Discussion on presented topics.

First hints of nature of dark matter already seen?

Axions? Light WIMPs (~ WISPs)?

Andreas Ringwald
7th Patras Workshop on Axions, WIMPS and WISPs
Mykonos, Greece, 28 June 2011

HELMHOLTZ ASSOCIATION

DESY

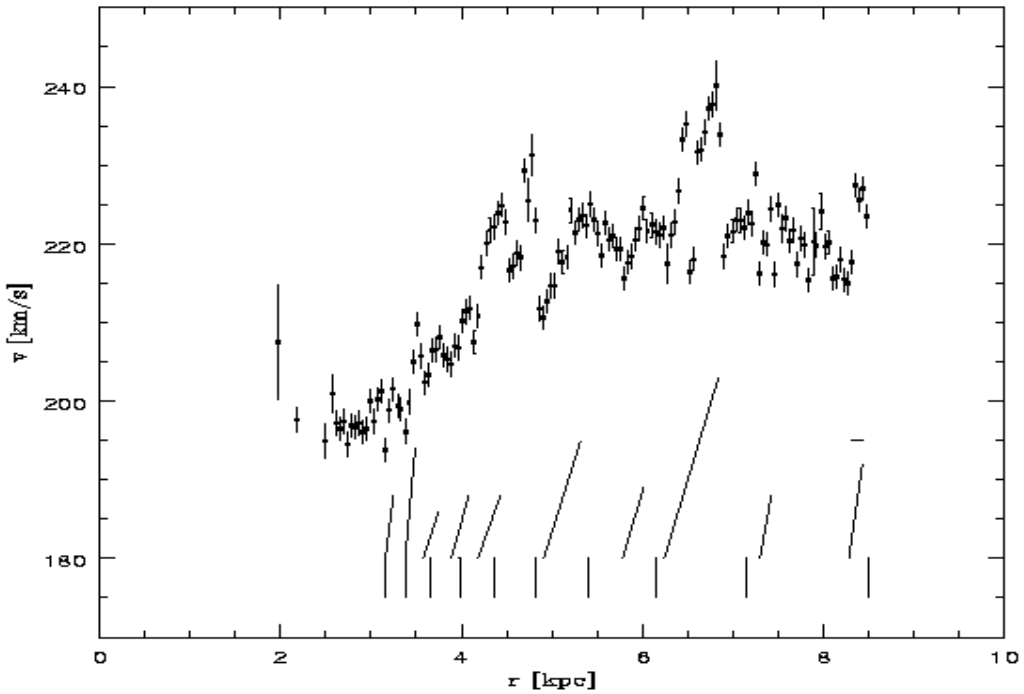
First hints of nature of dark matter already seen?

- Axions?
  - Observational evidence for caustic rings in Milky Way and Andromeda?

    Consistent with N body simulations? …

Axions?

