Proposals
vs
Papers

Some similarities:
Both are all about
“the story”

Some similarities:
Both require awareness
& management of
“reader expectations”

But, differences in tone, goal, structure are substantial.

In a paper, the reader is already sold.

They read the abstract, and chose to keep going.

For proposals, the reader is reading a stack of 50-100.

They have to read them, whether they want to or not.

They are probably sick of reading proposals by the time they get to yours.

Or, if your proposal was first, they will likely have forgotten much of it by the end.

An Aside:

There's often weeks of delay between when they read your proposal, and when they discuss it with the committee.

An Aside:

So even if the reviewer understood your proposal the first time, they may have forgotten key information by the time it's discussed.

In a paper, the reader probably already knows something about your field.

For a proposal, you cannot count on the reader having any particular expertise. Or interest.

Nor can you count on them *not* knowing every single seminal paper in the field*.

*This is much less likely. Better to assume you're talking to a smart, non-expert.

In a paper, the reader would like to be convinced of your result.

In a proposal, the reader is looking for reasons *not* to be swayed.

For typical proposals, only 5-30% will be approved.

Proposal readers are looking for reasons to shunt you into the 70-95%.

Well that's depressing.

However, with some forethought and writing skill, you can probably make it into the top quarter.

Two major kinds of proposals:

- Proposals for resources
  - Telescope time
  - $$ for specific projects or activities
- Proposals for supporting you
  - Fellowship applications

Proposals for resources

At least 2/3 of proposal ideas qualify as "Good to do"

This isn't enough.

Telescope time and $$$ are always more limited than the supply of good ideas from smart people

You need to move
from
"*Good to do*"
to
"*Must be done*"

This requires a *really* strong story.

Backed by a *really* strong argument.

Explained with impeccable clarity.

Proposals for resources

1. Crafting a strong story.

1. Topic X is important and interesting.

2. But.

3. This is how we will address "But."

Same principles as in an introduction.

http://blogs.discovermagazine.com/cosmicvariance/2009/11/02/unsolicited-advice-x-how-to-frame-a-winning-proposal/

1. Crafting a strong story.

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3. This is how we will address "But."

For a one-page proposal, this should be clear *within the first paragraph*.

1. Crafting a strong story.

1. Topic X is important and interesting.

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3. This is how we will address "But."

For a multi-page proposal, this should be clear *within the first page*.

1. Crafting a strong story.

1. Topic X is important and interesting.

2. But.

3. This is how we will address "But."

Your goal with #3:
Put words in the reviewer's mouth that they can parrot back to the committee.

Example:

1. Topic X is important and interesting.

2. But.

The use of Stellar Population Synthesis (SPS) models is ubiquitous in extragalactic astronomy. In these models, one adds together combinations of "simple stellar populations" (i.e., groups of stars with a single age and chemical composition) to produce the galaxy spectrum corresponding to an adopted star formation history. SPS models translate observed galaxy flux into meaningful physical properties like stellar mass, star formation rate, age, and metallicity (see recent review; Conroy 2013). In principle, deriving these critical astrophysical quantities from a given galaxy spectrum is a straight-forward minimization problem to identify the best-fit model. In practice, however, the degeneracies are significant, and one typically needs to adopt a host of simplifying assumptions about dust geometry, chemical enrichment, and the star formation history. As such, while SPS models provide profound physical intuition for understanding galaxy spectra when used in one direction (i.e., to predict how a given set of parameters will affect the emergent spectrum), whether or not they accurately represent the true galaxy properties is unclear, when used in the other direction (i.e., to infer physical parameters from observed spectra).

Paragraph #1

"Stellar Population Synthesis models are widely used & useful, but degenerate for interpreting galaxy spectra.."

Example:

1. Topic X is important and interesting.

2. But.

In spite of these challenges, previous work characterizing the broad properties of the galaxy population has been largely robust to uncertainties and systematics in spectral fitting, simply because properties of the galaxy population span many orders of magnitude in almost every parameter of interest. However, even factor of two uncertainties can significantly impact the shape and scatter of well-known galaxy scaling relations. Moreover, the current generation of IFU surveys (e.g., MaNGA (Bundy et al.); CALIFA (Sánchez et al.); SAURON (de Zeeuw et al.)) are pushing spectral fitting into new territory, where it must also analyze trends *within* individual galaxies, where internal variations are likely to be comparable to the degree of systematic error inherent in spectral fitting. This instills a sense of urgency; not only will current SPS codes fail to robustly characterize the properties of individual galaxies, but it will be nearly impossible to determine what the biases are *a priori* and how they will propagate through the models, which has has profound consequences for the broader analysis of galaxy SEDs – both for spectra at $z = 0$ and for photometry at $z = 10$.

