# DEVELOPMENT OF COGNITIVE PERFORMANCE DECREMENTS AS A FUNCTION OF TIME FOLLOWING EXPOSURE TO HZE PARTICLES

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## INTRODUCTION

On exploratory class missions astronauts will be exposed to types and doses of radiation that are not experienced in low earth orbit. The type of radiation encountered in space is composed of alpha particles, protons and particles of high energy and charge (HZE particles). Previous research has shown that exposure to HZE particles and protons produces deficits in cognitive performance when tested 1-4 months following irradiation. The long-term effects of exposure remain to be fully established.

## METHODS

Rats were exposed to a variety of HZE particles ($^{16}O$, $^{12}C$, $^{28}Si$, $^{48}Ti$, $^{56}Fe$) and protons at the NASA Space Radiation Laboratory at Brookhaven National Laboratory. Following irradiation, the rats were shipped to UMBC for cognitive/behavioral testing. Performance was measured on the novel object recognition task (learning and memory) and operant responding on an ascending fixed-ratio schedule (motivation; responsiveness to environmental stimuli). The threshold (lowest) dose of HZE particles or protons needed to produce a performance decrement was determined in the same subjects at two time points: 1-4 months following irradiation and again 12-17 months following exposure. At each time point the threshold, the lowest dose which produced a significant change in performance, was determined.

## RESULTS

Overall, the results showed that exposure to doses of HZE particles that did not affect cognitive performance in young rats did affect performance as they aged. This was shown as a lower threshold for the disruption of cognitive performance on the second test when the subjects were 10-14 months older than when tested the first time at 2-4 months of age.

## DISCUSSION

Exposure to HZE particles produces “accelerated aging” resulting in an interaction between age and irradiation which is shown as an increased sensitivity (lower threshold) in older rats to the disruptive effects of exposure to HZE particles and protons on cognitive performance.

## CONCLUSIONS

The present results indicate that astronauts on exploratory class missions may be at risk for cognitive deficits both during a mission and following its conclusion. The long-term degenerative effects of exposure to low doses of HZE particles and protons (NASA-relevant doses) has the potential to affect the “quality of life” of astronauts long after the successful completion of a mission .

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