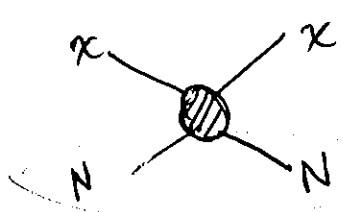


Anthony: DIRECT DET.

6 NOV.

4

REF: 1810.8327 (snowmass)



ASSUME = WIMP

DM SCATTERING OFF NUCLEI

SOMETIMES e^- , BUT THAT'S USUALLY BG (CHARGED OR γ)

SIGNAL:

$$\frac{dR}{dE_r} = \frac{\sigma_0 \rho}{2M_\chi M_N} F^2(|\vec{q}|) \int v f(v) dv$$

RECOIL E

$R = \frac{N \text{ EVENTS}}{(\text{TIME})(\text{DET. MASS})}$

DM DENSITY

M : REDUCED MASS OF χ, N SYS

$\sigma_0 = \sigma_N$ @ LOW MOMENTUM TRANSFER

F = NUCLEAR FORM FACTOR, eg CAN MEAS USING NEUTRON

[diff] for SD & SI

"I can't continue because I'm talking to morons."

UPPER BOUND ON $R \rightarrow$ UPPER BOUND ON σ

EXPT-DEP!
REPORT RESULTS IN TERMS
OF σ_{int} (NUCLEON)

$$\sigma_{\text{int}} = \left(\frac{M_{\text{int}}}{M_{\text{N}} x} \right) \frac{1}{A^2} \sigma_0$$

↑ assuming $p = \text{neutron}$ as
for as WIMPS ARE CONCERNED.
 \Rightarrow MODEL DEPENDENCE!

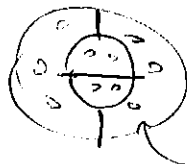
EXPERIMENTS : TECHNIQUES

- ① IONIZATION
- ② SCINTILLATION (fast + slow)
- ③ PHONONS

eg. CDMS



IONIZATION $\sim 11 \text{ eV}$
Si or Ge (SEMICONDUCTOR)
↑ DON'T NEED FULL IONIZ, JUST PUSH INTO CONDUCTION BAND



PLATES THAT MEAS. CHARGE

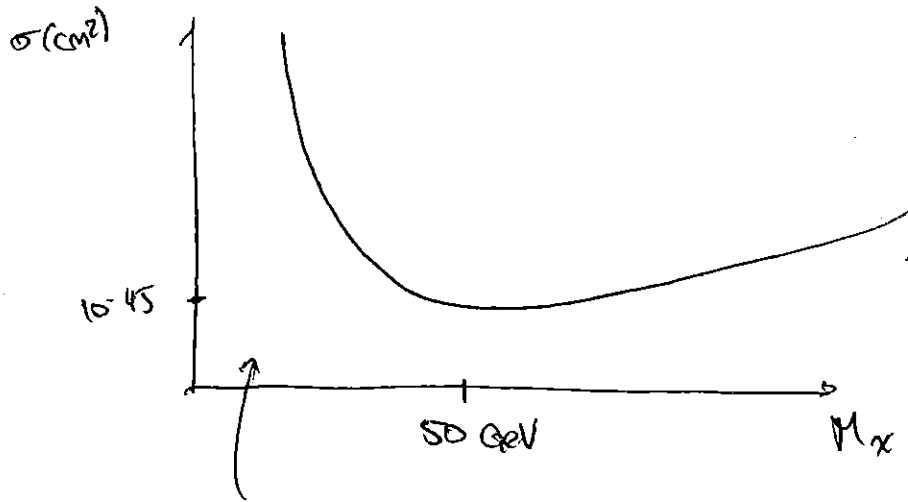
DOTS MEASURE PHONONS
(SUPERCONDUCTOR, PHONON
BREAKS COOPER PAIR)

CAN ALSO REMOVE SURFACE EVENTS.

CALIBRATED w/ n/α BEAMS

\rightarrow SOURCES (FOR e^- BECAL HANDLE)

EXCLUSION PLOTS



← @ HI MASS:
SINCE ρ_x KNOWN,
NUMBER DENSITY
MUST BE SMALL

@ LOW MASS
THEN E_p IS SMALL →
HARD TO MEAS.

SPIN (IN)DEPENDENCE

INDEP: "COUPLES TO MASS" ↔ $\sigma \sim A^2$

↗ want high
Atomic #

SPIN DEP: "COUPLES TO SPIN" ↔ $\sigma \sim \langle S_N \rangle^2$

↑
only big for
things w/ odd # of nuclei } $S \sim 0.3$

in general: $\sigma_{SI} < \sigma_{SD}$

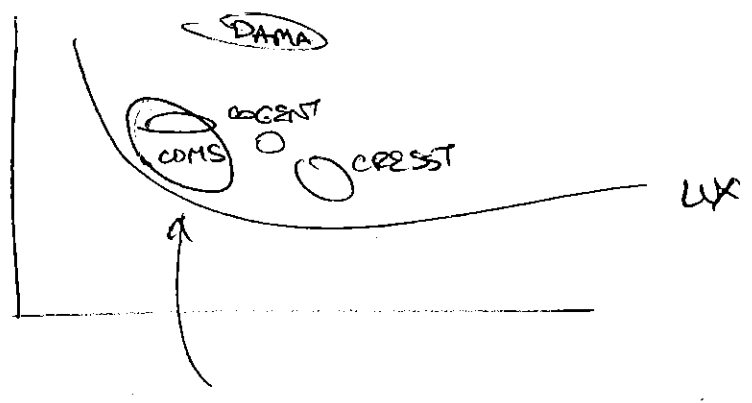
↑ hard to make big

eg. XeNOX 100:	^{129}Xe	26%	$J = 1/2$
$S_2 p^+$	^{131}Xe	21%	$J = 3/2$
	^{132}Xe	26%	$J = 0$

So for ^{129}Xe : $\langle S_p \rangle \approx 0.01$ even # of p
 $\langle S_n \rangle \approx 0.36$ odd # of n
 depend on nuclear model

Q: why do we consider σ_{SI} OR σ_{SD} ?
 in general, can have both

- ↳ bounds assume $\sigma_{SI} = 0$ $\sigma_{SD} = \sigma$, etc.
- ↳ conservative.



If WIMP sees p & n differently,
can move blobs around.

↑ ISOSPIN play.

Recent: PUSH for low mass expts

DAMPIC \approx LIQUID He

↑
OS?

NEUTRINO BG

$\sigma \sim 10^{-48} \text{ cm}^2 \Rightarrow$ NEUTRINOS HIT BG

What to do?

ANNUAL MODULATION?

DIRECTIONAL DET? - WIMP WIND

Some other time: AXIONS