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SQM-ISS: A dual-mode detector for the search of Strange Quark Matter and other Dark Matter candidates in space

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The SQM-ISS detector is an advanced instrument designed to search from the International Space Station (ISS) for heavy, slow-moving particles, such as strange quark matter (SQM), Q-balls or primordial black holes. These particles, if they exist and form a part of dark matter, are expected to travel at speeds of up to 250 km/s, which corresponds to typical galactic orbital velocities. The detection of such objects could provide new insights into cosmic rays and the possible role of exotic nuclear states in dark matter. Unlike many dark matter searches relying on physics beyond the Standard Model, SQM-ISS explores scenarios explainable within quantum chromodynamics, where SQM may represent a stable phase of hadronic matter.

The detector combines two complementary measurement techniques: plastic scintillators with silicon photomultipliers for charge detection, and piezoelectric sensors on metal plates to measure vibrations caused by passing massive particles. A time-of-flight system provides precise velocity measurements, helping to distinguish exotic candidates from the cosmic ray background. This unique combination provides sensitivity to both charged and neutral particles, extending the range of detectable mass and charge.

Operating on the International Space Station, SQM-ISS benefits from microgravity, which eliminates atmospheric absorption and seismic noise, allowing direct sampling of interstellar and solar system material. Real-time data processing and adaptive triggering allow efficient event selection, long-term autonomous operation and fast data transfer to Earth. Its modular design allows for future upgrades and integration into next-generation space missions. The mission was selected by the European Space Agency (ESA) under the SciSpacE programme in recognition of its scientific and technological value. The results from SQM-ISS can refine our understanding of cosmic-ray composition, constrain flux limits for exotic matter, and provide valuable data for exploring the possible role of stable quark matter in dark matter models.

In this work, I will present the detector design, its science objectives, and the perspectives for flight under the ESA evaluation.

Eligibility for ”Best presentation for young researcher” or ”Best poster for young researcher” prize

No

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