Open Questions About Dust

- What is the UV extinction/attenuation vs. environment? What can we learn from it about dust?
  - How do we correct for UV extinction in moderate-to-high z galaxies?
  - How prevalent is the 2175 A bump? How do we sort through the range of extinction curves currently predicted?
  - In general, how do we handle dust-mixed-with-stars situations?
- What is the chemistry of ice and molecular deposition on grains?
  - How does it depend on optical depth in dark clouds?
- What is the rate of dust production by stars? And of dust destruction by stellar feedback (e.g., supernova shockwaves)?
- How can we measure and constrain dust formation and destruction in the ISM?
  - What about aromatic (PAH) formation and destruction?
- How do we get accurate dust masses?
  - How do the masses of proto-planetary nebulae relate to planet formation?
  - How do we convert accurately from gas to dust mass?
- How much dust escapes galaxies in wind? What fraction of metals in the circum-galactic medium are in dust? How does intergalactic dust affect distance indicators?
- How does the bright emission by polar dust change our view of AGNs?
- How do dust properties evolve with redshift? How does that affect the observables?
- How do we constrain gas masses in high-z galaxies (relationship to dust-to-gas ratio, metallicity)?
  - What does the gas content teach us about assembly of massive halos vs. typical galaxies?
  - What do we expect the cosmic dust mass function and gas mass function to look like from theory/modeling perspective, and how can we push observations to shed light on both?
- How can we get accurate measures of the obscured star formation at high z down to lower L?
- By what physical mechanism do the first (second) stars form in the absence of (most) dust?

How to approach the questions

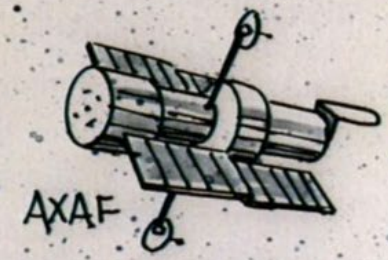
- We are now a widespread, highly interactive and interdisciplinary field

- Previously, we have often focused on how some single approach or facility would make major advances
  - That is no longer how we work
  - Putting together a strategy (e.g., our decadal survey) needs to recognize the interdependence of methods
  - Doing this thoroughly can make not only a better plan, but a stronger case for the plan

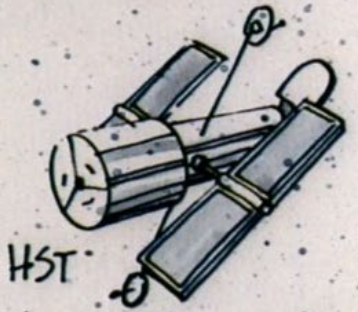
- An example: “The Great Observatories” promoted by former NASA astrophysics head Charlie Pellerin
  - Pellerin wanted to promote AXAF (now Chandra) but preserve SIRTF (now Spitzer) for the next mission
  - He packaged them together as a comprehensive plan
  - And had a very talented artist put together a brochure selling this plan (two example pages follow)

- When SIRTF was cancelled by Congress, Lennard Fisk (Associate Administrator for Space Science) felt obligated to save it because it was part of Pellerin’s larger plan
  - And Fisk did!!!

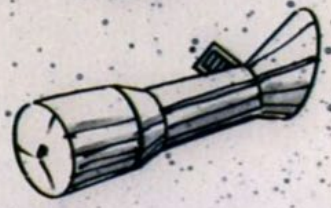
WHAT IF WE COULD SEE
ONLY ONE OR TWO COLORS OR WAVELENGTHS?



