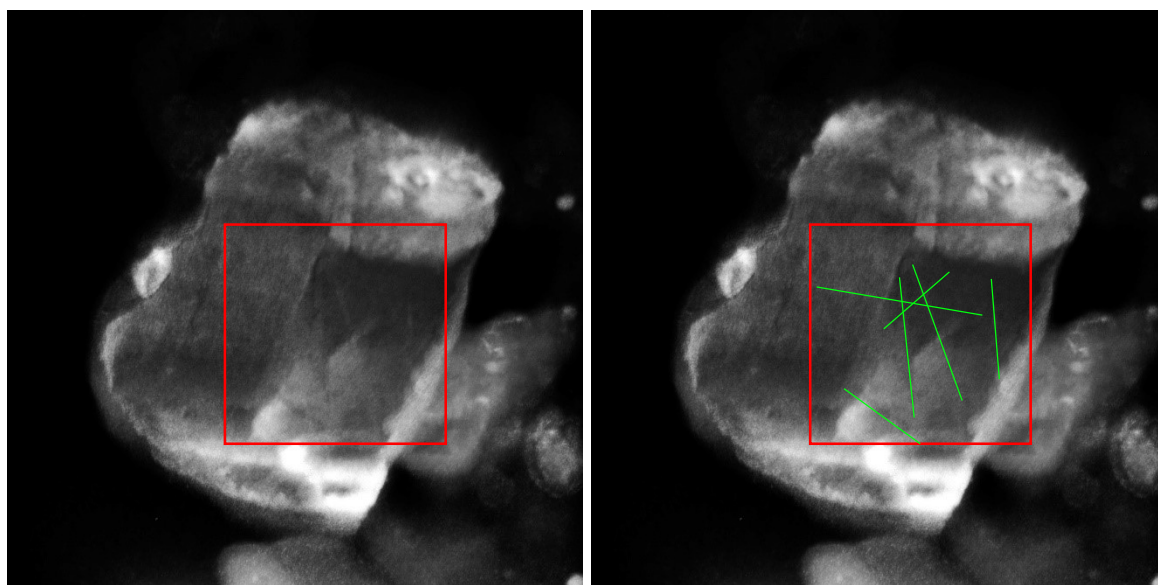


Figure S15. IDP L2011*B5 with a track density of $6 \times 10^{10} \text{ cm}^{-2}$.

