The authors develop a simple pseudo-potential (PP) approach to complicated processes of electron capture and transfer and collisions. They show the best results for inverting a many-electron potential to yield effective one-electron charges is by the Depurated Inversion Method they previously published.

This is well-presented, on the whole and the application is ambitious so I suggest publication after some points are modifies.

The description of numerical difficulties in obtaining the pseudo-charges is detailed, in particular for the 2s AO of the lithium atom. One problem is that a singularity appears due to charge repulsion at around r=1 au. This resembles an electron-electron cusp and could be interpreted physically, because the charges have been defined (although an orbital may be empty) and could be averted by explicit correlation factors.

Let me comment the CH4 application.

This uses PPs to replace node-less AOs so it is not a case where the arguments developed and illustrated by fid 1 and 2 are actually applied.

In below (3), the claim concerning H-atoms is correct but a physical interpretation of the PP in this case is missing.

So, for CH4 oscillations in the AO basis are not modified by use of a PP. They come from defects in the GTO basis as the authors mention.

A-why not use an ETO basis? The first term of eq (31) is like an LCAO of Is ETOs.

The n=2 shell could be compared with simple semi-cartesian Sturmians:

S(1) = N (s+x+y+z) A(r)

S(2) = N (s-x-y+z) A(r)

S(3) = N (s-x+y-z) A(r)

S(4) = N (s+x-y-z) A(r)

Here N=1/2 for othonormal functions, A(r) = exp(-(Z\_eff r)/2

s= (2/a –r)

and x,y,z are just the Cartesian functions.

They are bases for the Irreps a2 (S(1)) and t1 (S(2), S(3), S(4)) Z\_eff is to be optimised and could be given a value from the Clementi tables.

It is well-known that modest GTO basis sets introduce oscillations, since grad (\rho] / \rho is not smooth.

The FD finite difference HF seems to cure this and it should be benchmarked against ETOs.

I would suggest that NaH would be a nice example, with a 10-electron core PP and comparison to the detailed study of Li and H.

However, the desired properties are obtained quite well.

A small point is that a PP is not the same as ‘GGA’ which is a family of functionals. The ABINIT GGA is PBE by default and the PP is calculated within that framework. The important point it that it is ‘norm-conserving’.

The English is rather poor.