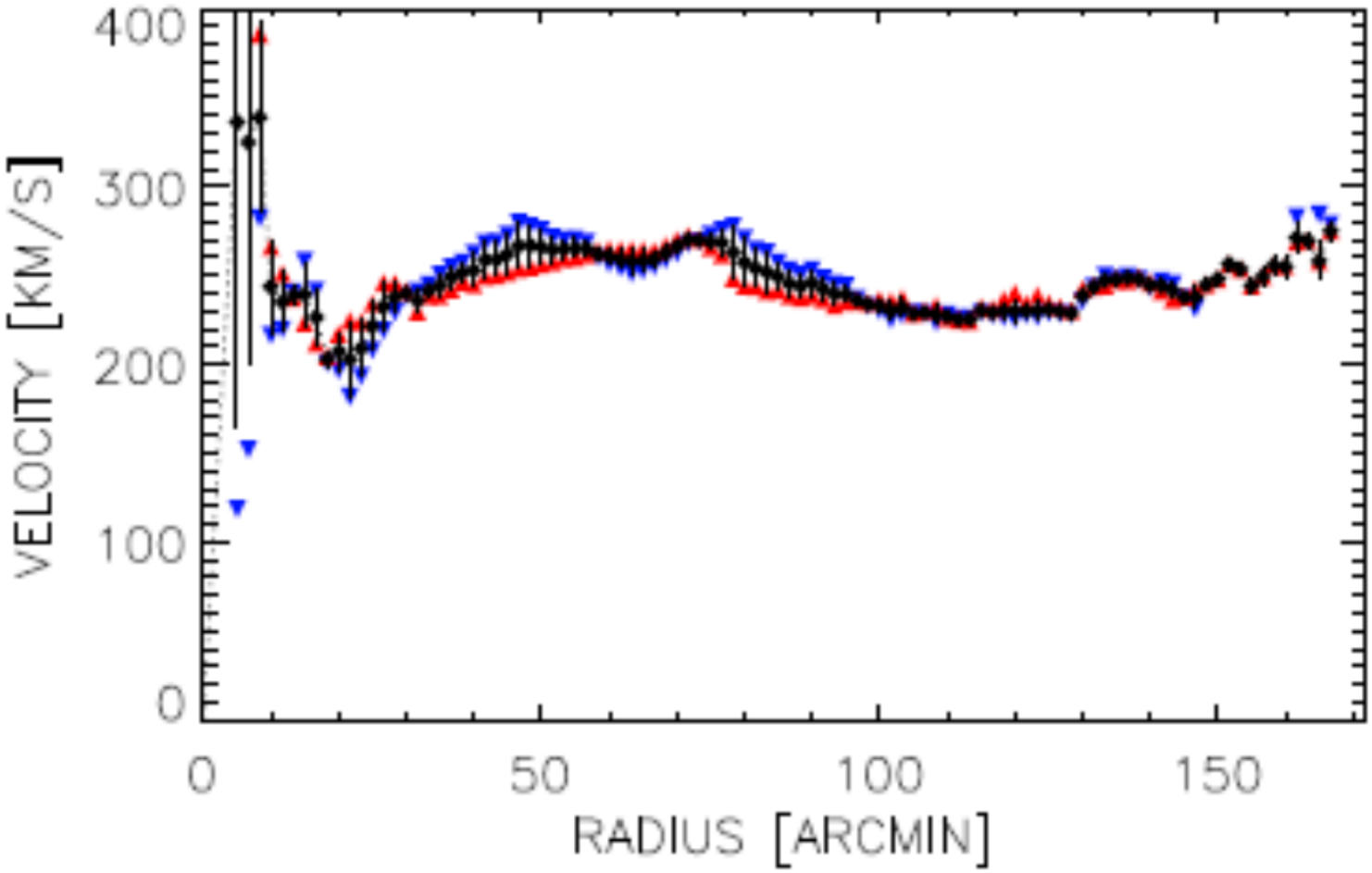
Inner Galactic rotation curve



DESY

Axions?

Rotation curve of Andromeda Galaxy:



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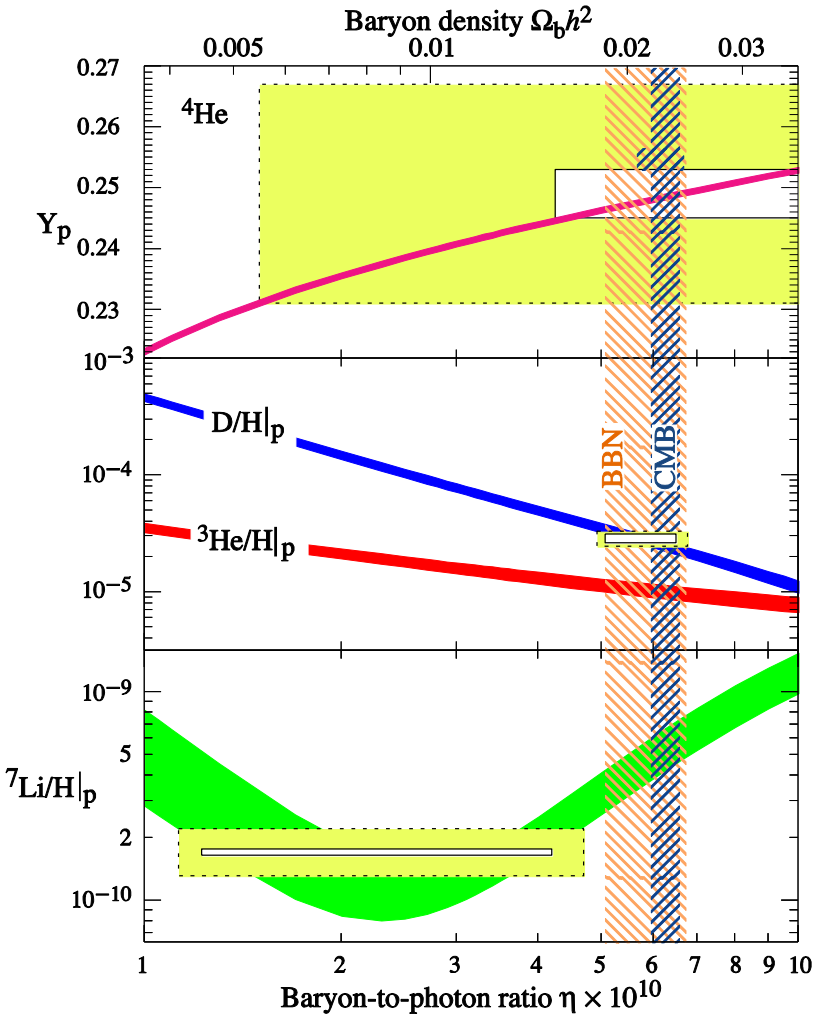
  - Solution of Li problem in BBN?