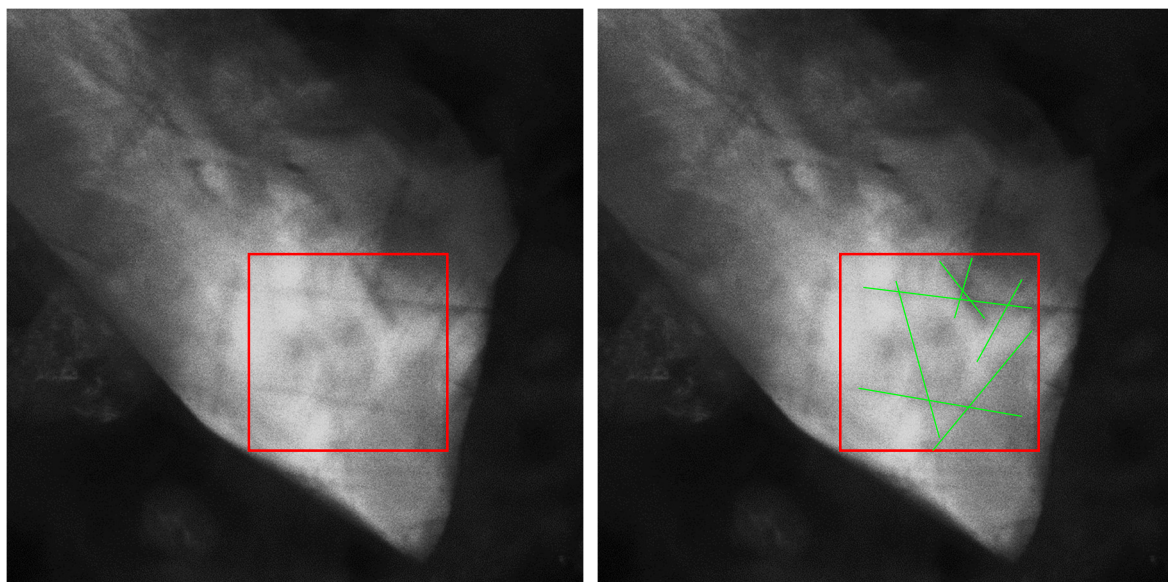


Figure S16. IDP L2006O15 with a track density of $7 \times 10^{10} \text{ cm}^{-2}$.

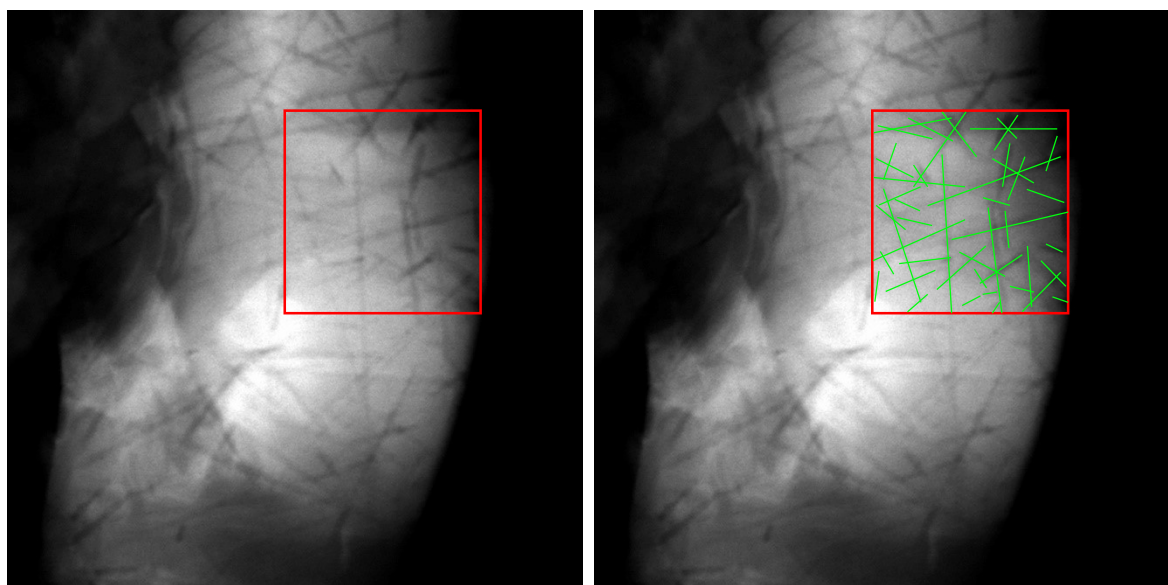


Figure S17. IDP L2005Q1 with a track density of $5 \times 10^{11} \text{ cm}^{-2}$.