Paragraph #2

"Past work has been largely robust, but with IFU spectroscopy, uncertainties will dominate, to a degree we don't understand."

Example:

3. This is how we will address "But."

With this proposal, we will use stellar population observations from Hubble Space Telescope imaging to develop and release a suite of "ground truth" star formation histories and coupled IFU spectra, to serve as a baseline for improving the accuracy, robustness, and assessment of uncertainties in widely used SPS models.

Paragraph #3

"If you approve this proposal, we'll fix it."

Example:

3. This is how we will address "But."

With this proposal, we will use stellar population observations from Hubble Space Telescope imaging to develop and release a suite of "ground truth" star formation histories and coupled IFU spectra, to serve as a baseline for improving the accuracy, robustness, and assessment of uncertainties in widely used SPS models.

Reader has a clear statement of what the writer is planning on doing and why.

1. Crafting a strong story.

1. Topic X is important and interesting.

2. But.

3. This is how we will address "But."

Run this story by peers and colleagues early.

If they're anything less than enthusiastic, you must revise.

1. Crafting a strong story.

Note: "*The Story*" is distinct from "*The Presentation of the Story*".

If the story isn't compelling, *it doesn't matter how well it's presented!*

2. Defining your argument.

1. Topic X is important and interesting.

2. But.

3. This is how we will address "But."

A proposal is best viewed as an *argument* that leaves the reader believing that #1 & #2 are true and that #3 is the best way forward.

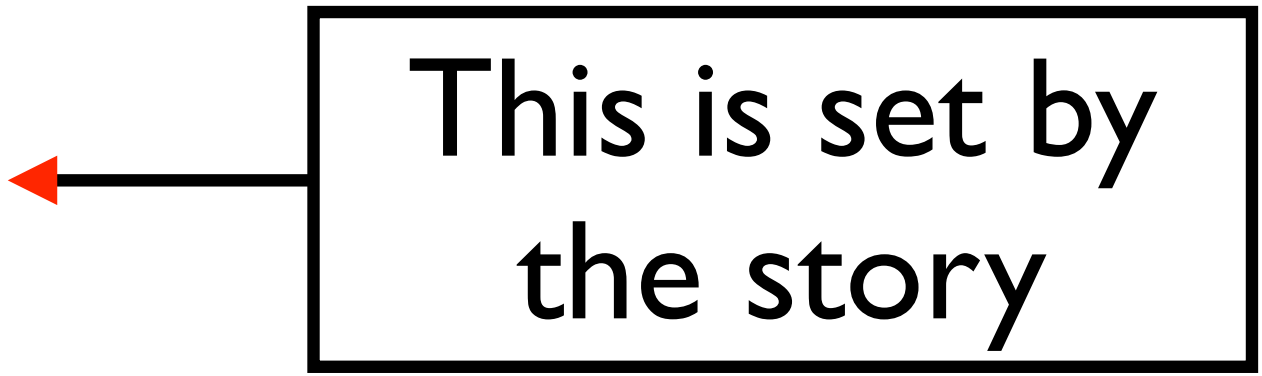
2. Defining your argument.

Your proposal should make the case that the proposed research is:

- Important
- Feasible
- Efficient

http://blogs.discovermagazine.com/cosmicvariance/2012/01/24/unsolicited-advice-xiii-how-to-craft-a-well-argued-proposal/

- Important
- Feasible
- Efficient



- Important
- Feasible
- Efficient

Is there a convincing, direct path to the promised scientific result?

- Important
- Feasible
- Efficient

The proposed work must be *the best* way to address the questions raised by the story

Defining your argument.

- Important
- Feasible
- Efficient

The reviewer must believe that *every single one* of these is true.

Defining your argument.

- Important
- Feasible
- Efficient

The reviewer must believe that *every single one* of these is true.

- Important
- Feasible
- Efficient

How do you judge this?

Is there an actual question to be answered?

Will other lines of study change if the question is answered?

Will the answer change what other people decide to work on?

Do not shy away from making these explicit for your audience of "smart non-experts"

Is there an actual question to be answered?

Will other lines of study change if the question is answered?

Will the answer change what other people decide to work on?

