PREPARATION OF EFFECTIVE SCIENTIFIC TALKS

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Theses:

- Giving good scientific presentations (talks or posters) is important.
- There are a number of elements involved in preparing effective scientific talks.

Outline:

- Importance
- Steps In Talk Preparation
- Talk Organization
- Preparation Of Visuals
- Some key points and examples
- Special Considerations For Poster Sessions
- Summary

Giving Effective Talks Is Important

- Your Important Results Should Be Communicated To The Scientific Community
  - If results are not important, why is talk/poster being given?
- Your Professional Reputation Will Depend In Large Part On How Well You Communicate Your Key Results
  - If your colleagues cannot understand your work, they will have little appreciation of it or your contributions to it
- Competing Ideas Are Often Forcefully Presented
  - Major laboratories have presentation courses, talk rehearsals, etc. to hone their talks

A Number Of Steps Should Be Followed In Preparing A Talk

- Consider Audience, Level And Mode Of Presentation

  Specialists, generalists, etc.
  Oral, poster, demonstration, etc.

- Decide On Presentation Thesis

  What do you want listener to learn from talk (prepare summary and presentation thesis visuals first!)?

- Prepare Visuals To Develop Sequentially The Key Points Of The Presentation Thesis

  Say only what needs to be said | eliminate irrelevant information
  Put work in proper context for full spectrum of prospective audience
  Take out or explain jargon, especially local jargon

- Give Rehearsal Before Colleagues

  Revise as necessary

Talks Should Be Tightly Organized

- First Visual

  Title, author, presentation, abstract (if appropriate), thesis, brief outline

- Second Visual (if not covered on first visual)

  Presentation thesis

- Third Visual (if not covered on previous visuals)

  Outline of points to be made to support presentation thesis

- Fourth, ... Visuals

  Development of key points that substantiate presentation thesis

- Last Visual

  Conclusion or summary that should follow from presentation thesis and body of presentation

- In Oral Presentations Allow About One Minute Per Visual

Effective Visuals Have 5 Components

(outline of topics covered in most of remainder of this talk)

- A Title That Is A Thesis
  - What is to be learned from this visual?
- No More Than Six Major Points
  - More will seldom be absorbed by audience
- Large, Clearly Readable Lettering Separated By Adequate Spacing
  - Key points should be obvious, not buried
- Self-Explanatory Major Elements
  - Audience should be able to grasp major points without verbal explanation
- Maximum Use Of Graphs Or Pictorials
  - A picture is worth 1000 words"

Every Visual Should Have A Thesis

- A Thesis Takes The Form Of A Simple Declarative Sentence With An Action Verb
  - The titles of these visuals provide examples
- A Thesis Makes A Statement
  - It is a statement of the point made or proved on the visual - message" of the visual
  - It is not simply a label - e.g., not "graph of y versus x," "this is a horse"
- Limit The Thesis To 10 Words Or Less, If Possible
  - More words usually just indicates verbosity
- The Major Points Developed In A Talk Should Be Obvious From Reading The Theses (Titles) Of The Visuals
  - The titles of the visuals should provide the observer with an outline of the key points of the talk
  - They should also lead to the conclusion(s) presented on the last visual

Too Much Information On A Visual Tends To Obscure The Basic Message Which Is Being Presented On A Visual

- Most People Do Not Absorb More Than Six Facts From Any One Visual
- Putting More Facts On Any One Visual Tends To Confuse The Basic Message
- It Is Difficult To Compress A Lot Of Information Onto One Visual
- It Is Better to Limit The Amount Of Information On A Visual To Only The Critically Important Issues
- By Putting Too Many Points On One Visual, One Tends To Confuse Trivial Points With Important Ones
- One Should Decide Which Are The Important Facts Germane To The Thesis Of The Visual And Limit The Visual To Those Facts
- Major Facts Can Be Amplified By Subfacts
  Subfacts can be indicated by a different typeset or capitalization
- If Too Many Facts Are Presented On A Visual The
- Audience's Long Term Memory May Be Dominated By A Trivial Fact
- The Various Facts On A Visual Should Be Presented Hierarchally With The Major Facts Obviously Dominant And The Minor Ones Subordinate
- Ample Space Should Be Left Between Separate Points So They Don't Become Blurred Together
- Major Points Should Be Explained In As Simple And Clear A Form As Possible
  Example of a bad visual|far too much stuff on one visual

