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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 culminating in an Axion-Like-Particle search with this closed system utilizing the MORPURGO magnet at CERN, which will also host the MADMAX prototype in the future. Along with these activities the development of the prototype booster and its components is advancing, including various tests of piezo-electric actuators foreseen for the manipulation of the dielectric disks at cryogenic temperatures and high magnetic fields in CERN as well as DESY facilities.

In this contribution, results from the small scale closed booster system, including the ALP search at CERN, 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 results form the tests of the newly developed piezo based drive system at cryogenic temperatures and high magnetic fields 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 ALP search at CERN as well as on ongoing developments such as future low noise receivers.

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