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# Cellular immunity monitoring in long-duration spaceflights based on an automatic miniature flow cytometer

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## Highlights

- An automatic miniature flow cytometer for spaceflights is developed.
- Disposable microfluidic chips are designed to enable the plug & play operation.
- Automatic blood sample preparation is realized in micro gravity environment.
- Cellular immunity was monitored in 4-astronauts 180-day enclosed experiments.
- The compatibility of microgravity is proved by parabolic flight experiments.

## Abstract

Monitoring cellular immunity is essential for long-duration spaceflight missions. To address this need, we developed an automatic miniature flow cytometer that is targeted to monitor the cellular immune function of astronauts or passengers during long-duration spaceflights. Automatic sample preparation, a disposable sheathless focusing chip, optical self-alignment, and side scatter (SSC) detection capability were developed to meet the strict requirements of spaceflight applications. SSC and four colors of fluorescence are measured to realize lymphocyte subsets counted from whole blood. This technology was used in four-subject 180-day controlled ecological life support system (CELSS) experiments to monitor the cellular immunity of four crewmembers by counting the lymphocyte subsets (total CD3+, CD3+CD4+, and CD3+CD8+ cells). The microgravity compatibility was

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