Overview of the Decadal Process
&
How (Not to) Write a White Paper

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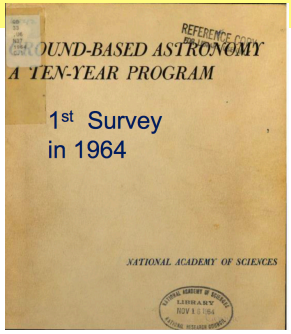
Caveats to this talk

- I participated (at a high level) in Astro2010.
- This shorthand that we invented for ourselves seems to have stuck, and the next NAS decade survey is apparently going by the name Astro2020.
- I have nothing to do with Astro2020.
- Everything I say here is predicated on:
  - my experience as the Executive Officer for Astro2010
  - my projection of what sensible people would do in running Astro2020.

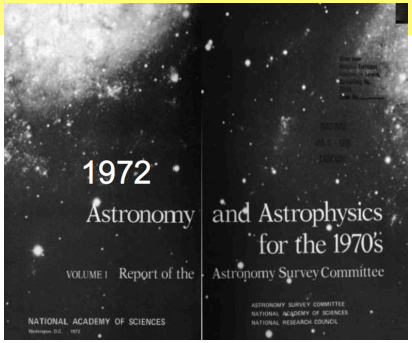
Side note: yellow-background slides are from 8-10 years ago.

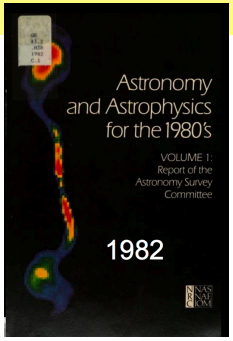
Decadal Surveys in Astronomy and Astrophysics

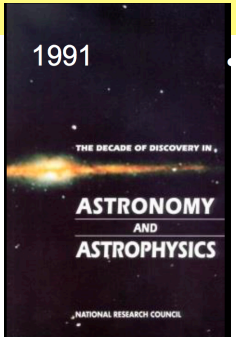
- **1964: Ground-based Astronomy: A Ten Year Program (Whitford)**
- **1972: Astronomy and Astrophysics for the 1970s (Greenstein)**
- **1982: Astronomy and Astrophysics for the 1980s (Field)**
- **1991: The Decade of Discovery in Astronomy and Astrophysics (Bahcall)**
- **2001: Astronomy and Astrophysics in the New Millennium (McKee-Taylor)**
- **2010: New Worlds New Horizons (Blandford)**

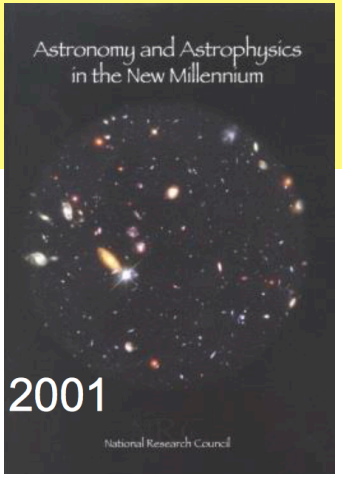


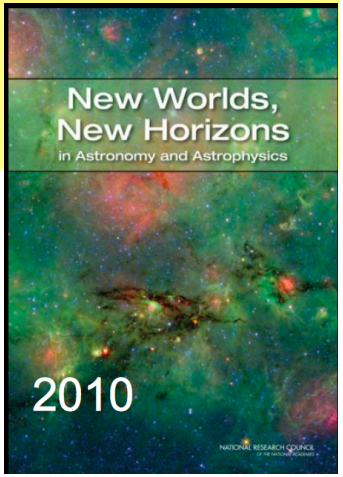
1st Survey in 1964











Why do we do these?

- The majority of funding for astronomy and astrophysics comes from NASA / NSF / DOE, and these agencies have come to rely on guidance from the decade surveys.