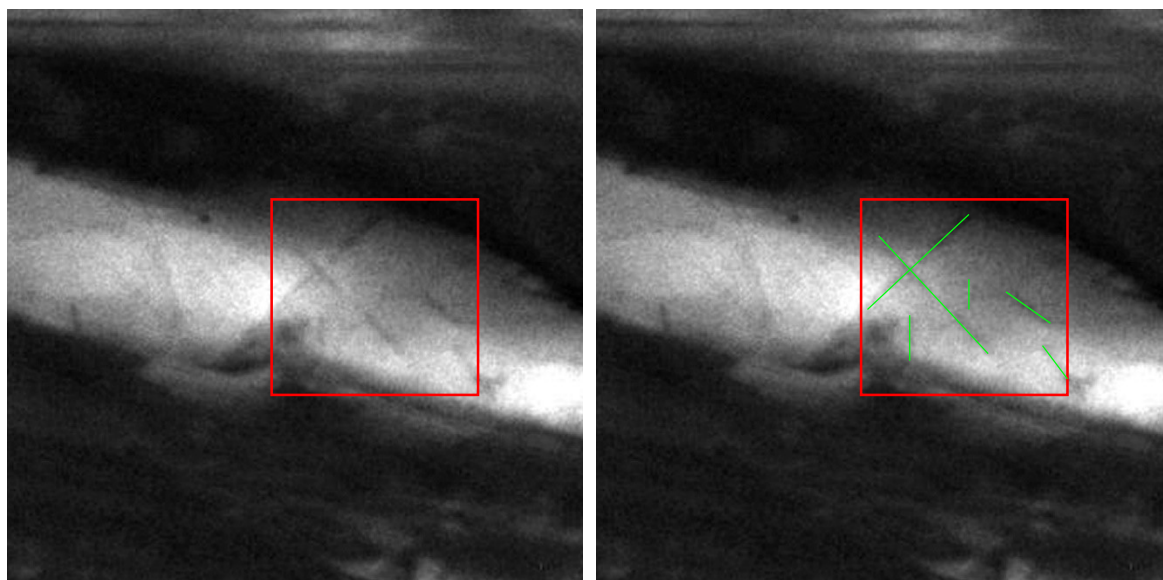


Figure S18. IDP L2079C35 with a track density of $6 \times 10^{10} \text{ cm}^{-2}$.

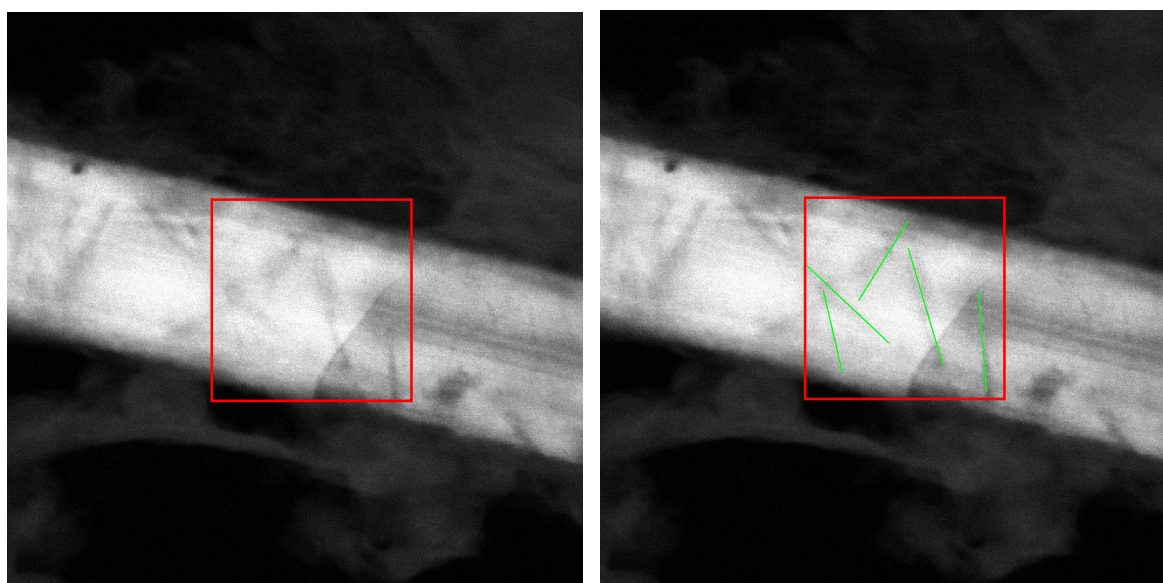


Figure S19. IDP U2153M1 with a track density of $5 \times 10^{10} \text{ cm}^{-2}$.

