Lamb's Balance

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Abstract

We show how the variations on nuclear stability at the drip lines can be connected to the bosonic sector of electroweak theory. This connection hints strongly towards the existence of a non minimal Higgs sector.

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Recoil corrections to the bound states of a relativistic two body system $m < M$ can be expressed as a polynomial $P_m(1/M)$. If the small particle m has an additional coupling to a yukawian field of mass M', one can use the shape of $P_{m,M'}(1/M)$ to determine the mass of the field M'. We call this method the *Lamb's Balance*.

The Lamb's Balance Conjecture is to suppose that the shape of $P_{m,M'}$ presents a maximum when $M \sim M'$. The nuclear LBC assumes that this effect will be measurable at proton and neutron drip lines, where external nucleons are far from the rest of the nucleus -neutrons even are in a distinctive skin- and exchanged momentum is small, so that the rest of the nucleus can be seen as a single particle.

In these conditions, the nuclear LBC is able to assign a mass to each magic number as they cross the drip lines; it is enough to express in GeV the weight of the corresponding nucleus. The results can be seen in tables I and II, for the proton and neutron driplines respectively. We refer the reader to [6, figure 8] for a view of the graphical procedure over the HFB+SkP nuclear model. The analysis is more or less model independent; driplines from FRDM95 or FRDM92 can also be used without sensible differences.

Z=	40	50	82	114
GeV	68	91	175	246

TABLE I: Weight of nuclei having magic numbers at the proton drip line

N=	50	82	126	184
GeV	68	115	175	246

TABLE II: Weight of nuclei having magic numbers at the neutron drip line

The proton line pinpoints the Z_0 and other two well known scales: the mass of the Top and the vacuum expected value of the Higgs Field (in the minimal version). Besides, the semimagic (but very strong) Z=40 marks a 68 GeV signal, that has been sometimes suspected of detection at L3 [1–3].

The neutron dripline selects -at different numbers; again, see [6] for plots- the same masses at 175 and 246 GeV, as well as the one at 68 GeV. And for N=82, it gives us 115 GeV, the signal measured [7, 8] during the last run of LEP.

Magic numbers 8 and 20, in both lines, are excluded because its origin is completely known, coming from the nuclear well potential. All the other magic numbers are generated from a spin orbit coupling which is partly relativistic partly phenomenological (and mass-dependent). This phenomenogic part is the one that appears reflected in our balance. The extant Z=28 (N=28-30) magicity is in the borderline of needing phenomenologic input, so we have some doubt about including it in our survey. If we did, it would predict a unique additional mass about 42-46 GeV, a range already discarded by precise measurements at the Z_0 pole.

Except for this doubt about 28, all the magic numbers are used in this predictions. Now, What does it happen if we reverse the argument, taking the masses as the startpoint to meet the magicities? We can contemplate the whole panorama in table III. Perhaps the more doubtful issue is the role of W, that only seems to correspond to weak semimagicities, if any. But here one must remember the very special role that W has in the nuclear table, as it is the responsible of the process of beta decay. Then a virtual W, besides to contribute to the dressing of nucleons, is able to draw energy from them and to decay to electron plus antineutrino; a process a lot more important that dressing and recoiling.

Beyond the W, the boson Z_0 intersects the neutron dripline about $n = 64$, a partial shell closure that can be considered semimagic. And, last, the 115 GeV signal intersects the proton line about $z = 60$, in the middle of the competition between levels g7/2 and d5/2. The resultant closures 58 and 64 are very well known of any student of alpha-decay: it is the lanthanide area.

All the others intersections correspond to the magic numbers we have started from.

Finally, which output can a model-builder extract from the nuclear Lamb's Balance conjecture? It strongly points towards a non minimal Higgs sector, say 2DHM etc. One particle should appear within a very few percent of the 264 GeV vacuum. At least one particle appears at a mass lower than the Z_0, and if -as suggested- it is a charged Higgs, then the compatibility with SUSY is troublesome. But on the other hand the mass at 175 GeV is known to be the one of the Top quark, whose coupling to the nucleon could be only described using its family of very short lived mesons. So another possibility is that one of the extant bosons from the higgs sector is mass-degenerated with the top quark.