Use No More Than Six Statements Or Concepts Per Visual

- Audience's Short Term Memory Saturates At About Six Facts Per Visual
- More Will Confuse The Audience And Obscure Your Message
- Worse, A Trivial Fact May Replace An Important One In The Audience's Long Term Memory
- Statements Or Concepts Discussed At Each Level Of The Hierarchy Of Visual Elements Should Be Of Comparable Importance
    - Subordinate points can be distinguished by indentation, a smaller font, or less capitalization

Visuals Should Be Very Readable

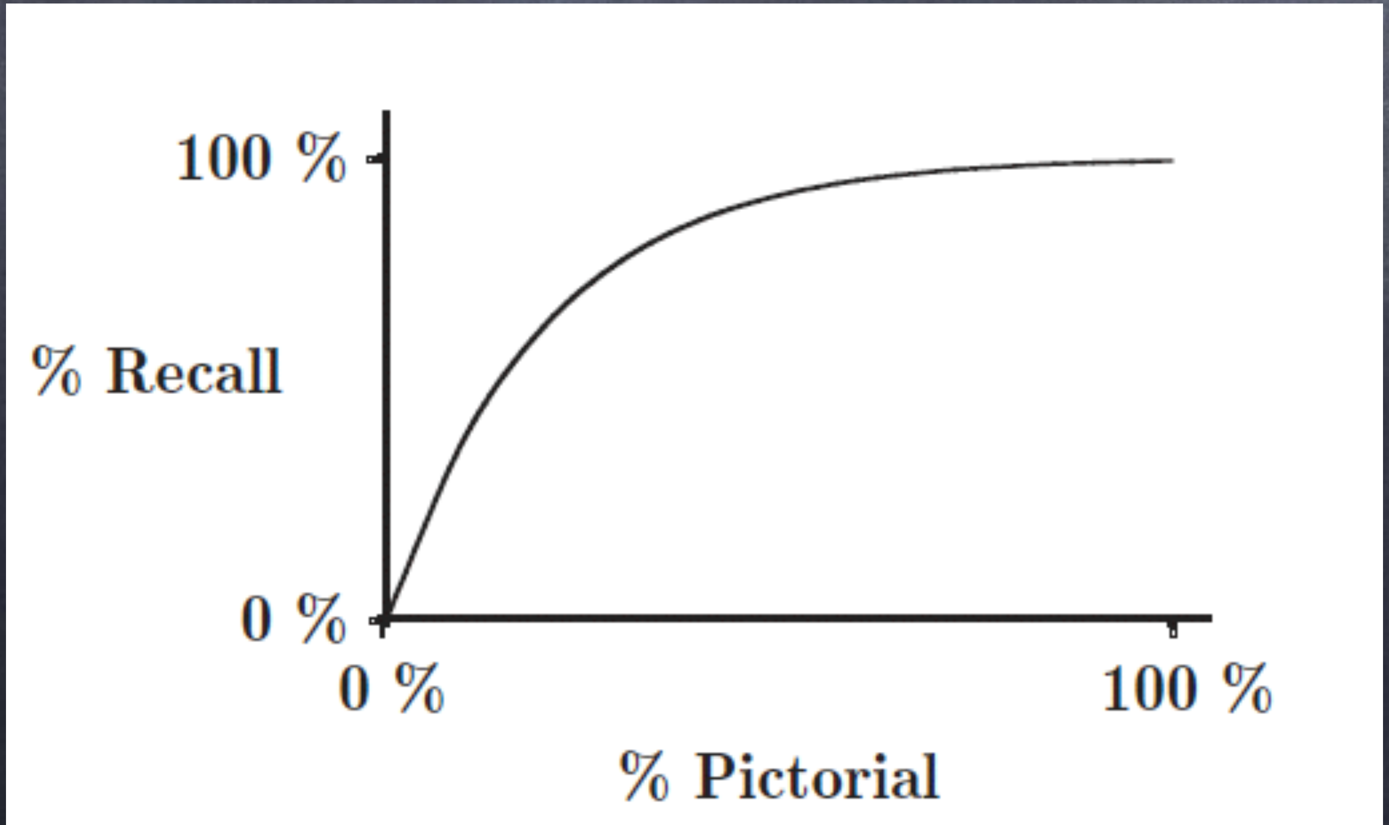
- Use Large, Clearly Readable Lettering
  - Maximum should be about 10 lines of up to 30 letters per line
- Provide Adequate Spacing Between Major Elements
  - Otherwise points get blurred visually and conceptually
- Make Key Points Obvious Visually
  - Subordinate points should be indented, have smaller letters, not be capitalized, etc.
- Present Major Elements Clearly
  - Use simple statements, formulas, graphs, etc. and only those necessary to elucidate the key points