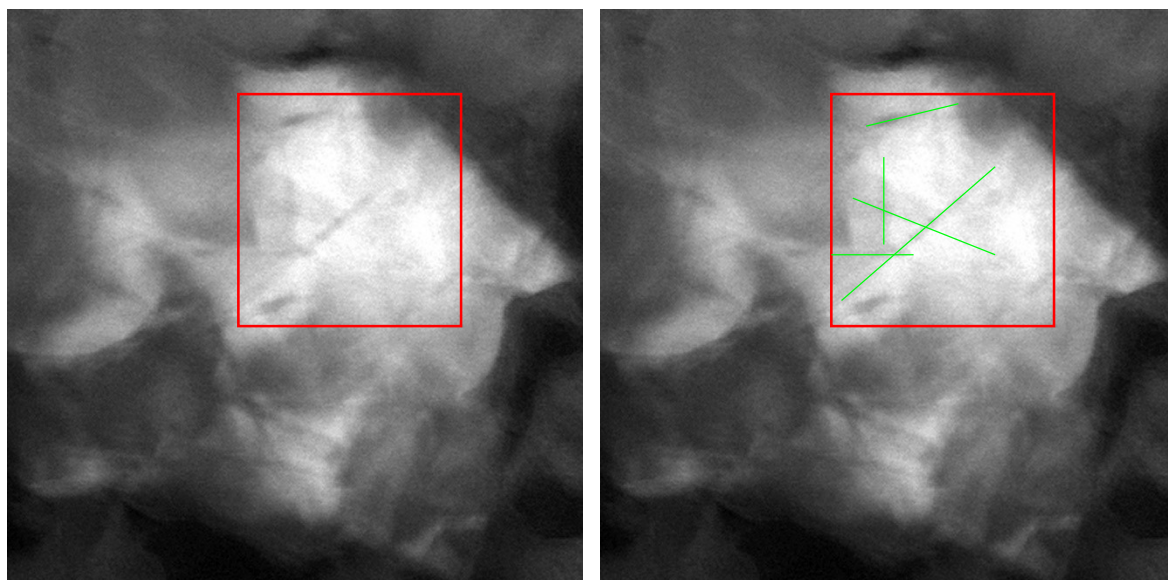


Figure S20. IDP U2153L1 with a track density of $5 \times 10^{10} \text{ cm}^{-2}$.

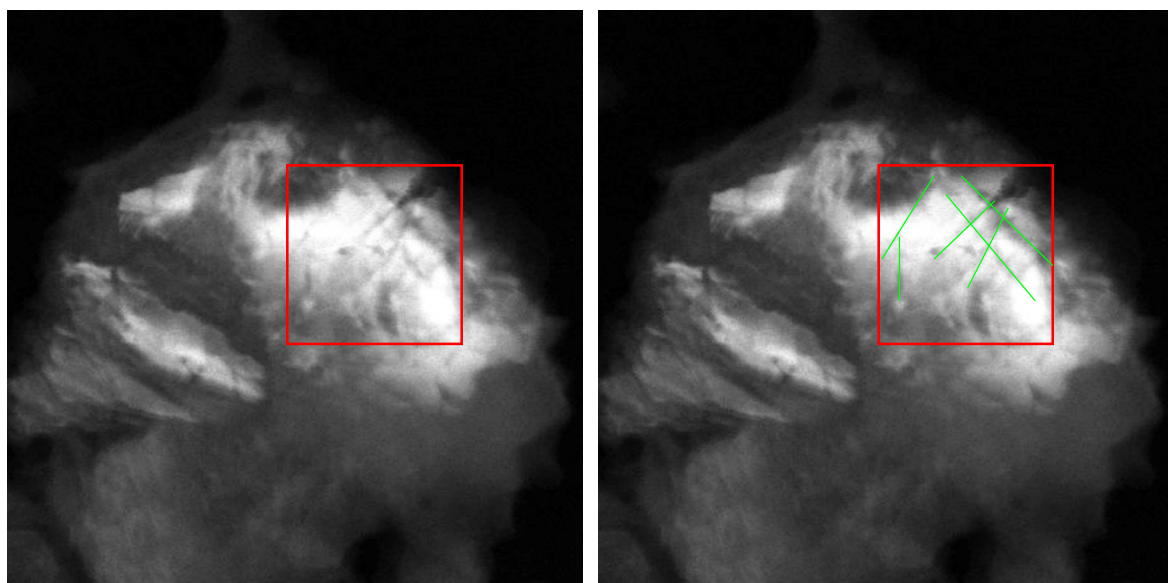


Figure S21. IDP L2083E46 with a track density of $6 \times 10^{10} \text{ cm}^{-2}$.