Ways to show "importance"

"Hot Topic"

Sometimes, you get lucky and it's obvious

For example, it's a good year to work on gravitational wave sources

Ways to show "importance"

"Hot Topic"

But, can also demonstrate by showing that there is a lot of literature back-and-forth going on

(i.e., a hot topic in your subfield may not be obvious to a non-expert, but can be demonstrated)

Ways to show "importance"

"Novelty"

Never been:

- Observed
- Detected
- Measured

Ways to show "importance"

"Clear, preferably binary, results"

Straight-forward "path to science"

- Yes or no?
- This model or that one?
- Exists or doesn't exist?

Ways to show "importance"

"Clear, preferably binary, results"

Even better if multiple possible outcomes are useful

(i.e., interesting upper limits or non-detections).

Ways to show "importance"

"Qualitatively new regime"

Is this a different kind of experiment than could ever have been done before?

Ways to show "importance"

"Qualitatively new regime"

- Order of magnitude increase in sample size or detection limit
- Systematic study vs "mish-mash" in the literature
- New, unique approach that opens up parameter space (speed, new selection criteria, novel analysis tools that fix stuff)

Ways to show "importance"

"A Really Cool Story"

Sometimes an idea or puzzle is just *really really* cool, and people will want to know the answer, as long as it's not too expensive.

2. Defining your argument.

- Important
- Feasible
- Efficient

Ways to show "feasibility"

It's hard to beat a test case

- Sample data from the archive
- Simulations
- Example from the literature
- Example from pilot study
- Benchmarks

Ways to show "feasibility"

Is there a signal to measure?

Will different models produce distinguishable results?

Do models or simulations suggest the size of an effect?

Is that effect actually measurable?

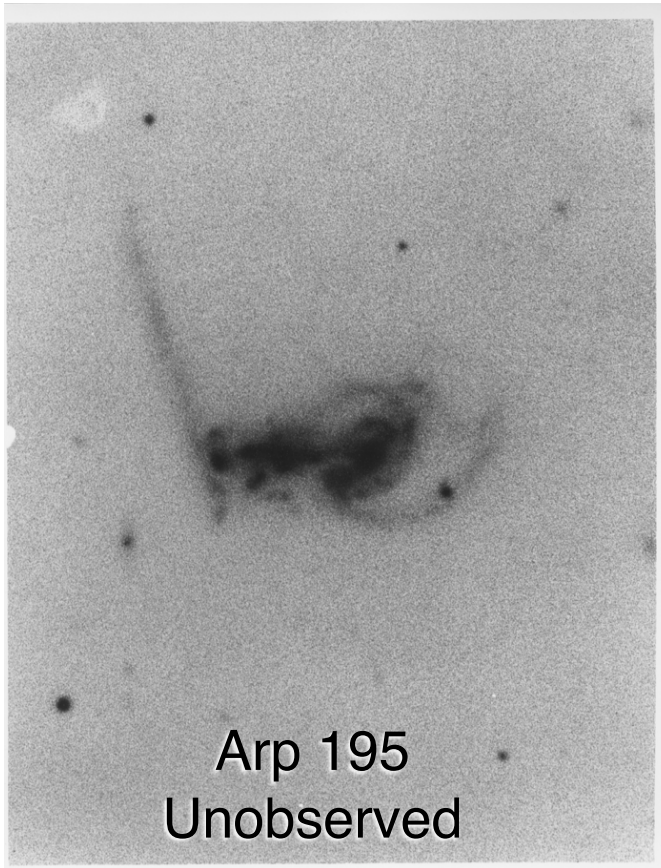
Ways to show "feasibility"