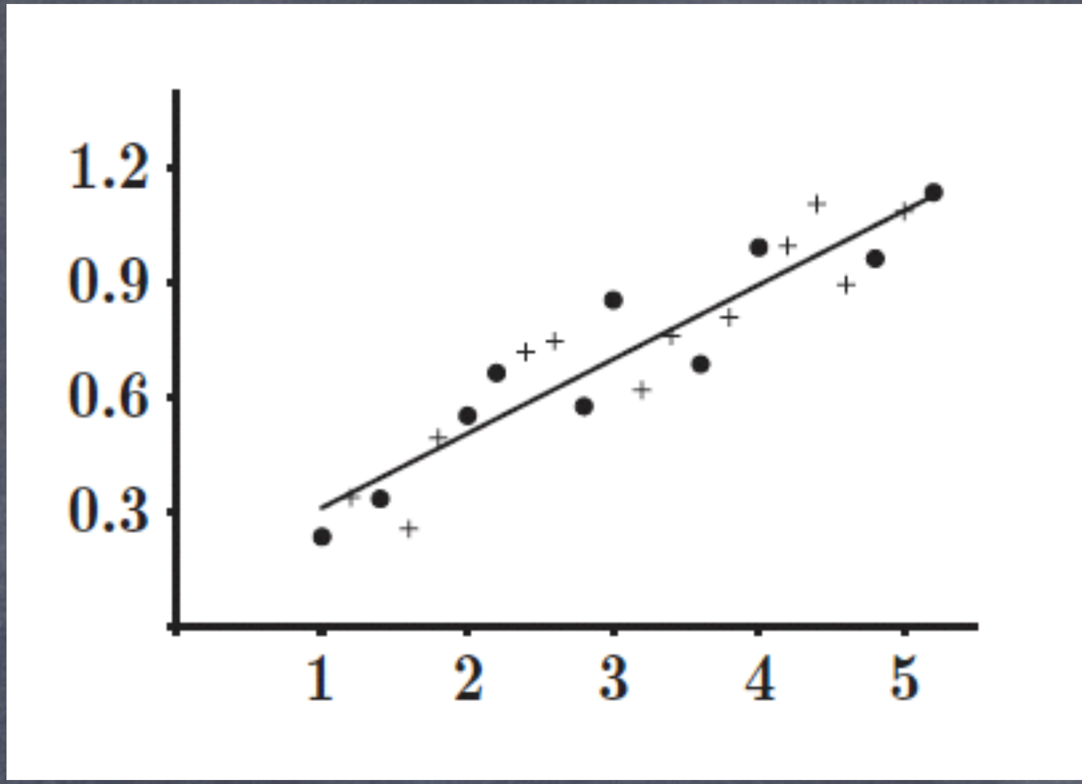
Major Elements Of Visuals Should Be Self-Explanatory

- Material Is More Understandable If Audience Can Independently Comprehend The Major Elements
  - Talk structure should reflect logic of critical scientific elements and their interrelationships
- Message Should Be Apparent Without Speaker's Verbal Presentation
  - Key points of talk should be apparent from visuals themselves
  - People don't always listen carefully to what the speaker says
- Audience Tends To Read Past Speaker's Present Point In Presentation
  - Did you read this before I said it?

