Scope of the Conference

On Search for Baryon and Lepton Number Violation

LBL, Sept. 20-22, 2007

WHY ?

- **Baryon number non-conservation touches many areas of physics and cosmology:**

-- Matter-Anti-matter asymmetry of the Universe;

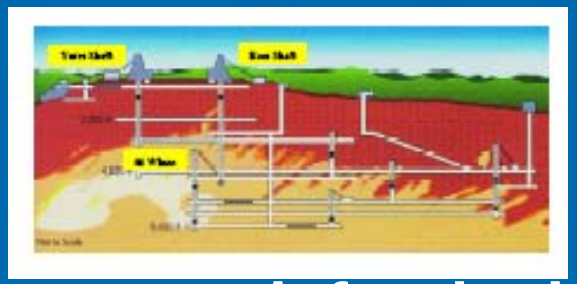
-- Successful standard model and most of its popular extensions break baryon number.

-- B-violation under intense experimental scrutiny– in past and possibly in future !

Yet most recent conferences don't have any discussion of this topic.

Interesting moment in the History of Particle Physics

- LHC is starting- will probe physics of the origin of mass in the TeV scale !



- DUSEL closer to reality .
- Many neutrino experiments e.g. search for double beta decay, oscillation experiments and lepton rare decay searches $\mu \to e + \gamma$ probe flavor physics, neutrino mass.

--These provide extensive probe physics up to 10 TeV scale .

Higher Energy Reach

- Next generation of colliders e.g. ILC

  more precision machines than higher energy reach machine !
- So how do we probe physics at higher energy scales, which are of great theoretical interest e.g. in connection with Grand unified theories and string theories etc?
- One sure way is to devote part of the resources to more rare process searches !!

One example is search for Baryon non-conservation

- Search for baryon non-conservation probes scales anywhere from 10^5 to 10^16 GeV.

- DUSEL provides a unique opportunity to conduct these searches now. It could be the Baryon and lepton non-conservation search machine !!

Proton Decay & N-N-bar Oscillation

- Two distinct $\Delta B \neq 0$ modes: probe different physics:
- $p \rightarrow e^{+}\pi^{0}$ conserves B-L;
- $N - \overline{N}$ breaks B-L=2; very compelling if neutrino is Majorana

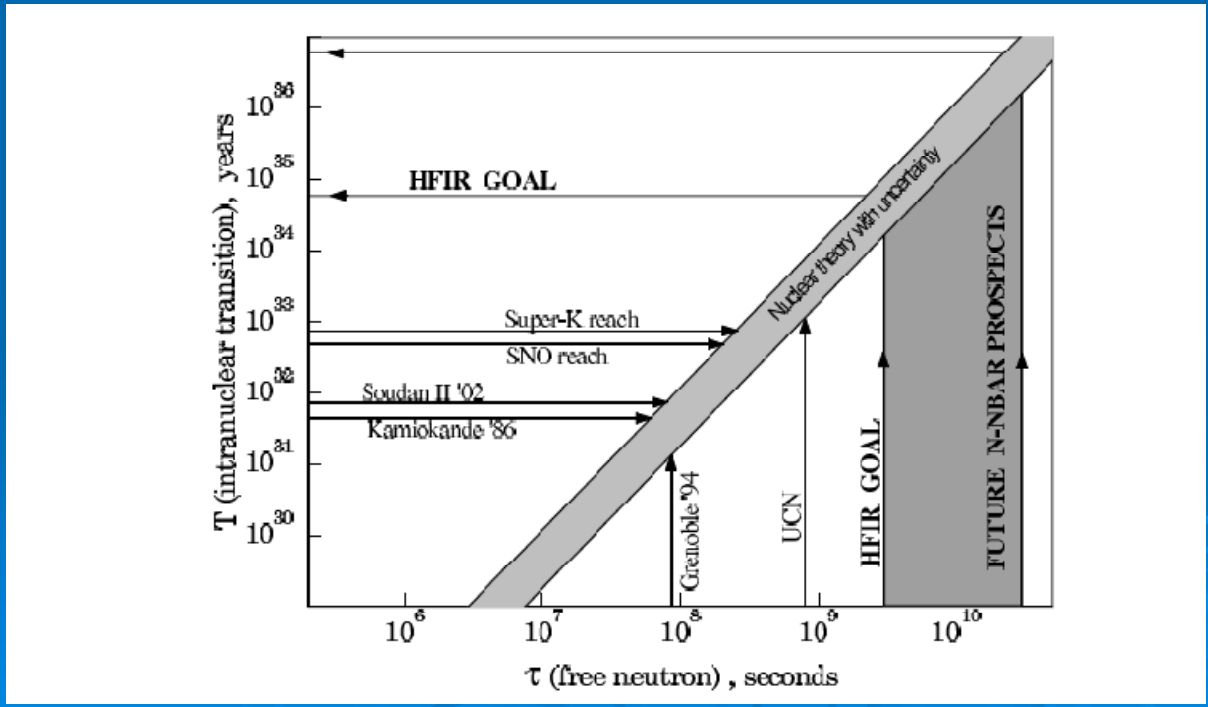
Since it also breaks B-L=2 in the leptonic channel. N-N-bar search complementary to double beta search in exploring B-L scale.

P-decay vs N-N-bar oscillation

- **Proton decay explores GUT scale physics whereas**
- **Neutron oscillation explores intermediate scale B-L physics.**

Limit on Matter Stability

- Higher matter stability reach in N-N-bar than proton decay search:



Community sense

- Many proton decay expts have been done and more are planned. (IMB,Kam, SK,Soudan, etc planned UNO, Hyper-K);
- Do we need to attack the problem of baryon number non-conservation from another complementary angle ?
- Is time ripe for a direct high sensitivity search for N-N-bar which is complementary to proton decay ? (Only one N-N-bar expt so far (ILL,1994)

Apprehensions: Are they justified ?

- An often expressed apprehension : Is there a solid prediction for N-N-bar osc time ?
- Many important discoveries have been made without definite predictions –e.g.

-CP violation, c,b,t quarks, tau lepton ..

-- On going search for neutron, lepton edms.

--Possibility of serendipitous discovery e.g SN1987A nus in Kam-II and IMB.

- Do N-N-bar theories fit into the big picture of physics and cosmology ? Yes.

Organization

- With this in mind, we have assembled both theorists and experimentalists in the area of B-L and related physics and cosmology.
- Goal is to take stock of where we are and where we should go;
- Talks on GUT theories,
- Pre-GUT intermediate scale models;
- Origin of matter in both models.

Experimental Outlook

- How far the N-N-bar and proton decay search could be pushed and how we should proceed ?
- Evaluate the role of DUSEL which could be a key part of the experimental future in this area.
- Can LHC be used to provide useful information on B-L violation ?