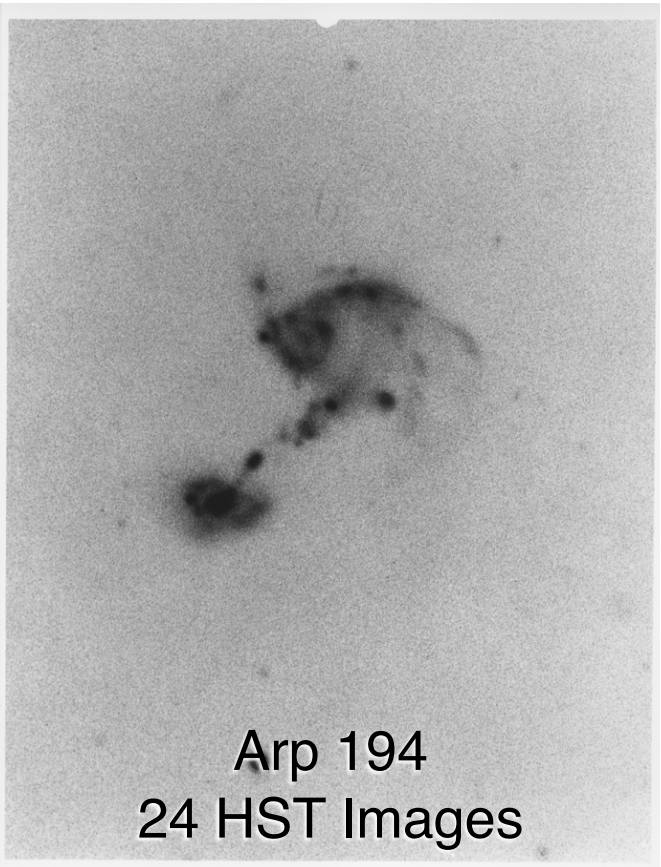
It's hard to beat a test case

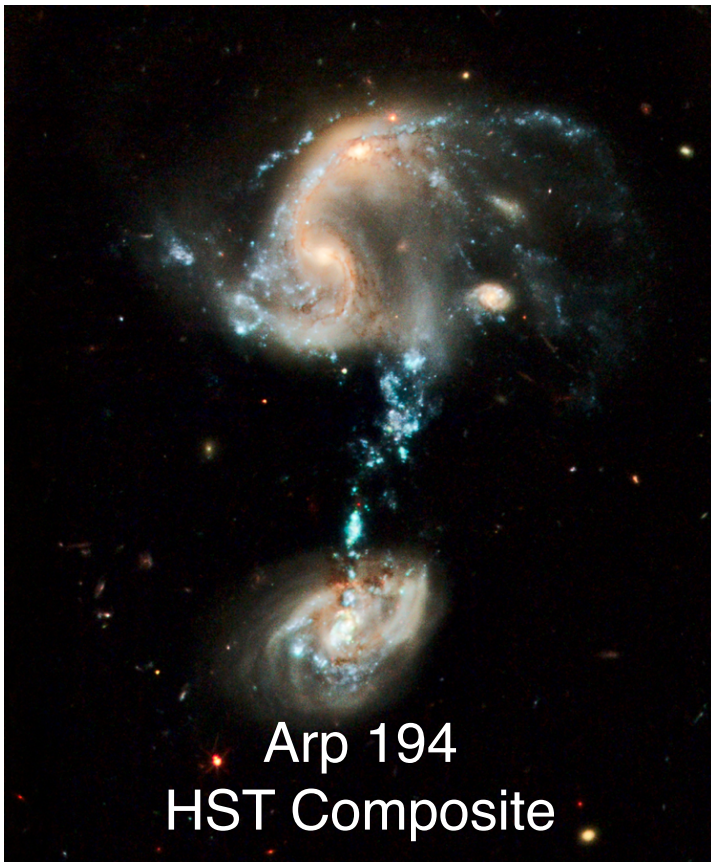
Figures showing what the data would look like are super effective.

Makes the hypothetical concrete.

Ways to show "feasibility"