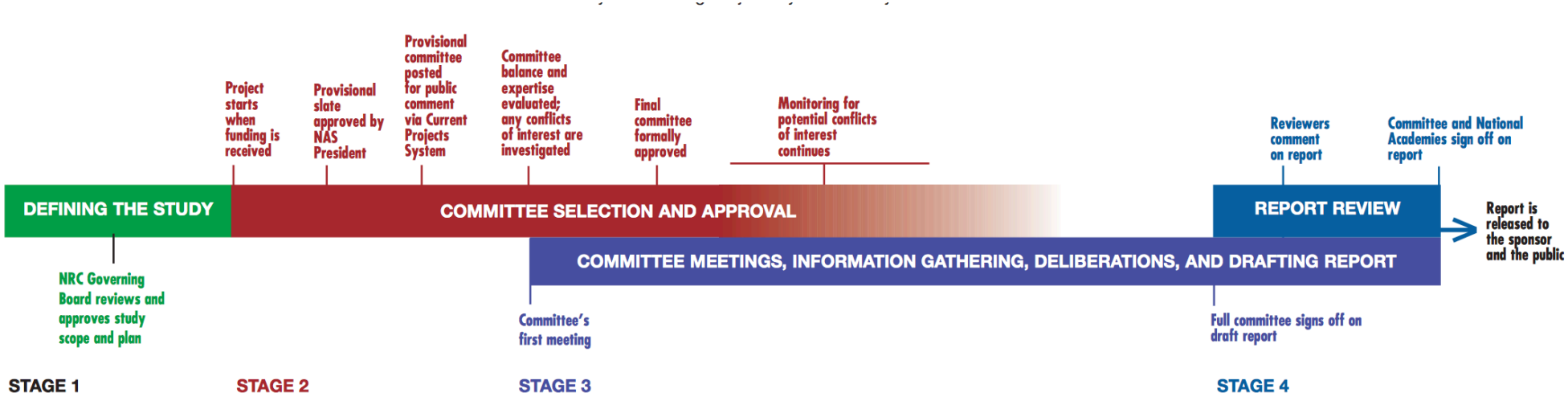
- For NASA, actually congressionally mandated.

- Congress and the White House / OSTP are also consumers of the decadal survey reports.

- It is always useful to take stock of the present, and attempt to plan ahead in a strategic manner.

Basics of the Decadal Survey Process

- A "Study" of the National Academies
- First step is negotiation of the "Statement of Task" between the sponsors (i.e. the agencies) and NAS
- Follows a rigorous committee procedure, including report writing and review under NAS rules.



Astro2010 Charge

- **The Astro2010 committee will survey the field of space- and ground-based astronomy and astrophysics, recommending priorities for the most important scientific and technical activities of the decade 2010-2020.**

- **The principal goals of the study will be to carry out an assessment of activities in astronomy and astrophysics, including both new and previously identified concepts, and to prepare a concise report that will be addressed to the agencies supporting the field, the Congressional committees with jurisdiction over those agencies, the scientific community, and the public.**

Committee on Astro2010

Roger Blandford, Chair, Stanford University
Lynne Hillenbrand, Executive Officer, California Institute of Technology

Subcommittee on Science

Martha P. Haynes, Vice Chair – Science Frontiers, Cornell University
Lars Bildsten, University of California, Santa Barbara
John E. Carlstrom, The University of Chicago
Fiona A. Harrison, California Institute of Technology
Timothy M. Heckman, Johns Hopkins University
Jonathan I. Lunine, University of Arizona
Juri Toomre, University of Colorado at Boulder
Scott D. Tremaine, Institute for Advanced Study

