

Wonder-ful final remarks

Roberto Petronzio

INFN

wonder

- 1.
 - a. One that arouses awe, astonishment, **surprise**, or admiration; a marvel: "The decision of one age or country is a wonder to another" (John Stuart Mill).
 - b. The **emotion** aroused by something awe-inspiring, astounding, or marvelous: gazed with wonder at the northern lights.
- 2. An **event inexplicable by the laws of nature**; a miracle.
- 3. A feeling of **puzzlement or doubt**.
- 4. often Wonder A **monumental human creation** regarded with awe, especially one of seven monuments of the ancient world that appeared on various lists of late antiquity.

A good title for the workshop

- Dark matter came as a surprise,
- A strong emotion is associated with the awareness that we seem to know the basic laws of nature but we still miss... what is the universe made of..
- Raises doubts on our understanding of early universe
- Its discovery may need a monumental effort
- **BUT, hopefully it CAN be explained by the laws of nature**

Progress on DM

- Evidence from Dama/Lybra ...
CDMS, Cogent ... and from indirect searches (Pamela, Fermi, Atic)
 - A low mass Bino or RH sneutrino ???
 - The LEP limits challenged
- Improvements of upper bounds on wimp-nucleon cross section (Xenon100)
 - the challenge of low-mass wimps
- Spin dependent versus spin independent measurements as an important tool
 - Different cross sections
 - LSP and LKP

Technological developments

- External background
active and passive shielding, pulse analysis
- Internal background
material selection, purification, new photon detectors
- Light yield, energy threshold
- 3D reconstruction → direction

Impressive progress

Many puzzles

- The WHY NOW problem
- The dark energy size compared to existing vacuum expectations

Associated (??) puzzles

- Matter antimatter asymmetry
- The antineutrino oscillations (LSND)
- The sterile neutrinos and/or CP violation

(Too) many candidates

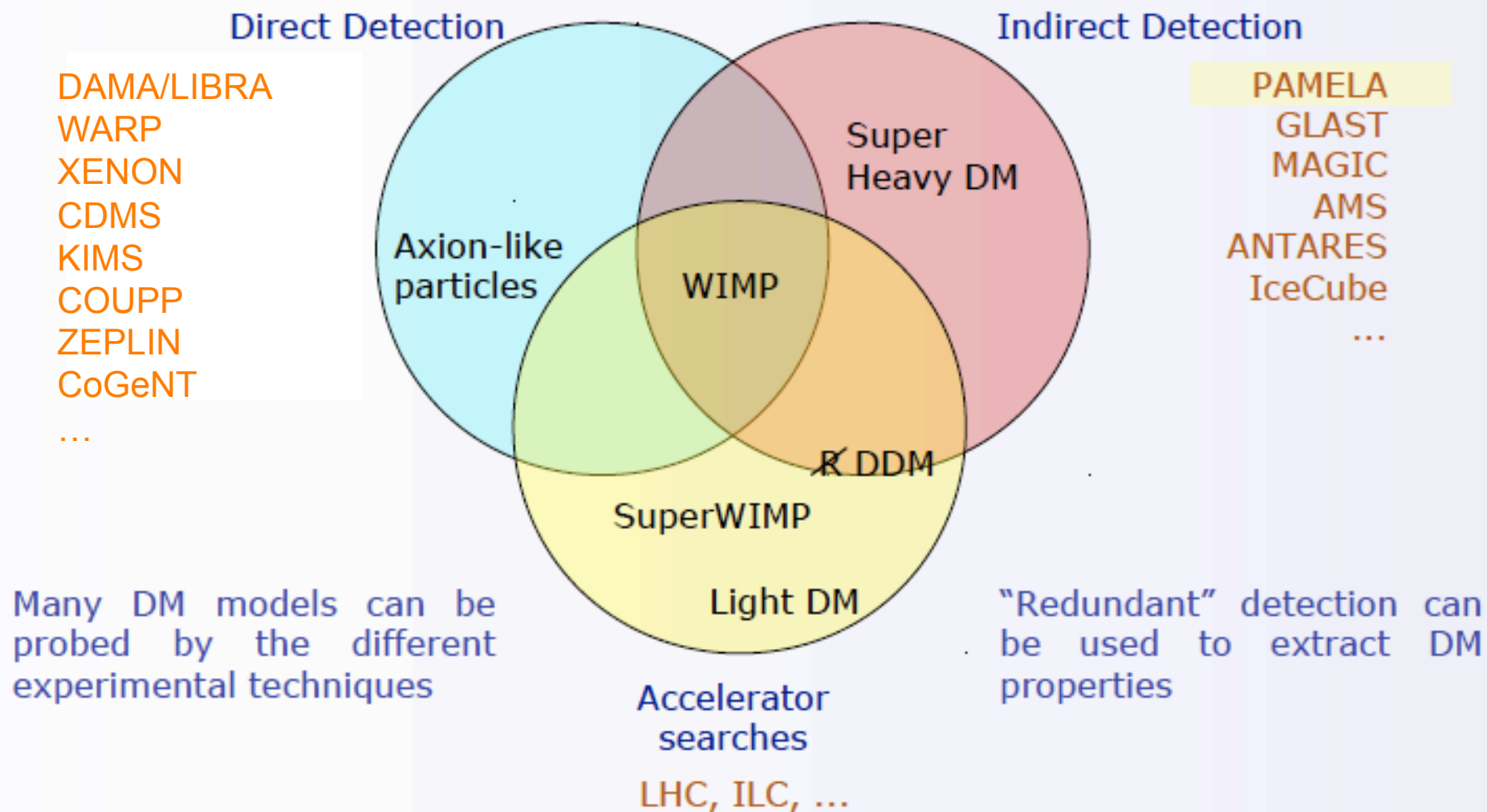
- Susy
- Kaluza-Klein and extra dimensions
- Axion-like
- Right handed neutrinos or sterile neutrinos

...

Need for different experimental approaches

Complementarity of DM searches

- We are attacking the DM in various fronts:



The LHC challenge

- Do next two years of LHC running complement passive detector based searches ??
- What sizes/technologies make good competition ??
- How does the competition extend to higher energy/luminosity of LHC ??
- Toward a composite strategy, not just a single experiment issue... a wonder

LNGS

- Dark matter and Majorana neutrinos as the main program in the next years
- Dark matter:
 - Profit from Warp/Xenon experience
 - Profit from Icarus: the prototype large detector
 - Clarify further Dama results, with additional investments
 - develop complementary options (High A-low A liquid gases..??)

Guide-lines

- Do not trust theory too much
- Stick to experimental results
- Do not take anything for granted
- Do not leave holes around