This is what we'll target

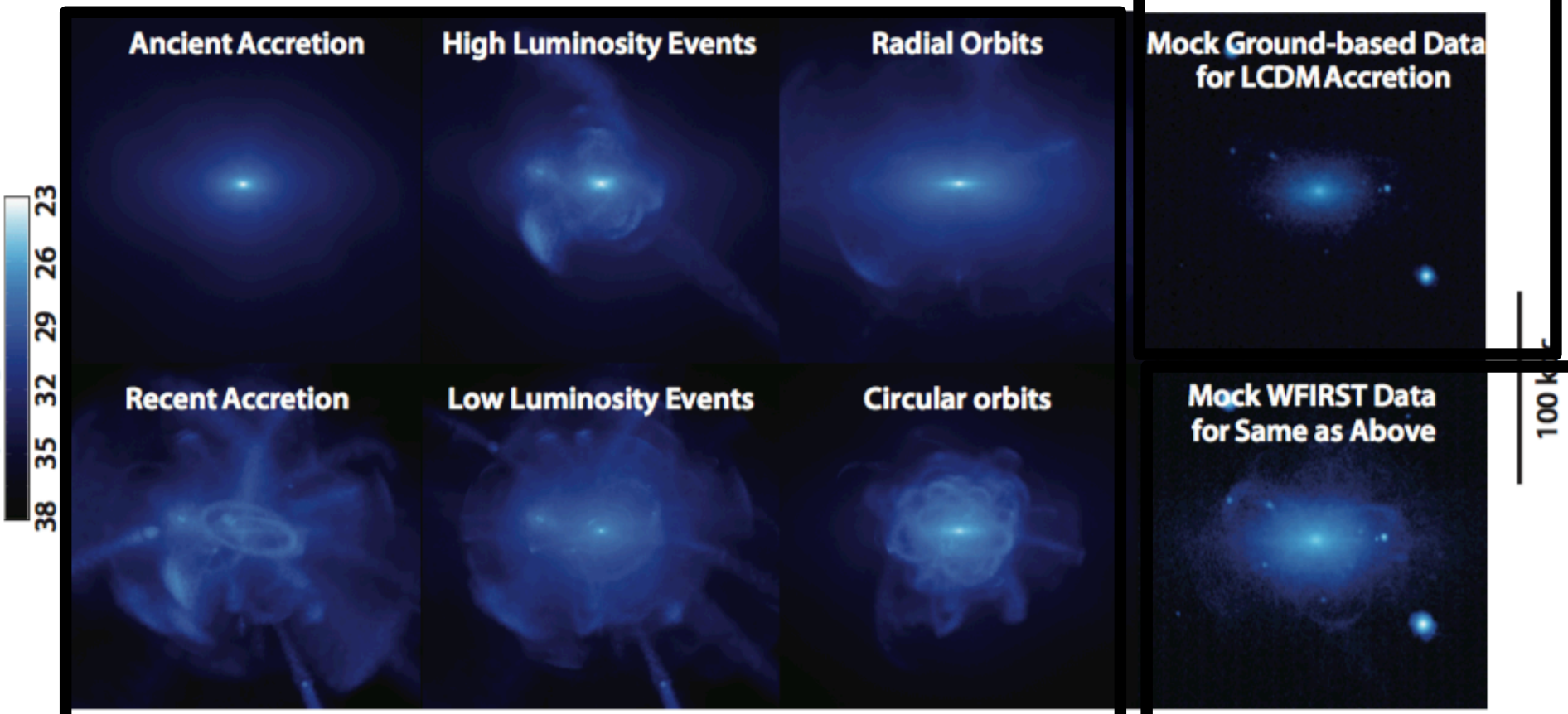
This has already been observed

Wow! That's going to look great!

Ways to show "feasibility"

The ground can't do it

Ben Williams' proposal to study nearby galaxies w/ WFIRST

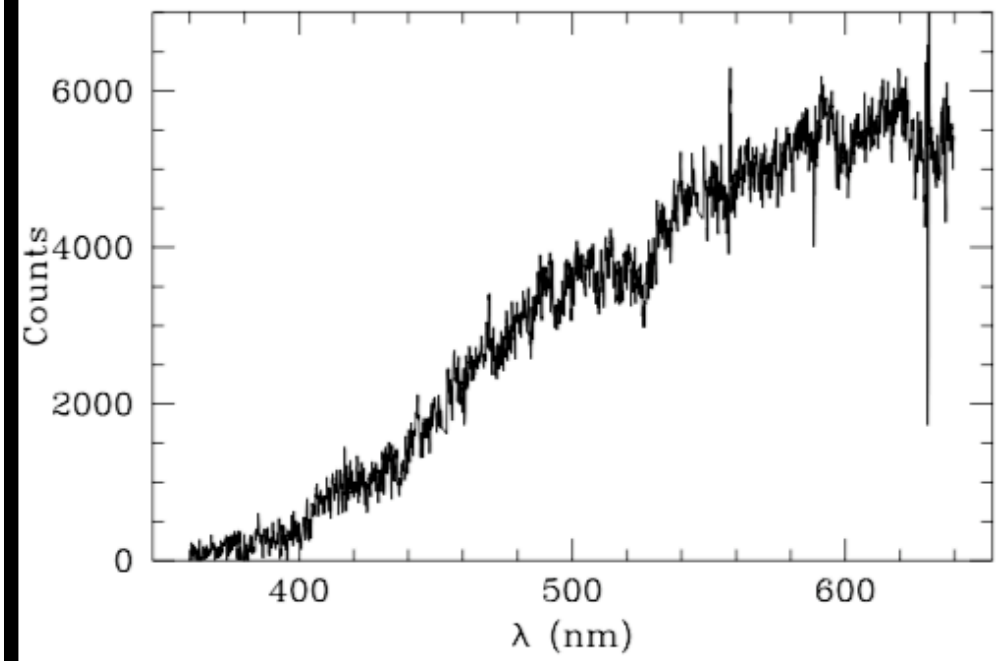


Simulations indicate there should be variety that reflects different physics

Wow! That's going to look great!

