Response to Referee A:

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*The paper deals with a long-standing topic in plasma physics and fusion research, i.e., shear flows and turbulence modification, which is tightly related to the plasma confinement. The authors provide, in  
this paper, a very clear and quantitative relationship between shear flows and turbulence modification and the exact causes in the reduction of fluctuation-driven transport (e.g., amplitude reduction, change in crossphase) in a systematic manner, using a linear device where more precise measurement can be done with traditional probes, in contrast to fusion-oriented devices of high temperature. However, I find a serious problem with a paper. A bunch of works on this subject has shown, at least qualitatively, that the intense shear flows should result in the reduction of turbulence and turbulence-driven transport. My overall impression is that the paper is well-written in presenting their experimental results and their comparison with the BDT-theory, however, the new and significant points that the paper should add to the existing works are not so clearly demonstrated in the present form of the paper. Therefore, I suppose that the problem should be fixed in a revised version in order to have the paper worth published Phys.  
Rev. Lett.*

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We would like to thank referee A for providing a careful and insightful review. We appreciate the referee's remarks on the clarity and well-written nature of our manuscript. We also understand the referee's concerns about the need to clarify how our work stands out from previous research in this area. There is a large body of experimental work, both on fusion devices and basic plasma devices, which provides evidence of the suppression of cross-field transport by sheared flow. However, as the referee points out, a large fraction of this work is qualitative in nature: a connection between increased shearing and transport reduction is established, but the quantitative details of how transport varies with shear is generally lacking. We feel that our work is the first to quantitatively document the variation in turbulence and turbulent transport using external control of flow and flow shear in a dedicated experiment. This has been enabled by the ability to continuously vary the edge flow in LAPD using biasable limiters. There have been a number of prior attempts to create a dedicated basic plasma physics experiment (generally in linear devices) for establishing the quantitative relationship between flow shear and transport reduction, but the difficulty has always been achieving control over the flow and so no previous linear device has been able to gather the dataset reported in this manuscript. Having said all of this, we do agree that we need to do a better job elucidating the new and significant discoveries associated with our work; here we list the points we feel justify the publication of this manuscript in PRL:

1. **Our data shows that the modification of turbulence and transport depends primarily on the magnitude of the shearing rate and not the direction of the flow or sign of the shearing rate; an observation enabled by the ability to continuously vary flow including reversing the flow direction in LAPD.** Biasinghas been used to drive flow in a variety of devices for over two decades; most of these experiments have used cold electrodes for biasing. There have been attempts to drive flow in opposite directions (e.g. See Silva PPCF 2003), however current collection on a cold electrode can only be large in electron collection and therefore the ability to reverse the current (and the associated torque) is very limited. In LAPD, spontaneous rotation in the edge is strong and in the ion diamagnetic direction; biasing drives flow in the opposite direction. This has allowed a variation from significant flow in the ion direction to strong flow in the electron direction in LAPD.
2. **The achievement of a nearly-zero flow and flow shear state allows for study of turbulence in a mean-shear-free state.** Biasing can be used to reduce the spontaneous flow in LAPD and produce near-zero flow over a wide range of the radial profile in LAPD. This allows for a direct measurement of turbulence properties and transport response without the influence of flow and flow shear (whether driven or spontaneous). This shear-free state is also desirable as a point of comparison as the shearing rate is increased (e.g. we are able to normalize the shearing rate to the no-shear turbulent autocorrelation rate).
3. **We observation that turbulent transport and amplitude reduction can be achieved for shearing rates less than the no-shear autocorrelation rate**

Theories suggest that strongly sheared flows (10-100 times autocorrelation rates) would be necessary to reduce turbulent transport via “standard” processes (e.g. decorrelation) [CAN WE ADD CITATION HERE]. Some experiments have shown suppression with very strong shear (at least 10x autocorrelation rate---see Weynants 1998, Boedo 2000). In the data reported here, we find substantial reduction of transport and turbulent amplitude for shearing less than the autocorrelation rate. By a normalized shearing rate of 1-2 (comparable to the no-shear autocorrelation rate) we find complete suppression of turbulent transport in these experiments.

