Review of the manuscript « Intermittency in fluid and MHD turbulence analyzed through the prism of moment scaling predictions of multifractal models » by Pouquet et al.

This manuscript strongly focuses on the "quasi-parabolic" K(S) law relating kurtosis (K) to skewness (S) by a power law with an exponent close to 2 for a wide variety of turbulent fields ranging from fluid flows to MHD and beyond. In particular, the authors argue that the She-Lévêque (SL) model, including its generalization for MHD, yields a parabolic law K(S) for maximum intermittency.
The fact that this manuscript was prepared as part of the 2024 EGU Lewis Fry Richardson Medal and is co-authored with leading turbulence specialists reinforces NPG's interest in publishing this paper as is, being considered a legacy. However, I believe that this paper can be further improved, at the discretion of the authors. I hope the comments and suggestions below could be helpful in this direction.

- Page 1 (L10-16):

It is surprising that in their introduction to intermittency, the authors do not really mention the wind turbulence that has been considered *per se* for some time, at least since Kolmogorov 1941 and the questions raised by Arnold about its intermittency, which led to first models of intermittency (Kolmogorov, 1962). Furthermore, fundamental paradigm shifts occurred when two earlier EGU Lewis Fry Richardson Medalists demonstrated that the atmospheric spectrum could no longer be split into 2D/3D turbulence for large and small scales respectively (e.g., Lovejoy and Schertzer (2013)).

- Page 1 (L38):

It could be restrictive to define intermittency by the presence of “localised structures”, whereas if structures are more obvious at small scales, the scaling of turbulence nevertheless implies structures at all scales.

- Page 3 (L81-83):

Contrary to what is stated on L82, the kurtosis is not “recentered” by 3 in what follows. It may be useful to recall that mono/uni-fractality of the field *f* yield strictly scale invariant *K* and *S*, which is no longer the case for multifractal fields.

- Page 4 (L84-91):

It would be interesting to have early historical overview of the quasi-parabolic relation between the skewness and the kurtosis

- Page 4 (L99 and elsewhere, including Fig.1 caption):

ε_v is presented as the kinetic energy dissipation, whereas it could correspond to the energy flux density. It should be made very clear from which papers the figures of Fig.1 are taken should be clearly indicated. This is a systematic problem of every figure caption.

- Section 4.1 (L.162-171):

- the She-Lévêque (SL) model is the main model used to theoretically derive a few properties of the *K*(*S*) law, but it is only abruptly presented by the scaling exponent ζ_p of its structure function (Eq.7), not the stochastic model itself;
- whereas important limitations may result from the fact that, like shell models (e.g. Frick et al., 1995), SL has only scales, not any space extension, and hence properly speaking no structures, contrary to multiplicative cascade models and, of course, DNS;
- in particular the *x* parameter (often noted Δ in other papers) is supposed, as usual, to be related to the co-dimension of the most dissipative structures, but this is not obvious due to the previous remark, however this parameter does not play a key role in what follows;

- the role of the β parameter is much more important (see Eq. 7). Its definition does not seem fully satisfactory for me, but could be understood as the sensitivity of the intermittency to the statistical order. The main problem that its value 0 is from time to time claimed to correspond to maximal intermittency (e.g. in the abstract and L.153-154), while elsewhere it is indeed regarded as vanishing intermittency (e.g. L.165).

- Section 5

Both section 5.1 (Langevin models) and 5.2 (S.O.C.) only seem to describe other approaches, but do not yet provide quantitative results. Regarding S.O.C., it seems surprising that P. Bak is not cited.

- Section 6 (Conclusion)

In their conclusions, the authors draw up an impressive list of research extensions, e.g. taking helicity into account. However, to clarify the possible outcome of the present work, I would suggest that the authors look at the framework of universal multifractals (see the references already cited), in particular to show that the strict parabolic law of K(S) is reached with vanishing multifractality. This could be particularly helpful for understanding the physics behind a quasi-parabolic law $K(S)$ for maximum intermittency.