

miniCLEAN

- AND THE -

QUEST FOR

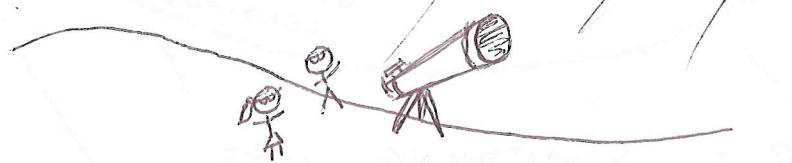
DARK MATTER

By Andy MASTBAUM

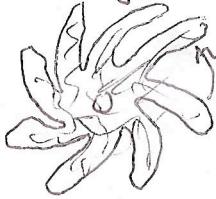
LANL P-23

(WITH APOLOGIES TO THE  
DEAP/CLEAN COLLABORATION)

Once upon a time,

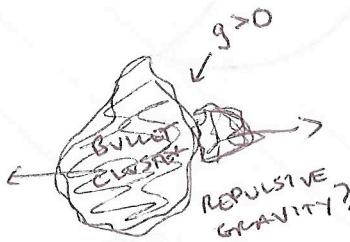


SOME SCIENTISTS WERE LOOKING  
UP AT THE SKY.



GRAVITY  
ROTATION  
VELOCITIES  
 $\gg$  light!

$$v \gg v_{\text{KEPLER}}$$

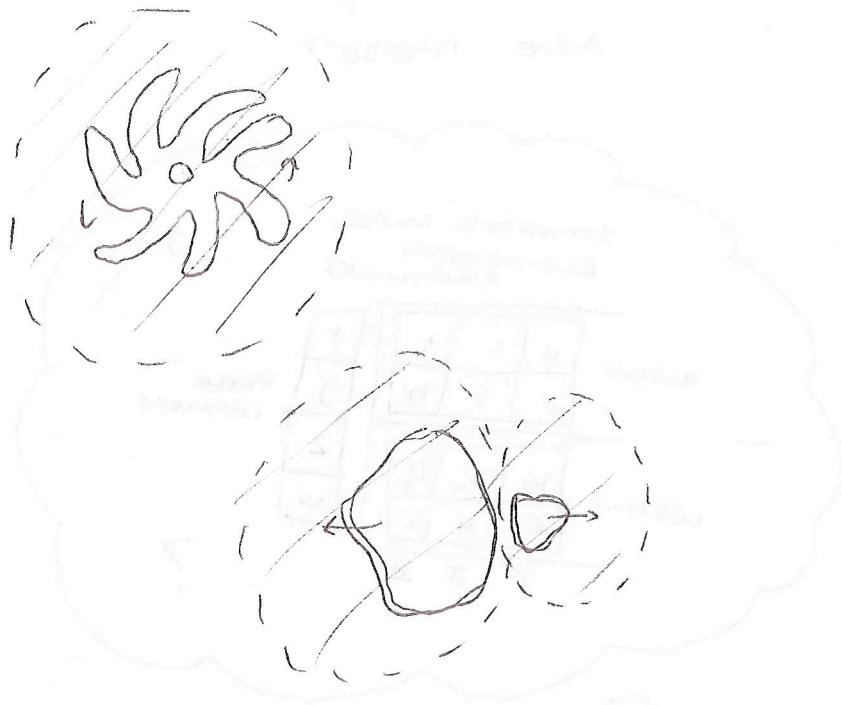


Ancient  
gravitational  
Lensing!

BUT SOMETHING WAS

WRONG!

IT WAS LIKE THERE WAS  
ERNA MATTER THEY  
COULDN'T SEE...



SOME SORT OF...

