Searching for a Dark Matter Candidate in Particle Physics Experiments

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Outline

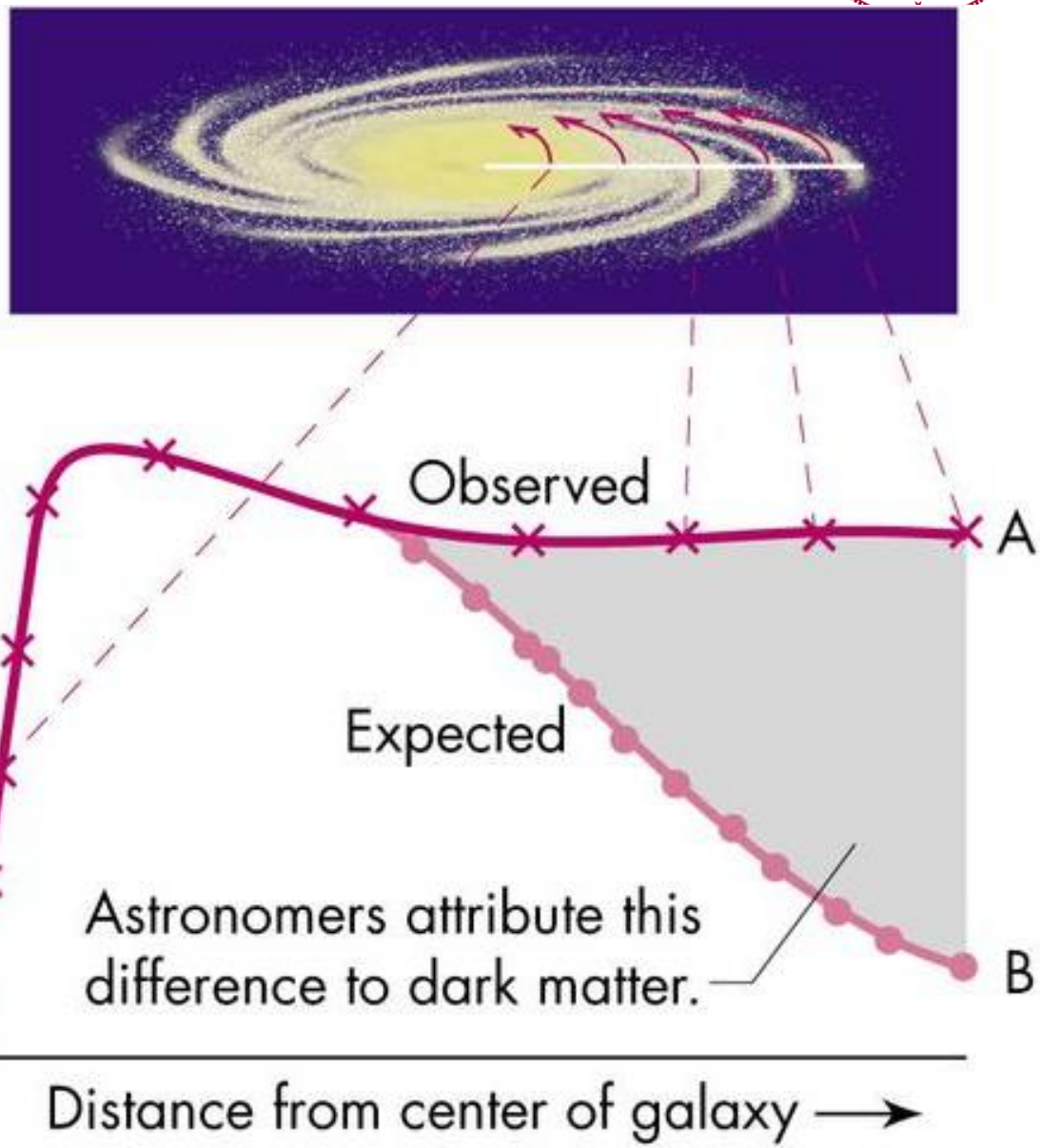
- What is dark matter?
- A dark matter candidate
- The idea behind the experiment
- Results
- Conclusion

