
Decision on Nature manuscript 2013-04-05673A

From : decisions@nature.com
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15th November 2013

* Please ensure you delete the link to your author home page in this e-mail if you wish to forward it to your coauthors.

Dear Dr Zheng

Your manuscript entitled "Quarks Through the Looking-Glass -- New Measurement of Parity Violation in Electron-Quark Scattering" has now been seen by three referees, whose reports are enclosed below. As you will see, all the referees are complimentary about the work, although they have differing views on whether the advance is such that it would justify publication in Nature. This, however, is an editorial judgement, and after consultation with my colleagues I am pleased to inform you that we can in principle offer to publish the paper. First, however, we would like you to revise your paper to address the specific points made by the referees, and to ensure that it complies with our Guide to Authors (www.nature.com/nature/authors/gta).

Please note that the title of the paper may not contain punctuation or exceed 90 characters (including spaces). We suggest simply "Measurement of Parity Violation in Electron-Quark Scattering".

Letters begin with a fully referenced paragraph, ideally of about 200 words, aimed at readers in other disciplines. This paragraph starts with a 2- to 3-sentence, basic introduction to the field; continues with a 1-sentence statement of the main conclusions starting 'Here we show' or an equivalent phrase; and finally, concludes with 2 to 3 sentences putting the main findings into general context so it is clear how the results described in the paper have moved the field forward. A downloadable, annotated example is available at www.nature.com/nature/authors/gta/index.html#a1.2. Summary paragraphs can be up to 300 words long if necessary to explain complex material for readers in other fields. The extra length, however, is for introduction and context, and not for additional technical information.

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Authors should ensure that any statistical analysis used is sound and that it conforms to the journal's guidelines (see www.nature.com/nature/authors/gta/index.html#a5.6 for guidance).

Please ensure that all references contain final page numbers. Footnotes are not permitted, so please incorporate item 27 within the main body of the text.

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Given the complexity of your Methods section, it is fine to supply this as a separate "Supplemental Methods" pdf.

Please supply the following electronic files:

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We hope to hear from you within two weeks; please let us know if the process may take longer.

Yours sincerely

Dr Karen Howell
Senior Editor

Referees' comments:

Referee #1 (Remarks to the Author):

The paper entitled "Quarks Through the Looking Glass - New Measurement of Parity Violation in Electron-Quark Scattering" presents an important experimental result, which opens up a new program of study from an old field of physics, and certainly deserves publication. The collaboration that performed this measurement consists of leaders in the field of polarized electron scattering, and the road to future measurements at higher energy has begun. Given the great success of the polarized electron scattering program at Jefferson Lab with its 6 GeV beam energy, and the many technical accomplishments that have been realized over the years, there is little doubt as to the robustness of the present measurement. The re-establishment of measurements of parity violation in the deep inelastic scattering after nearly 35 years is an attractive accomplishment and bodes well for the future of the parity violation program.

Although the experiment is notable, reliable and publishable, the challenging issue is whether the result is of such significance that it justifies publication in Nature, where the scientific criteria is that the paper be "of extreme importance to scientists in the specific field" and "to be acceptable, a paper should represent an advance in understanding likely to influence thinking in the field. There should be a discernible reason why the work deserves the visibility of publication in a Nature journal rather than the best of the specialist journals." For example, is this publication of such impact that Physical Review Letters is not adequate enough exposure?

The authors present the following key features to justify the overall significance of the results.

It is the first measurement of parity violation in deep inelastic scattering in the past 35 years. For testing a combination of the electroweak constants, C2q's, the measurement is five times more precise than what was done previously. The results yield the first non-zero determination of the electroweak coupling constants C2q's, predicted by the Standard Model. And, the results put a new constraint on the existence of Λ+- parameters probing the 4 to 5 TeV scale, surpassing limits on similar constants from HERA at DESY and providing comparable sensitivity to that probed by the ATLAS experiment at CERN.

The difficulty is the impact of the measurement on fundamental physics. The result puts constraints on new physics comparable to the ATLAS test of the left-left isoscalar model. However, the ATLAS measurement was published in Physical Review D and, though important, it is one of many constraints on potential new physics channels and did not fundamentally advance the field beyond what was expected. Overall, it is fair to conclude that the ATLAS result and the parity violation measurement presented in this paper are of comparable impact on physics searches, and therefore could be published in equivalent level journals.

However, there is an additional difficulty in this paper concerning the interpretation of the measurement. The beam energy is very low and as a result, the kinematic range is limited. There is one measurement at Q2 = 1 GeV2 and a second measurement at Q2 = 2 GeV2. The concern is the existence of higher twist effects. In the last sentence the paper states that "our results on C2u,2d are largely not affected by this effect at the present precision." But, it is arguable whether these low Q2 are in a region where higher twist effects can be safely ignored and not have even a significant impact on the overall new physics sensitivity.

Take the following case. Assume that the result implies a violation of the Standard Model and a potential discovery of new physics. The first line of attack on the measurement would be that the Q2 was too low and that the results disagree with the Standard Model due to higher twist effects. The only way to respond to this criticism would be to perform measurements at higher Q2, which is, indeed, already in the long-term plan of the Jefferson Lab program. In fact, the search for higher twist effects is by itself an important study with implications towards understanding nucleon spin structure. But, if these effects are large, they weaken the case that the measurements are sensitive to new particle physics phenomena at higher energy scales.

The two measured asymmetries, at comparable Q2, are probably not adequate to constrain potential deviations coming from higher twist effects. Unfortunately, theoretical calculations on higher twist effects are difficult and generally not reliable numerically.

