



Deep Profiling of the Spaceflight Plasma Proteome reveals Changes in Reactive Oxygen Species, Extracellular Matrix and Lipid Metabolism



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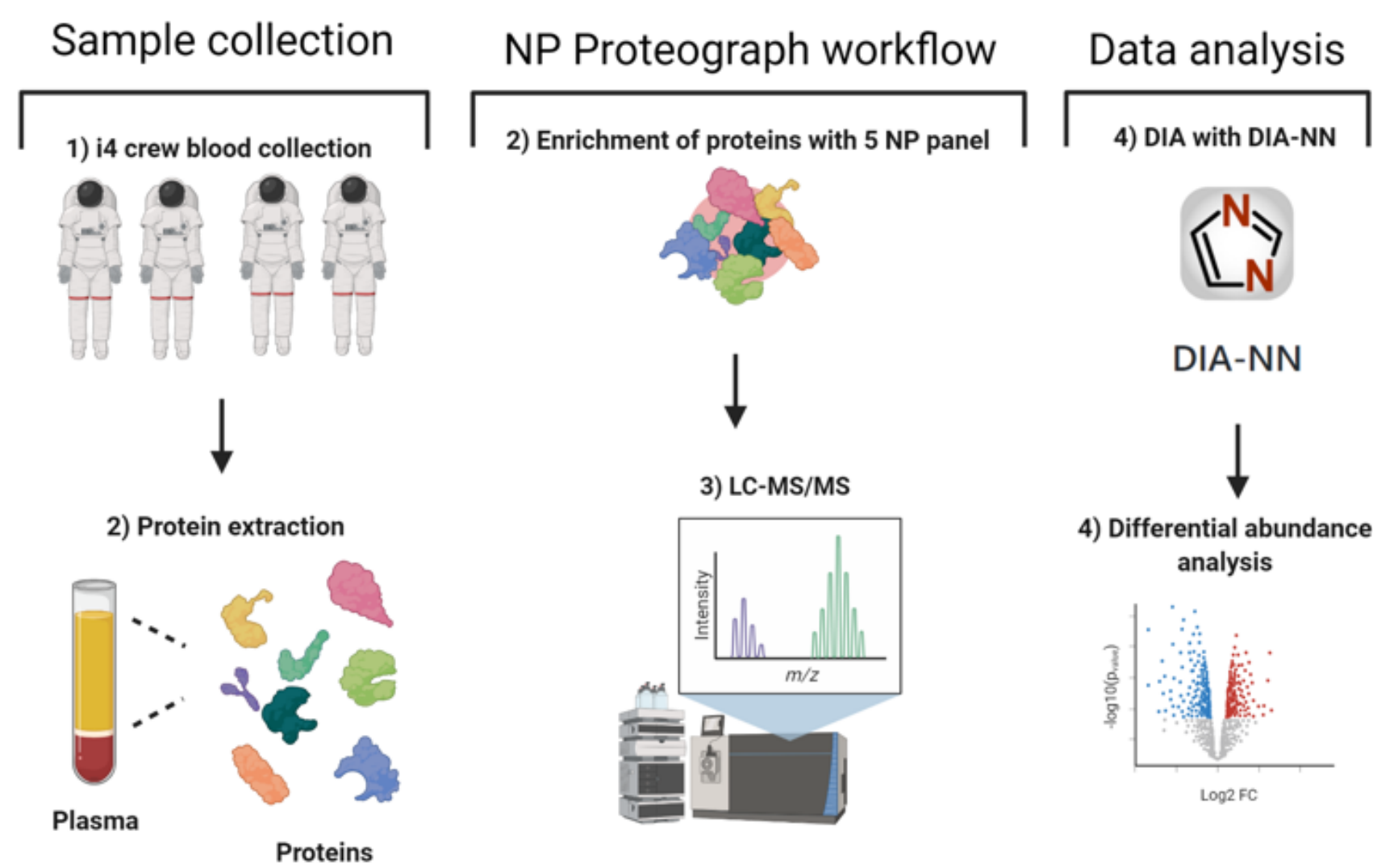
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Introduction

