RESPONSE TO COMMENTS OF GUNAR AND PIET

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1 GUNAR has raised two issues, one regarding notation, the other interpretation.

1.1 Notation

I am sympathetic to Gunar's complaint against using g_T for the tensor charge. Indeed, in BLT we use the Jaffe-Ji notation δ. However, a very important Physics Report by Barone, Drago and Ratcliffe appeared [**359** (2002) 1] and this uses g_T [see Eqns (4.4.4)]. Actually, I don't like δ very much either. But, regarding general questions of notation, I strongly advise everyone to read page 7 of Barone et al. However, you will see that there is a contradiction between page 7 and Eqns (4.4.4)—-on page 7 they say they will use δ, but in (4.4.4) they use g_T . Help!!

1.2 Interpretation

There is not the slightest doubt that it is the sum of $\Delta_T q(x) + \Delta_T \bar{q}(x)$ that appears in the BLT sum rule. I don't understand what Gunar means by 'non-interacting' quarks. Of course they are bound together to form the nucleon, and this is expressed via their wave-function. For example, in ordinary QM, the fact that we can expand a wave-function in plane waves does not mean the constituents of a bound system are free.
Moreover I want to stress that exactly the same manipulations, **regarding Fock states**, go into deriving the Transverse sum rule as go into deriving the Longitudinal sum rule. This is crucial. If you are unhappy about the one you have to question also the other!

2 PIET has commented on operators and other versions of the transverse sum rule

2.1 An operator interpretation

Piet made an interesting comment about trying to relate the sum of quark and antiquark transverse densities to an operator, which it seems has to be non-local.

2.2 Other transverse sum rules

Piet also quotes the Teryaev, Pire, Soffer sum rule. If you look at this unpublished paper you will see that **there is no derivation**. It is simply written down! And it is simply stated that $g_T(x)$ "is the natural measure of the quark contribution to transverse polarization".

One problem with the latter is that $g_T(x)$ does NOT have a direct, probabilistic partonic interpretation, unless you take the mass of the parton to be meaningful. But, as a general rule, any quantity calculated in the parton model that ends up proportional to a parton mass is suspect. [See e.g.the paper of Anselmino and Leader, Phys. Letts. **B293** (1992) 216 where a most beautiful formula for g_2 is derived, which, alas, is sheer nonsense.]