Structures Propagation in Texas
Helimak

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Texas Helimak

- Helicoidal magnetic field lines.
- Cold Plasma similar to the SOL of Tokamaks
- 1D MHD equilibrium
- 16 bias plates with many probes.
Texas Helimak

- The electric field profile can be changed by externally applying an bias on the plates.
- This also changes the regime of the turbulence.
Density Profile

![Density Profile Graph](image-url)
Bursts in Texas Helimak

Example of Ionic Saturation Current

P.D.F. of the $I_{\text{sat}}$
(Self) Conditional Average
(Self) Conditional Average

Burst instants $t_n$
(Self) Conditional Average

Burst instants $t_n$

$$I_m(\tau) = \frac{1}{N_b} \sum_{n=1}^{N_b} I(t_n + \tau)$$
The bias value does not affect the mean pick width, just changing the base line value.
(Cross) Conditional Average
(Cross) Conditional Average

Reference Probe
(Cross) Conditional Average

Reference Probe

Target Probe
(Cross) Conditional Average

\[ I_m(\tau, r, p) = \frac{1}{N_b^{(r)}} \sum_{n=1}^{N_b^{(r)}} I^{(p)}(t_n^{(r)} + \tau) \]
Conditional Average

The appearance of trends in the conditional average indicates that the burst structure propagates outwards.

And upwards.
How can we measure the velocity?

- If we use only the time delays and distances, the measured burst speed will be wrong.
- The actual structure velocity is both smaller and points to another direction.

\[
\Delta t = \frac{d_{ef}}{V} \\
V_{ap} = \frac{d}{\Delta t} = V \frac{d}{d_{ef}} = \frac{V}{\cos \theta}
\]
Propagation of Bursts

Time
(0 is when the burst appears in the reference probe)

Conditional Average values

Probes

Reference Probe
Propagation of Bursts
Burst Fit

- Constant velocity,
- Two characteristic lengths,
- The intensity decreases as the burst gets further from the reference probe,
- Lorentzian shape (best fit)
Burst Fit
Burst Fit

![Graph showing the relationship between velocity and bias voltage. The graph has a blue line for velocity in km/s and a black line for bias in V. Velocity increases as bias increases.]
Top Plate
Top Plate

[Graph showing data points and lines indicating delay vs bias]
Top Plate
Top Plate
Radial Dependence

![Graph showing radial dependence with different V_0 values.](image)

![Graph showing vertical dependence with different V_0 values.](image)
Radial Dependence
Conclusions

• The conditional average fit shows that the structures that generates the bursts propagates in the vertical and radial direction.

• Estimate velocities using time that takes to an object pass two different probes may give absurd results.

• The bursts radial velocities, size and duration increase with the radial position.