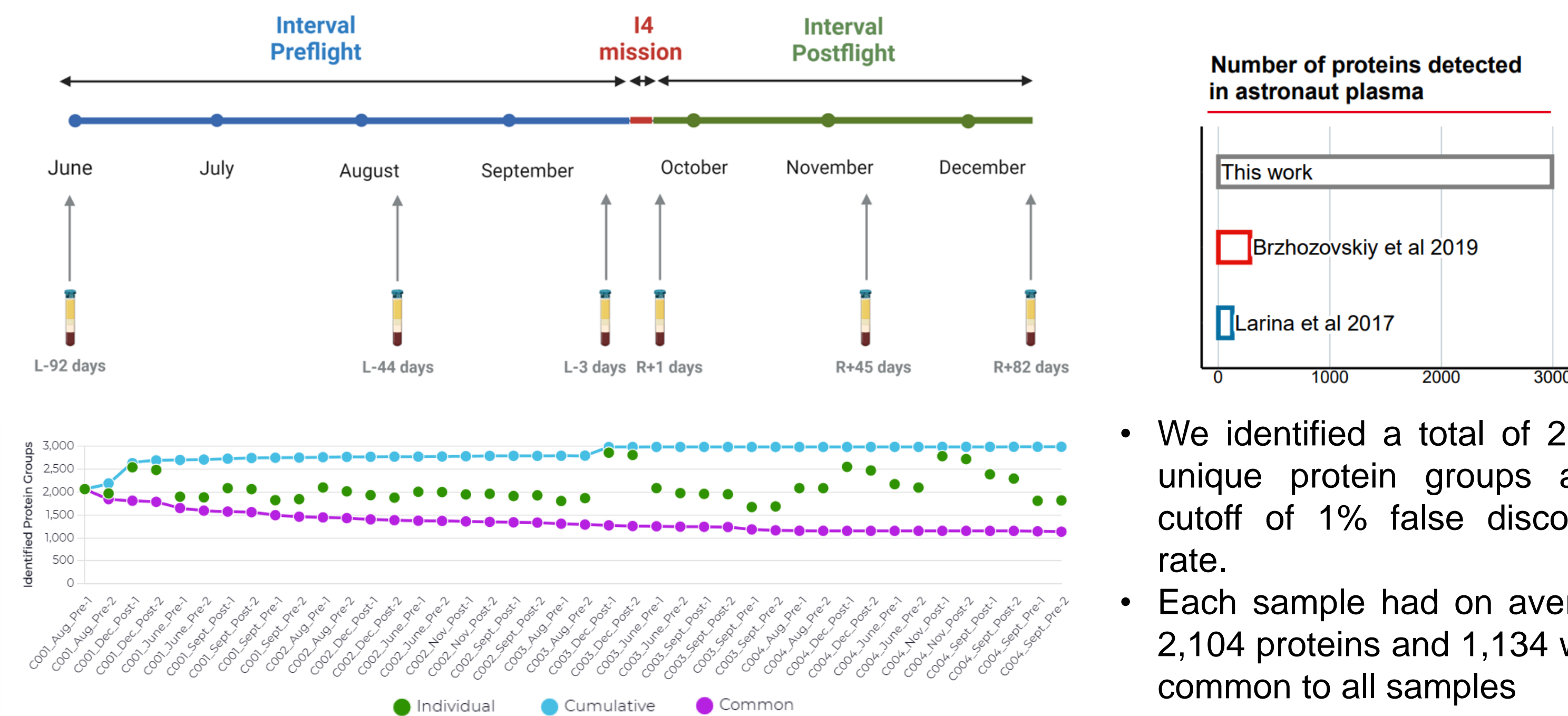
The radiation landscape present in space combined with the interstitial fluid and blood volume shifts that occur in microgravity creates a unique set of factors that influence human health. To better understand these changes, we profiled plasma from circulating blood of the Inspiration4 crew (n=4 astronauts) collected via venipuncture at three time points before and after their 3-day spaceflight.