Develop Analog Graphics For Many Of Your Visuals

- Audience Recall Of Analog Graphics (Curves, Sketches, Graphs, Bar Charts, etc.) Seems To Be Unlimited
- Reinforcement Of Facts And Ideas By Use Of Pictorials Improves Audience Recall By A Factor Of 10
- Analog Graphics Improves Retention Of Facts And Ideas Over Use Of Statements And



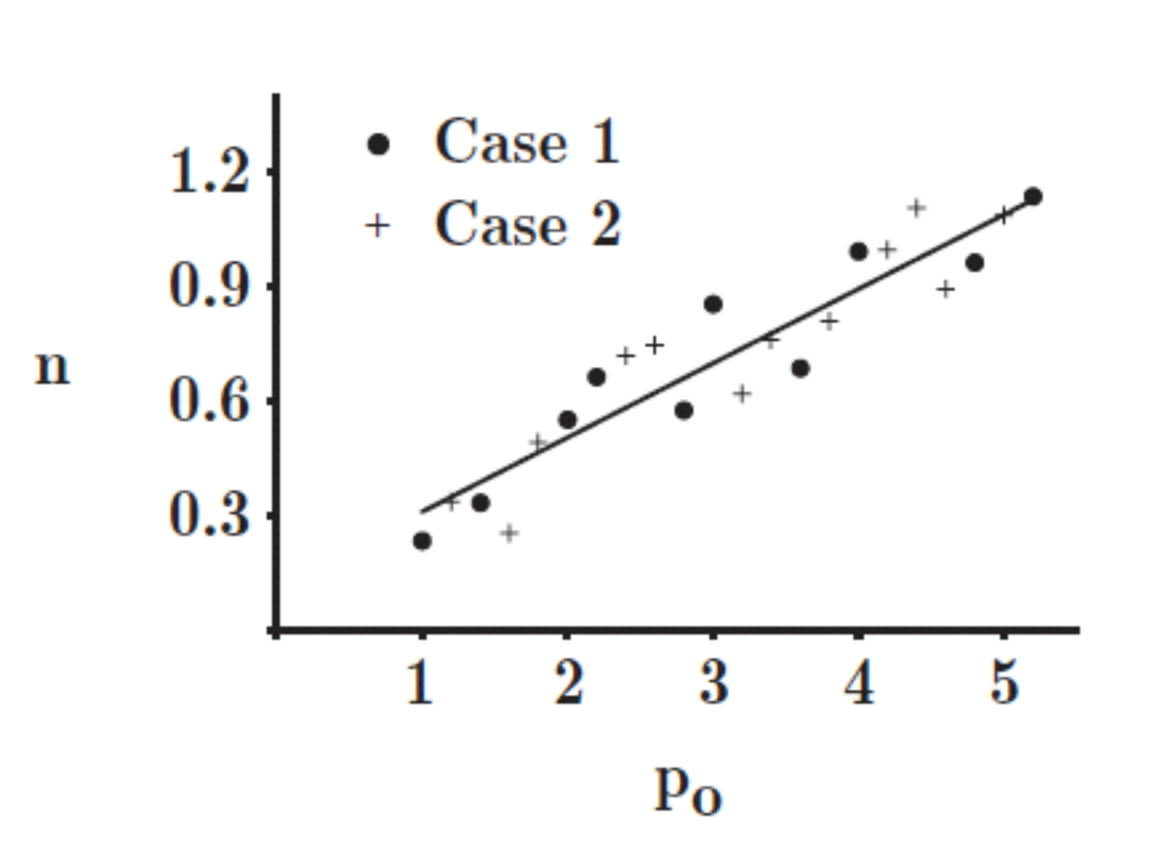


Terrible Experimental Data Illustration

No title, no labels, no indication of what the data represent or why there is a line on the graph

