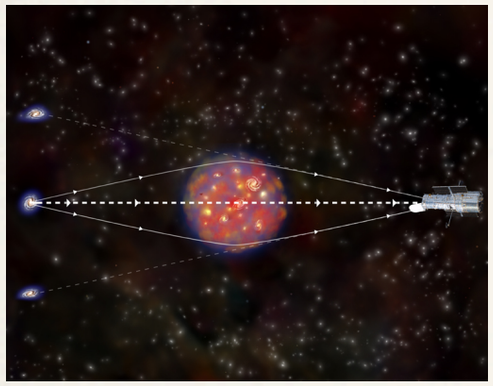
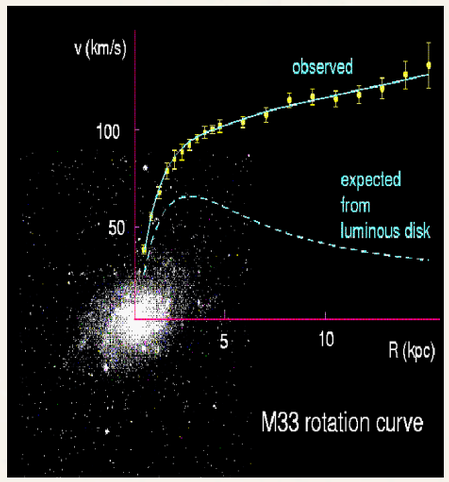
La nature de la matière noire, des astroparticules au LHC

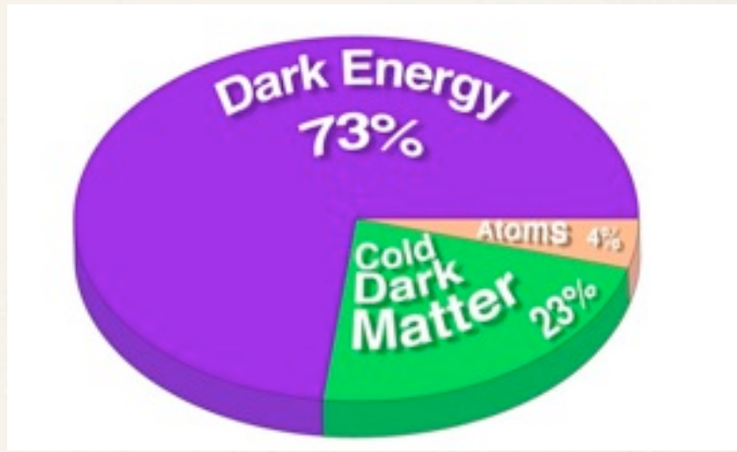
DMAstroLHC (ANR 2012-2016)