AXAF



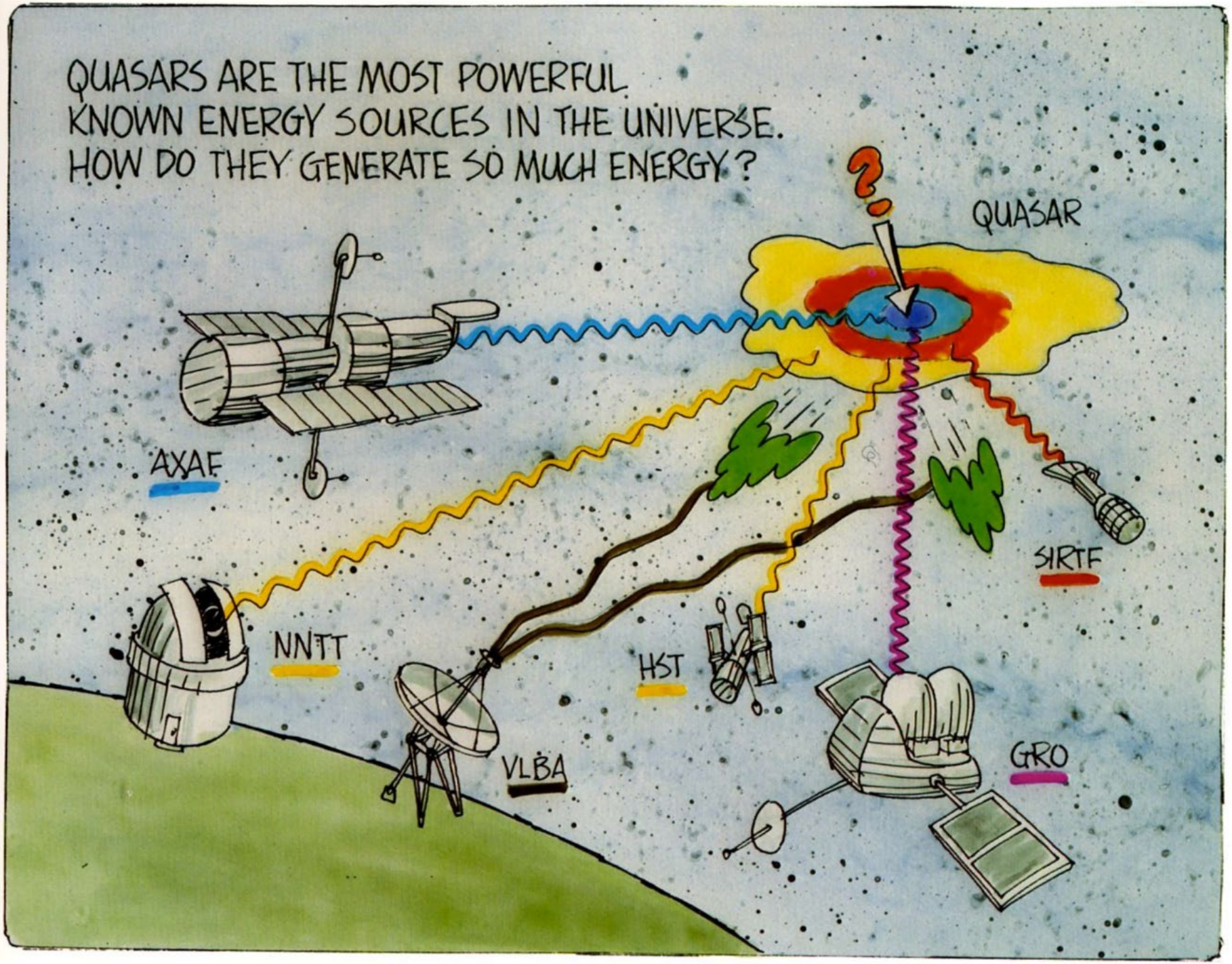
HST



SIRTF

WE MIGHT MISS A

DISCOVERY


QUASARS ARE THE MOST POWERFUL KNOWN ENERGY SOURCES IN THE UNIVERSE. HOW DO THEY GENERATE SO MUCH ENERGY?
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QUASAR
AXAF
NNTT
VLBA
HST
SIRTF
GRO