Materials and methods



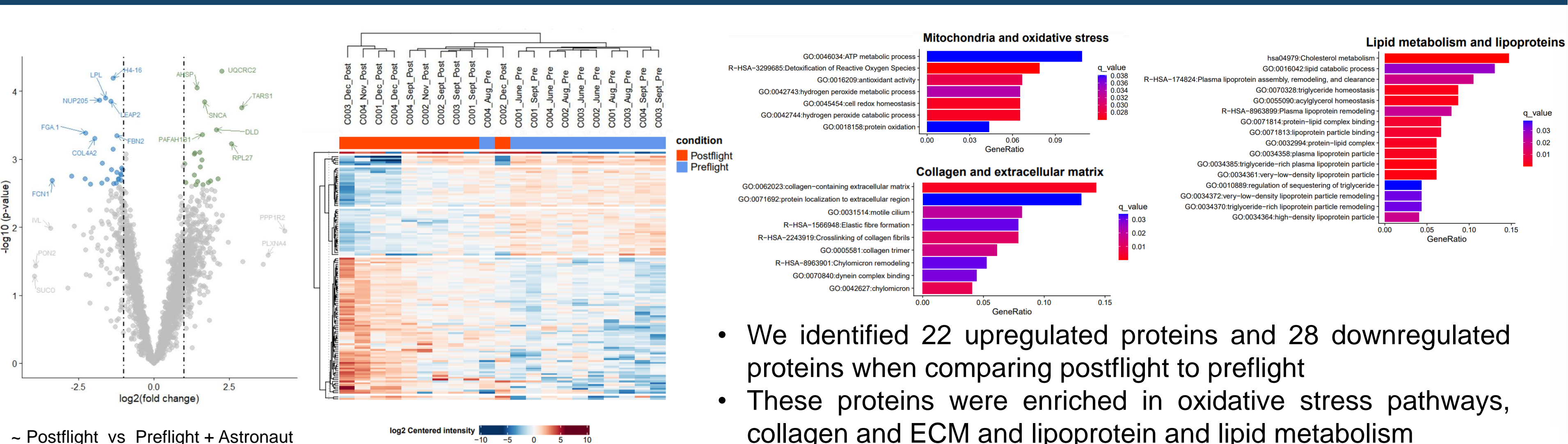
Plasma was isolated from BD cell processing tubes (CPTs) containing sodium heparin. Crew plasma samples were processed using Seer's 5 nanoparticle (NP) sample processing to generate purified peptides for LC-MS/MS analysis. Peptides were analyzed by DIA LC-MS/MS using a 20 min gradient for each of the 5 nanoparticles of each sample, on a Bruker timsTOF Pro 2 followed by data upload and DIA-NN data processing in Seer's Proteograph Analysis Suite.