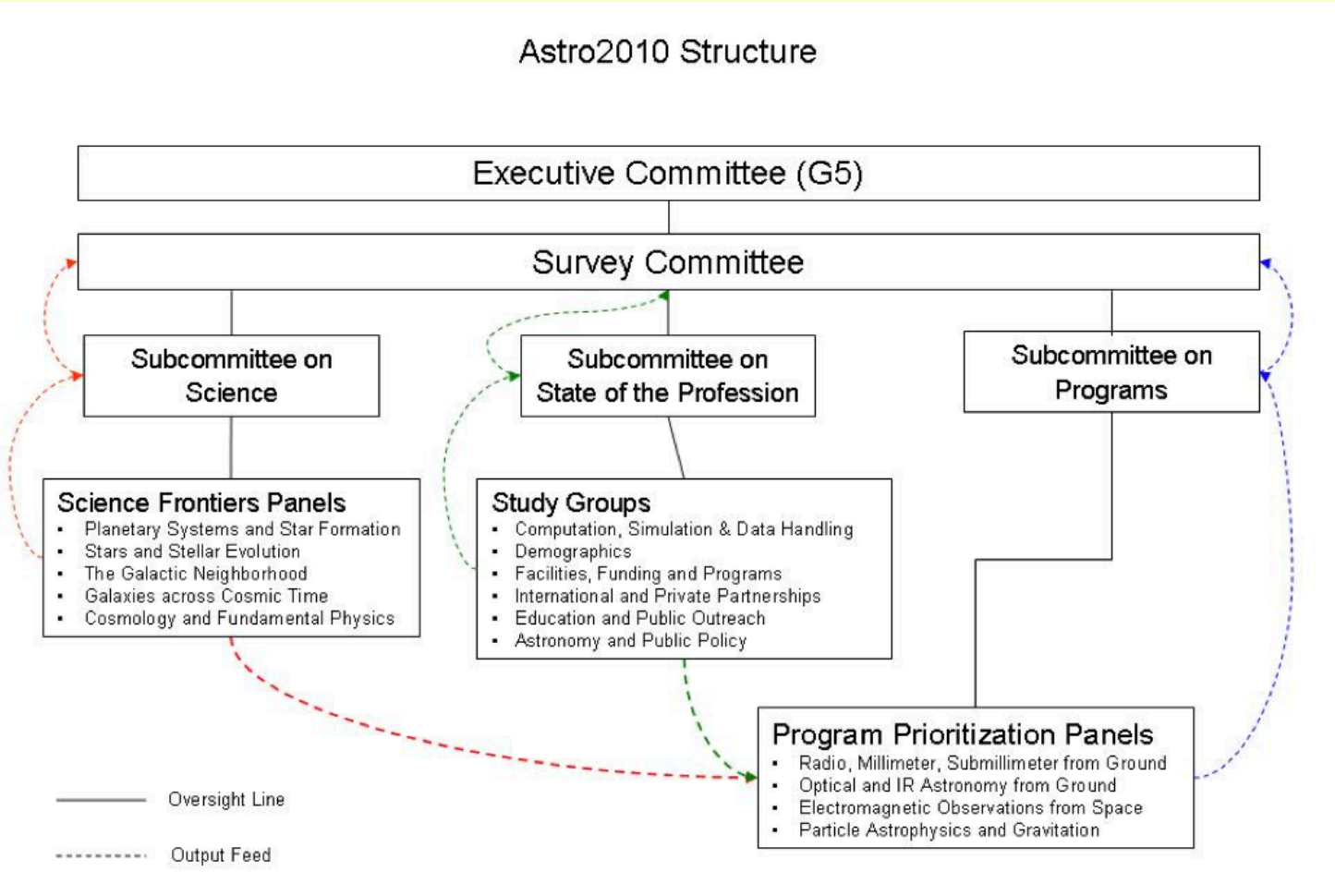
Subcommittee on State of the Profession

John P. Huchra, Vice Chair – State of the Profession, Harvard-University
Debra M. Elmegreen, Vassar College
Joshua Frieman, Fermi National Accelerator Laboratory
Robert C. Kennicutt, Jr., University of Cambridge
Dan McCammon, University of Wisconsin-Madison
Neil de Grasse Tyson, American Museum of Natural History

Subcommittee on Programs

Marcia J. Rieke, Vice Chair – Program Prioritization, University of Arizona
Steven J. Battel, Battel Engineering
Claire E. Max, University of California, Santa Cruz
Steven M. Ritz, NASA Goddard Space Flight Center
Michael S. Turner, The University of Chicago
Paul Adrian Vanden Bout, National Radio Astronomy Observatory
A. Thomas Young, Lockheed Martin Corporation [Retired]

Astro2010 Structure



More detail available at www.nationalacademies.org/astro2010

Input and Considerations

- Agency-level and division / directorate planning docs
- Recent high-level reports by agencies, NAS, AAAC
- Relevant OSTP/OMB memos
- Community input
  - open email address
  - white papers (solicited)
  - presentations (invited)
  - town hall meetings
- Budget projections
- Scientific importance and feasibility + tech readiness
- Health, vitality, and balance within the field

Significantly enhanced transparency in Astro2010 relative to previous surveys.

We do our science within a much larger ecosystem!

Some Other Reports

- 2003: Connecting Quarks with the Cosmos (Turner)*
- 2003: Beyond Einstein: From the Big Bang to Black Holes (Phinney)
- 2004: The Physics of the Universe (OSTP)
- 2004: The President's Vision for Space Exploration (White House)
- 2004: The Quantum Universe (Drell)
- 2004: TPF Letter Report (Freedman)*
- 2005: Astrophysical Context of Life (Szostak-Wheeler)*
- 2005: Mid-Course Review (Urry)*
- 2005: Options for Extending the Life of HST (Lanzerotti)*
- 2005: AAAC CMB Task Force (Weiss)
- 2006: Revealing the Hidden Nature of Space and Time (Shapiro)*
- 2006: From the Ground Up – NSF/AST Senior Review (Blandford)
- 2006: AAAC – Dark Energy Task Force (Kolb)
- 2007: NASA Astrophysics Performance Assessment (Keller)*
- 2007: AAAC/HEPAP Dark Matter Science Assessment (Sobel)
- 2008: Beyond Einstein Program Assessment Committee (Kennel)*
- 2008: AAAC- Exoplanet Task Force (Lunine)

* = NRC

White Papers

- Leftover nomenclature, but basically a position paper written in the persuasive style, to convince somebody or some group of your point.
- In Astro2010 we invited white papers on:
  - Science
  - State of the Profession
  - Technology Development and "Activities"
- For Astro2020, the CAA solicited the first round of white papers on science, before survey even got going.

