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MADMAX - Towards a Dielectric Axion Haloscope

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The Magnetized Disc And Mirror Axion eXperiment is designed to search for dark matter axions in the mass range of 40 to 400 μeV , a range previously inaccessible by other experiments. This mass range is favored by models in which the PQ symmetry is broken after inflation. The required sensitivity is reached in MADMAX by applying the dielectric haloscope approach, exploiting the axion to photon conversion at dielectric surfaces within a strong magnetic field. For MADMAX a system of 80 movable dielectric discs of 1.25 m diameter, the so-called booster, inside an approximately 9 T magnetic field is foreseen. The experiment will be located at DESY Hamburg in Germany and is currently entering its prototyping phase.

One of the important steps on the path towards the MADMAX prototype is of course the understanding and calibration of the booster and its behavior which is currently pursued using small scale closed systems. Vast progress has been made here in the last year, but also in the design of prototype booster and testing of its components as well as in the preparations for an operation of the MADMAX prototype inside the MORPURGO magnet at CERN allowing for an Axion-Like-Particle search as a first physics run with the prototype.

In this contribution, results from the small scale closed booster system, showing good agreement between simulation and measurement, will be shown along with the results of extensive simulation studies looking at various aspects of the prototype and full-scale booster. Also, the advanced design of the prototype booster including test results on the newly developed piezo based drive system for the dielectric discs will be presented. Together with all these results guiding the path towards the MADMAX (prototype) experiment an outlook will be given on the time schedule for the MADMAX prototype including the operation and the planned ALPs search at CERN as well as on ongoing developments such as future low noise receivers.

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