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Characterization of the DIMS system based on astronomical meteor techniques for macroscopic dark matter search

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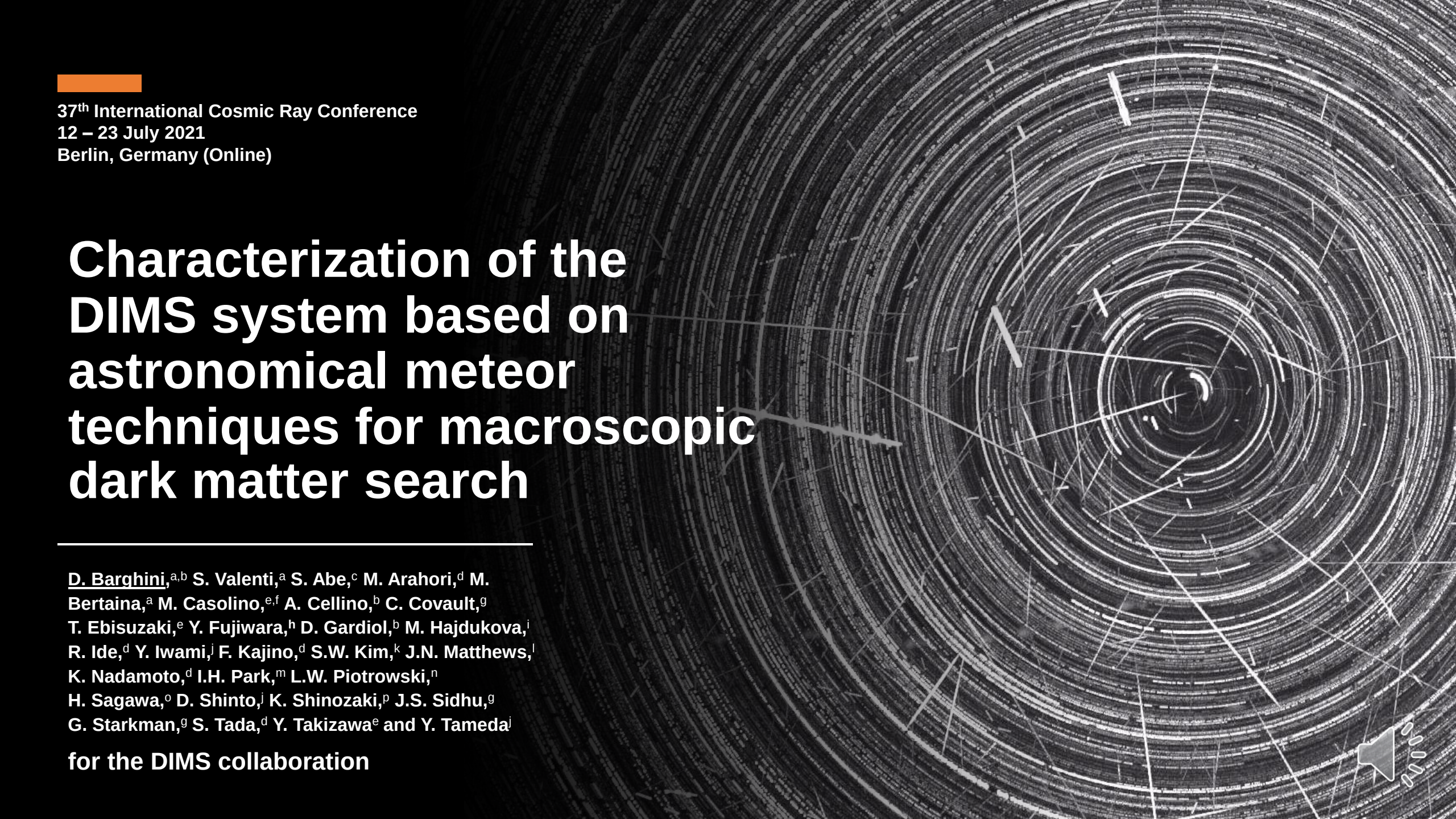
for the DIMS collaboration