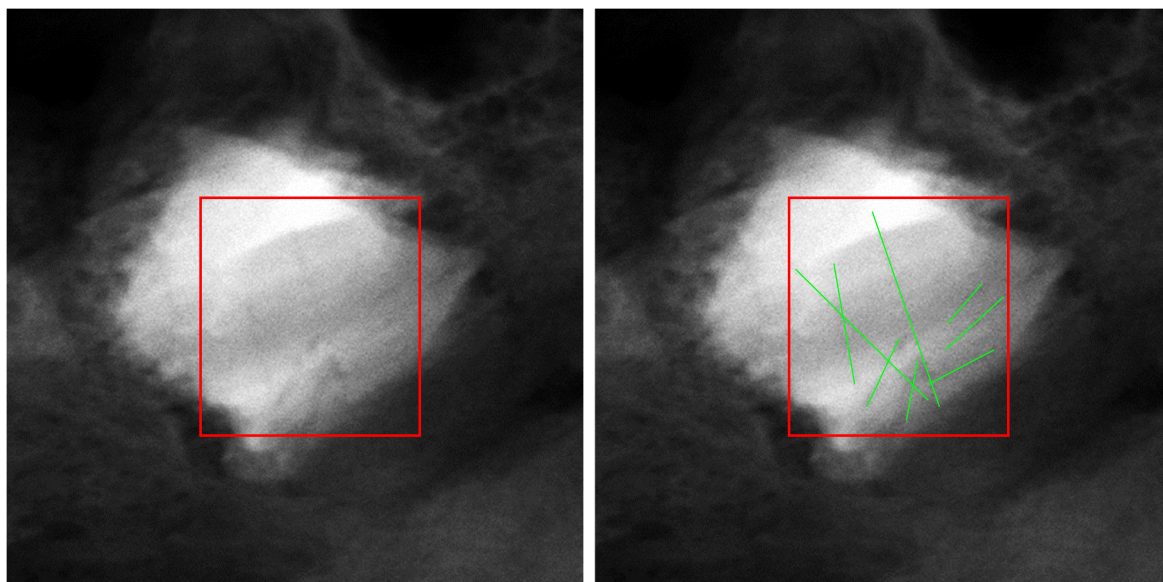


Figure S22. IDP L2083E25 with a track density of $8 \times 10^{10} \text{ cm}^{-2}$.