The experiment is groundbreaking in that it opens up a new field of study of parity violation in deep inelastic scattering. The experiment is challenging in that there is a large pion background in these measurements, and this difficulty was addressed. However, technically it is perhaps not as novel as other parity violation experiments that have been performed at Jefferson Lab, in particular those that have measured much smaller asymmetries.

Several minor comments:

(1) "Standard Model" should be capitalized. It is capitalized once in this paper, but appears otherwise not capitalized. It should be capitalized everywhere, which is the convention in particle physics.

(2) At the end of the first introductory paragraph, there is a statement that this experiment "opens the door to even more precise measurements in the future". The paper would benefit from a discussion in the conclusion about future plans. At least one major improvement will be to run the experiment with a higher energy beam. There are a number of approved experiments that will be performed at Jefferson Lab and it would be worthwhile to mention this to the reader.

(3) As noted in the comments above, the statement that the two measured asymmetries place a restrictive enough limit on potential higher twist effects so that those effects can be ignored at these Q2 values is not really convincing.

(4) The section on Method Summary should be incorporated into the main text. It presently contains quite a bit of redundancy compared to what is already given in the main text. For example, there is no reason to state twice the location of the experiment (Jefferson Lab) or restate the target (deuterium) and beam used. This is a short enough publication that tightening the main text should be doable.

(5) There are some grammar weaknesses in the abstract that should be cleaned up. "report ON a .." ...." Five times MORE PRECISE .... (not BETTER)" "(the) quantities" → "quantities", etc...

If there is a PhD thesis on the experiment, it should be referenced for further details on the experiment. Even if all the experimental details are kept, as is, they should appear upfront in the section where the experiment is described to avoid repetition.

The credit to previous work is appropriate.

Referee #2 (Remarks to the Author):

This is a publication which scientific community has been waiting for a long time. Jefferson Laboratory very accurately measured parity violation in electron-quark scattering, provided new tests of the Standard Model and limits on new physics beyond the Standard Model. This is one of the most important experimental works in elementary particle physics, and it certainly deserves to be published in Nature.

Referee #3 (Remarks to the Author):

This is an interesting, albeit expected, result. It represents the first improvement (by about a factor of 5) in parity violating deep-inelastic polarized electron-deuteron scattering since the classic SLAC E122 experiment by Prescott et al in 1978. That important experiment confirmed the electroweak sector of the standard model at a time when it was in doubt and made a relatively precise measurement of the weak mixing angle. It probably should have been awarded a Nobel prize.

This paper concentrates on parity violating effects due to the quark weak neutral axial-vector current of the standard model. It confirms expectations at the 95% confidence level and uses the results to constrain new contact interactions (beyond standard model expectations) to be > O(5TeV), if they exist. That is a reasonably competitive bound (but not the best). Future measurements at higher JLAB energies hope to further significantly improve the results.

The paper is fairly clear, but relies heavily on details presented in the Supplementary Information that would be linked online to the article. The analysis appears straightforward. However, I was surprised to not see an error stated for the standard model predictions that were compared with. An error must result from truncation of the perturbative series and neglect of some QCD effects.
The authors should state clearly in the Text the approximate theory error and what has been neglected. They may find that QCD is more important in modifying the prediction than they seem to think and suggest.

Some of the physics terminology is confusing, if not incorrect. For example, in the Abstract and Text, the authors suggest that quark chirality flipping is being measured in the scattering asymmetry via an axial-vector interaction. However, all gauge interactions studied, vector and axial-vector conserve chirality for both the electron and quarks. Chirality flipping usually suggests an interaction that changes left to right and vica-versa. No such interactions are in play here. Those comments should be modified or if the authors feel they are correct, an explanation of exactly what is meant should be given.

Some of the way literature is cited seems peculiar. For example, how can one discuss parity violation without mentioning Lee and Yang. Instead, the paper simply gives credit in the text for the discovery of parity violation to C.S. Wu (with no mention of others, even collaborators) for parity violation. Another example is the suppression of higher twist effects where work by Bjorken should have been cited.

Readers may be confused by the extrapolation of the results down to Q^2=0 in for example eq(6) and the subsequent discussion, since such an extrapolation is not needed either for the weak mixing angle determination (at the Z mass) or for the constraints on contact interactions.

Some of the equations have unusual normalization that looks peculiar. For example, why is the 6/5 in eq(3) not factored out in eq(2) and simpler definitions of a_1 and a_3 used. Also, why not mention that the formulas are given in a valence quark approximation although the analysis includes sea quark effects.

To be accessible to a wider audience, the authors should make the title and text crisper and explain in a bit more detail why the experimental results are particularly important.

Although the results are novel and worthy of publication, I do not see the need
to publish in Nature. In fact, a more technical article that incorporates and expands the Supplementary Information into the text would be much more useful, particularly if it the analysis and assumptions were thoroughly explained. A Nature article should be reserved for stronger evidence than a (less than) 2 sigma effect, or for an unexpected finding of dramatic consequence. In addition, it should be of interest to a more general, wider audience of Scientists than specialized workers in the field.

Perhaps this paper can be made more exciting in tone, motivation and implications in a way that would make it more suitable for Nature. For example, a crisper, more provocative title might be: "Unveiling Quark Properties Through a Parity Violating Looking Glass". Also, to be of wider interest, it might incorporate some of the early history and mystery of parity violation while also elaborating the discussion of elegant experimental technique. One might also mention the importance of (rather large) quantum corrections probed by this experiment and some history of their evolution and successes.

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