The X-ray Technology Development Plan (TDP)

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Technology Development Plan - Background

- Need for a TDP suggested by outcome of 2012 X-ray Mission Concepts Study
  - Primary conclusion was that ~$1B class X-ray missions that address a substantial share of NWNH science are feasible for a start this decade, but only if technology is advanced to high TRL before mission start
  - Report sketched out technology needs for all notional missions and beyond
  - TDP expressly requested from the PCOS Project Office by NASA HQ

- The objective of the TDP is specific: answer the question: “What are the timescale and cost for maturing those technologies that would support a mid decade selection of an X-ray probe-class mission?

- The decision to broaden the TDP to include other, longer term technology needs was a decision made by the X-ray SAG, and is not required by NASA HQ

- The split between near term and longer term technology needs is reflected in separate funding mechanisms
  - Near term – SAT
  - Longer term – APRA
The TDP addresses those technologies that support mid decade selection of AXSIO-based Probe Class mission (and serve as the foundation for longer term – next decade mission- needs)

- Light Weight arc second Slumped Glass Optics
- Kilo-pixel Calorimeter Arrays
- Gratings; Critical Angle and Off Plane Technologies
- X-Ray CCD’s

- All of these technologies are currently funded through successful SAT proposals
- These are the same technologies supported by NASA for IXO
  - The TDP is similar to many technology roadmaps developed for Con-X/IXO (but updated)
Technology Development Plan – Process and Schedule

• Inputs were sought from key technology developers
• Inputs integrated into common format
• Activities necessary for probe-class mission identified, and distinguished from other input from developers
  • Example – activities leading toward sub-arc second segmented mirrors were removed, and will be covered in longer term needs section
• TRL 5 and 6 demonstrations are clearly identified
• Schedules and costs developed and integrated for all technologies
  • Example on next slide
• Schedule
  • Full draft by end of April
  • Final version by end of May
<table>
<thead>
<tr>
<th>Task</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
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</thead>
<tbody>
<tr>
<td><strong>Substrate Fabrication</strong></td>
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<td>Slumped Glass</td>
<td>Mature technique at 6” Level for each pair of substrates to meet 10” mission requirements</td>
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<td>Single Crystal Silicon</td>
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<td>Proof of concept; Single Wolter-I Pairs at 2” Level to meet 5” for mission performance margin</td>
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<td><strong>Coating</strong></td>
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<td>Magnetron Sputter</td>
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<td>Develop the selected method to meet 10” mission requirements</td>
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<td>Further development to meet 5” for mission performance margin</td>
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<td>Atomic Layer Deposition</td>
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<td><strong>Alignment</strong></td>
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<td></td>
<td>Improve thermal control to 0.5 degrees C over a week</td>
<td>Improve thermal control to 0.1 degrees C over a week</td>
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<td><strong>Mirror Segment Integration</strong></td>
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<td>Bonding</td>
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<td>Improvement of smart-bonding to meet 10” mission requirements</td>
<td>Investigation &amp; downselect between edge-bonding and kinematic bonding</td>
<td>Development of bonding technique to meet 5” for mission performance margin</td>
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<td>Module Design, Analysis, Testing</td>
<td>Achieve TRL-5 for making modules meeting 10” mission requirements</td>
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<td>Construct and test high fidelity modules to meet TRL-6 for 10” mission requirements and 5” for mission performance margin</td>
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<td><strong>Budget Amount/Estimate</strong></td>
<td>$1.9M</td>
<td>$2.3M</td>
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Technology Development Plan – Anticipated Outcome

• Identified technologies will be recommended as SAT funding priorities
• NASA HQ will use TDP as input when establishing X-ray priorities and the funding level for the SAT program for FY15 and possibly beyond
  • (It is hoped that sufficient resources are available for relevant high ranking proposals for FY14)
• If X-ray probe is selected in 2015, funds needed beyond ~2016 could be directed rather than competed.
• If a probe is not selected, TDP provides a guide for resources needed to have these technologies ready to be part of a mission to be proposed to the 2020 decadal survey
  • NWNH recommended ~$180M for IXO technology; we’ll have to live with less
• Long term needs will help to define APRA funding priorities
PCOS-Funded X-ray Study Activities

• X-ray Technology Development Plan (TDP)
  – Draft by end of April; final by end of May

• Preparations for FY2014 Probe-class mission study
  – Revisit science case (via X-ray SAG subcommittee)
    • Compare IXO priorities with NWNH science questions
    • Determine if X-ray investigations can help answer additional NWNH questions
  – Determine key technical and mission trades using notional mission concepts (AXSIO and N-CAL) as starting point

• Discussions with European counterparts about participation in L2/L3 X-ray mission
  – ESA call for L2/L3 white papers is out; responses due in late May
  – European X-ray community is preparing white paper on science associated with Athena+
  – Subset of high priority IXO science
  – NASA has offered to participate in L2/L3 missions at the ~15 percent level
X-ray Probe-class Mission Study (FY 2014-15)

• X-ray probe class mission study
  – Called for in NASA Astrophysics Implementation Plan
  – Goal is to develop reasonably well defined concept for an X-ray mission with cost to NASA of ≤$1B, that fulfills a substantial share of highly ranked IXO science
• Input needed for NASA midterm decision in 2015
• Will include science trades, technical studies, design lab sessions, and independent costing
• Anticipate that NASA will form a Science Definition Team in fall 2013
• Rough timeline:
  – Form SDT, initiate study – fall 2013
  – First design lab session – December 2013
  – Interim report to NASA HQ – March 2014
  – Final science/technical report to NASA HQ – January 2015
  – Final independent costing results – February 2015
• Study is contingent upon NASA HQ having adequate funding