White Papers

- In Astro2010, from the SWP call alone we received:
  - PSF – 86 responses
  - SSE -- 109
  - GAN – 90
  - GCT – 103
  - CFP -- 117

  (includes double-counting for those directed to >1 panel)

- SoP and TD/A calls yielded hundreds more.
- Lots of effort both to produce and to consume the WPs.
- Astro2020 prospects seem daunting…..

Astro2010: The Astronomy and Astrophysics Decadal Survey

Science White Papers

The Astro2010 Science White Papers were used as input to charges investigated by the Science Frontier Panels. The list below is of all the science white papers received by the close of the submission window on February 15, 2009. You can download the text of each science white paper below.

Science White Papers Received by Science Frontier Panel

Planetary Systems and Star Formation

	White Paper Title	Lead Author	Science Frontier Target
1.	Searching for the Secrets of Massive Star Birth	Bally, John	PSF, GAN
2.	Formation and Evolution of Planetary Systems	Beichman, Charles	PSF
3.	A Census of Explanets in Orbits Beyond 0.5 AU via Space-based Microlensing	Bennett, David P.	PSF
4.	Achieving the Goals and Objectives of the 2008 NASA Astrobiology Roadmap	Boss, Alan	PSF
5.	Science-Operational Metrics and Issues for the "Are We Alone?" Movement	Brown, Robert A.	PSF
6.	Fragmentation in Molecular Clouds and the Origin of the Stellar Initial Mass Function	Carpenter, John	PSF
7.	Mass Transport Processes and their Roles in the Formation, Structure, and Evolution of Stars and Stellar Systems	Carpenter, Kenneth G.	PSF, SSE
8.	Comparative Planetology: Transiting Exoplanet Science with JWST	Clampin, Mark	PSF
9.	O/IR Polarimetry for the 2010 Decade (PSF): Science at the Edge, Sharp Tools for All	Clemens, Dan	PSF
10.	Comets and Origin of the Solar System	Coanga, Jean-Maurice	PSF
11.	Science at Very High Resolution: The Expected and the Unexpected	Creech-Eakman, Michelle	PSF, SSE, GAN
12.	New Astrophysical Opportunities Exploiting Spatio-Temporal Optical Correlations	de Wit, Willem-Jan	PSF, SSE
13.	Exoplanet Forum: Transit Chapter	Deming, Drake	PSF
14.	Finding and Characterizing SuperEarth Exoplanets Using Transits and Eclipses	Deming, Drake	PSF
15.	Young stellar clusters and star formation throughout the Galaxy	Feigelson, Eric	PSF

Stars and Stellar Evolution

	White Paper Title	Lead Author	Science Frontier Target
1.	Cosmic Accelerators	Arons, Jonathan	SSE, GAN, GCT
2.	X-ray Timing of Neutron Stars, Astrophysical Probes of Extreme Physics	Arzoumanian, Zaven	SSE, CFP
3.	Fundamental Stellar Astrophysics Revealed at Very High Angular Resolution	Aufdenberg, Jason	SSE
4.	The Solar Chromosphere: Old Challenges, New Frontiers	Ayres, Thomas R.	SSE
5.	3-D Radiative Transfer in the Next Decade	Baron, Eddie	SSE
6.	Particle Acceleration and Transport on the Sun	Bastian, Tim	SSE
7.	Astrometry - Challenging our Understanding of Stellar Structure and Evolution	Benedict, G. Fritz	SSE, GAN
8.	Coordinated Science in the Gravitational and Electromagnetic Skies	Bloom, Josh	SSE, GCT, CFP
9.	Nuclei in the Cosmos	Brown, Edward	SSE
10.	Understanding Activity in Low Mass Stars	Browning, Matthew	SSE
11.	Toward the End of Stars: Discovering the Galaxy's Coldest Brown Dwarfs	Burgasser, Adam	SSE, GAN
12.	Mass Transport Processes and their Roles in the Formation, Structure, and Evolution of Stars and Stellar Systems	Carpenter, Kenneth G.	PSF, SSE
13.	From Molecular to Highly-Charged Ions: Expansion of Laboratory Astrophysics Through the Use of the Electrostatic Storage Ring and Electron Beam Ion Trap	Chutjian, Ara	SSE, GAN, CFP
14.	Extremely Metal-Poor Stars: The Local High Redshift Universe	Cohen, Judith	SSE, GAN
15.	Tests of Gravity and Neutron Star Properties from Precision Pulsar Timing and Interferometry	Cordes, James	SSE, CFP
16.	Measuring Stellar Ages and the History of the Milky Way	Covey, Kevin R.	SSE, GAN
17.	Science at Very High Resolution: The Expected and the Unexpected	Creech-Eakman, Michelle	PSF, SSE, GAN
18.	Low Mass Stars and Brown Dwarfs Beyond the Solar Neighborhood	Cruz, Kelle	SSE, GAN

What makes a Good White Paper?