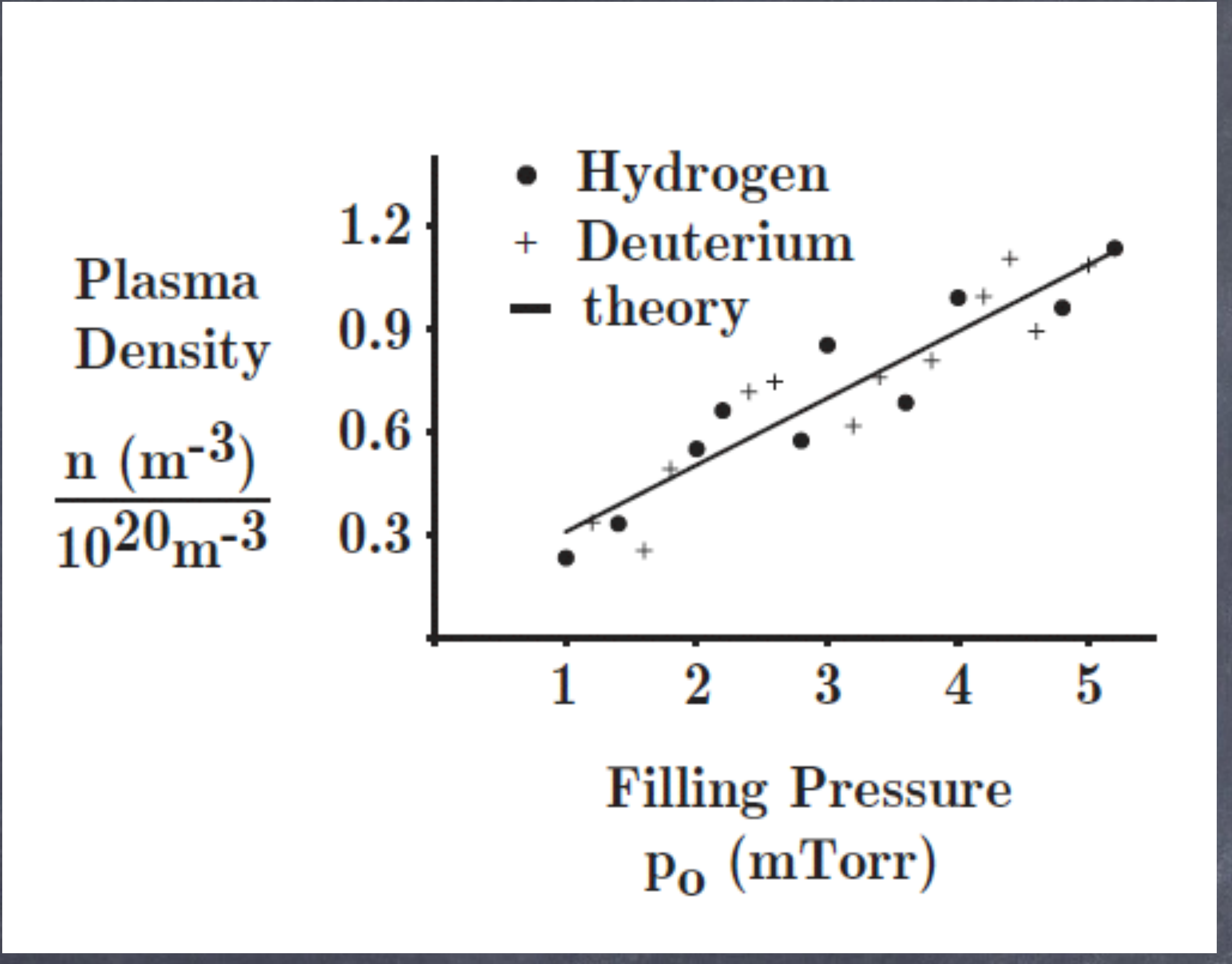
How is viewer supposed to figure out what the speaker wants to convey

Graph of n Versus p_o



- Poor Experimental Data Illustration
  - Title is only a label, not thesis of visual - it only tells us "this is a graph"
  - Labeling is not helpful - case 1, 2?, what are n, po?
  - Not clear what message of this graph is - the author can plot points near a line on n vs. p_o graph?

