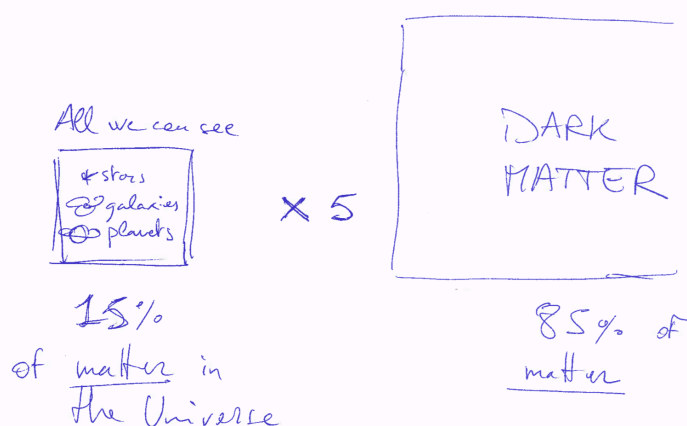


1. There is a wide range of astronomical evidence that all galaxies are immersed in a larger cloud of non-luminous matter - hence the term, Dark Matter - which is over 5 times more abundant than the ordinary baryonic matter ("*baryons*", such as neutrons and protons are the familiar particles that compose all atoms in the Universe). (MOTION GRAPHICS 2D + INFOGRAPHICS + VOICEOVER)



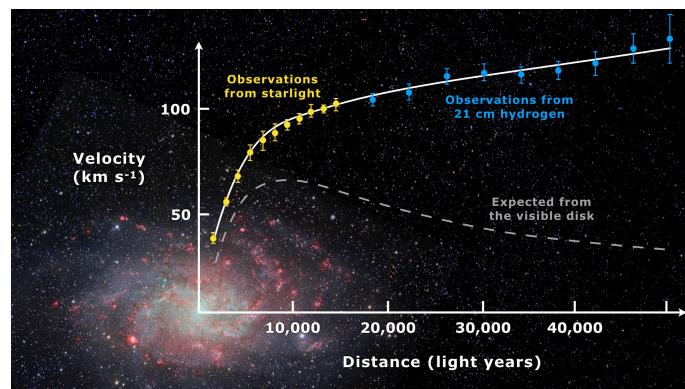
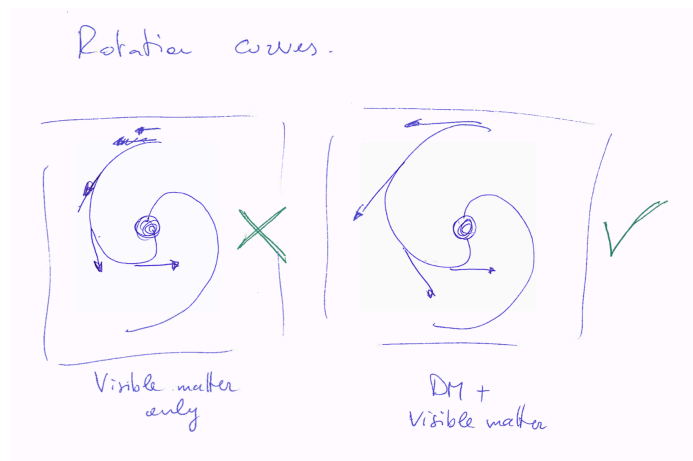
2. The first indication for the existence of Dark Matter comes in 1933, astronomer Zwicky coins the term to describe an invisible matter, necessary to explain galaxy motions in the Coma galaxy cluster. In 1970 clearer proof comes from the analysis of spiral galaxy rotation curves: Rubin, Ford and Freeman find that to explain the way galaxies rotate it is necessary to assume the presence of about 6 times the visible matter.

(MOTION GRAPHICS 2D + GALLERY + INFOGRAPHICS + VOICEOVER)

3. Let's see this fundamental indirect proof in more detail: if a large spiral galaxy like our own Milky Way would only be composed by the traditional visible matter we know of (stars, gas, planets, black holes) the inner stars would rotate at a higher speed than the peripheral ones (such as our Sun). (Infographic Milky Way, Sun, velocity vectors) However, from rotation velocity astronomical measurements we see a different behavior, the outer stars rotate around the galactic center as fast if not faster than the inner ones. This can

only be possible if the galaxy itself was immersed in a much bigger and massive “halo” of a matter we can’t see... Dark Matter!

Use here Cosmo simulations from SNS group, zoom in galaxy, show concept of rotation curves and explain plot of flat rotation curves (CAMERA ON 3D MODEL + INFOGRAPHICS + VOICEOVER).

