

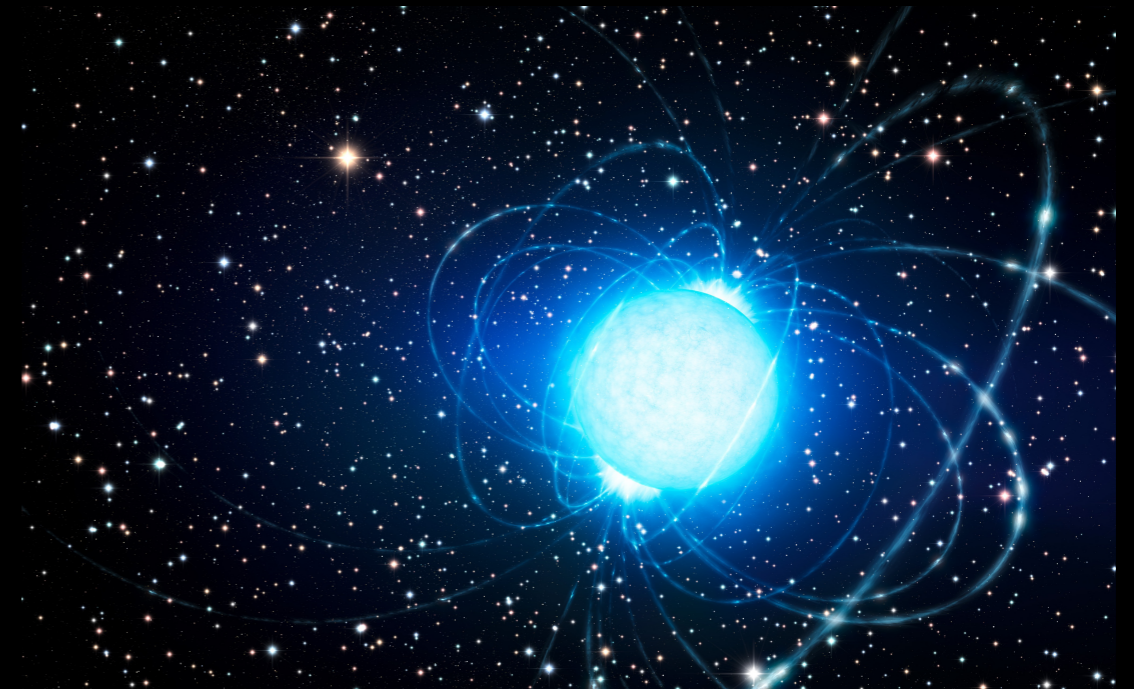
NICER Proposal Feasibility

How to write a (potentially) successful NICER proposal

George Younes -



Joint NICER/IXPE Workshop 2024



WHY WRITE PROPOSALS?

- Scientific curiosity
- You need money
 - NASA provides funding for successful observing proposals
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- Oversubscription rate imply that, depending on facility, anywhere between 1/2 to 1/10 of proposals will be accepted
- Currently $\sim 1/3$ for NICER - you have better chances for a successful outcome

You need to write the “best” proposal possible to ensure a successful outcome

Or, you simply need to be lucky (some people call this process a lottery)

- Oversubscription is a good and healthy thing for a mission —> the community finds interest in the mission and that the mission can pursue the “best” science —> more funding from agencies — longer operational time
- **WRITE YOUR PROPOSAL**

PROPOSAL OVERVIEW

- TITLE
 - Short and concise
- Abstract
 - The only thing that (almost) all reviewers will read
- INTRODUCTION (~1P)
 - Hit the big picture. Introduce the topic, emphasize why the science is interesting, and articulate the outstanding questions that need to be addressed to propel the field forward.
- SCIENCE JUSTIFICATION AND IMMEDIATE OBJECTIVE (~2P)
 - What part of the above are you going to address with your proposed program
- JUSTIFICATION OF REQUESTED TIME AND FEASIBILITY (~1P)
 - Argue the case for your proposed program and prove that it is in fact doable
 - **This is likely where your proposal will be rejected**
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Rule of Thumb: 1st page is uninteresting and panelists could not understand why the science is important —> you have lost