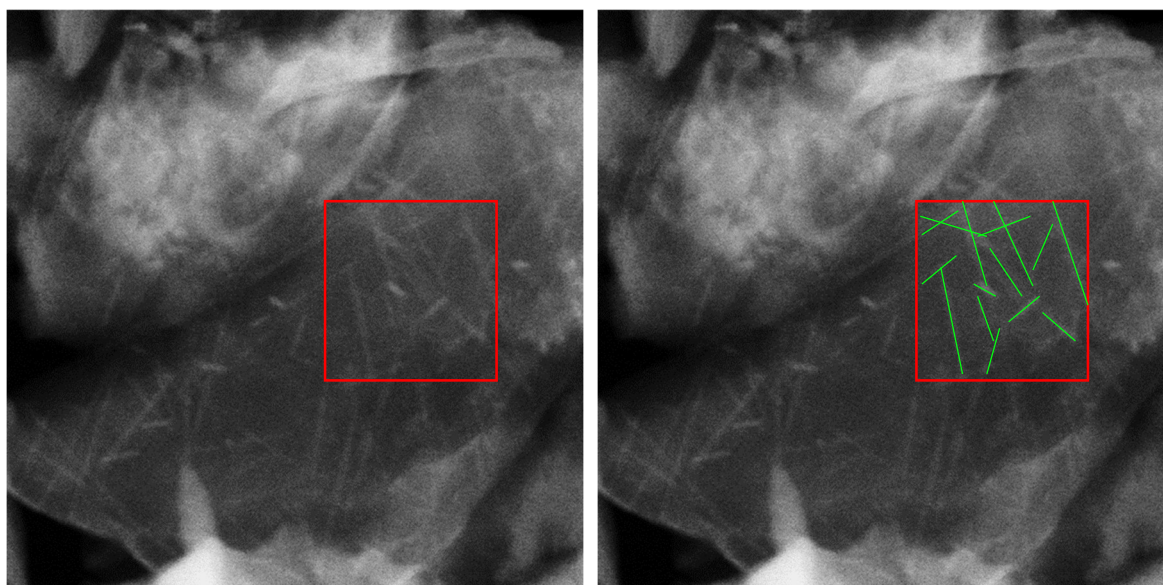


Figure S23. IDP L2098B1 with a track density of $15 \times 10^{10} \text{ cm}^{-2}$.

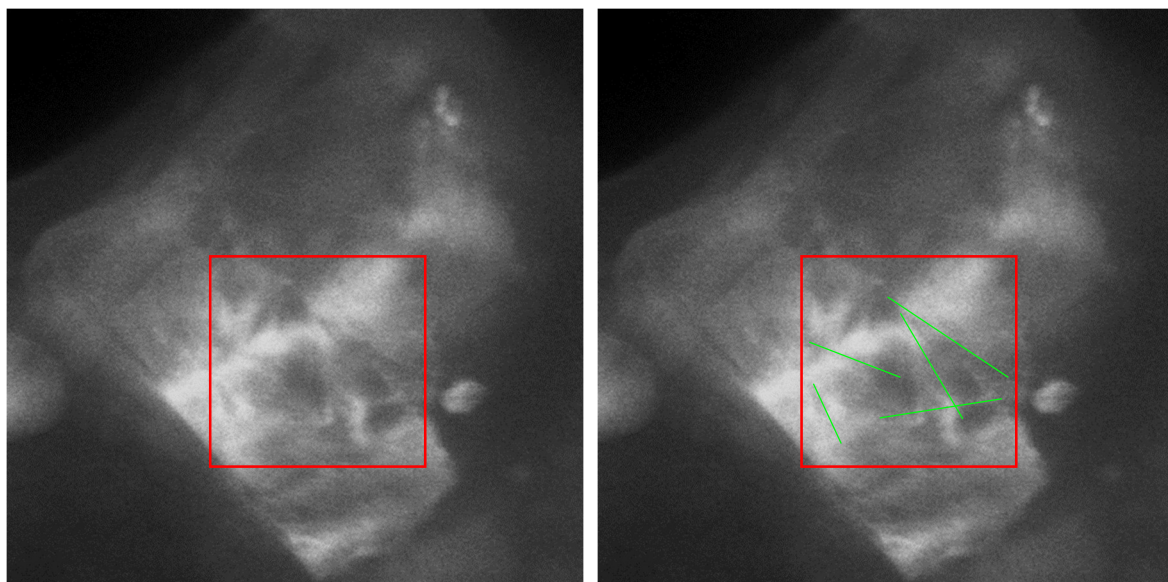


Figure S24. IDP L2083D58 with a track density of $5 \times 10^{10} \text{ cm}^{-2}$.