Plasma Density Increases Linearly With Filling Pressure



- Better Experimental Data Illustration
  - Simple declarative title with action verb that is thesis of graph
  - Axes and points are labeled physically and understandably
  - Graph supports declarative title|no more or less

$$DKE: \frac{\partial f}{\partial t} + v_\parallel \underline{n}\cdot\nabla f + \underline{V}_D\cdot\nabla f = C(f)$$

$$v_\parallel \underline{n}\cdot\nabla f = v_\parallel(\underline{n}_0\cdot\nabla + \frac{\tilde{B}}{B}\cdot\nabla)f = v_\parallel\frac{\partial f}{\partial s} + \frac{\tilde{b}}{B}\cdot\nabla f$$

$$\frac{\partial f}{\partial t} + \underbrace{v_\parallel\frac{\partial f}{\partial s}}_{\sim\omega_b} + \underbrace{v_\parallel\frac{\tilde{B}}{B}\cdot\nabla f}_{\sim\omega_D} + \underbrace{\underline{V}_D\cdot\nabla f}_{\sim\omega_D} = \underbrace{C(f)}_{\sim\nu}$$

$$\epsilon \sim \frac{\nu,\omega_D}{\omega_b} << 1,\ f = f_0 + \epsilon f_1 + \cdots$$

$$\epsilon^0: \frac{\partial f_0}{\partial s} = 0$$

$$\epsilon^1: \frac{\partial f_0}{\partial t} + \frac{m}{e\tau}\left[\frac{\partial J^{**}}{\partial\beta}\frac{\partial f_0}{\partial\alpha} - \frac{\partial J^{**}}{\partial\alpha}\frac{\partial f_0}{\partial\beta}\right] = \langle C(f_0)\rangle$$

$$\langle A\rangle \equiv \frac{\oint ds/v_\parallel A}{\oint ds/v_\parallel},\ J^{**} = \oint d\underline{s}\cdot\left[\underline{v}_\parallel + \frac{e}{mc}\underline{\tilde{A}}\right]$$

Mirror-trapped particles: $J^{**} = \oint ds v_\parallel = J(\alpha,\beta,E,\mu)$

$$\delta \sim \nu/\omega_D << 1,\ f_0 = f_0^0 + \delta f_0^1 + \cdots$$

$$\delta^0: \frac{\partial J}{\partial\beta}\frac{\partial f_0^0}{\partial\alpha} - \frac{\alpha J}{\partial\alpha}\frac{\partial f_0^0}{\partial\beta} = 0 \Rightarrow f_0^0 = f_0^0(E,\mu,J) + g(E,\mu)$$

$$\delta^1: \frac{m}{e\tau}\left[\frac{\partial J}{\alpha\beta}\frac{\partial f_0^1}{\partial\alpha} - \frac{\partial J}{\partial\alpha}\frac{\partial f_0^1}{\partial\beta}\right] = \langle C(f_0^0)\rangle$$

Toroidally-passing particles: $J^{**} = \oint d\underline{s}\cdot\left[\underline{v}_\parallel + \frac{e}{mc}\underline{\tilde{e}}\right] = J + \frac{e}{mc}\tilde{\psi}$

$$\delta \sim \omega_{Dp}/\nu << 1,\ f_0 = f_0^0 + \delta f_0^1 + \cdots$$

$$\delta^0: \langle C(f_0^0)\rangle = 0 \Rightarrow f_0^0 = f_{Max}(E,\alpha,\beta)$$

$$\delta^1: \frac{m}{e\tau}\left[\frac{\partial J^{**}}{\partial\beta}\frac{\partial f_0^0}{\partial\alpha} - \frac{\partial J^{**}}{\partial\alpha}\frac{\partial f_0^1}{\partial\beta}\right] = \langle C(f_0^1)\rangle$$

