Simple ELM Discrimination for RWM Active Control Signals in NSTX

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Real-time Discrimination of ELM Signals in Magnetic Sensors is Needed for Robust RWM Control in NSTX & DIII-D

- **Control robustness will be reduced by large "noise" signals (i.e. non-RWM signals)**
- **ELMs have large *n*=1,2,3… magnetic signal components detectable by RWM control sensors**
- **Studies[1] on DIII-D have indicated that control algorithm response to ELM *n*=1 signals can actually drive *n*=1 RWM unstable**

[1] C.M. Fransson, D.H. Edgell, D.A. Humphreys and M.L. Walker, *Physics of Plasmas* **10**, 3961 (2003).

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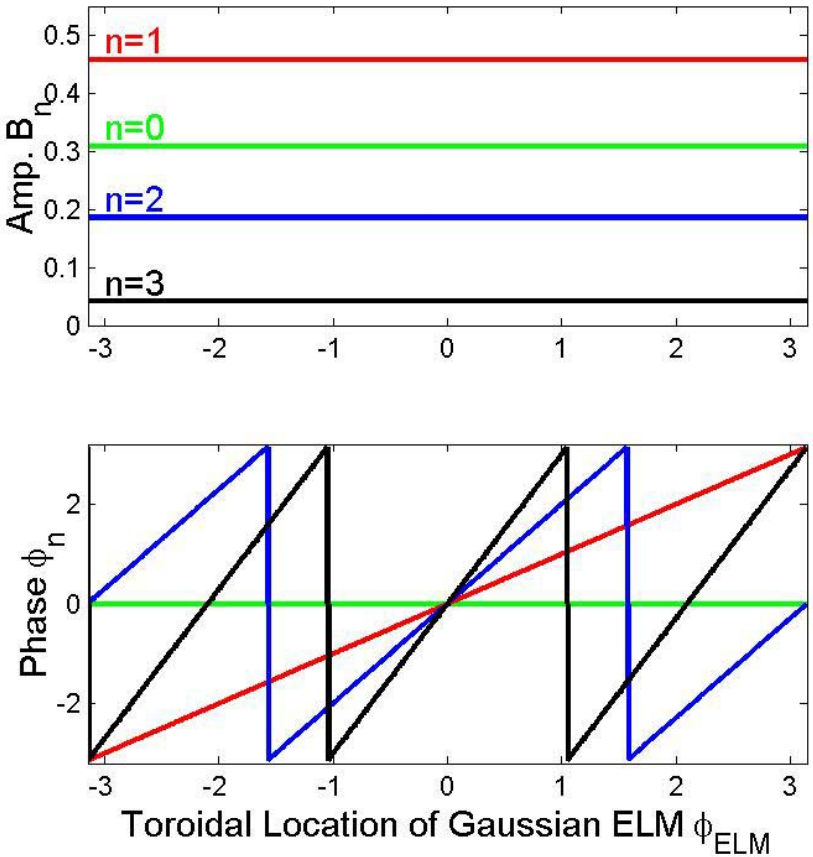
Correlation of *n*=1,2,3 ELM components may allow *n*=1 ELM signals to be subtracted from magnetic sensors in real-time before use in *n*=1 RWM active control on NSTX & DIII-D

- **Measurements of *n*=2,3 signals could be used to infer the amplitude and phase of the *n*=1 ELM component**
- **May eliminate need for more complicated noise removal methods, e.g. real-time Kalman Filtering**
- **Treatment needs to be experimentally validated**
  - *Assumption of Gaussian shape appropriate?*
  - *Variations in Gaussian width for different ELMs?*
  - *Effect of discrete probe positions and hardwired connections*



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Propose using NSTX's New Internal Sensor Set to Characterize the *n*=1,2,3 ELM Magnetic signals

- **NSTX new internal sensors ideal for characterizing ELM components**
  - *hardwired for n=1,2,3 (eliminates large n=0 equilibrium signal)*
  - *even spacing simplifies Fourier analysis*
  - *can determine whether the amplitude/phase of the n=1 component is reliably correlated with the n=2,3 components*
- **High-β_N plasmas (above the no-wall limit) with ELMs typical of RWM studies required**
  - *No dedicated time, strictly piggy-back*
- **Results will benefit future active RWM control experiments in NSTX**
- **If successful could argue for addition of *n*=2,3 sensors to DIII-D RWM *n*=1 control sensor set.**

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