- Addresses the call
- Understands and respects the intended audience
- Gives sufficient but not too much background
- Identifies critical questions and specific opportunities
- Makes a point that needs to be made
- Is clear and succinct
- Backs up claims and assertions with evidence
- Contains easily interpretable graphics / tables
- Is presented in a broad-minded fashion

What makes a Less Effective White Paper?

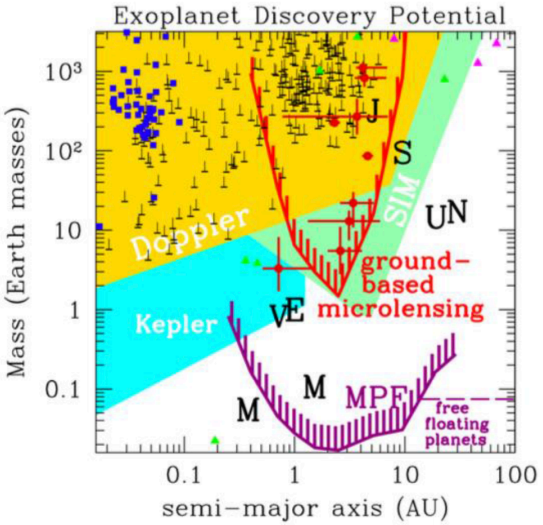
- Poorly written / organized / conceived.
- Narrow-minded advocacy without consideration of the bigger picture.
- Repetitive of other white papers in an unnatural or inorganic way (i.e. looks like stuffing the ballot box).
- Blatantly exceeds the page or font guidance.

Tactics of some influential ones from Astro2010

(according to former SFP panel chairs and members)

A Census of Exoplanets in Orbits Beyond 0.5 AU via Space-based Microlensing

White Paper for the Astro2010 PSF Science Frontier Panel



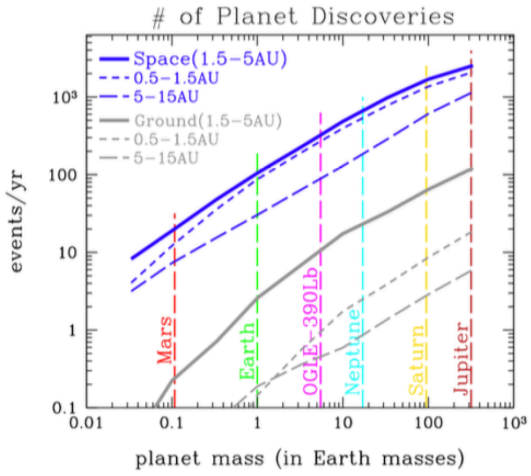


Fig. 4: *The expected number of MPF planet discoveries as a function of the planet mass if every star has a single planet in the given separation of ranges.*

Early Career Focus Session for Astro 2020

5. Implementation of a Space-based Microlensing Mission

A space-based microlensing mission requires a space telescope of at least 1m-aperture, with a focal plane of > 0.5 sq. deg. in the near IR (or visible) with an orbit with a continuous view the Galactic bulge. It requires no new technology, and can be accomplished with a budget of less than $300 million (excluding the launch vehicle). The Microlensing Planet Finder or MPF (shown on the cover page) is an example of such a mission (Bennett et al. 2004), which has been proposed to NASA's Discovery program. Another, very similar, design known as DUNE (for Dark Universe Explorer) had been proposed to CNES and ESA to study dark energy via the weak lensing method (Refregier et al. 2008). This remarkable similarity between these designs suggests that a joint mission could be even more cost effective.

Tactics of some influential ones from Astro2010

(according to former SFP panel chairs and members)

Fragmentation in Molecular Clouds and the Origin of the Stellar Initial Mass Function