Density Conservation Equation:

$$\frac{\partial}{\partial t}\oint\frac{ds}{B}\frac{2\pi}{m^2}\sum_\sigma\int\frac{dEd\mu B}{|v_\parallel|}f + \oint\frac{ds}{B}\frac{2\pi}{m^2}\sum_\sigma\int\frac{dEd\mu B}{|v_\parallel|}\left[v_\parallel\frac{\tilde{B}\cdot\nabla f}{B} + \underline{V}_D\cdot\nabla f\right] = 0$$

or, $\frac{\partial n(\alpha,\beta,t)}{\partial t} + \frac{2\pi}{m^2}\sum_\sigma\int dEd\mu\frac{m}{e}\left[\frac{\partial J^{**}}{\partial\beta}\frac{\partial f_0}{\partial\alpha} - \frac{\partial J^{**}}{\partial\alpha}\frac{\partial f_0}{\partial\beta}\right] = 0$

or, $\frac{\partial n(\alpha,\beta,t)}{\partial t} + \frac{1}{\oint ds/B}\left\{\frac{\partial}{\partial\alpha}\frac{2\pi}{m^2}\sum_\alpha\int dEd\mu\frac{m}{e}\frac{\partial J^{**}}{\partial\beta}f_0 - \frac{\partial}{\partial\beta}\frac{2\pi}{m^2}\sum_\sigma\int dEd\mu\frac{m}{e}\frac{\partial J^{**}}{\partial\alpha}f_0\right.$

$$\left. + \frac{2\pi}{m^2}\sum_\sigma\int dEd\mu\frac{m}{e}f_0\left[\frac{\partial^2 J^{**}}{\partial\alpha\partial\beta} - \frac{\partial^2 J^{**}}{\partial\beta\partial\alpha}\right]\right. = 0$$

i.e., $\frac{\partial n(\alpha,\beta,t)}{\partial t} + \frac{1}{\oint ds/B}\left[\frac{\partial\Gamma_\alpha}{\partial\alpha} + \frac{\partial\Gamma_\beta}{\partial\beta}\right] = 0$

Bad Theory Visual - no thesis title, too much information that is not well labeled or clearly explained

EBT Neoclassical Transport Theory For Field Error Effects Done With Multiple-Time-Scale Expansions

- **Beginning Point Is Gyrophase-Averaged "Drift-Kinetic" Equation**

$$\frac{\partial f}{\partial t} + \underbrace{v_\parallel \underline{n}\cdot\nabla f}_{\substack{\text{parallel motion} \\ \text{("bounce" motion)}}} + \underbrace{\underline{v}_D\cdot\nabla f}_{\substack{\text{drift} \\ \text{motion}}} = \underbrace{C(f)}_{\text{collisions}} \quad , \quad \underbrace{\underline{n} \equiv \underline{B}/B}_{\substack{\text{unit vector} \\ \text{along } \underline{B}}}$$

- **Magnetic Field Unit Vector Is Split Into "Perfect" And "Field Error" Parts**

$$\underline{n} = \frac{\underline{B}}{B} = \frac{\underline{B}_0 + \widetilde{\underline{B}}}{B} \simeq \frac{\underline{B}_0}{B_0} + \frac{\widetilde{\underline{B}}}{B_0} = \underline{n}_0 + \frac{\widetilde{\underline{B}}}{B_0}$$

"perfect" closed field line magnetic field — "field error"