Ways to show "feasibility"

Simulated spectrum



How well you can measure things with the expected SNR

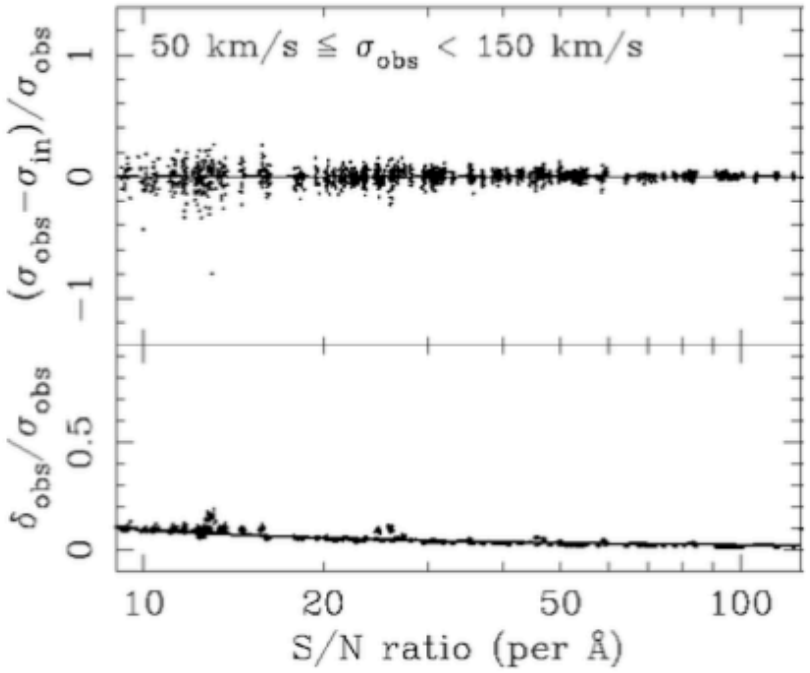


FIGURE 2: *Simulated spectrum of a 10″ region of the thick disk, for a 1-night Gemini observation (left) and the resulting accuracy of velocity dispersion measurements as a function of SNR/Å (right).* The SNR of this observation ($\gtrsim$15/Å) would be sufficient to measure the rotational velocity and velocity dispersion to better than 5% within ∼10 radial bins across the galaxy. Sky subtraction and flat-fielding uncertainties have been included, and the underlying spectrum was assumed to be comparable to an elliptical galaxy at $v_r = 5000$ km/s. The right panel is taken from Kelson et al. (2002) and uses simulations to demonstrate the accuracy with which σ can be measured for a given SNR/Å.

My NSF CAREER proposal from when I was a baby faculty member…

2. Defining your argument.

- Important
- Feasible
- Efficient

Ways to show "efficiency"

Are obvious alternatives viable?

- Why can't you use a different facility? (i.e., why Keck when you have APO?)
- Why this approach when other methods are commonly used?

Ways to show "efficiency"

- Why can't you use a different facility? (i.e., why Keck when you have APO?)

"These observations would take 2 weeks on a 4m class telescope"

"Only this instrument has the needed combination of blue-sensitivity and FOV"

- Why this approach when other methods are commonly used?

"Unlike FIRE, this code includes on-the-fly radiative transfer needed to properly calculate thermodynamics"

"Although transits are the most efficient way to detect large numbers of planets, they are biased against X"

Ways to show "efficiency"

Panels *always* ask "Could you ask for less?"

- Why not a smaller sample?
- Why not less exposure time?
- Why not less $$$ (tied to effort — i.e., why 2 years of support rather than 1)

Ways to show "efficiency"

- Why not a smaller sample?

"Assuming Poisson statistics, we need X stars to measure the rate to 20%, which is needed to distinguish models A and B."

- Why not less exposure time?

"All viable models predict that the QSO will have a luminosity of at least X. To reach a SNR=10 detection limit (needed to measure Y), we require at least Y hours per source"

- Why not fewer $$$?

Give a detailed work plan that maps out the effort, so that it's clear that a project will take the full duration of funds

Refining your argument.