GeV	$\sim 45??$	68	80.4	91.2	115	175	246
neutron dripline, N=	28-30	50	56?	64	82	126	184
proton dripline, P=	28	40	?	50	58-64	82	114

TABLE III: Whole table of associations between weights and magic (or semimagic) numbers in both driplines

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[7] Pedro Teixeira-Dias *The Standard Model Higgs boson search at LEP: combined results* http://arxiv.org/abs/hep-ex/0108002

[8] *Observation of an excess in the ALEPH search for the Standard Model Higgs boson* http://arxiv.org/abs/hep-ex/hep-ex/0108001

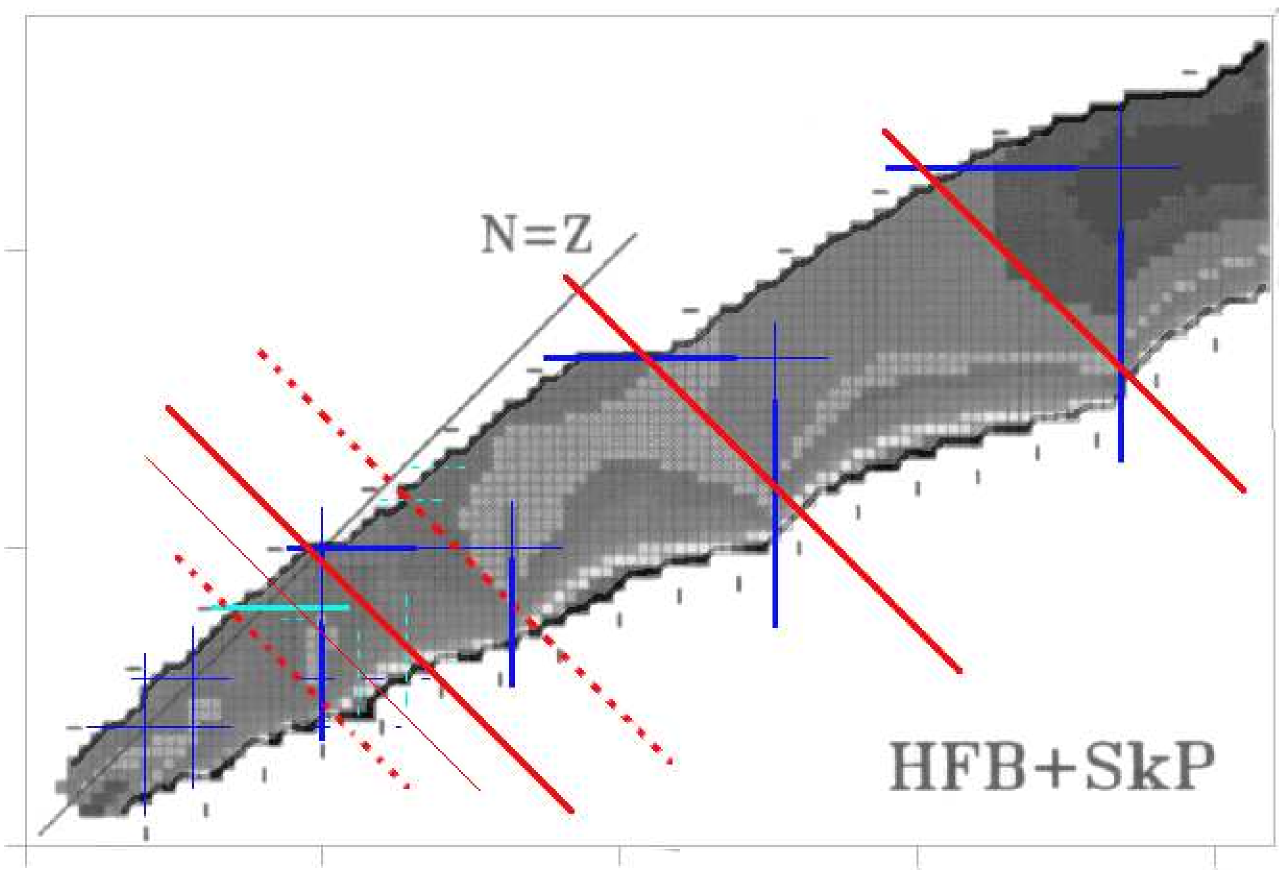

Figure 1 LS9530 24May2004