Dark Matter

- Very little is known about dark matter
- Why is it called "**dark**"?
  - Never interacts with light (hence we cannot see it)
- Has mass and attracts other objects through gravity
  - This is how we know it exists

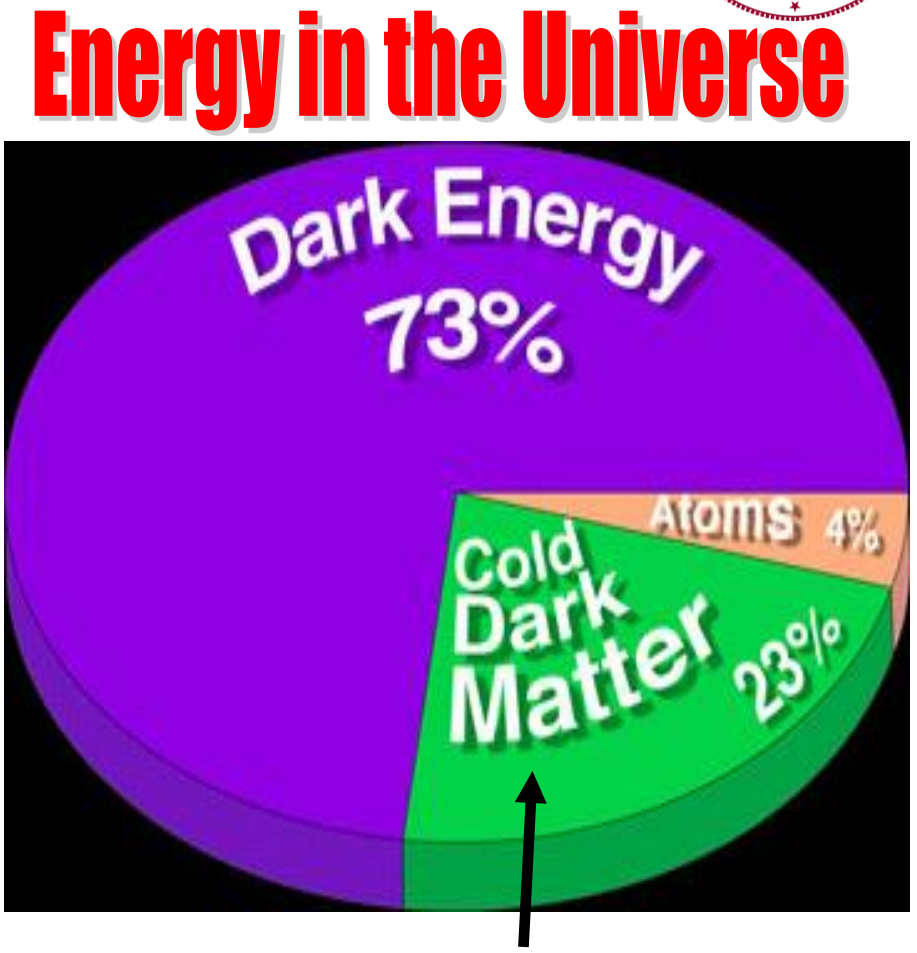
Experimental Evidence

- The rotational velocity curves in galaxies are not what we expect
- So there must be additional mass (dark matter) spread throughout galaxies



A Dark Matter Candidate

- No known particle can be dark matter
- Supersymmetry is a theory that predicts many new particles
- One of these new particles could be what dark matter is made of
- Our dark matter candidate is called the gravitino, $\tilde{G}$

