

NASA SUPPORT FOR ATHENA

– AN UPDATE

Ann Hornschemeier presenting for Randall Smith
September 24, 2018

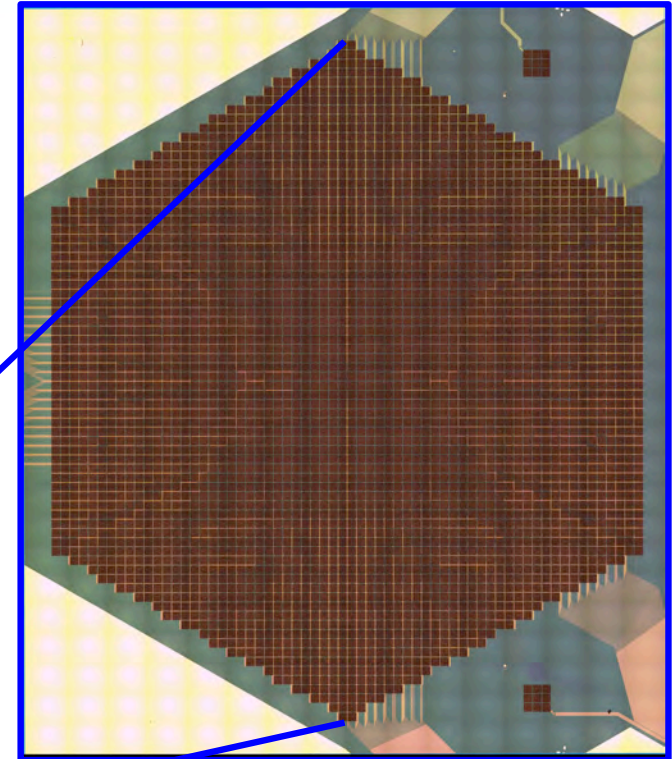
Overview

- **Instrument Contributions**
 - X-IFU (Please see Poster by Simon Bandler)
 - WFI

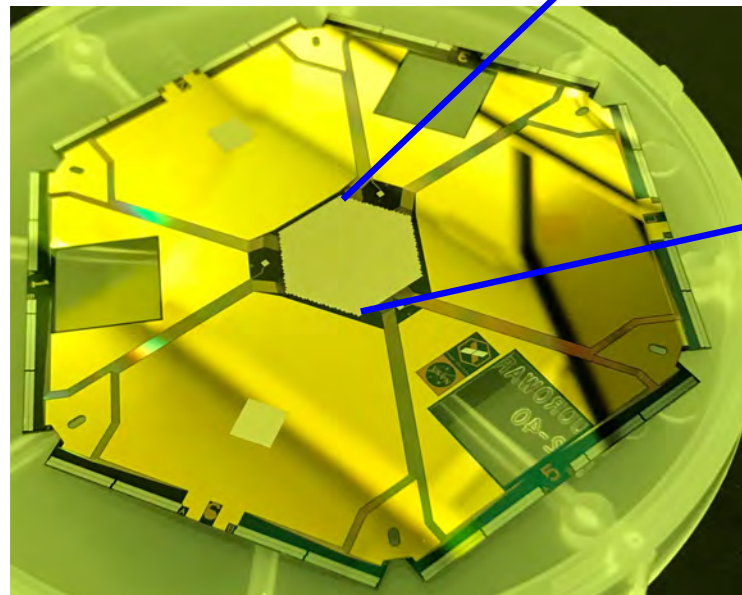
- **Upcoming US Decadal**
 - White papers

Main US deliverable: the X-IFU focal plane array

Parameter	DM Req	Athena
Energy Range	0.3-12 keV	0.2 – 12 keV
Energy Resolution - instrument level	< 3 eV (FWHM)	2.5 eV (E < 7 keV) 5 eV (E = 10 keV)
Number of Pixels	~1000	FOV = 5' diameter hexagon (~3264 pixels)
Pixel Size	0.25-0.3 mm	Pitch: ~275 μm
Event throughput at required resolution	1.5 cps/pixel	1 mCrab (100 cps/array > 80% high-res events) 1 Crab (> 30% low-res events)

