Direct detection of very small clumpy Dark Matter

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Clumps

Let's think about "sub-structures" of DM...

- Weakly interacting particles
- Gravitationally loose cloud

Some motivation...

Mass distributions of galaxies.
Prediction of novel compact objects

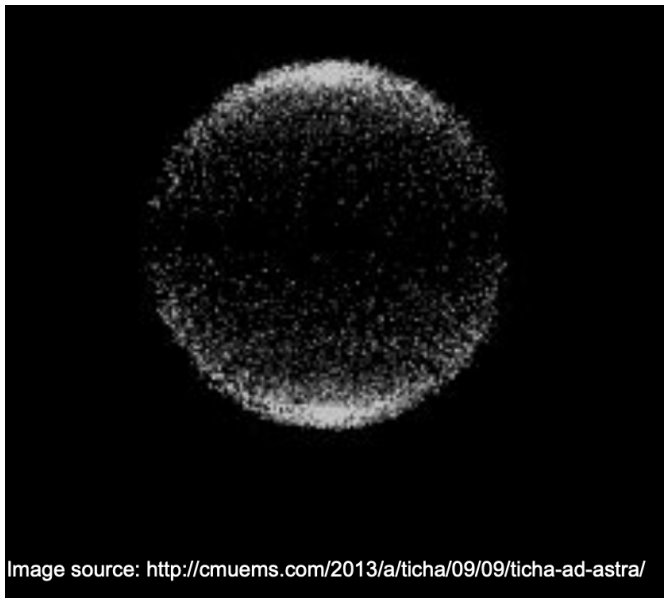

Figure: Small scale clump.

And then the questions arises: Will we be able to distinguish this very small scale clumpy DM? If so, under which conditions?