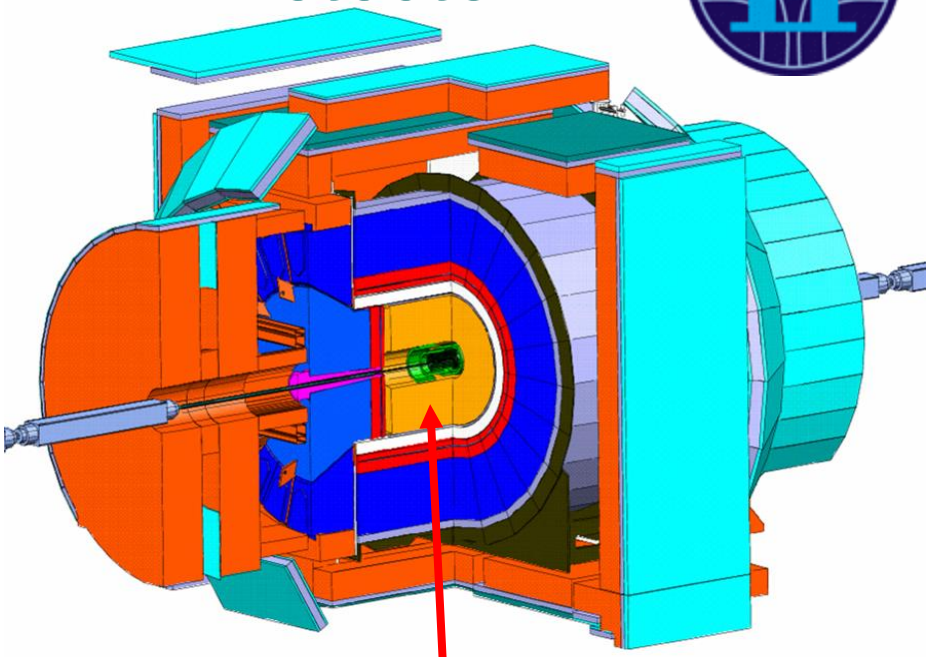


Large fraction of the energy in the universe

Producing Dark Matter

- We may be able to produce dark matter in particle collisions
- I will look for signs that this has occurred in the supercollider at Fermilab