WRITING STYLE

- Do not expect any specialists in your specific field on the panel - rest assured some will be non-specialists
- Keep the language simple and avoid jargon — you really do not want to turn off or annoy in any way the panelist while reading your proposal, they have another 20 to read, or they have gone through 20 already

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- Be explicit in what you want to do (do not assume the panel will work out what you meant)
 - Use bold face/Italic to emphasize the important elements. Use bullet-points, or number the questions you will be addressing, or why the science is important, e.g., **measuring the spin of a BH is crucial to several fundamental aspects of astrophysics such as (1) the physics of jet launching, (2) feedback into the galaxy environment, (3) etc etc.**

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- Use good English
 - Have a native read your proposal

FEASIBILITY

- How is your proposed observing campaign uniquely suited to answer the outstanding questions you cite?
 - First and foremost, has there been any similar observations of the same target(s)? If so, why can't they be used to accomplish your goals? —> This must be addressed (trust me, some panelists will look into this). If not addressed, it will not matter whether you can or cannot do the science with the archival observations

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 - Second, can any other instrument perform your proposed experiment? I.E. are you using the unique capabilities of the telescope you are proposing for? This also **must** be addressed
 - **Uniqueness of NICER**: large effective area, especially at the softest energies $\sim 0.3-5$ keV, dynamic observing ranges (in flux and time!), fast response time, high time-resolution (microseconds)
 - **Drawbacks**: no imaging capabilities and cannot provide uninterrupted observations for many ks at a time
 - **Yet**, do not completely rule out NICER capabilities for the study of extended sources! E.g., you are interested in a high S/N soft X-ray spectrum of a few arc-minute large SNR (or part of it, e.g., performing spatially-resolved spectroscopy of large SNRs)

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 - **Double the scrutiny** for joint programs! Make sure NICER program is crucial - do not make it look like your proposal is recycled from another mission.

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- **Exposure**: justification will depend on science case. Here are some examples:
 - Simple detection at $X\sigma$: might not require more than a webpimms simulation.
 - Simple spectral analysis (e.g., constrain shape of a PL): WebSpec or Xspec simulation might suffice (if previous source observations exist, could use those arf/rmf/background files, otherwise see **NICER Proposal Tools**)
 - Complex spectral analysis (e.g., constrain spin, detect lines, etc.): detailed Xspec simulations, ought to show contour plots
 - Detect pulsations (or QPOs) in a single observation: simple analytical formulae might suffice, but be careful with background (Fourier techniques in X-ray Timing, van der Klis 1989; Handbook of Pulsar Astronomy Lorimer & Kramer 2004)
 - Measure ephemerides: simulations to argue cadence + exposure per visit
 - Anything else: **SIMULATE, SIMULATE, SIMULATE**

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- Is your proposed program justified? Exposure (total and per visit), number of visits, cadence, target list, number of targets, etc. If ToO, also response time.
 - Target flux, rule of thumb:
 - $\gtrsim 10^{-12}$ erg s⁻¹ cm⁻² is easy to reach
 - $\gtrsim 10^{-13}$ erg s⁻¹ cm⁻² is relatively easy to reach but in good conditions (5 σ detection in $\gtrsim 5$ ks)
 - $\lesssim 10^{-13}$ erg s⁻¹ cm⁻² is accessible, e.g. for pulsed sources, but requires long exposures (depends on the details)
 - **Perform your simulations and homework ahead of time!**

FEASIBILITY

- Visibility (technical feasibility - See Elizabeth's talk)
 - Are your targets visible to NICER when you need them to be? Sun and Moon constraints.
 - Is your observation time constrained? Phase/time-dependent
 - Do you require low background at soft and/or hard X-rays.
 - Ask the GOF ahead of time to perform a detailed visibility calculation if you know your observations will require multiple time and background constraints.

GENERIC COMMENTS

- Start early! Do not wait until the last minute
- Ask colleagues to borrow some of their past successful proposals
- Talk to colleagues about your idea (at least the ones that you know will provide constructive criticism)
- Read the call-for-proposal to familiarize yourself with the details of the proposal call.
- Once final, check for consistency throughout the proposal - do you have the proper exposure time everywhere in the proposal, and in the forms? Are the targets consistent everywhere?

GOOD LUCK WITH YOUR NICER PROPOSAL