1. **We provide the most detailed, quantitative data set to date on the variation of transport and turbulence properties with shearing rate.** As the referee points out, he ability to do a detailed analysis of biasing and shearing in a linear device like LAPD is useful as the issues associated with magnetic field curvature are not present. On LAPD, unlike on most fusion plasma devices where biasing done, one can conduct detailed probe measurements as well as (as will be shown in later papers) fast camera measurements.

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*The other important points are as follows.  
1) According to the recent understanding of the plasma turbulence and  
transport, zonal flows are one of the major players for the plasma  
turbulence. Therefore, if all stories contained in the paper are  
limited to the shearing flows, the paper seems behind time. If the  
authors can state anything about the behavior of zonal flows in their  
experiment, the paper is much stronger.*

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In a linear device such as LAPD, the mean azimuthal flows are more or less the same as zonal flows. Moreover, zonal flows are not the only player in the understanding of plasma turbulence. While the role of zonal flows on LAPD may not play as large a role in terms of understanding turbulence and transport, experiments such as that presented can explore other players such as the role of crossphase between density and electric field fluctuations, or shear/flow driven modes such as Kelvin-Helmholtz modes which are stable in devices with curved magnetic configurations

2) The authors do not show exactly the radial positions of the  
measurement on shearing rate, gradient, turbulence-driven fluxes, and  
so on. Are they the averaged values like the shearing rate in Fig. 1c,  
as the authors mention?

The paragraph at the bottom of page 4 indicates that all spatially averaged quantities are averaged over the range 27 to 31cm just as is indicated in Fig. 1b  
  
3) References seems insufficient, particularly in recent works of  
fusion research.  
  
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Report of Referee B -- LT13360/Schaffner  
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This paper reports a study of the suppression of turbulence and  
turbulent transport associated with sheared-flow in the edge of the  
LAPD device. The magnitude of the flow and flow-shear is adjustable  
continuously using a biased electrode arrangement. Measurements in the  
shadow of a biased limiter indicate that the flow-shear acts to reduce  
the amplitude of the turbulence, and therefore the turbulent particle  
flux. Few experiments have been conducted with this type of precise  
control of the flow. The paper is well written. I have only relatively  
minor comments for the authors to consider in a revision. These points  
are aimed to help improve the paper.  
  
1. There is a passing comment that drift waves are responsible for the  
turbulence. Earlier papers in the references state that the turbulence  
is drift-Alfven. It would be helpful for context for the authors to  
describe briefly the nature of the turbulence directly in this paper.  
If known, it would also be helpful to indicate the likely nature of  
the coherent mode that appears with the addition of the biasing.

The origin of the coherent mode that appears with strong flow/biasing is currently under investigation.  
  
2. While it is clear the turbulent particle flux is reduced, the  
context relative to overall particle balance in LAPD is not quite  
clear. Is the perpendicular loss dominant? One can imagine that  
parallel effects might be large in this plasma. It would be helpful to  
have a short discussion of the relative importance of the turbulent  
flux relative to overall particle balance.

The length of LAPD (approximately 20m) is sufficient to allow perpendicular transport of particles to compete with the parallel losses. A more detailed analysis of the particle balance is underway and will likely be presented in a future paper.  
  
3. I do not see in the paper a statement of the axial location of the  
radial profile measurements. Presumably it is between the limiter and  
end mesh, but the location should be noted. Is there any reason to  
expect the measurements would vary along the axial direction? In  
particular, is the shear flow axially uniform (between the  
electrodes)? One might imagine it is weaker away from the limiter.

The axial location can be noted.   
  
4. A minor point, are electron temperature fluctuations ignorable,  
such that floating potential measurements reliably yield the  
turbulence electric field? This might be important in regard to  
conclusions regarding the cross-phase, in particular.

Fluctuating electric field measurements in this experiment are made using two floating tips spaced 0.08cm apart. While temperature fluctuations do exist in the region of interest, an assumption is made that the difference over which the electric field is calculated is small enough that the two tips essentially see the same temperature and thus would not affect the field measurement.