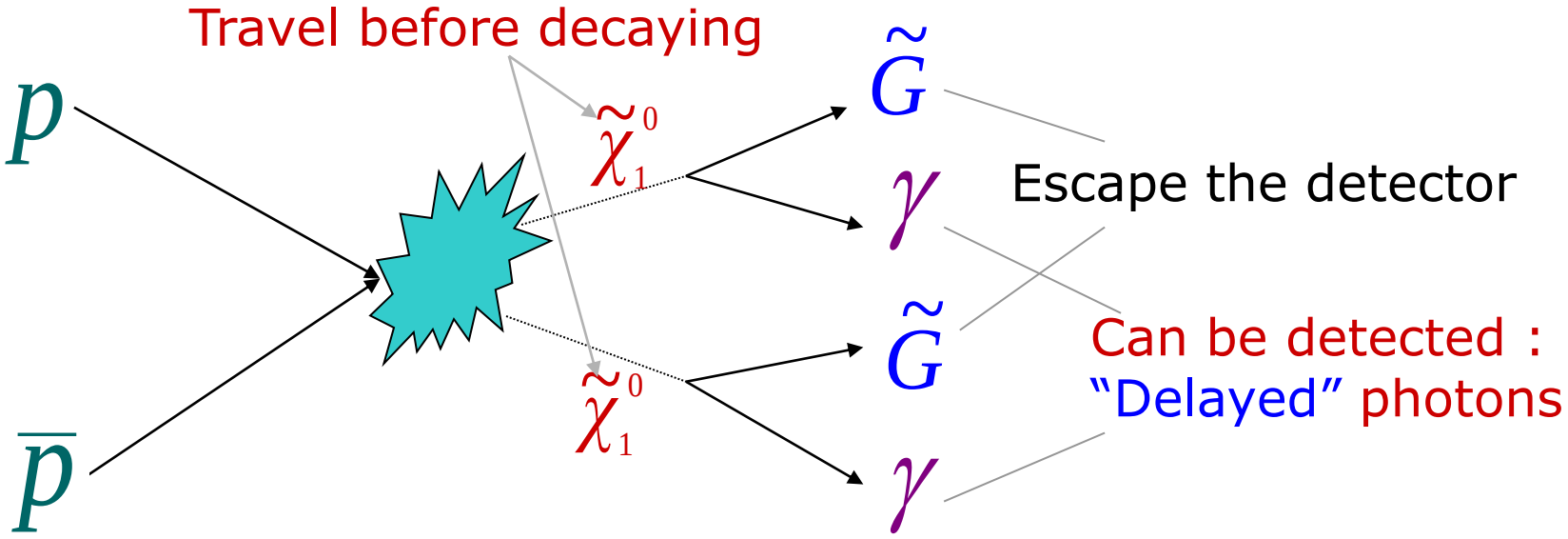
Particle Collision Detector



Surround the collision point with a huge detector

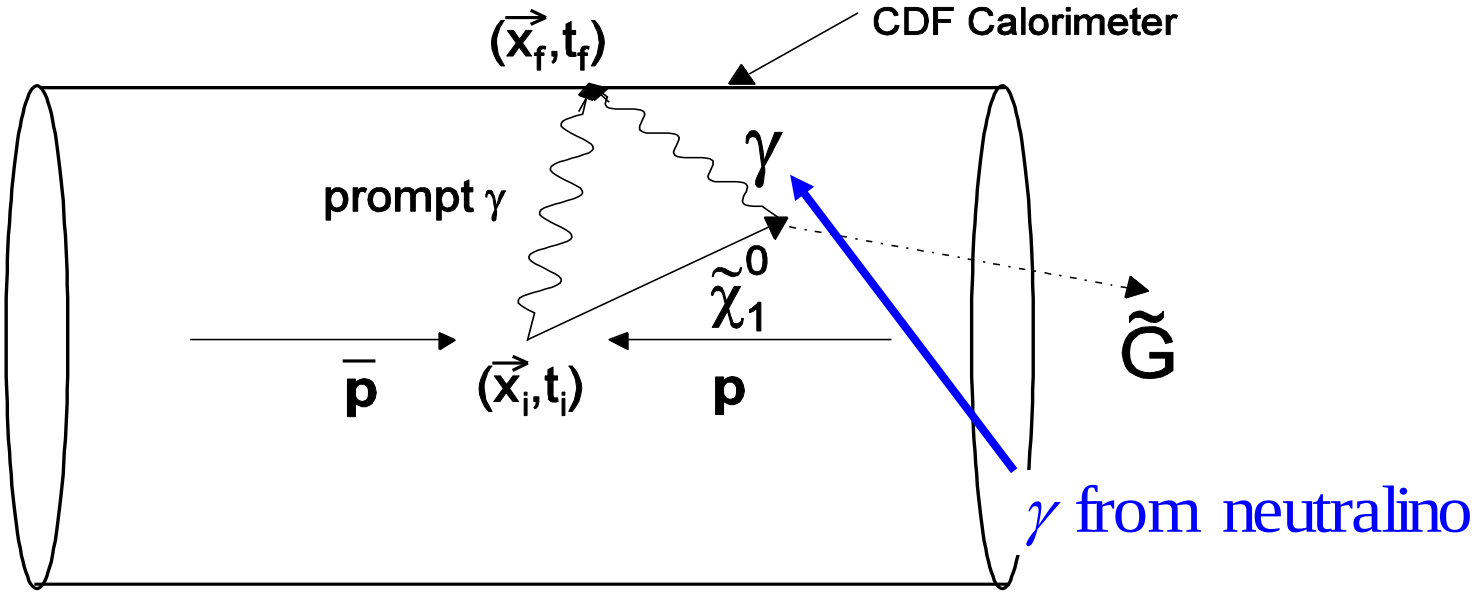
Producing Dark Matter

- The neutralino, $\tilde{\chi}_1^0$, (another particle predicted by supersymmetry) may be produced in pairs at Fermilab and decays via $\tilde{\chi}_1^0 \rightarrow \gamma \tilde{G}$
- The $\tilde{G}$ is our dark matter candidate
- The γ is a photon- these are the particles that light is composed of