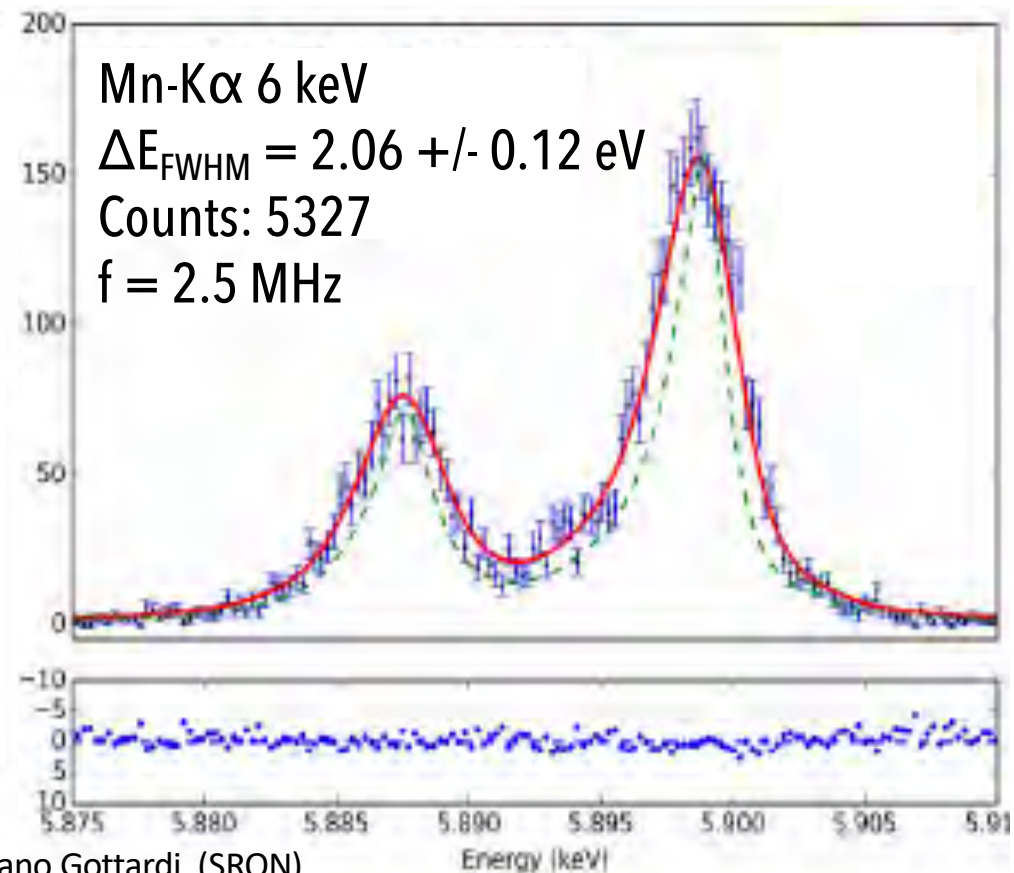
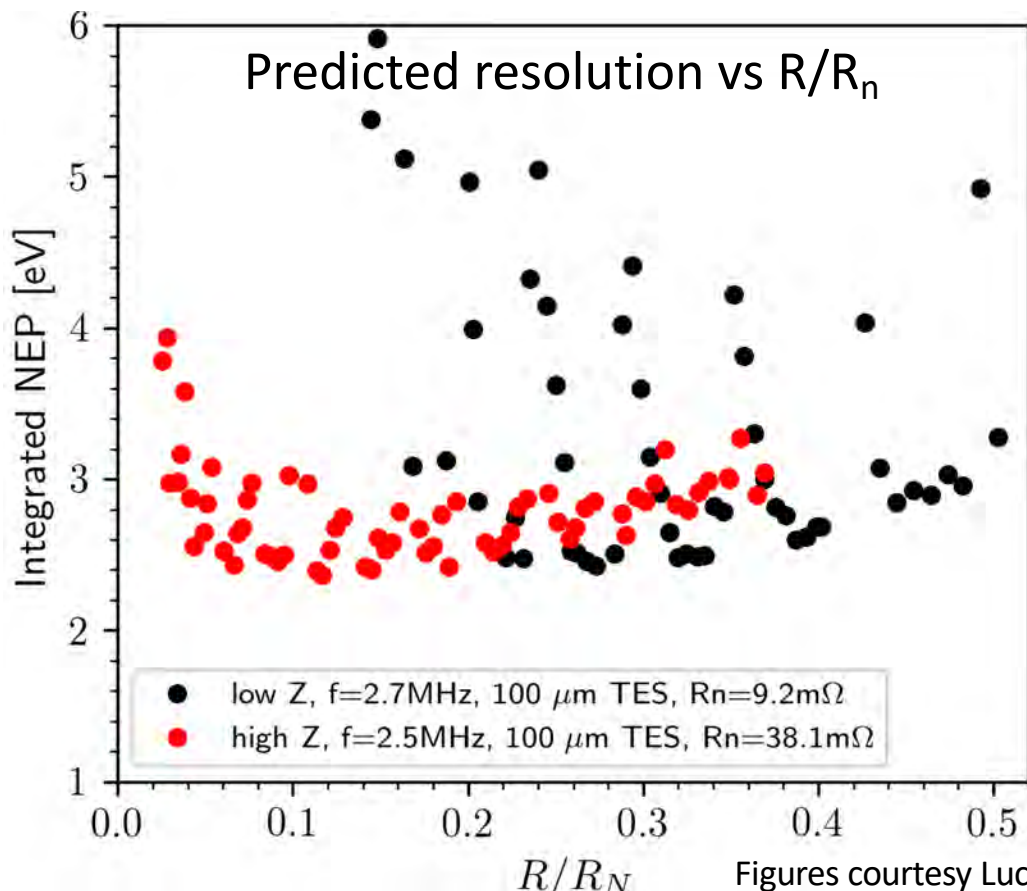


