FY2026 Joint Usage and Research Report

<table>
<tr><td colspan="2">Title of Research Project</td><td colspan="3">Stress-Responsive Immune Remodeling in Blood: Defining Cell Subsets, Biomarkers, and Therapeutic Targets for Inflammatory Disease</td></tr>
<tr><td rowspan="2">Applicant</td><td>Institution</td><td>Ludwig-Maximilians-University Hospital Laboratory of Translational Research 'Stress and Immunity', Department of Anesthesiology</td><td>Put a ○ if under 35</td><td>Put a ○ if under 40</td></tr>
<tr><td>Job title and Name</td><td>Academic Director / Professor</td><td></td><td></td></tr>
<tr><td rowspan="4">Research collaborators
(Please add lines as appropriate)</td><td>Institution</td><td></td><td></td><td></td></tr>
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<tr><td colspan="2">Host researcher at IGM</td><td colspan="3">Masaaki Murakami</td></tr>
<tr><td colspan="2">Purpose of the Research Project
(approx. 250 words)</td><td colspan="3">The purpose of this joint research project was to integrate the complementary expertise of the applicant and the host investigator, Dr. Murakami, to advance the discovery of stress-dependent molecular and immunological signatures relevant to stress-associated inflammatory diseases. The applicant has extensive experience in translational stress and immunity research using human samples obtained under extreme environmental conditions, including spaceflight and Antarctic stays. Dr. Murakami has established a research program focused on stress-related inflammatory mechanisms, biomarker discovery, proteomic analysis, and multidimensional immune-cell profiling. By combining these strengths, this project aimed to create a collaborative framework linking human extreme-environment research with disease-oriented immunological and proteomic analysis.
A central concept of this collaboration was to use spaceflight and Antarctic environments as informative human models of complex stress exposure. Astronaut blood samples and blood specimens collected during Antarctic stays provide rare opportunities to examine how psychological and physical stressors, including isolation, hypoxia, microgravity, confinement, and other environmental challenges, influence immune regulation and systemic molecular responses. The applicant contributes unique experience in extreme-environment stress research, access to rare human biospecimens, and contextual knowledge necessary for interpreting biological changes observed under such conditions.
Through this collaboration, the applicant and Dr. Murakami sought to bridge clinical stress physiology, space and extreme-environment medicine, immunology, and proteomics. By applying high-dimensional analyses such as SomaScan and Dr. Murakami's established multidimensional immune-cell analysis platform, the project aimed to promote the identification of stress-specific immune-cell subsets, circulating soluble factors, and proteomic markers that may contribute to the assessment of stress burden, inflammatory disease risk, resilience, and vulnerability.</td></tr>
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Development of the Research Project and Results (approx. 850 words) *Enter the number of web meetings.	This joint research project was developed through close collaboration between the applicant and the host investigator, Dr. Murakami. The project was designed around two complementary scientific foundations: the applicant's expertise in human stress research under extreme environments, and Dr. Murakami's expertise in stress-associated inflammatory mechanisms, biomarker discovery, proteomic analysis, and multidimensional immune-cell analysis. The applicant's research experience with astronauts and Antarctic cohorts provided a valuable human model system for examining how complex environmental stressors affect immune regulation. Dr. Murakami's analytical platforms, in turn, provided the basis for identifying and characterizing stress-dependent molecular and cellular signatures in these rare samples. During the project period, one web meeting was held to discuss the conceptual framework, available sample types, analytical strategy, and future direction of the collaboration. In addition, the applicant visited Japan once from March 23 to March 26. During this visit, the applicant had direct discussions with Dr. Murakami and related researchers and also delivered an on-site seminar. This visit provided an important opportunity to confirm the collaborative research direction, discuss how rare human blood specimens from extreme environments could be incorporated into the analytical pipeline, and exchange views on how stress-related molecular and immune-cell changes should be interpreted in the broader context of inflammatory disease research. Separately from the seminar conducted during the Japan visit, the applicant presented related research at ISGP2025, the 44th International Society for Gravitational Physiology meeting, which was organized by Dr. Murakami as the Congress President. The ISGP2025 presentation was based on the topic "The Space Pace: Why Holistic Research in Extreme Environments Helps Understanding Immunity." In this lecture, the applicant discussed how research on the International Space Station, commercial orbital platforms, and analog environments such as Antarctic research stations can provide unique insights into immune regulation under prolonged exposure to extreme conditions. The presentation emphasized that isolation, hypoxia, microgravity, confinement, and other environmental challenges can alter immune function and may contribute to immune dysregulation. These perspectives supported the scientific rationale of the present collaboration, in which spaceflight and Antarctic environments are used as human models for investigating stress-induced immune and molecular alterations. The research plan involved the use of human blood specimens obtained through the applicant's extreme-environment research activities, including astronaut blood samples and samples collected during Antarctic stays. When collected across pre-, during-, and post-exposure time points, these samples provide valuable opportunities to study longitudinal molecular and immunological changes induced by extreme environmental stress. In addition to the samples themselves, the applicant provides critical contextual information regarding exposure conditions, physiological stressors, operational constraints, and the scientific background of the cohorts. Such information is important for interpreting observed molecular changes and distinguishing general stress-related biological responses from environment-specific phenomena. Dr. Murakami's group has been continuously subjecting the provided samples to proteomic analyses such as SomaScan and related molecular profiling approaches. These analyses are expected to

