Boris Morukov, a Russian cosmonaut and doctor who led an extraordinary experiment in which volunteers simulated a flight to Mars while never leaving a Moscow car park, has died at 64, his scientific institute said Friday.

"We announce with grief that Boris Morukov died suddenly on New Year's Eve," Moscow's Institute of Biomedical Problems, where Morukov was deputy director, said on its website.

Morukov, a doctor and a former cosmonaut, was project director of the unprecedented Mars-500 simulation, in which an international team of six men spent 520 days in isolation to simulate a flight to Mars.

The experiment, which began in 2010 and ended in 2011, was organised jointly with the European Space Agency and the Institute of Biomedical Problems.

The experiment simulated the duration and isolation of a return journey to the Red Planet, even including "walks" on a sandpit replicating the Martian surface and 20-minute time gaps in communication with outside.

The international team of one Chinese, one Italian, one Frenchman and three Russians spent the entire period in a 180-square-metre wood-lined complex in the carpark of the Moscow institute.

"Everything that we got out of this, both the positive and perhaps the negative, undoubtedly can be used in planning a real Mars flight," Morukov said after the experiment ended.

Morukov earlier led a series of experiments into the effects of long-term weightlessness on the human body. In the most extreme experiment that started in 1986, a group of eight men spent 370 days lying in tilted beds to study the effect on their bone mass.