Prototype,
Athena-scale TES array



First results from high resistance TES under AC bias at SRON

- *First spectral measurements of mixed arrays at SRON yielded best AC bias x-rays results*



Figures courtesy Luciano Gottardi (SRON)

Wider detector development program overview

- **Ongoing array fabrication & testing**

- Demonstration Model (DM) Array delivered
- New baseline designs still being investigated, optimizing performance under AC bias

- **Studies of physics and performance of TESs under AC bias**

- Collaborative study of GSFC TESs at SRON, GSFC & NIST
- Frequency Domain Multiplexing (FDM) read-out electronics now being used at GSFC

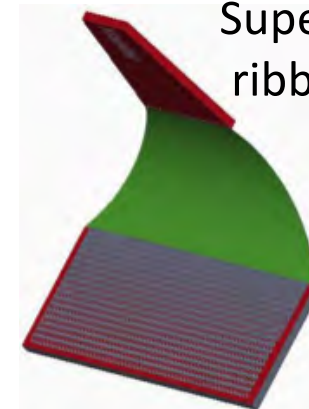
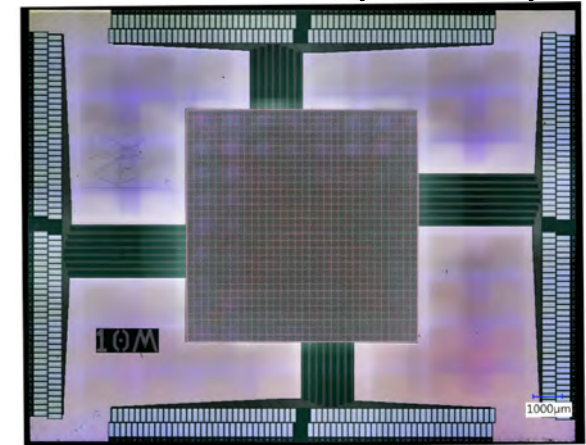
- **Support of CNES system & detection chain teams**