- Important
- Feasible
- Efficient

You and your collaborators need to do a *brutal* assessment of every weakness, and make plans for how you will shore them up.

A strategy I use:

- Selling points
- Potential weaknesses
- Possible figures

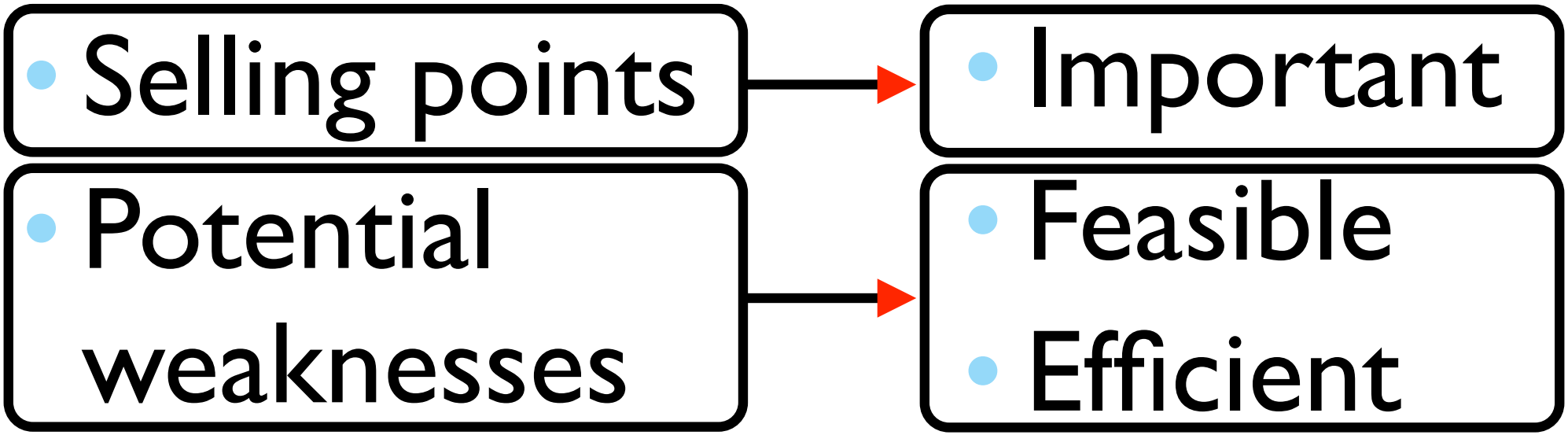
I start an ascii file where I brainstorm every possible selling point, every possible criticism, and possible figures.

- Selling points
- Potential weaknesses
- Possible figures

These sections are close to "word stacks"

Unprioritized bullet points that may or may not make it into the final proposal

These categories map directly to the argument



Example of "Selling Points"

- AGB stars best probe of intermediate age SF (in absence of MS turnoff)
- AGB stars can dominate NIR light (critical for interpreting buildup of stellar mass over cosmic time),
- But, models of AGB not well calibrated outside of the MW, LMC, and SMC. Lack of data covering a range of metallicities and SFHs.
- AGB stars brightest NIR sources, so short exposures sufficient to detect them, making them ideal SNAP targets.
- Existing deeper archival optical data allows construction of CMDs with only 1 NIR filter, and comparison between SFHs derived from deeper data and that derived from AGB stars.
- Short exposures also get upper RGB stars, whose colors can be metallicity indicators for older populations (does full optical-IR range help separate AGB from RGB below the TRGB, and thus improve metallicities?).
- Calibration of TRGB for NIR work, which is where JWST will be working.
- Need NIR data to even know that AGB stars are there (can't get full census in the optical).
- If you go outside the local group, you can get the galaxies' *entire* AGB census in a single pointing.

Example of "Potential Weaknesses"

- What about AO from the ground?
- Why this many targets? How many do you actually need?
- What about dust (i.e., is one NIR filter ok?)
- Are the models really in need of improvement?
- How can we claim to do galaxy science while simultaneously arguing the models aren't up to it?
- Are the results confused depending on the fraction of O-rich vs C-rich AGB?

Example of "Potential Weaknesses"

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- Are the results confused depending on the fraction of O-rich vs C-rich AGB?

You need to ask these questions before the reviewer does!

