Proposal writing

(adapted for AST555, in 2018)

Start: science idea

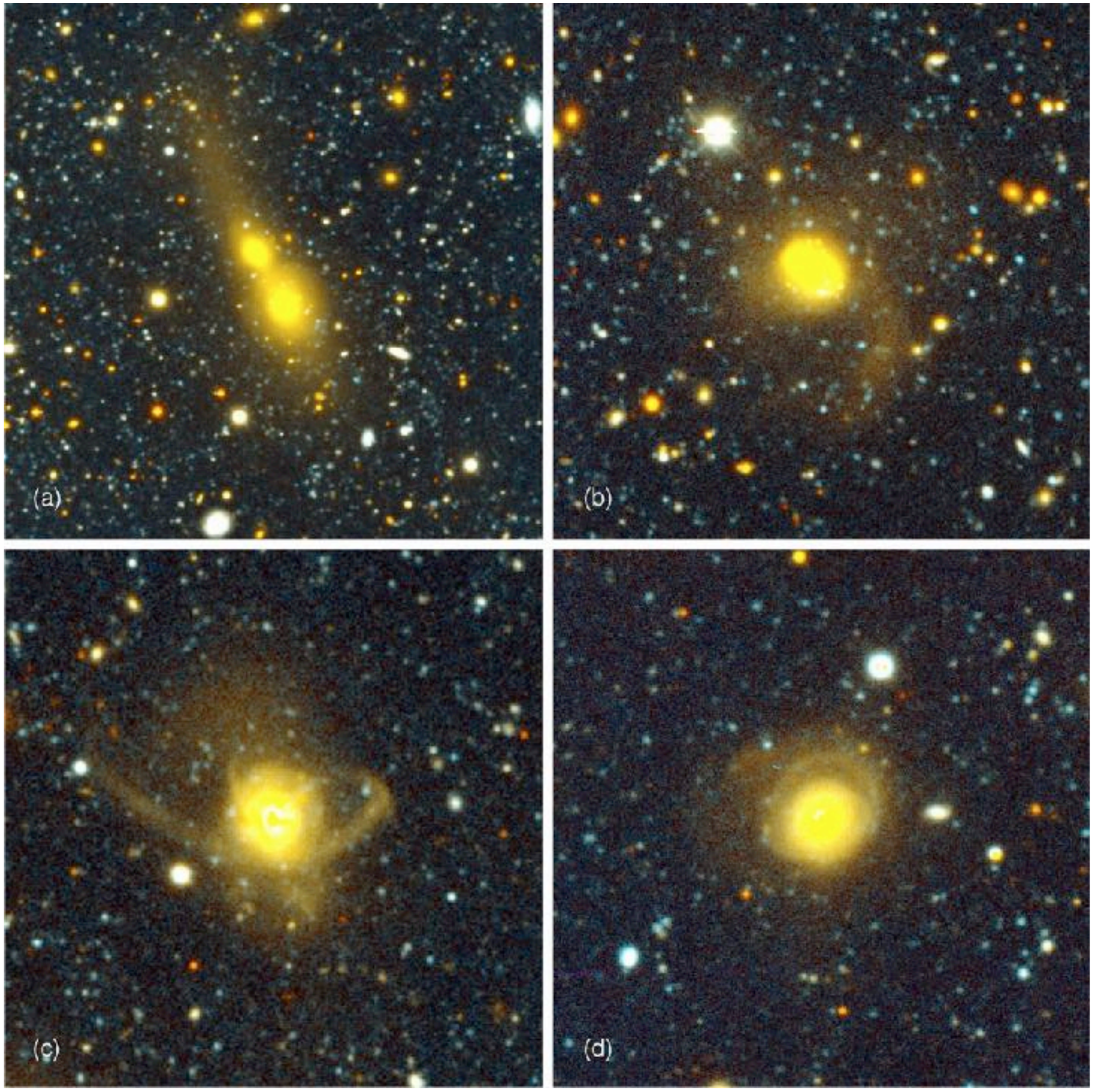
- Ideally: "I want to figure this out. What data do I need?"
- Often, particularly for grad students: "I have (or was given) these data. What can I do with them?"
- Developing a sense of what the important questions are is one of the most crucial, and most difficult, skills to develop

Is a proposal needed?