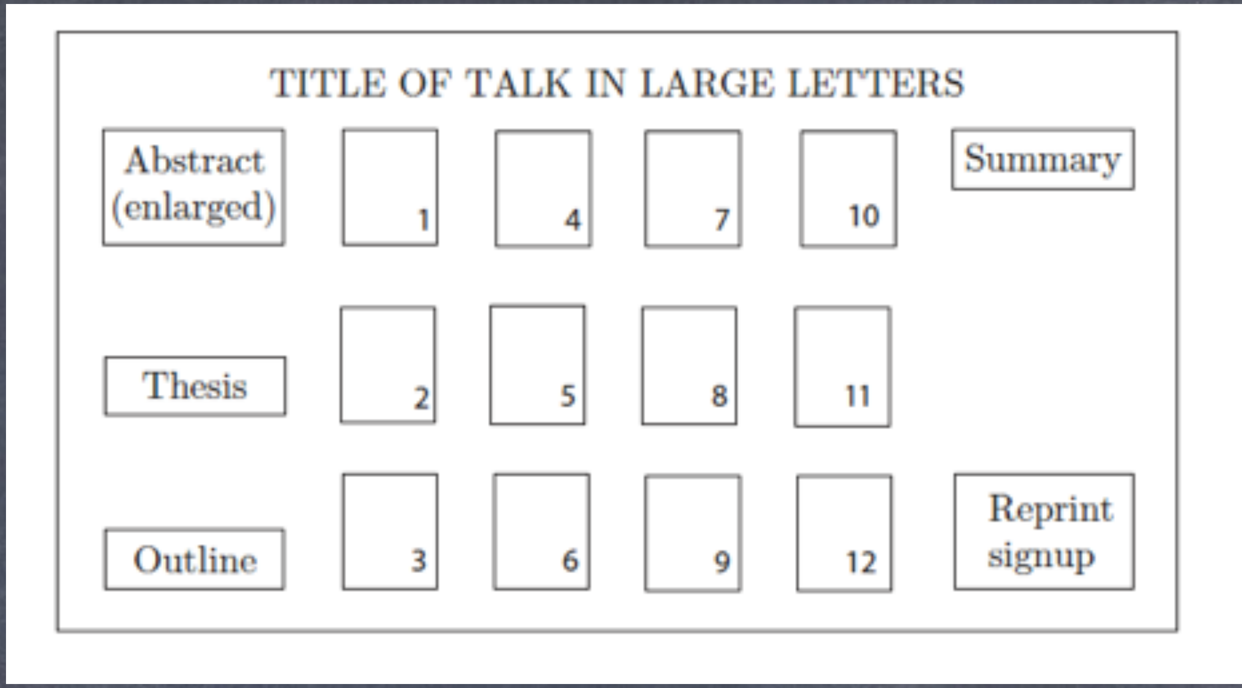
- **Various Frequency Scales Emerge From Drift-Kinetic Equation**

$$\frac{\partial f}{\partial t} + \underbrace{v_\parallel \frac{\partial f}{\partial s}}_{\sim\omega_b f} + \underbrace{v_\parallel \frac{\widetilde{\underline{B}}}{B}\cdot\nabla f}_{\sim\omega_D f} + \underbrace{\underline{v}_D\cdot\nabla f}_{\sim\omega_D f} = \underbrace{C(f)}_{\sim\nu f}$$

frequencies: bounce, drift, drift, collision

- Better Theory Visual - thesis at top, steps explained and reasonably spaced

Poster Presentations Have Additional Special Requirements



- Audiences
  - Window-shoppers (they usually read (at most) title, first visual and summary) - what's new, noteworthy?; what subject area is being discussed?
  - Serious customers (if title, first visual and summary are compelling they may look at entire poster) - what's new, same?; what are details of work done?
- Special Requirements
  - Large, easily read title (1" lettering or greater)
  - Enlarged copy of abstract
  - Brief summary at end in large lettering that can be quickly read by the window-shoppers and understood by serious customers
  - Signup sheet for copies of poster on right side of board

Pedagogical points in giving talks

- Mechanics of talking...facing audience, pointer use, speaking loadly and clearly, eye contact, dynamics referencing , practice, timing

Summary

- Giving Good Scientific Presentations (Talks Or Posters) Is Important
  - Your scientific results need to be effectively communicated
  - Your professional reputation will be based largely on the presentations you give
- Scientific Talk Preparation Has A Number Of Key Elements
  - Consider audience, level and mode of presentation
  - Develop a presentation thesis
  - Prepare visuals to prove thesis
    - thesis heading, 6 points or less, readable, self-explanatory, graphs
  - Include summary at end
- Rehearse before colleagues

Project

Presentation and web page

Presentation 10+5 min (paper ~10-15 pages)

- Science background
    - Why and What
- Optimization
    - What and how did it work
- Parallelization
    - What and how did it work
- Visualization
    - Pretty pictures