1. Abstract
2. Introduction
   1. What is plasma? Fusion? Why is it important?
   2. Advantages of a tokamak vs mirror vs spherical device.
   3. Toroidal and poloidal modes / mode numbers.
   4. What are fast ions? What are alfven waves? (not in relation to DIII-D, yet)
   5. What is clustering?
      1. Short description of k-means algorithm.
      2. Why k-means *almost* works for us.
         1. Our solution. (EM-VMM)
   6. DIII-D tokamak
      1. Figure of the device
      2. Plasma parameters (from my presentation slides)
         1. Major Radius
         2. Minor Radius
         3. Magnetic Field
         4. Plasma Current
         5. Electron Density
         6. Core Electron Temp
      3. Toroidal & Poloidal Array (magnetic Mirnov coils)
         1. How they work, where they are, signal outputs.
      4. ECE array (electron cyclotron emission)
         1. What is ECE? Short discussion on how ECE radiation is emitted.
         2. How the probes work, where they are, signal outputs.
      5. Instabilities
         1. What they are, what causes them, why we should study them.
         2. TAE’s, RSAE’s, BAE’s.
            1. How do I identify these myself?
3. Data Analysis
   1. Shot list and time windows selected to analyze.
      1. Shots [159243 -> 159257] from Times [300 -> 1400] ms.
   2. Analysis Pipeline. Slightly different for ECE. Still working on it.
      1. Data acquisition, STFT (short time fourier transform), average STFT spectra, select peaks from spectra, calculate phase differences between each probe pair, perform the clustering analysis on the phase differences with k-means, perform clustering analysis again with EM-VMM, filter out low-density clusters. Once you’ve done ^ for all shots, perform another clustering analysis on *all* events.
   3. Plots of spectras, clusters, and identification of modes.
   4. Is here a good place to talk about how we verified that the algorithm was sorting clusters correctly?
4. Results
   1. I’m not entirely sure what to put here, yet.
5. Appendix
   1. Code repository (github.com/syntaxvoid/pyfusiondiiid) and examples
   2. Misc plots

**Helpful Links**

Clustering Narrative:

<http://www.cs.cmu.edu/~sgopal1/papers/ICML14.pdf>