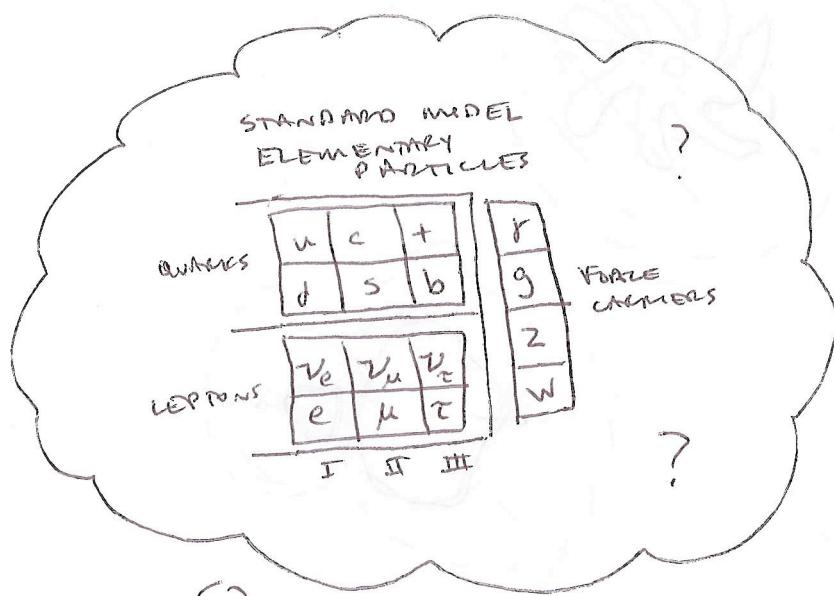
DARK MATTER!

BUT --

WHAT IS IT?

WHY CAN'T WE SEE IT?

WHAT KINDS OF PARTICLES  
ARE THESE?



IT MUST BE SOMETHING

WE'VE NEVER SEEN

BEFORE...

... some kind of  
NEW PHYSICS!

$\tilde{\chi}$ , THE LIGHTEST NEUTRALINO

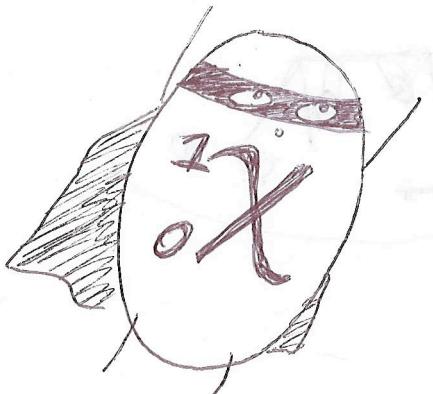
(IN THE MINIMAL  
SUPERSYMMETRIC  
STANDARD MODEL),

A SUPERPARTICLE

SEEMS

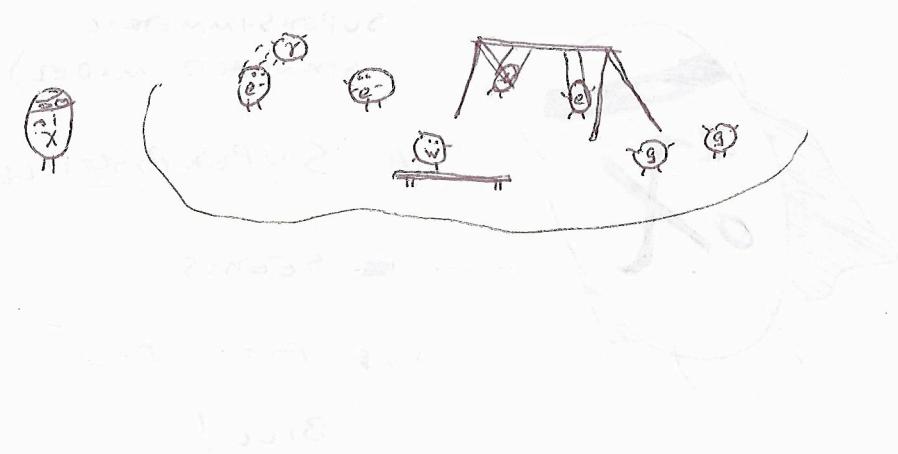
TO BE AT THE

BILL!



X IS A WIMP (weakly  
INTERACTING MASSIVE PARTICLE),  
AND DOESN'T INTERACT  
MUCH WITH OTHER MATTER.

(shameless self-promotion)



IT COULD EVEN GO  
STRAIGHT THROUGH IT  
EARTH WITHOUT EVEN  
NOTICING.