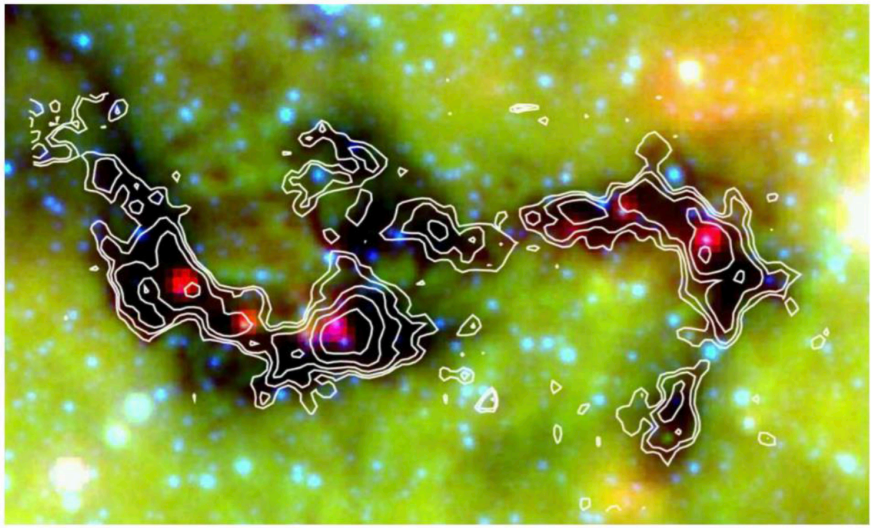


Image courtesy of C. Brogan, R. Indebetouw, & T. Hunter (NRAO)

3. Observational Goals

- *Sensitivity to clumps capable of forming a 0.01 $M_\odot$ brown dwarf*
- *Observations of the dust continuum and molecular lines*
- *Angular resolution $< 5''$ to resolve 0.05 pc diameter clumps to 1 kpc*
- *Surveys over tens of square degrees to image molecular clouds*
- *Multi-wavelength observations to measure dust temperatures and emissivity*

Tactics of some influential ones from Astro2010

(according to former SFP panel chairs and members)

X-ray Timing of Neutron Stars, Astrophysical Probes of Extreme Physics

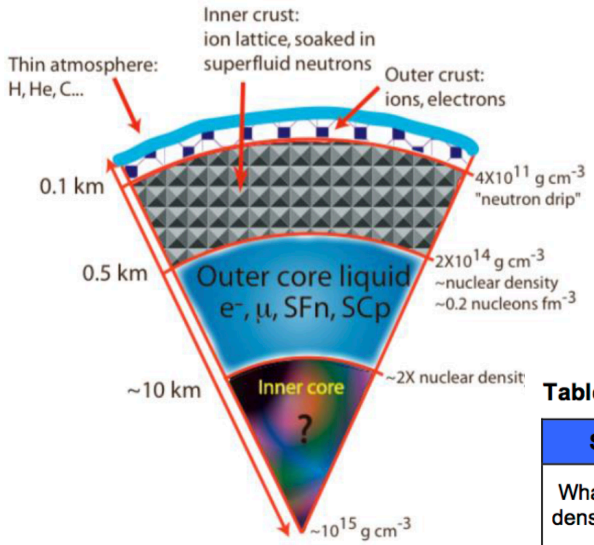


Table 1. Fundamental questions of neutron star structure and dynamics.

Science Questions	Measurements Needed	Implications
What is the nature of ultra-dense matter in the interiors of neutron stars?	The mass-to-radius ratios of several neutron stars to ±5%.	Discriminate among proposed EOSs; constrain a basic unknown of nuclear physics, the nuclear symmetry energy.
What is the physics responsible for the dynamic behavior of neutron stars?	Characterization of outbursts, oscillations, and rotational irregularities.	Constrain the bulk properties of dense matter. Probe quantum phenomena in neutron stars.

Measurement	*M*, *R* dependence	Approach
Redshift/compactness	$\beta = GM/Rc^2$	Lightcurves and spectra
Surface gravity	$g = GM/R^2$	Lightcurves and spectra
Light-bending magnified radius	$R_\infty = R/\sqrt{1-2GM/Rc^2}$	Thermal spectra
Inner edge of accretion disk	$R_{\rm disk} \geq R$	Broadened Fe lines
kHz QPO frequency (one of several theoretical relations)	$\nu_{\rm QPO} = \sqrt{GM/4\pi^2 R_{\rm disk}^3}$	Fast timing of X-ray binaries in outburst
Maximum mass	$M \leq M_{\rm max}$, for all R	Pulse timing
Minimum spin period	$P_{\rm min} \propto \sqrt{R^3/M}$	Pulsation searches
Fractional moment of inertia in crustal superfluid	$\Delta I/I \propto R^4/M^2$	Glitch monitoring
Seismic vibrations	Mode-dependent	Flux oscillations in flares, bursts

Tactics of some influential ones from Astro2010

(according to former SFP panel chairs and members)

The Promise of Low-Frequency Gravitational Wave Astronomy

Lead Author: Tom Prince (Caltech/JPL)
for
Members of the LISA International Science Team

Finding and Using Electromagnetic Counterparts of Gravitational Wave Sources

E. Sterl Phinney

Abstract

The principal goal of this whitepaper is not so much to demonstrate that gravitational wave detectors like LIGO and LISA will help answer many central questions in astronomy and astrophysics, but to make the case that they can help answer **a far greater range of questions** *if we prepare to make the (sometimes substantial) effort to identify electromagnetic counterparts to the gravitational wave sources.*

Tactics of some influential ones from Astro2010

(according to former SFP panel chairs and members)

TECHNOLOGY DEVELOPMENT FOR COMPUTATIONAL RADIO ASTRONOMY: 2010-2020

Common issues in processing and computation across all wave-bands for the observational projects of the coming decade include:

i) large-scale data management,
ii) distributed, massive storage and federated databases,
iii) high-speed network connections,
iv) long-term data curation support,
v) community software development,
vi) data mining, reduction and analysis tools,
vii) common data access protocols (e.g. Virtual Observatory); and
viii) open and equitable community scientific access.