Longitudinal deep profiling of the proteome



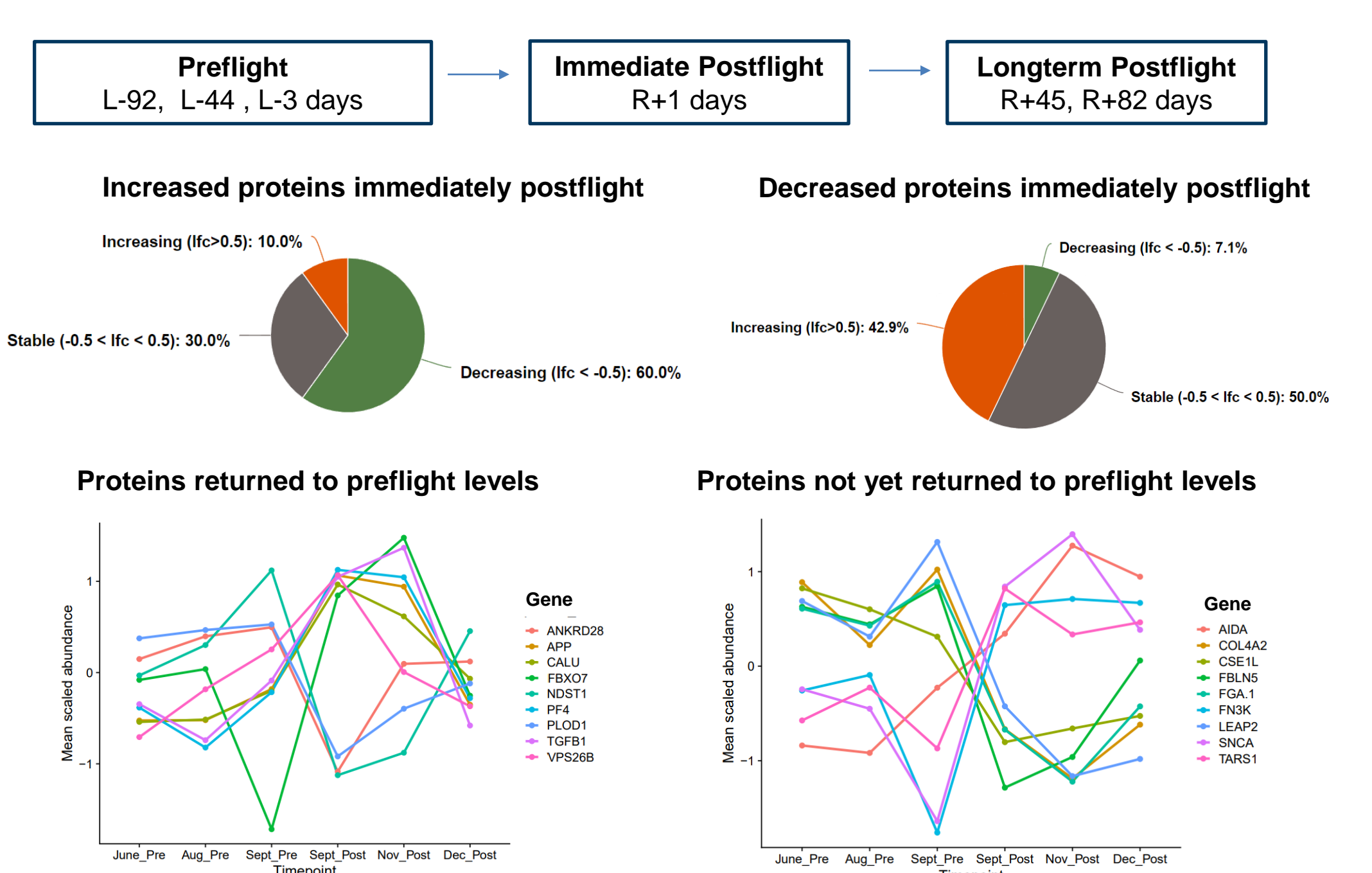
- We identified a total of 2,992 unique protein groups at a cutoff of 1% false discovery rate.
- Each sample had on average 2,104 proteins and 1,134 were common to all samples

Proteomic changes in Postflight vs Preflight samples



- We identified 22 upregulated proteins and 28 downregulated proteins when comparing postflight to preflight
- These proteins were enriched in oxidative stress pathways, collagen and ECM and lipoprotein and lipid metabolism

Temporal dynamics of affected proteins



Conclusions

- Using deep whole proteome profiling, we identified 50 differentially abundant proteins (adj p-value <0.1 and |log₂FC| > 1) in all postflight vs all postflight samples
- When comparing proteins dysregulated immediately postflight (R+1 days), we found that some proteins returned to preflight levels by R+82 days while others were still dysregulated at R+82 days.
- Even short-term spaceflight can have an impact on human physiology which needs further investigation and monitoring.