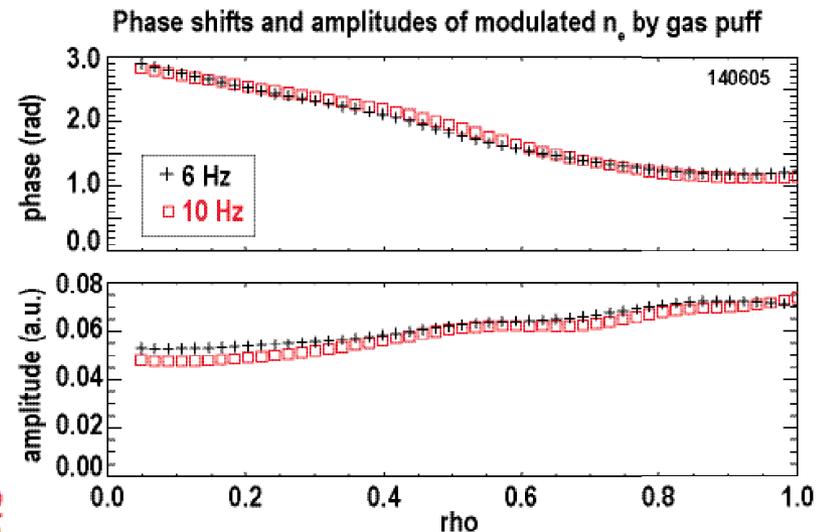
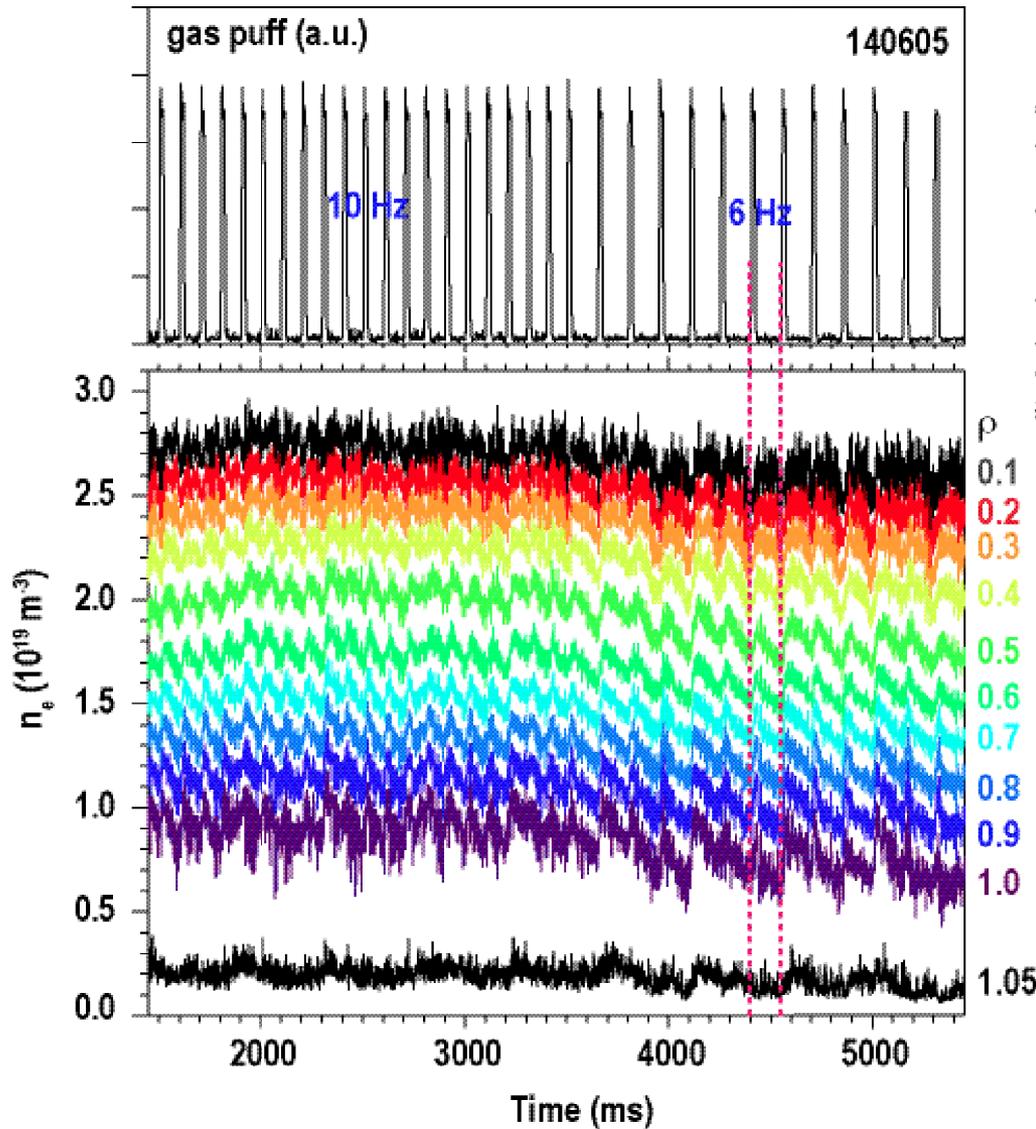