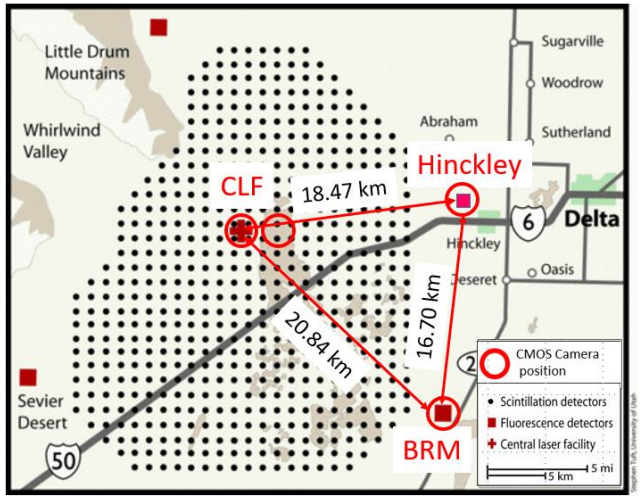


DIMS EXPERIMENT

The **DIMS** (Dark matter and Interstellar Meteoroid Study) experiment was born in 2017 aiming to search for fast-moving objects in the Earth's atmosphere by observing the sky with wide-field and **high-sensitivity CMOS cameras** [1].

→ macroscopic dark matter (e.g., **nuclearites**)

→ **interstellar meteoroids**



[1] Kajino et al., 36th ICRC Proc. (2019);

NUCLEARITE DYNAMICS

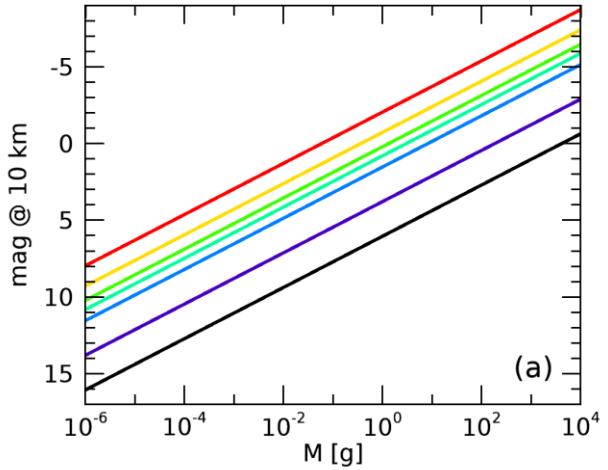
We reviewed two models for the theoretical description of nuclearite dynamics into the atmosphere

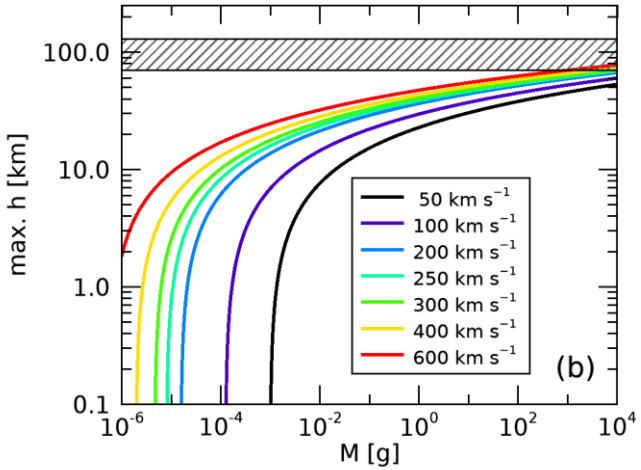
→ we generalized [2] for an **arbitrary nuclearite speed**

→ [2] and [3] give **huge differences in the visual magnitude** of such objects

$$\begin{cases} M = 1\ \mathrm{g} \\ h = 10\ \mathrm{km} \\ \rho = \rho_N \\ v = 250\ \mathrm{km\ s^{-1}} \end{cases}$$

$$\rightarrow \boldsymbol{\Delta\mathcal{M} = +43}$$





[2] De Rujula & Glashow, Nature (1984)
[3] Sidhu et al., JCAP (2019)