	identify circulating soluble mediators and proteomic signatures that change in response to extreme environmental stress. Candidate molecular classes include cytokines, chemokines, endothelial activation markers, inflammatory mediators, and other stress-response indicators. In parallel, the project utilizes Dr. Murakami's established multidimensional immune-cell analysis platform to identify, quantify, and phenotypically characterize stress-specific immune-cell subsets. By combining proteomic profiling with multidimensional immune-cell analysis, the collaboration aims to obtain a comprehensive view of stress-induced biological changes. A major expected outcome of this collaboration is to promote the discovery of stress-dependent markers by integrating the applicant's human extreme-environment stress research with Dr. Murakami's disease-oriented immunology and biomarker research. Astronaut samples and samples collected during Antarctic stays are particularly valuable because they represent rare human cohorts exposed to well-characterized combinations of physical and psychological stress. By analyzing these specimens through SomaScan, related proteomic approaches, and multidimensional immune-cell profiling, the collaboration can identify immune-cell signatures, circulating soluble factors, and proteomic patterns that reflect biological responses to extreme stress. These candidate markers can then be compared with other stress-related or disease-related cohorts to evaluate their biological relevance, reproducibility, and translational value. Importantly, this collaboration is based on human samples and does not involve genetic modification experiments. Animal experiments were not required within this specific collaborative project, although mechanistic follow-up studies could be considered separately if needed. The collaboration therefore provides a feasible and translationally relevant route for connecting clinical stress physiology, space medicine, Antarctic research, proteomic analysis, immune-cell profiling, and inflammatory disease research. In summary, this project established and strengthened a collaborative framework in which the applicant and Dr. Murakami each played essential and complementary roles. Through one web meeting, one in-person visit to Japan from March 23 to March 26, an on-site seminar during the visit, and a related presentation at ISGP2025, the 44th International Society for Gravitational Physiology meeting organized by Dr. Murakami as Congress President, the project promoted direct scientific exchange and clarified future analytical directions. The collaboration is expected to contribute to the identification of stress-dependent molecular and immune-cell signatures relevant not only to astronaut health and extreme-environment medicine, but also to inflammatory disease prevention, monitoring, and intervention on Earth.
Publication *Enter the information of conference or journal (vol, page, year) where the above work was presented.	【Conference, symposium, workshop etc.】 • Alexander Choukér, The Space Pace: Why Holistic Research in Extreme Environments Helps Understanding Immunity, The 44th Annual ISGP Meeting, Graduate School of Medicine, Hokkaido University, May 21, 2025, 9:00-9:40 • Alexander Choukér, "Life in Space, the Principles of Stress and adaptation and the use of space analogue environments for Human Spaceflight Challenges", Division of Molecular Psychoimmunology, Institute for Genetic Medicine, Hokkaido University, Mar 24, 2025, 9:30-10:15

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