# Electron Particle Transport Using Modulated Gas Puff

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- **In support of FY2012 JRT Milestone**
  - Measure core electron particle transport
    - > L-mode (Ohmic and NB-heated)
    - > H-mode possibly after October 2011 (requires DIII-D V-band system)
  - Simultaneous measurement of core turbulence
  - Connection to theory
  - Comparison with DIII-D results
- **Measure particle diffusion coefficient (D) and pinch velocity (v)**
  - Modulate edge particle source with gas puff using SGI
    - > Identical to method used on DIII-D in 2010
    - > Analysis by Takenaga (JT-60U) assumes cylindrical symmetry
  - Use ultrafast-swept frequency reflectometers for density profile response
    - >  $n_e = 0.2-3.5 \times 10^{13} \text{ cm}^{-3}$ ,  $\Delta t > 4 \mu\text{s}$  resolution
- **Turbulence measurements**
  - Ultrafast-swept frequency reflectometers
    - >  $\delta n/n$ ,  $k_r$  spectrum ( $0-20 \text{ cm}^{-1}$ ), radial correlations
  - BES, high-k, FReTIP, correlation & fixed-frequency reflectometers
    - >  $\delta n/n$ ,  $k_r$  &  $k_\theta$  spectra, radial & poloidal correlations
- **Theory prediction will use nonlinear GYRO**
  - Low order comparisons: D and v
  - High order comparisons:  $\delta n/n$ , spectral shape, correlations
  - $v^*$ ,  $I_p$ ,  $B_T$  scans

# Example of Technique and Analysis



Assume local perturbation:  $\tilde{n} = A(r) \sin(\omega t - \phi(r))$

Assume cylindrical symmetry, modulated transport equations yield:

$$D = -\frac{\omega(X + Y) \sin(\phi)}{r \frac{\partial \phi}{\partial r} A}$$

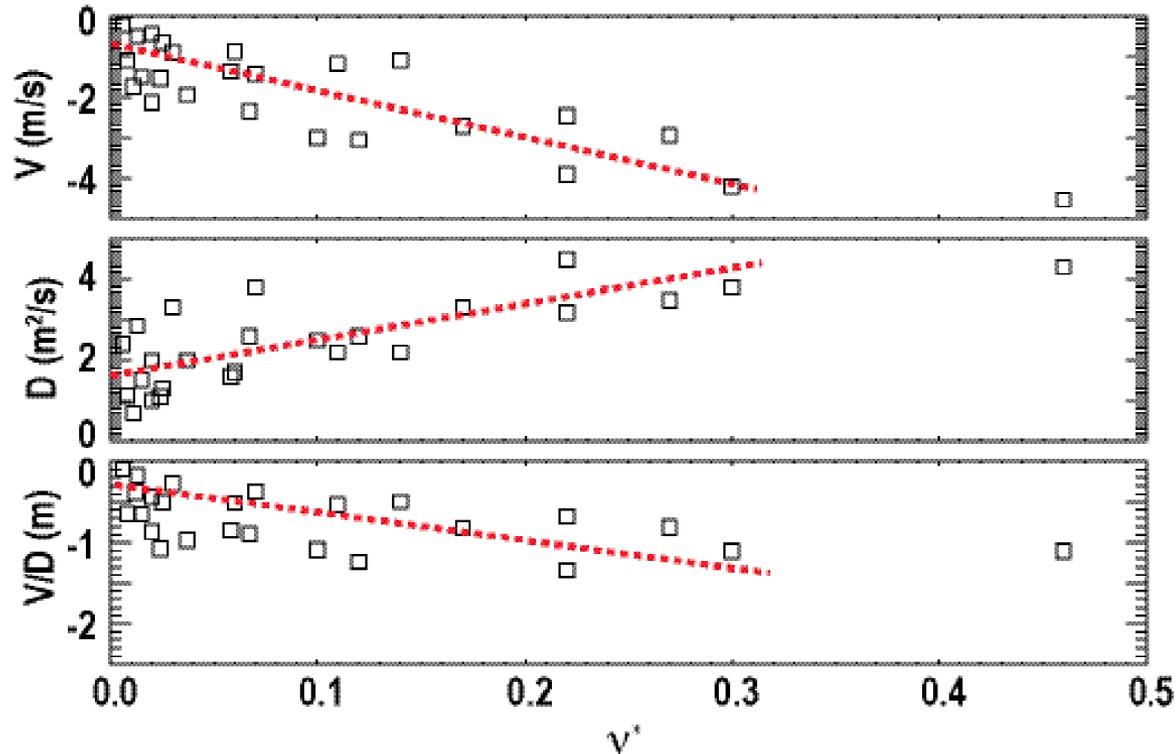
$$v = -\frac{\omega \left( \frac{\partial A}{\partial r} Y - \frac{\partial \phi}{\partial r} A X \right) \sin(\phi) + \left( \frac{\partial \phi}{\partial r} A Y + \frac{\partial A}{\partial r} X \right) \cos(\phi)}{r \frac{\partial \phi}{\partial r} A^2}$$

$$X = \int_0^r r A \cos(\phi) dr$$

$$Y = \int_0^r r A \sin(\phi) dr$$

# Investigate $v^*$ Dependence

## Particle transport analysis



- **Dependence on collisionality**
  - **Diffusion coefficient, inward pinch velocity increase with  $v^*$** 
    - > Same observation seen on many machines
  - **Turbulence driven**
    - > On NSTX compare with turbulence measurements ( $\delta n/n$ ,  $k$  spectra, correlations)

# Experimental Plan

- Requested run time: 2 days
- Day 1: Develop 2 standard target discharges
  - Necessary conditions
    - > MHD-free during time of interest
    - > L-mode with density below  $3.5 \times 10^{13} \text{ cm}^{-3}$
  - Develop Ohmic target, adjust SGI parameters 9 shots
  - Document Ohmic target 6 shots
  - Develop NB-heated target, adjust SGI parameters 9 shots
  - Document NB-heated target 6 shots
- Day 2:  $v^*$ ,  $I_p$ ,  $B_T$  scans
  - 3 point scans in NB-heated targets, combined with Day 1 shots 30 shots
- Requirements
  - Diagnostics:
    - > Reflectometers, BES, high-k, FIRETIP, etc.
    - > MPTS, CHERS, MSE, USXR, etc.
  - Would benefit from some experience with SGI operation in L-mode prior to Day 1
- Analysis
  - LRDFIT, TRANSP, GYRO, etc.

# Some Thoughts About H-Mode

- **Requires DIII-D V-band system**
  - **Delivery after end of DIII-D run (October 2011?)**
  - **Extends frequency range to 72 GHz**
    - >  $n_e = 0.2 - 6.4 \times 10^{13} \text{ cm}^{-3}$
  - **Turbulence measurements will require modifications**
    - > **Increase HTO tuning voltage circuit to 10 MHz**
    - > **RF shielding**
    - > **Repackaging for equipment rack**
    - > **Waveguide fabrication**
    - > **Antenna mock-up fabrication**
    - > **Frequency and distance calibration (in NTC during maintenance weeks)**
  - **Equipment will be activated**
    - > **Will need to arrange for access outside NTC**
  - **Could be available January 2012**
- **Gas puff modulation into H-mode**
  - **Penetration of perturbation to core more difficult**
    - > **Will require more time to optimize SGI puff**
- **Requires considerable effort and planning.**
- **Need to know soon whether this will be worth the effort.**