    D problem instead? What if PLANCK finds N_eff < 6.7?

Axions?

- Photon cooling after BBN:
  - baryon-to-photon at CMB larger than at BBN



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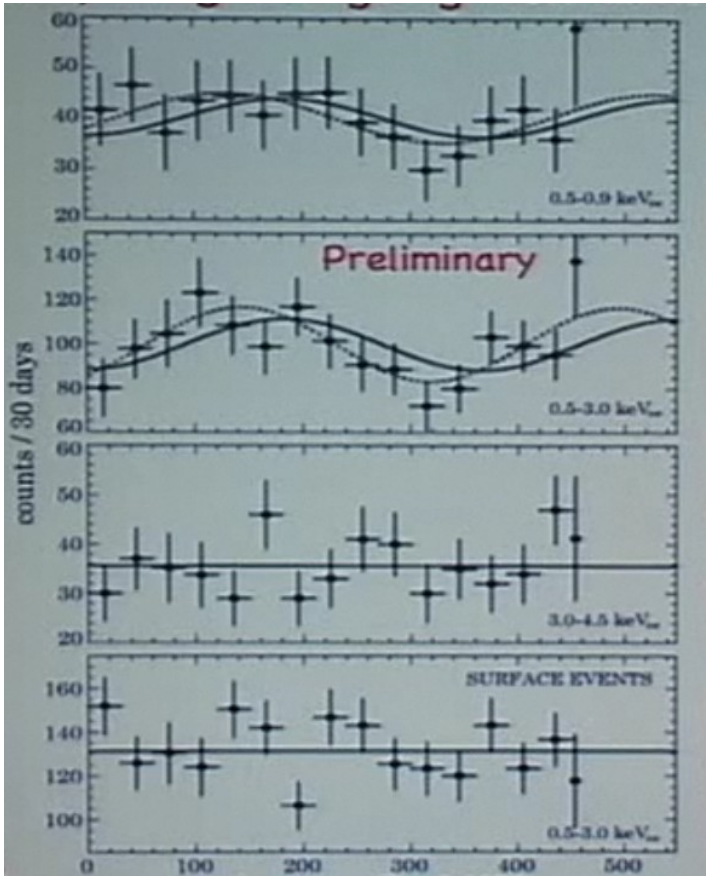
  - Annual modulation seen by DAMA and CoGeNT?

Light WIMPs?

- Annual modulation seen by CoGeNT?



The solid line is the expectation from dark matter, and the dashed line is the best modulation fit to the signal. The phases of the two are within 1 sigma. CoGeNT estimates that the modulation hypothesis is preferred at 2.8 sigma. The modulation is most pronounced in the 0.5-2 keV region while it is absent for surface events.
(Source: Resonances Particle Theory Blog)

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    D problem instead? What if PLANCK finds N_eff < 6.7?
- Light WIMPs?
  - Annual modulation seen by DAMA and CoGeNT?
  - Excess events seen by CoGeNT and CRESST?

    Already firmly excluded by CDMS and XENON? Compatible with experimentally viable MSSM?
    Other well motivated particle physics models (asymmetric/mirror/hidden sector dark matter)?

Light WIMPs?