I then brainstorm how to mitigate the weaknesses

- What about AO from the ground?
  - Not many galaxies w/ bright guide stars
  - Exposure time longer because background (true?)
  - Need accurate mags over large areas to get large AGB samples
- Why this many targets? How many do you actually need?
  - Existing NIR CMDs very, very few, and this is direction JWST/WFIRST is going in, so need to characterize now
  - Estimate #'s of AGB stars as function of age from SFH?
- Etc…

This is an excellent form for getting input, early

- Selling points
- Potential weaknesses
- Possible figures

Circulate your ascii file to collaborators and mentors.

They can prioritize the first and help shore up the second.

Use this to pick your story

- Selling points
- Potential weaknesses
- Possible figures

You should pick a final, single story that naturally fits as many of the selling points as possible.

"Calibrating models of AGB stars"

- AGB stars best probe of intermediate age SF (in absence of MS turnoff)
- AGB stars can dominate NIR light (critical for interpreting buildup of stellar mass over cosmic time),
- But, models of AGB not well calibrated outside of the MW, LMC, and SMC. Lack of data covering a range of metallicities and SFHs.
- AGB stars brightest NIR sources, so short exposures sufficient to detect them, making them ideal SNAP targets.
- Existing deeper archival optical data allows construction of CMDs with only 1 NIR filter, and ~~comparison between SFHs derived from deeper data and that derived from AGB stars.~~
- ~~Short exposures also get upper RGB stars, whose colors can be metallicity indicators for older populations (does full optical-IR range help separate AGB from RGB below the TRGB, and thus improve metallicities?).~~
- ~~Calibration of TRGB for NIR work, which is where JWST will be working~~.
- Need NIR data to even know that AGB stars are there (can't get full census in the optical).
- If you go outside the local group, you can get the galaxies' *entire* AGB census in a single pointing.

You should
minimize and/or leave out
selling points that distract from your story.

Why?

The reader (reviewer) may believe that *anything you mention* is part of your main story.

They will then mark you down for not fully justifying something you considered to be a minor aside.

Finally

- Selling points
- Potential weaknesses
- Possible figures

If your selling points aren't convincing, and/or the weaknesses are too many, *consider scrapping the proposal.*

Other tips

Features of compelling proposals

- “First”
- “Largest”
- “Only”
- “Most precise”
- “Complete”
- “Uniform”
- “New”

Making it easy on the reviewer

- Bullet points & lists
- Meaningful subsection titles
- Flow charts
- Explicit "path to science"
- Don't rely on "in prep"- use figure instead
- Do not try to get around page limits
- Don't overuse "crucial", "urgent", "critical"
- Use bold/italics judiciously (not too much)

Caution!

It is extremely difficult to teach reviewers something that contradicts standard wisdom

Proposals the require completely reorienting a reviewers world view are challenging.

Caution!

It is extremely difficult to teach reviewers something that contradicts standard wisdom

Work with their existing schema! Acknowledge it before you try to break it.

"It has become standard lore that X, but recently there has been growing evidence for Y"

Proposals for supporting you

Fellowship proposals are trying to support future leaders

“Leader”

Someone who will influence, shape, and change the future of a field

“Leader”

This is *not* the same as being the most technically proficient, or even the most productive

So, your proposal should make you look like:

"*Someone who will influence, shape, and change the future of a field*"

Qualities to demonstrate leaderliness

- Clear vision of big picture
- Broad outlook, but depth of knowledge in core area
- Ability to craft a strategic plan that can impact a field
- Ambition and/or bravery
- Innovation

These are all skills you can cultivate!

- *Clear vision of big picture*
- *Broad outlook, but depth of knowledge in core area*
- *Ability to craft a strategic plan that can impact a field*
- *Ambition and/or bravery*
- *Innovation*

The act of finding stories and developing sound arguments goes 85% of the way there!

Writing is where much of this happens

- *Clear vision of big picture*
- *Broad outlook, but depth of knowledge in core area*
- *Ability to craft a strategic plan that can impact a field*
- *Ambition and/or bravery*
- *Innovation*

By writing well, you will *naturally* develop leaderliness.

So what does this mean for concrete actions?

Ingredients of a strong fellowship proposal

- Clear vision of big picture
- Broad outlook, but depth of knowledge in core area
- Demonstrating a strategic plan that can impact a field
- Ambition and/or bravery
- Innovation

Other ingredients of a strong fellowship proposal

- Well matched to timescale of fellowship (ambition ≠ foolish).
- But, with awareness of a longer time horizon.
- Good match between goals and resources.

Things to avoid

- Redoing your thesis
- Failing to look distinct from your Famous Advisor
- Creating a research program that would leave you in the same intellectual place in 3 years
- Lack of enthusiasm