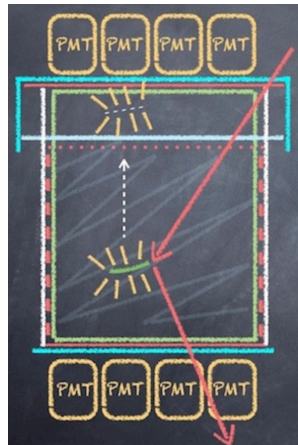


4. Could there be something we don’t understand about the physics of galaxy rotation rather than a mysterious Dark Matter? Unlikely: with the passing decades, more and more indirect evidence accumulates from different sets of cosmic observations (gravitational lensing, CMB anisotropies...). Dark Matter is absolutely necessary to explain the Universe as we see it. (MOTION GRAPHICS 2D + INFOGRAPHICS + VOICEOVER)

5. We believe Dark Matter to be made of some particle whose nature is still unknown. DM represents a fundamental puzzle to solve for our understanding of the Universe. One leading explanation, motivated by the so-called supersymmetry theory, is that dark matter is comprised of yet undiscovered Weakly Interacting Massive Particles (WIMPs) formed in the early universe and subsequently gravitationally clustered in association with baryonic matter. DM only interacts with baryonic matter by gravity or by extremely rare collision, this is why it is so hard to find. *(MOTION GRAPHICS 3D + INFOGRAPHICS + VOICEOVER)*
  
6. WIMPs could be detected in terrestrial experiments through their rare collisions with ordinary nuclei, giving them observable recoils. The predicted collision rates are extremely small and require detectors with very large target masses (1-100 ton), located in deep underground sites to eliminate background coming from radiative decays (terrestrial) and cosmic ray muons (cosmic). *(ANIMATION 3D + VOICEOVER)*
  
7. In physics, the so-called cross section is the quantity that measures the interaction probability between two particles, the higher the most likely two particles are to collide. *Add analogy to most recent constrains to WIMP-nuclei cross section. (ANIMATION 3D + VOICEOVER)*
  
8. Darkside is an international collaboration etc etc... *Introduce DarkSide, list of members, e.g. world map with countries being colored as mentioned. (INFOGRAPHICS 2D + ANIMATION 3D GEO-ZOOM GOOGLE EARTH + VOICEOVER)*

9. *(Highlight why Argon vs other liquids used in other experiments)*. Liquid argon is a cryogenic material with very good properties for a DM experiment (*details of scintillation and ionization properties?*). If WIMPs exist, they are expected to collide with atomic Argon nuclei, causing the nuclei to recoil and, at the same time, ~~with kinetic energies up to about 100 keV. The recoiling nuclei produce short tracks of ionized and metastable excited argon atoms~~ ionize – i.e. losing some of the electrons orbiting the nucleus – and emit photons. *(INFOGRAPHICS 2D + VOICEOVER)*
10. The main ~~isotope~~ kind of argon found on Earth is Argon 40 – the number means the amount of protons and neutrons in the nucleus – (99.6%), which is stable, does not radioactively decay. However, in the Earth's atmosphere, Argon 39 (with one less neutron!) is produced by cosmic ray activity. How so? Cosmic rays from outer space produce fast neutrons when entering the atmosphere, which in turn interact with Argon 40, giving two neutrons and one atom of Argon 39, which, contrary to Argon 40, is not stable and can decay. If Argon 40 is good for DM experiments, Argon 39 is therefore bad, as decays would produce a high background. *(INFOGRAPHICS 2D + VOICEOVER)*
11. The best possible Argon sample is therefore extracted from a mine in Colorado: the Argon being buried there is shielded from cosmic rays, and most of the Argon 39 that was trapped underground has already decayed in thousands of years. The Argon extracted is then purified in successive steps, before making it to the Darkside experiment in Gran Sasso (*mention here Sardegna, Abruzzo, and other phases with notes about Region contributions*). *(INFOGRAPHICS 2D + ANIMATION 3D GEO-ZOOM GOOGLE EARTH + VIDEO FOOTAGE FROM MAIN LABORATORIES + VOICEOVER)*

12. MAIN PART ~ 1'30". Description of experiment and background shielding. 3D reconstruction of detector, animation about simplified physics of a single WIMP – Argon interaction. (MOTION GRAPHICS 3D + VIDEO FOOTAGE FROM MAIN LABORATORIES + INFOGRAPHICS + VOICEOVER)



13. CONCLUSION ON DARKSIDE 50 RESULTS, DARKSIDE 20K PUSHING THE ENVELOPE. Show animated plot of cross sections with analogies. (INFOGRAPHICS 2D + VOICEOVER)

