Fw: Your Submission

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Wed 12/16/2020 9:43 AM

To: contessi.lorenzo@gmail.com <contessi.lorenzo@gmail.com>; Johannes Kirscher <johannes.kirscher@manchester.ac.uk>; Mareš Jiří <mares@ujf.cas.cz>

Dear All,

we have just received PLB referee report which is rather positive but there are several comments and questions of the referee which should be addressed before its resubmission.

I would propose to read the report carefully and to reconvene on Monday to discuss it in more detail.

Martin

Referee report PLB-D-20-01192
Multi-fermion systems with contact theories
by M. Schaefer et al.

The authors investigate the stability of bound states of
distinguishable particles and two identical fermions as
well as few-body nuclei using theories with contact interactions.
In particular, they consider a theory with regularized
short-range two and three-body S-wave interactions. They find that there
are no bound states beyond A = 4 in the case of nuclei. In the case
of a spatially symmetric core including one identical fermion and at
least one distinguishable particle plus the second fermion
outside of the core, they find no bound states
if all particles have equal masses. They find that stable bound states
can be obtained if either an S-wave effective range or a P-wave scattering
volume is included, but they are not able to separate the two
effects. This is an interesting investigation, focusing on the timely
question of the minimum requirements for the existence of quantum bound
states. A properly revised version could be published but there are a
few issues that need to be addressed:

1) The paper is difficult to read and the assumptions and conclusions
are not well stated. I also find the terminology confusing. The authors
discuss the "stability" of the systems but really mean the stability
of bound states against decay into clusters. None of the considered
systems actually collapse and thus are perfectly stable. They are just
not bound. This is particularly confusing since the authors discuss stability
with respect to the Thomas collapse and the emergence of a three-body scale
in the introduction. Thus the reader is led to understand "stability" in
this context. I suggest to improve the presentation to make this difference
clear.

2) The citations in the introduction give a very distorted view

of the field. The authors choose to cite only the very first papers regarding the Phillips and Tjon lines and ignore later works that established the connection of these correlations to universality. Yet regarding the spectrum of multi-boson systems they change their strategy, omit all earlier works (e.g. by von Stecher, J. Phys.B 43 (2010) 101002, Gattobigio, Kievsky, Viviani, Phys. Rev. A 86, 042513 (2012), ...) and cite only one recent paper [10].
I suggest to discuss the previous literature in a more balanced way and/or to provide references to review articles that do so.

3) In Fig. 1: why does the 4He state apparently collapse as Lambda is increased? This appears to disagree with established knowledge of the four-nucleon system (see, e.g. Platter, Hammer, Meissner, Phys. Lett. B607 (2005) 254 or [23]). Why do the lowest decay thresholds show the 1/Lambda behavior? Will the behavior eventually flatten out?

4) The authors use the term "universality" class in a very loose way throughout the paper. Can they define clearly what they mean with this term and which classes are relevant here?

5) The change in methods to a two-channel resonating group method for A>6 is only superficially motivated by the "halo character" of the considered systems. Can the authors give explicit radii or separation energies to justify this rather drastic approximation? The evolution of binding energies in Fig. 2 suggests that the added fermion is not in a halo state except close to the value of Lambda where it crosses the dissociation threshold. Even if this is the case it is not clear that the qualitative behavior of the system does not change somewhere between 6 and infinity.

6) Are there any analytical arguments that support the authors numerical findings?

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Sent: Wednesday, December 16, 2020 1:37 AM
To: Schäfer Martin <m.schafer@ujf.cas.cz>
Subject: Your Submission

Ms. Ref. No.: PLB-D-20-01192
Title: Multi-fermion systems with contact theories
Physics Letters B

Dear Mr. Schäfer,

Reviewers' comments on your work have now been received. You will see that they are advising that you revise your manuscript. If you feel you can address the issues they have raised and you decide to revise

your manuscript, please submit a list of changes and a rebuttal against each point which is being raised when you submit the revised manuscript.

To submit a revision, please go to https://www.editorialmanager.com/plb/ and login as an Author.
Your username is: m.schafer@ujf.cas.cz

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Yours sincerely,

W. Haxton
Editor
Physics Letters B

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