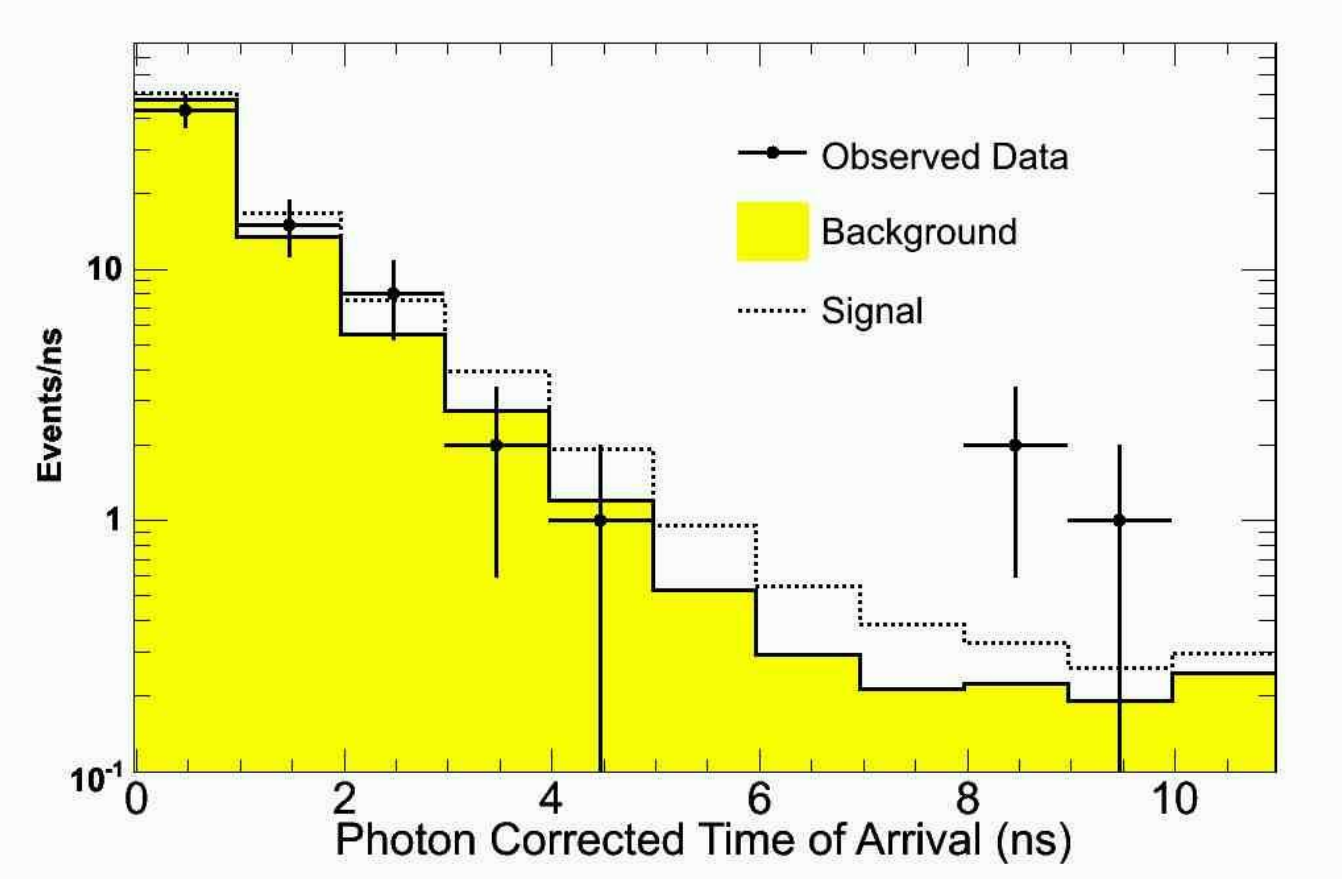
"Delayed" Photons

- In the current theory of particles, photons always travel directly from the collision point to the detector
- Neutralinos travel away from the collision point and then decay
  - The photon arrives at the detector later than expected, in other words "delayed"



Results

- We search for collisions that produce delayed photons



Conclusions

- We will improve this search by further refining our strategy and using additional data
- With these improvements and a little luck, we may solve the mystery of dark matter