Advice for your input to Astro2020

- Read the Statement of Task and the Astro2020 calls.
- Consider science, observations/experiment, theory, infrastructure, technology dev., state-of-the-profession, training, as appropriate.
- Empathize with the panel / committee members and help them to appreciate your important points.
- Join other efforts where it makes sense.
- Know when ``less is more'' is better than "more is more".

Statement of Task for Astro2020

The National Academies of Sciences, Engineering, and Medicine shall convene an ad hoc survey committee and supporting study panels to carry out a decadal survey in astronomy and astrophysics. The study will generate consensus recommendations to implement a comprehensive strategy and vision for a decade of transformative science at the frontiers of astronomy and astrophysics. The committee, with inputs from study panels covering the breadth of astronomy and astrophysics, will carry out the following tasks:

- Provide an overview of the current state of astronomy and astrophysics science, and technology research in support of that science, with connections to other scientific areas where appropriate;
- Identify the most compelling science challenges and frontiers in astronomy and astrophysics, which shall motivate the committee's strategy for the future;
- Develop a comprehensive research strategy to advance the frontiers of astronomy and astrophysics for the period 2022-2032 that will include identifying, recommending, and ranking the highest priority research activities — taking into account for each activity the scientific case, international and private landscape, timing, cost category and cost risk, as well as technical readiness, technical risk, and opportunities for partnerships. The strategy should be balanced, by considering large, medium, and small activities for both ground and space. (Activities include any project, telescope, facility, experiment, mission, or research program of sufficient scope to be identified separately in the final report.) For each recommended activity the committee will lay out the principal science objectives and activity capabilities, including assumed or recommended activity lifetime, where possible;
- Utilize and recommend decision rules, where appropriate, for the comprehensive research strategy that can accommodate significant but reasonable deviations in the projected budget or changes in urgency precipitated by new discoveries or unanticipated competitive activities;
- Assess the state of the profession, using information available externally and, if necessary, data gathered by the study itself, including workforce and demographic issues in the field. Identify areas of concern and importance to the community raised by this assessment in service of the future vitality and capability of the astronomy and astrophysics work force. Where possible, provide specific, actionable and practical recommendations to the agencies and community to address these areas. This report shall be made available following the completion of the study.

Call to the Astronomy & Astrophysics Community for Science White Papers

Submit in PDF via the web form that will be linked to

http://nas.edu/astro2020.html

Submissions must be made between 12:01am EST, Monday January 7, 2019 and 5:00pm, EST Tuesday, February 19, 2019

In preparation for the 2020 decadal survey in astronomy and astrophysics, the U.S. National Academies of Sciences, Engineering, and Medicine's Committee on Astronomy and Astrophysics (CAA) invites the community to submit white papers focusing on how our understanding of the scientific frontiers in astronomy may be advanced in 2020-2030 and beyond.

Science white papers provided crucial community input to the Astro2010 Decadal Survey. They played a major role in informing the Survey about what the community viewed as important science areas and provided guidance to the committee on areas that needed to be examined deeply. In particular, the work of the Science Frontier Panels was greatly facilitated by the information provided in the white papers.[1] For the upcoming Survey, the science white papers will be available at the outset, and the community will have more time to prepare them. We currently anticipate that the Survey will start in early 2019. In addition, we anticipate that there will be one or more additional call(s) for white papers on other essential topics, such as issues relating to the state of the profession and to missions, projects, and technology development, once the survey begins.

White papers should identify a primary thematic science area (and, if relevant, a secondary area) from the list below, and should specifically and succinctly identify new science opportunities and compelling science themes, place those in the broader international scientific context, and describe the key advances in observation, experiment, and/or theory necessary to realize those scientific opportunities within the decade 2020-2030.