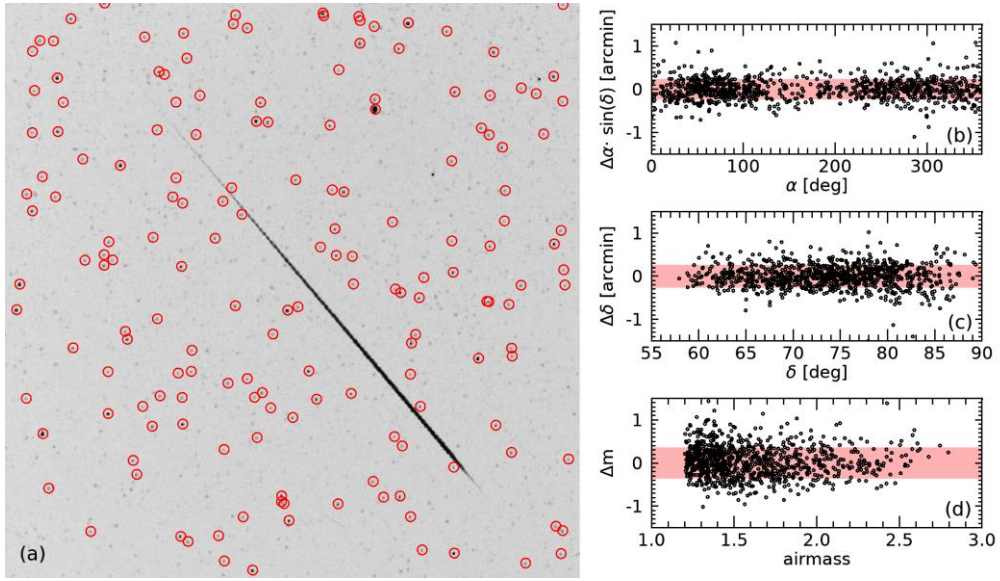
SENSOR CALIBRATION

We derived the calibration of the instrument by means of **astrometric and photometric techniques** applied to imaged stars in the FoV.

→ ~ 900 identified stars per image up to +8 mag

→ 57° x 34° FoV

→ sub-pixel positional precision



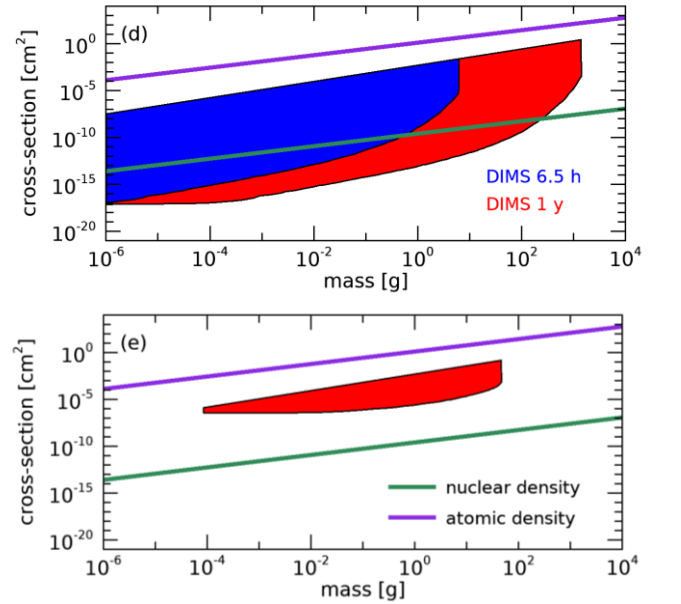
DIMS CONSTRAINTS FOR MACROS

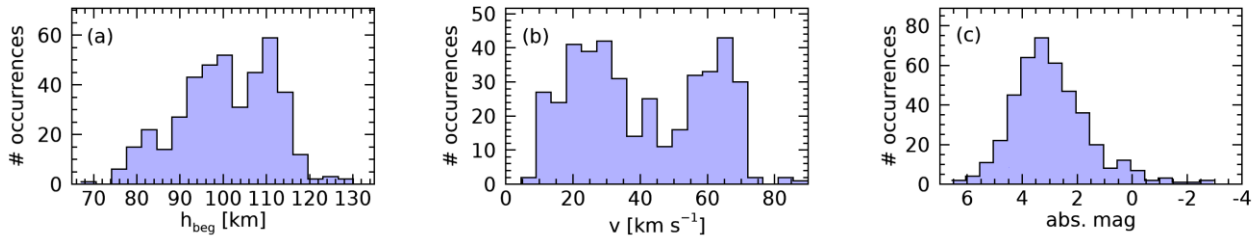
We deduced expected constraints [4] by the DIMS experiment for macro observations

→ **+6 limiting absolute magnitude** for meteors

→ none of the analyzed events showed a clear non-meteor origin

→ very different constraints in the parameter space according to the two models [2,3]





[4] Sidhu et al. PhRD (2019)