BUT ABOUT ONCE IN

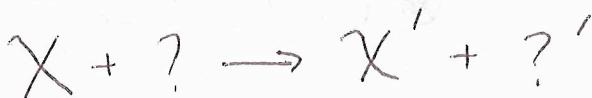
EVERY  $10,000,000,000,000$ ,

$00,000,000,000,000,000$ ,

$000,000,000,000,000,000$

CHANCES, IT WILL INTERACT

WITH SOME MATTER

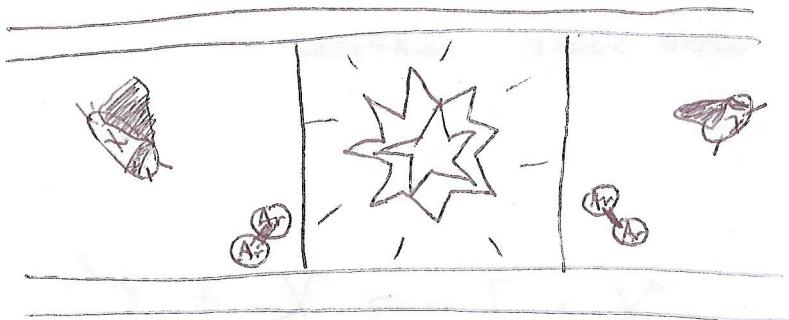


SO WE HAVE A CHANCE

TO FIND IT!

(WITH A LITTLE PATIENCE)

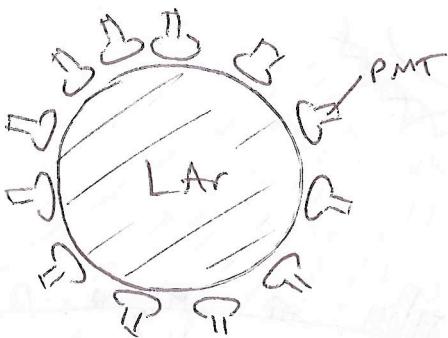
WHEN A  $\chi$  HITS A  
MOLECULE OF LIQUID ARGON  
OR LIQUID NEON, THERE  
IS A TINY FLASH OF LIGHT.



SO TO LOOK FOR  $\chi$ 'S, WE'D  
NEED:

1. A LOT OF LIQUID Ar OR Ne  
AS A TARGET
2. VERY SENSITIVE LIGHT  
DETECTORS

How about a big sphere  
of liquid argon surrounded  
by light-sensitive  
photomultiplier tubes (PMTs)?



We call this detector

"miniCLEAN" - for

CYCLOMICROSCOPIC LOW-ENERGY

ASTROPHYSICS WITH NOBLE GASES

WE'LL PUT IT WAY (2 km)

UNDERGROUND AT SNOLAB

IN CANADA, TO BLOCK

OUT COSMIC RAYS



COSMIC RAY MUONS CAN

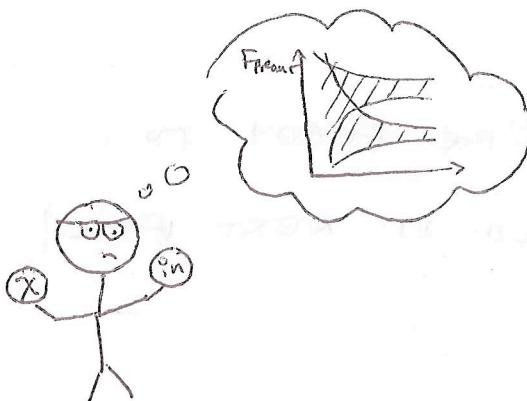
KICK NEUTRONS INTO THE

DETECTOR, WHICH LOOK

A LOT LIKE Xs. CAN'T

HAVE THAT.

WHEN A  $\chi$  INTERACTS  
INSIDE minICLEAN (ABOUT  
ONCE A YEAR OR TWO), THE  
PMTs TELL US WHERE,  
WITH WHAT ENERGY, ETC.  
  
WE CAN TELL IF IT WAS  
A  $\chi$  OR NOT (INST. SOME  
OTHER PARTICLE) BY THE  
PMTs' CHARGE & TIMING DATA.



IF WIMPS ARE OUT THERE,  
minICLEAN WILL FIND THEM!

BUT FOR NOW, WE'RE



RUNNING

SIMULATIONS

TESTING

DETECTOR  
COMPONENTS



OPERATIONAL  
PROTOTYPE  
EXPERIMENTS

SO WE'RE READY TO

BUILD IT NEXT FALL!