Keep in Mind

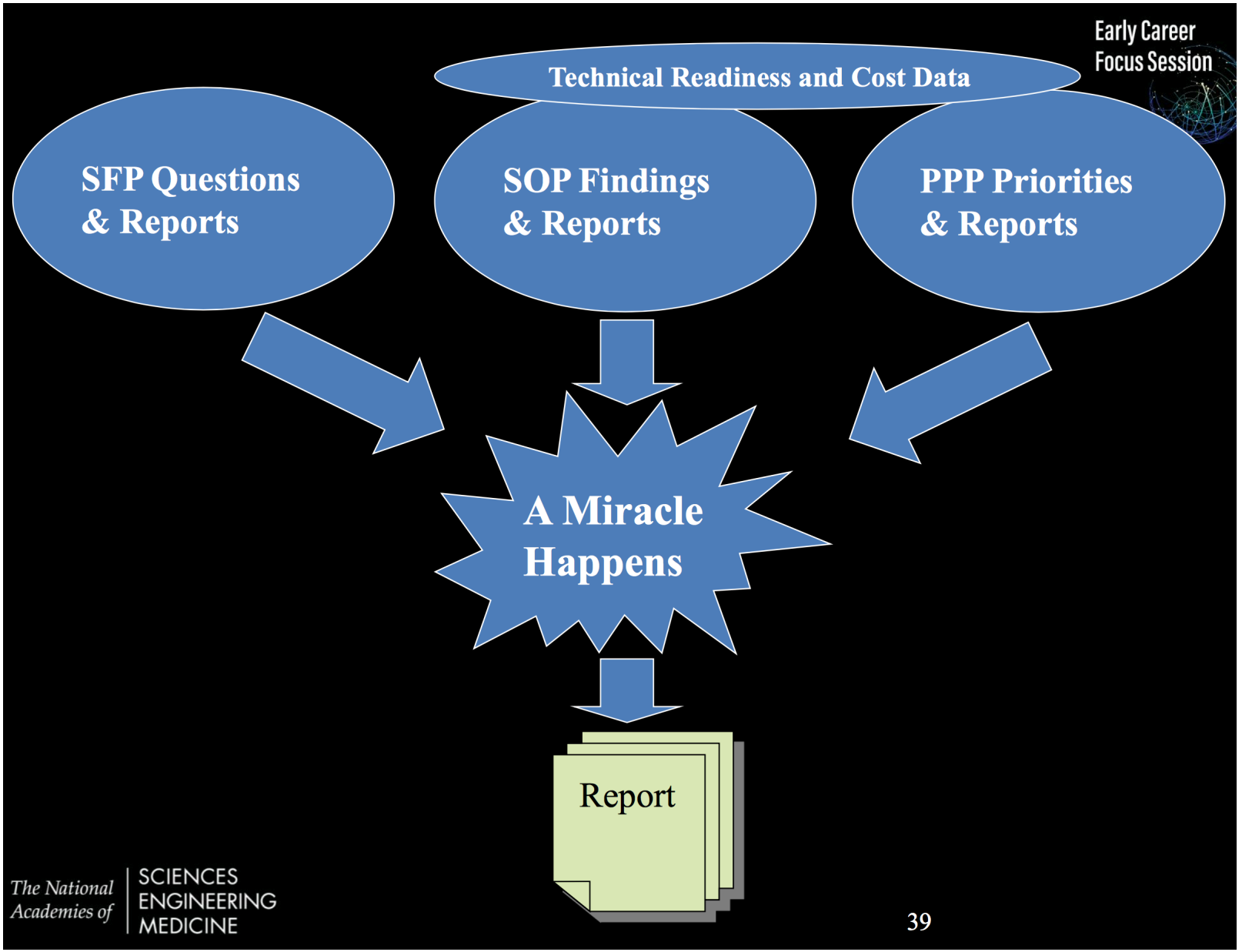
- There is no requirement that your white paper input is actually read and thoroughly digested.
- For the panel and committee members, it's more like journal or arxiv perusing, than a proposal review.
- It is up to you to make your WP both interesting and palatable. Really no "best" style or template though.
- The "menu" for Astro2020 will be sizable and heavy.

What Impact Do WPs Really Have?

- Inform Astro2020 participants coming with different backgrounds and varying expertise, in a uniform manner
- Influence panel/committee discussions and decisions
- Buttress arguments arrived at independently
- Good graphics/tables could be used in the reports
- Legacy value in recording state of the field circa 2020

The Final Deliberations of Astro2010

(slide courtesy of Marcia Rieke)



What Astro2010 Considered When Making its Recommendations

(as reconstructed by Marcia Rieke = Lead of PPP effort)

These parameters were used by the Survey Committee when assessing the Program and Science Panel results

Most important: Direct mapping to SFP question(s)/discovery area(s)

Other parameters:

A. Other science return
B. Value to the health of the overall community and to the discipline
C. Value as a precursor activity
D. Technical readiness
E. Cost
F. Risks: scientific and technical
G. Value to the nation

Regarding Astro2020

- While the co-Chairs have been announced, the committee structure and membership still unknown.
- Some things will be done a lot like last time.
- Many things will be done quite differently.

- Everything that is recommended must be justified by the science.

- Opportunities for community input will be ample.