A Bayesian view of the current status of dark matter direct searches

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Abstract. Bayesian statistical methods offer a simple and consistent framework for incorporating uncertainties into a multi-parameter inference problem. In this work we apply these methods to a selection of current direct dark matter searches. We consider the simplest scenario of spin-independent elastic WIMP scattering, and infer the WIMP mass and cross-section from the experimental data with the essential systematic uncertainties folded into the analysis. We find that when uncertainties in the scintillation efficiency of Xenon100 have been accounted for, the resulting exclusion limit is not sufficiently constraining to rule out the CoGeNT preferred parameter region, contrary to previous claims. In the same vein, we also investigate the impact of astrophysical uncertainties on the preferred WIMP parameters. We find that within the class of smooth and isotropic WIMP velocity distributions, it is difficult to reconcile the DAMA and the CoGeNT preferred regions by tweaking the astrophysics parameters alone. If we demand compatibility between these experiments, then the inference process naturally concludes that a high value for the sodium quenching factor for DAMA is preferred.

DESY

Light WIMPs?

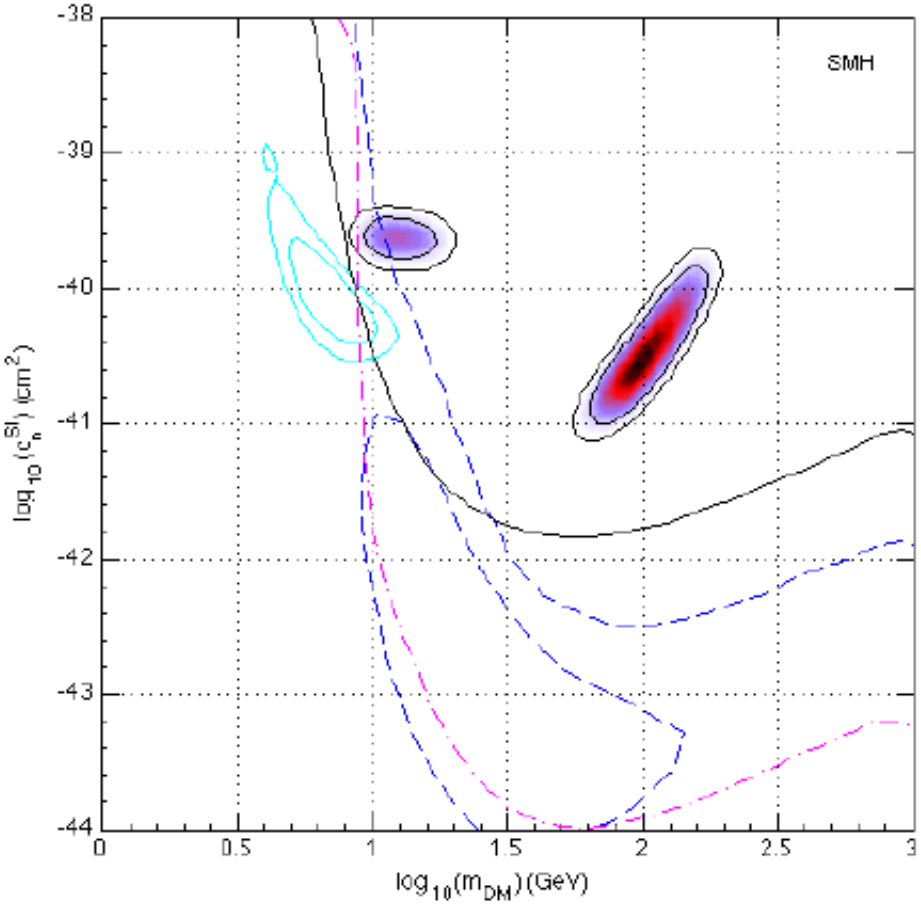

Figure 8. 2D credible regions for all experiments assuming the SMH. For DAMA (shaded) and CoGeNT (cyan) we show the 90% and 99% contours. The black solid line represents the 90_S% bound for CDMSSi, and the pink dot-dash curve for Xenon100. For CDMSGe we show both the 90_S% and 99_S% contours in blue dashed lines.

Light WIMPs?