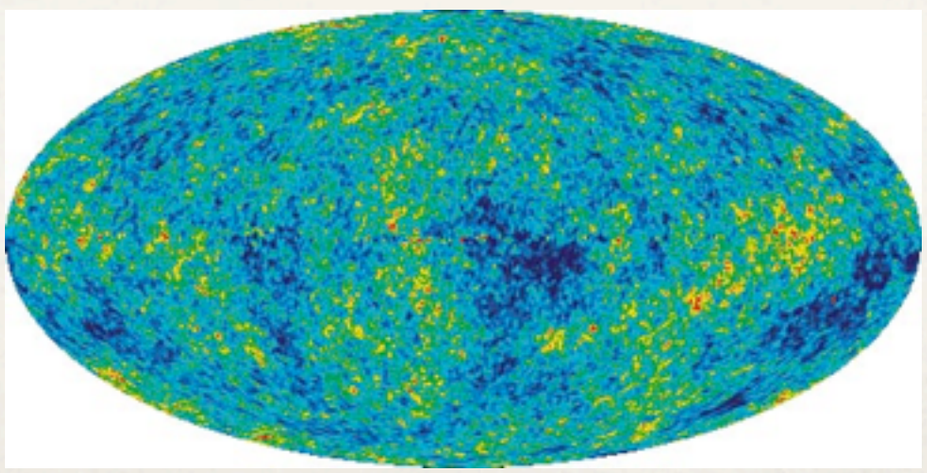
26 Janvier 2012

DM evidence









- Ordinary matter only 4% of matter content of the Universe

Dark matter searches

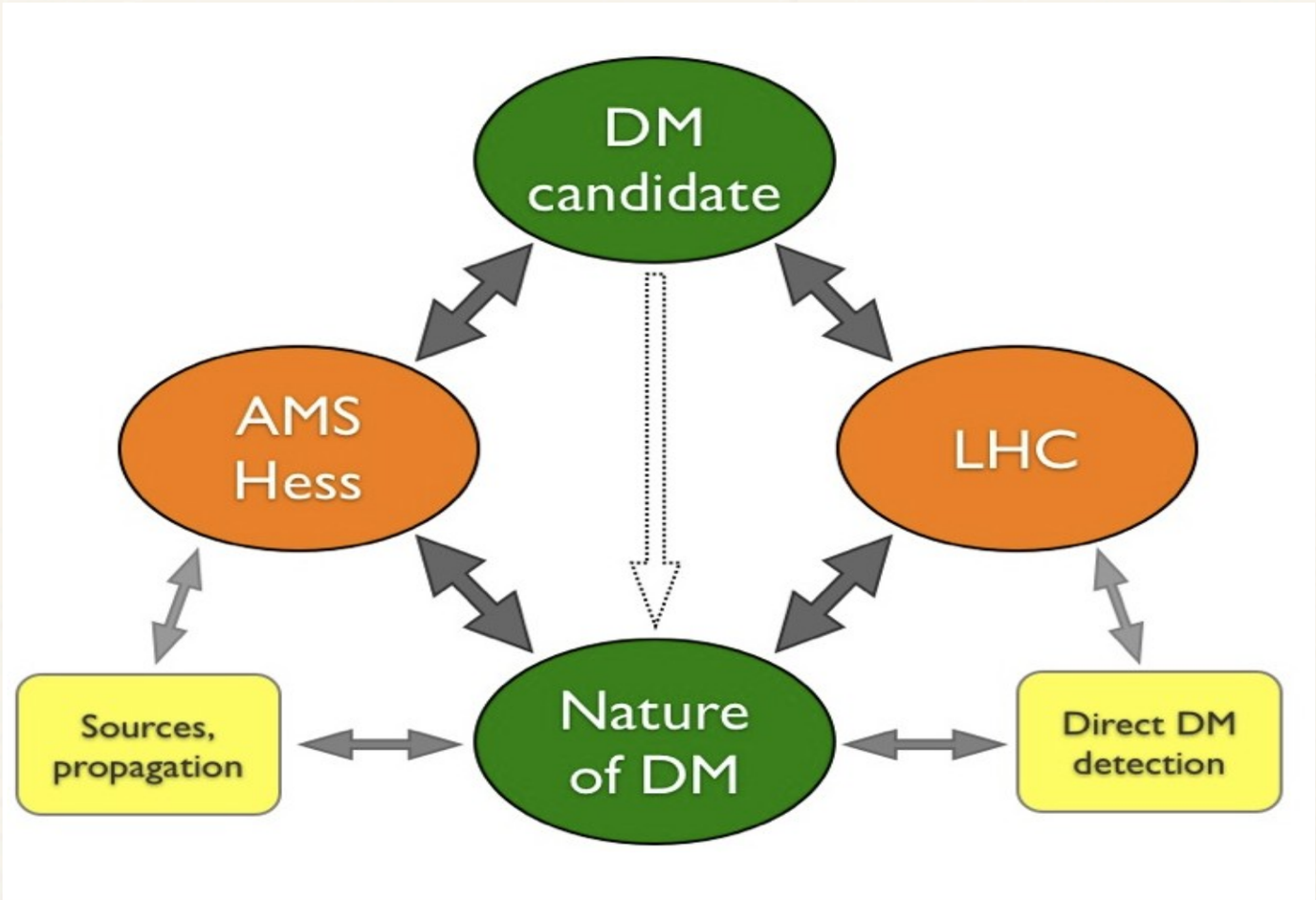
- Indirect detection: cosmic rays from DM pair annihilation : photons, antiprotons, positrons (FermiLAT, PAMELA, HESS, AMS) neutrinos (Icecube..)

- Direct detection with underground detectors (Edelweiss Xenon, CDMS, ...) - signal gives conclusive evidence that a new particle constitute DM

- LHC : searches for new particles, test the physics beyond the standard model, search for particle stable at collider scale, constraints on DM models

- PLANCK will give even more precise determination of relic density of DM -> impact on DM properties

Dark matter a new particle?



A timely project

- At the moment no confirmed signal of new physics at LHC, nor of DM in DM searches --- important to explore many possibilities

- In the next few years, expect lots of new data on all fronts, might change the picture for DM - is the new signal consistent with results from other modes? consistent with specific theoretical model?

- Need tools for interpretation of data, make analyses of impact of a given result on other search modes, refine theoretical predictions for DM in context of various DM models

Tasks and participants

- Probing Dark Matter at Colliders (S. Kraml)
- DM signatures in indirect searches (P. Salati & S. Rosier)
- Interplay direct/indirect/LHC searches for DM (GB)
  - Participants
    - LAPTH : GB, J. daSilva F. Boudjema, P. Salati, P. Serpico, R. Taillet
    - LAPP : S. Rosier-Lees, A. Fiasson, G. Lamanna, V. Poireau
    - LPSC : S. Kraml, B. Dumont, M.-H.Genest, S. Kulkarni, D. Maurin

Probing DM at colliders

- Analysis of LHC data within ATLAS collaboration with focus on channels that constrain DM scenarios (see also next project -S. Kraml)

- Interpreting experimental results within different scenarios for New Physics

- Work out phenomenology of models missed by current searches

- If discovery : determination of properties of new particles --> direct impact on DM observables

Indirect searches for DM

- Propagation of charged cosmic rays from DM annihilation : important to take into account to compute the DM flux
- Refine propagation module in micrOMEGAs, interface to USINE (D. Maurin), use constraints from B/C, 10Be/9Be
- Gamma Ray : improve theoretical predictions to disentangle DM gamma-ray signal from galactic diffuse emission, take into account CLUMPS - with CLUMPY (D. Maurin, C. Combet)
- Interpreting AMS results - disentangling DM signal from astrophysical sources
- Make use of complementarity between e+, anti-p data from AMS and gamma-ray HESS : tool to combine all results

Interplay direct/indirect/LHC

- Further development of micrOMEGAs
  - Extension to new DM particles (superweak, asymmetric, multicomponent) + modification cosmological model
  - Improve theoretical precision on DM observables
- Confront DM with new data: Correlation between observables (LHC, flavour sector, astro, cosmo), fitting methods
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