Density scenarios

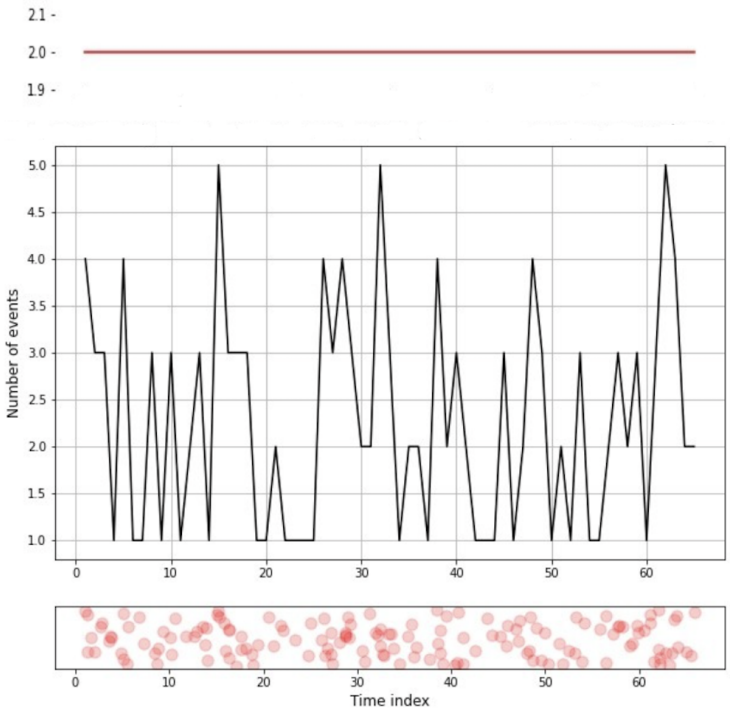

Figure: Homogeneous density distribution

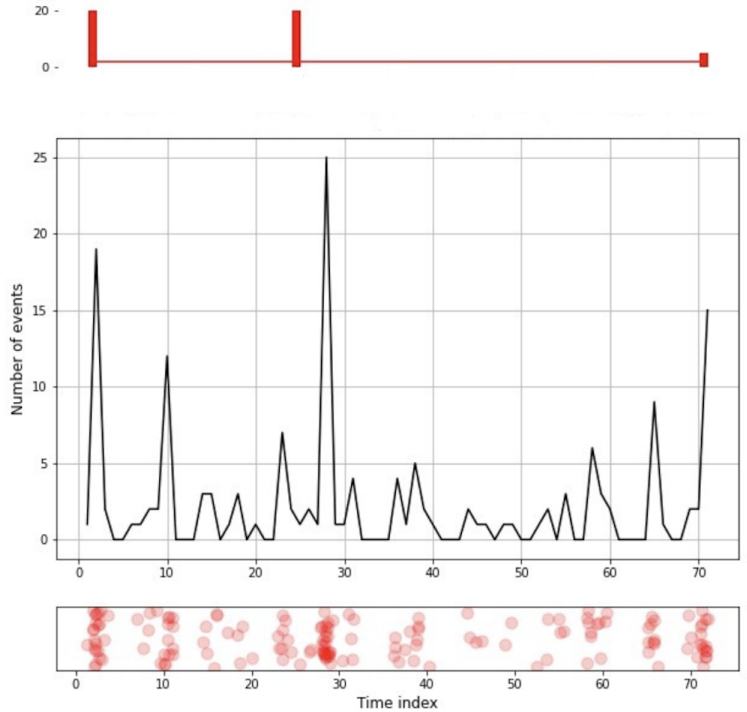

Figure: Clumpy density distribution

Distinguishable Over-densities

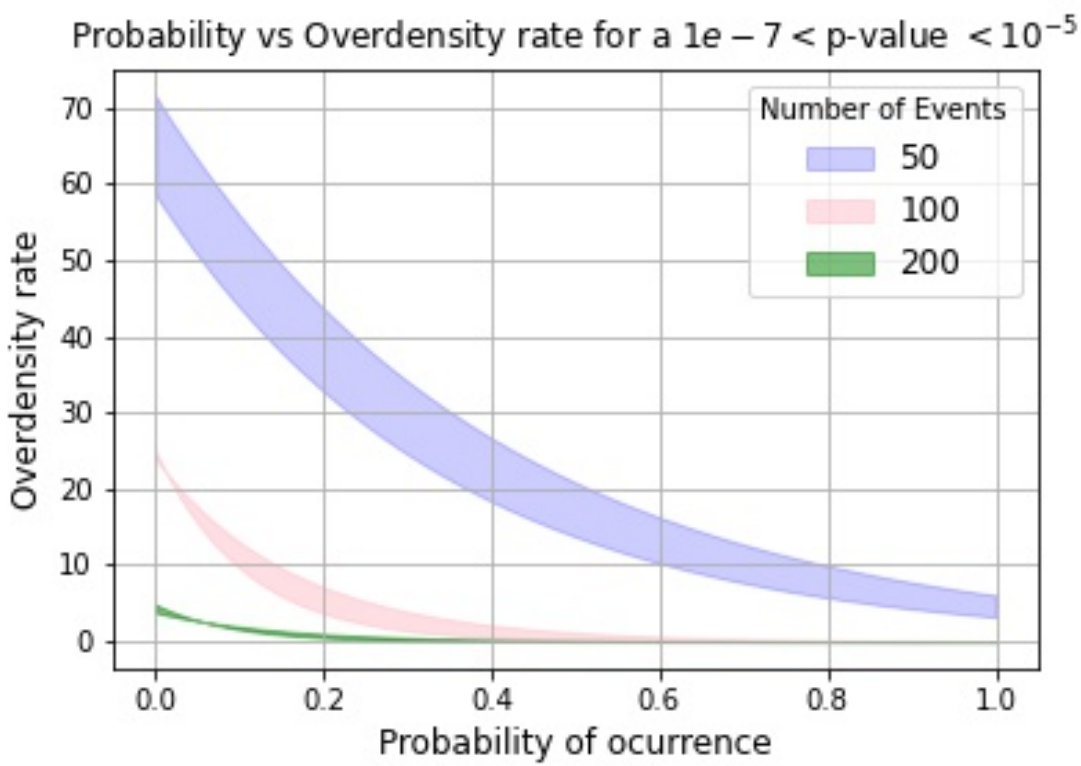

Figure: Pairs of (λ_{over}, P) for different number of events for significance level of order 5σ. The statistics for this scan was taken form $N = 100$ samples of each spectrum.

Interpretation

- Isotropy.
- DM local density is studied neglecting the evolution of the velocity distribution in time.

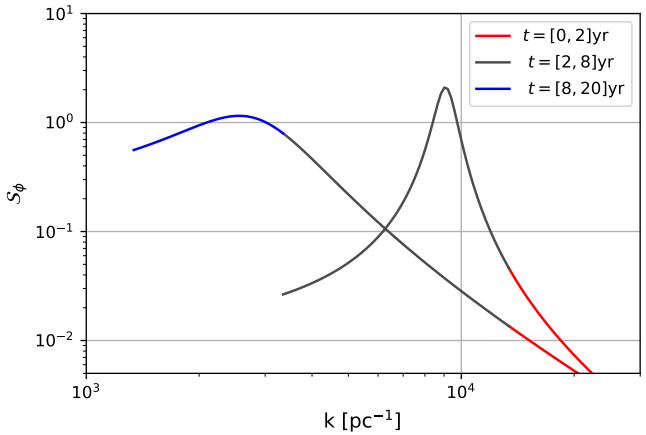

Figure: Clump dark matter contribution to the matter power spectrum locally, assuming a constant speed $v = 220\ km/s$. The picked curve corresponds to a clump with characteristic size of 1.5×10^{-3}pc, and the second broader line corresponds to a clump of characteristic size of 8×10^{-4}pc.

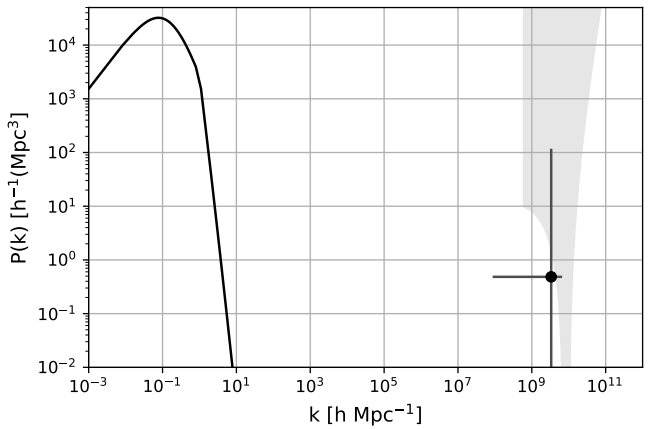

Figure: Mater power spectrum of the universe including the data point for DM clumps.

WIMP scenario

Observation time [yrs]					
Experiment	Mass [GeV/c^2]	σ_{SI}[cm^2]	50 evts	100 evts	200 evts
XENONnT	6	3×10^{-44}	13.1	26.3	52.6
XENONnT	50	5×10^{-47}	2.8	5.6	11.3
DARWIN	20	2×10^{-47}	1.6	3.2	6.4
DARWIN	100	2×10^{-47}	1.1	2.2	4.4

Table: Observation time for experiments to distinguish small dark matter structure. The projection of these times had into account the exposure time of each experiment, the fiducial volume and the statistical prediction of events during the exposure time for different masses and cross sections given by each collaboration.

Thanks!

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