Observations of annual modulation in direct detection of relic particles and light neutralinos*

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[2] *Dipartimento di Fisica, Università di Roma Tor Vergata, I-00133 Rome, Italy*
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(Dated: June 24, 2011)

The long–standing model–independent annual modulation effect measured by the DAMA Collaboration, which fulfills all the requirements of a dark matter annual modulation signature, and the new result by the CoGeNT experiment that shows a similar behavior are comparatively examined under the hypothesis of a dark matter candidate particle interacting with the detectors' nuclei by a coherent elastic process. The ensuing physical regions in the plane of the dark matter–particle mass versus the dark matter–particle nucleon cross–section are derived for various galactic halo models and by taking into account the impact of various experimental uncertainties. It is shown that the DAMA and the CoGeNT regions agree well between each other and are well fitted by a supersymmetric model with light neutralinos which satisfies all available experimental constraints, including the most recent results from CMS and ATLAS at the CERN Large Hadron Collider.

Light WIMPs?

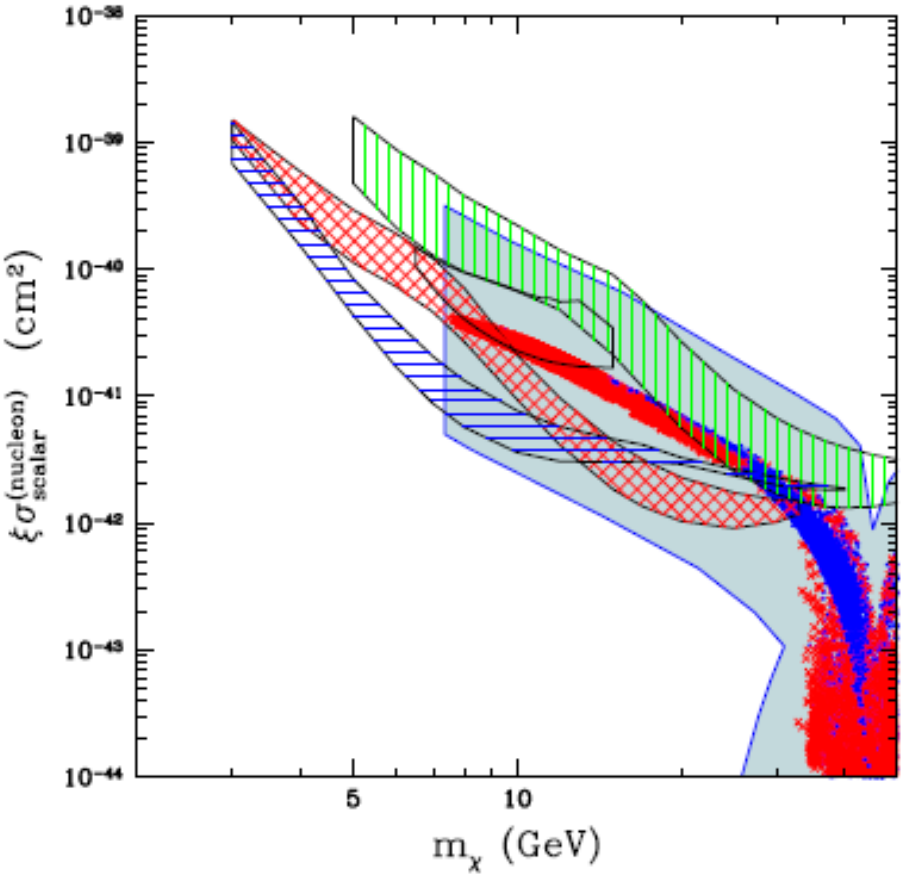

FIG. 6: $\xi\sigma^{(\mathrm{nucleon})}_{\mathrm{scalar}}$ as a function of the neutralino mass. The experimental annual-modulation regions are obtained as explained in the caption of Fig.1, except that here the used DF is an isothermal sphere with the following values for the parameters: $\rho_0 = 0.34$ GeV cm^{-3}, $v_0 = 220$ km sec^{-1}, $v_{esc} = 650$ km sec^{-1}. The theoretical scatter plot displays the whole sample of neutralino configurations: (red) crosses denote SUSY configurations with a neutralino relic abundance which matches the WMAP cold dark matter amount ($0.098 \leq \Omega_\chi h^2 \leq 0.122$) while (blue) dots denote the configurations where the neutralino is subdominant ($\Omega_\chi h^2 < 0.098$) (these two sets of configurations were shown separately in Fig.5). The scatter plot has been evaluated for $g_{d,\mathrm{ref}} = 290$ MeV. The (light-blue) flag–like region denotes the extension of the scatter plot upwards and downwards, when the hadronic uncertainties are included (see text).