- sharing knowledge from development of Hitomi

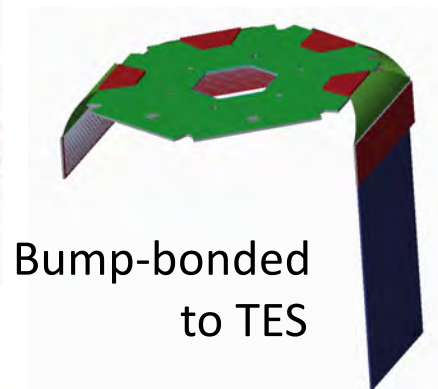
- **Development support technologies:**

- development of superconducting ribbon cables
- investigation of bump-bonded connections to TES wafer
- development of flight-compatible electronics for the Time Domain Multiplexing/Code Division Multiplexing (CDM) DC bias option

32x32 DM style array



Superconducting ribbon cable



Bump-bonded to TES

Goals of US WFI Contributions

Enhance science in 3 areas

- 1) Transient sources:
 - a) Search for serendipitous sources brighter than catalog fluxes.
 - b) Swift XRT found average of 10 such sources per day (Evans+20xx). Athena WFI has 100x the sensitivity and 3x the FOV.
- 2) Clusters and other extended sources:
 - a) Improve background determination through on-board analysis of all events.
 - i. Current design does not meet background requirement
 - ii. GEANT4 simulations show that most unrejected background events are associated with secondary electrons. Working on developing method to recognized electron tracks and veto associated events on-board.
- 3) Provide critical mechanical and electronics support required for successful instrument design (ASIC design and heat pipes).

Plan for US WFI Contributions

- An electronics board with custom science software called the Science Products Module (SPM)
 - The SPM will process the data stream from the WFI instrument and will produce high- level value-added science products for telemetry to the ground
 - The main purposes of the SPM are to:
 - Identify new and variable objects to trigger rapid alerts for follow-up observations
 - Provide supplemental on-board analysis of raw data frames that cannot be accomplished using the processed data telemetered to the ground.
 - **SPM hardware is at TRL-6+, Target Achieved**
 - Similar design EM has completed thermal testing
 - Ongoing environmental testing and launch of earlier mission will bring to TRL-9
- Engineering support for the VERITAS2 ASIC (part of the front-end electronics)

US 2020 Decadal Review Timeline

- 2018 January – first presentation at AAS Town Hall
- 2018 March – Astro 2020 proposal submitted to Agencies
- 2018 Summer – **Science White Paper call issued**
- 2018 December – Chair selected
- 2019 January – AAS Town Hall and other community outreach activities and **Science White Papers are due**

Expected to take ~2 years to complete the survey process and release the report.

US 2020 Decadal Review & NASA

- NASA has already kicked off 4 large ‘flagship’ studies (Lynx, LUVOIR, OST, and Hab-Ex) plus 10 ‘probe-class’ (\$1B) studies
- NASA has not requested that the Decadal rank or evaluate missions in development, including both NASA-led missions (JWST, WFIRST) or NASA-contributions (Athena, LISA)
- Obviously, however, the framework provided by these missions impacts the future, so it makes sense to give the Decadal panel an idea of what each will provide

US 2020 Decadal Review White Papers

- “In preparation for the 2020 decadal survey in astronomy and astrophysics, the ... Committee on Astronomy and Astrophysics 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.”
 - Identify scientific opportunities & themes for the coming decade
 - Describe their scientific context to other parts of astronomy
 - Focus on science, not specific missions or projects
 - Describe & quantify the key advances in observation, measurement, theory, and/or computation necessary
- No more than 5 pages plus cover page
- Due Dates are between January 7 – January 18.

US 2020 Decadal Review White Papers

- Science Themes for White Papers
 - Planetary Systems; exobiology and the search for life
 - Star and Planet formation
 - Stars and Stellar Evolution
 - Formation and evolution of compact objects
 - Resolved stellar populations and their environments
 - Galaxy Evolution
 - Cosmology and Fundamental Physics
 - Multi-Messenger Astronomy and Astrophysics
- Plan is to organize US Athena members to develop white papers on Athena science topics, focusing especially on new areas developed since Athena's selection