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Small Satellites — Big Science: A Review of Astrophysical and Cosmophysical Experiments on CubeSats and Microsatellites

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Over the past decade, small satellite platforms — especially CubeSat nanosatellites and microsatellites with masses of up to several tens of kilograms — have undergone a profound transformation from educational tools into fully fledged scientific platforms. This shift is particularly pronounced in astrophysics and cosmic-ray physics. Compact detectors based on various types of scintillators coupled with silicon photomultipliers, as well as lightweight silicon microstrip and pixel detectors, are now operating in orbit. Space companies, together with scientists, students, and even schoolchildren, are developing concepts for constellations of satellites carrying small scientific instruments, which enable monitoring of various objects — for example, tracking gamma-ray bursts, observing solar flares and energetic particles, and solving many other problems. This review examines both flown and in-development missions, including GRBAlpha, VZLUSAT-2, GRBBeta, BurstCube, AGILE, NATALIA and others, their scientific goals, technical solutions, and observational results. The analysis shows that small satellites have already provided the detection of about 360 gamma-ray transients, low-latency response to extreme events such as GRB 221009A, and measurements of cosmic-ray flux characteristics. The review concludes by discussing the prospects for next-generation constellations such as COMCUBE-S and argues that small satellites are transitioning from “technology demonstration” to “scientific contribution,” becoming indispensable for solving many problems of modern astronomy and astrophysics.

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