Detection forecasts for annihilating DM in M31 and M33 galaxies with the Cherenkov Telescope Array

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cherenkov telescope array — the observatory for ground-based gamma-ray astronomy
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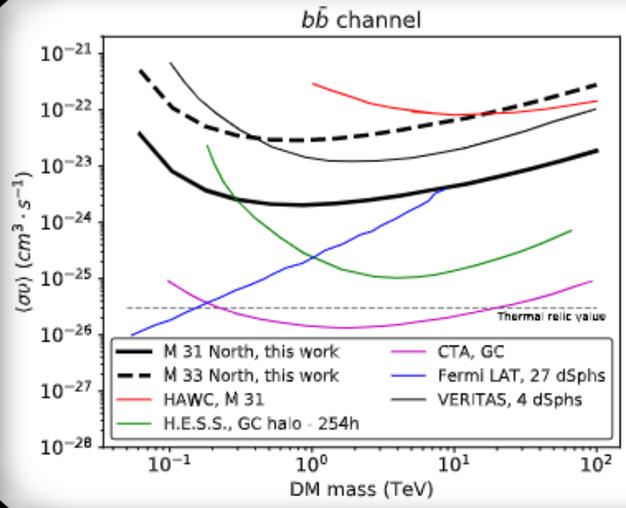
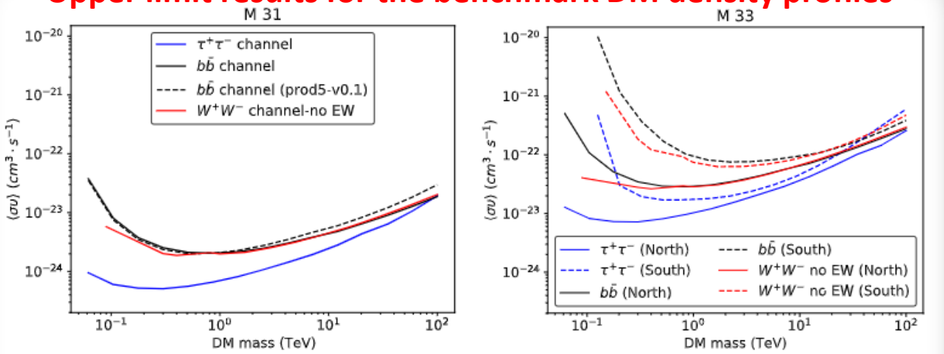


CTA sensitivity in comparison to current IACTs, Fermi/LAT & HAWC

- CTA does not appear sensitive enough to detect DM for the two targets considered in this work, for 100 hours exposure time.
- Current studies may present better sensitivity results (e.g., H.E.S.S. towards the GC), but they are targeting DM dominated regions at a much closer distance.
- CTA appears to be more sensitive than current IACTs (e.g., VERITAS) even when the latest perform stacked analysis towards DM dominated targets (e.g., dSphs).
- When considering common DM target (i.e., M 31) and assuming the same DM density distribution in that target (i.e., the Einasto benchmark profile for M 31 in this work) **CTA is expected to be an order of magnitude more sensitive** than HAWC (Albert et al. , 2018b).

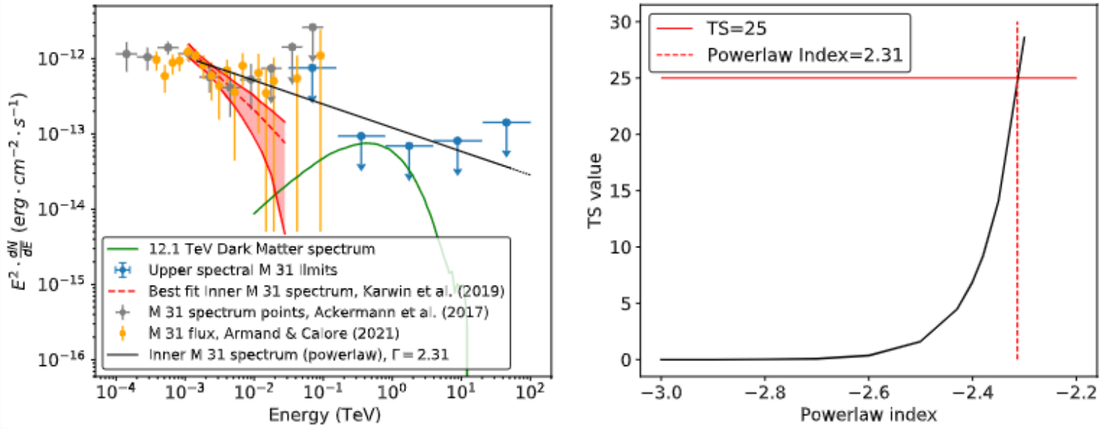
Upper limit results for the benchmark DM density profiles



- 95% confidence level expected CTA upper limits on velocity-averaged WIMPs annihilation cross-section from 100h long observations of M31 (left panel) and M33 (right panel)
- We show that a 100h long observation campaign will allow CTA to probe annihilation cross-sections up to $5 \cdot 10^{-5}\ cm^3 s^{-1}$ for the $\tau^+\tau^-$ annihilation channel.

Gamma ray detection of the Inner M31 bulge by CTA?

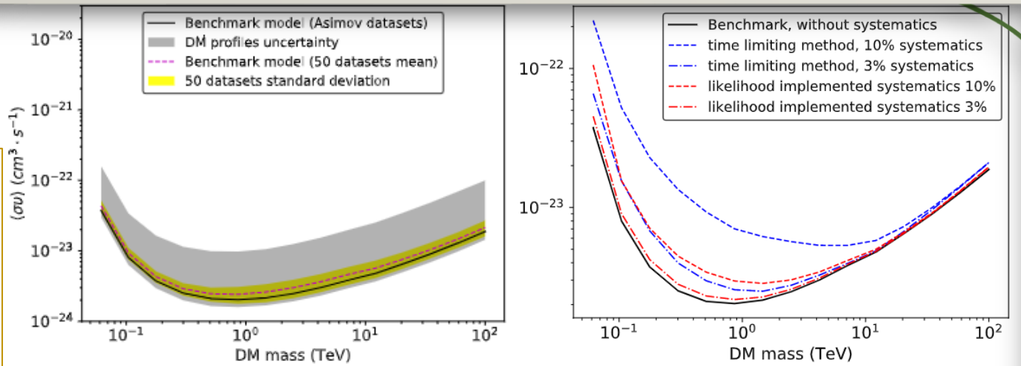
A dedicated search towards Inner M 31 was conducted to check whether or not this extended source (previously detected by Fermi-LAT) is detectable by CTA.



- **A power index value of -2.31 or harder** was derived for a high significance detection of the extended Inner M 31 bulge (illustrated with the black solid line in the left panel of the figure above).

DM density profile uncertainty

- Grey uncertainty band: Unertainty region due to the **lack of knowledge of the exact dark matter density distribution – up to an order og magnitude.**
- Yellow uncertainty band: **50 different realization** values for the Asimov data set used.



Systematic uncertainty results

- **Systematic uncertainty results** derived based on a modified Poissonian (red color). Additionally, an alternative methodology was implemented where one can address the impact of systematic uncertainties by modelling them via limiting the statistic of the data (time limiting methodology- blue color).
- 10% energy scale systematic uncertainties (worst case uncertainty scenario**) which caused an order of magnitude worsening of the upper limits**. Llower levels of systematics were exploited (i.e., 1% and 3%).
- The time limiting allows to **"free" some CTA time** which can be dedicated to searches of other targets.