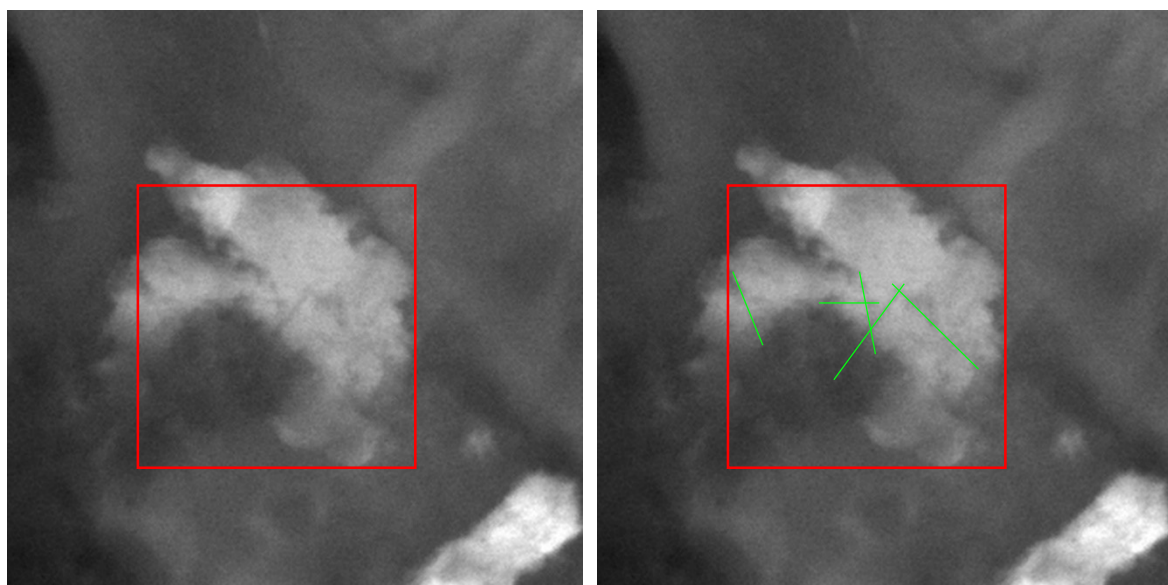


Figure S25. IDP L2083E47 with a track density of $5 \times 10^{10} \text{ cm}^{-2}$.



Figure S26. IDP L2005P9 with a track density of $3 \times 10^{10} \text{ cm}^{-2}$.

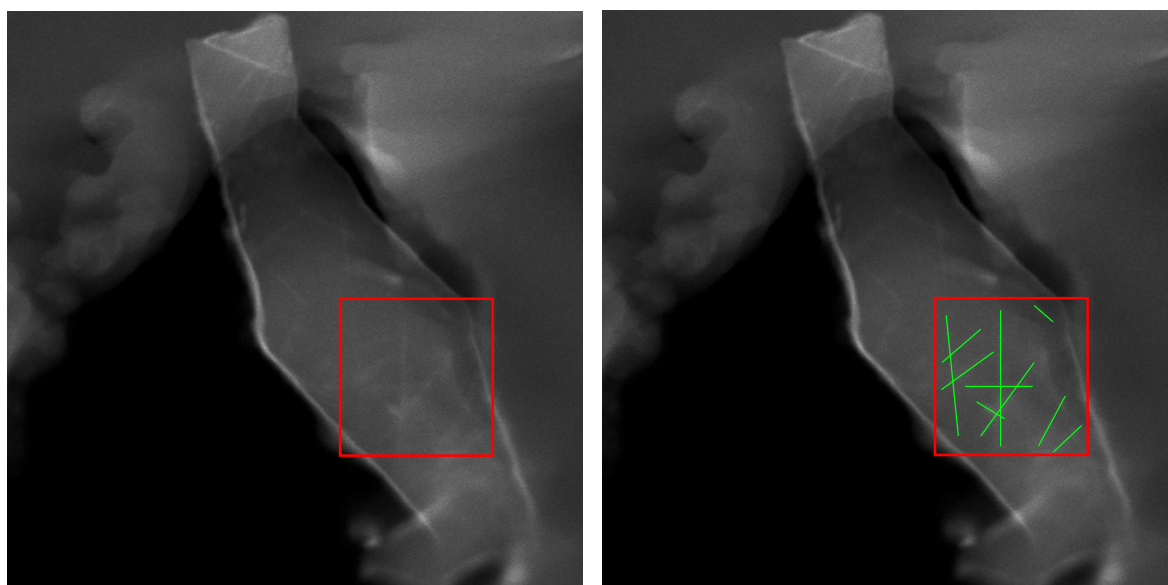


Figure S27. IDP L2009O4 with a track density of $1 \times 10^{11} \text{ cm}^{-2}$.