- Large, public datasets readily available: often it won't be necessary to write a proposal

[Example]

- How were elliptical galaxies assembled ?
- Prediction from theory: in mergers
- Problem: mergers take only a short time, so they are difficult to see and quantify
- Solution: look for tidal debris around elliptical galaxies, as it should survive for billions of yrs
- Needed: very deep, high quality images of elliptical galaxies
- Turns out these were available from public archives


(a)
(b)
(c)
(d)

[Example]

Broad question

- How were elliptical galaxies assembled ?
- Prediction from theory: in mergers

Learn from papers, conferences

- Problem: mergers take only a short time, so they are difficult to see and quantify

Figure out why this has not been solved yet

- Solution: look for tidal debris around elliptical galaxies, as it should survive for billions of yrs

Idea: the hard part! Talk to people, listen to colloquia, etc

- Needed: very deep, high quality images of elliptical galaxies

Need to know strengths/weaknesses of instruments

- Turns out these were available from public archives

Be aware of literature, surveys

Develop the project - I

- What type of data are needed ? (spectra, optical images, radio data, ...)
- How many photons are needed ? How many objects ? What is the required resolution (spatial and spectral) ? Etc etc
- What telescope / instrument is needed ?
- With all questions: aim for quantitative goal, e.g. a 5 sigma detection
- Tools: software to simulate your experiment (IDL, etc); exposure time calculators

Develop the project - II

- Best to bootstrap from existing data
  (we already have 10 minutes, need 10 hrs)
- Tip: use fraction of telescope time to do pilot observations for future projects
- Telescope: aim for smallest / least capable telescope that can do the job
- Identify key collaborators and involve them early (make sure to give an "out" when asking..)

TACs

- Time on telescopes is almost always awarded by committees
- "TAC", or Time Allocation Committee; composed of astronomers (= people)
- Sometimes multiple panels, each with particular expertise (e.g., HST)
- Sometimes 1 panel, with huge variation in background (e.g., Yale)
- Usually feedback given - but not always useful

TACs

- Goal of a TAC: eliminate 70%, or 90%, of proposals
- First aim is therefore to avoid any red flags !

Red flags

- "This can be done with existing data"
- "This can be done on a smaller / ground-based / different telescope"
- "First analyze the 2 objects they have before granting time to do 20 more"
- "Why 20? Why not 10?" (or: "why 7 sigma? why not 5?")
- Perceived, or real, technical errors or omissions: "it was unclear why the proposal required 500 hrs of HST time"

Seldom said:

- "The proposers lack the required expertise"

Weaknesses

- The TAC had much skepticism about previous results + treatment of errors from this group

- "The proposed science is not interesting / important"

Structure of a proposal

- Title
- Abstract
- Body of text
- Figures
- Technical sections

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All are important!

Structure of a proposal

- Title: steers reader in a particular direction
- Abstract: crucial for getting to top ~half of proposals (at this point your proposal has been provisionally graded)
- Body of text: will often be glanced at rather than read, so must be very easy to read
- Figures: need to convey the key points independent of the text
- Technical sections: will be checked for red flags

Structure of text body

- Motivation: explain why this is an interesting area of study
- The problem: this is what limits progress right now
- The solution: here's how we will deal with the problem

[Example]

- Movitation: Transiting planets give us crucial and unique information on planetary systems
- Problem: Rare, and signals of Earth-like planets are too weak to be detected from the ground
- Solution: Build a satellite that provides stable photometry for 100,000 stars over several years

Other factors ...

- TAC members can be friends, enemies, or frenemies - or of your advisor!
- Usually your proposal is assigned to a "primary reviewer" - this person has a huge influence on the outcome
- TACs make mistakes .. but that can also work in your favor