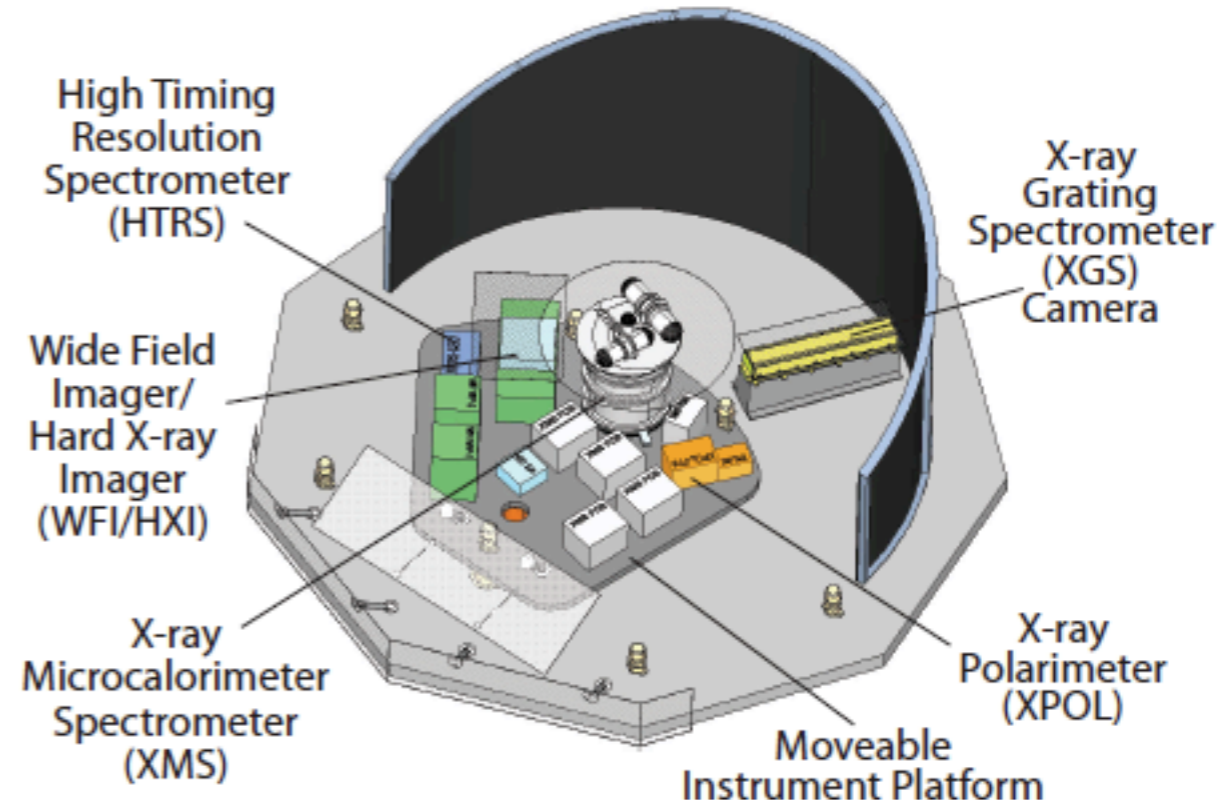
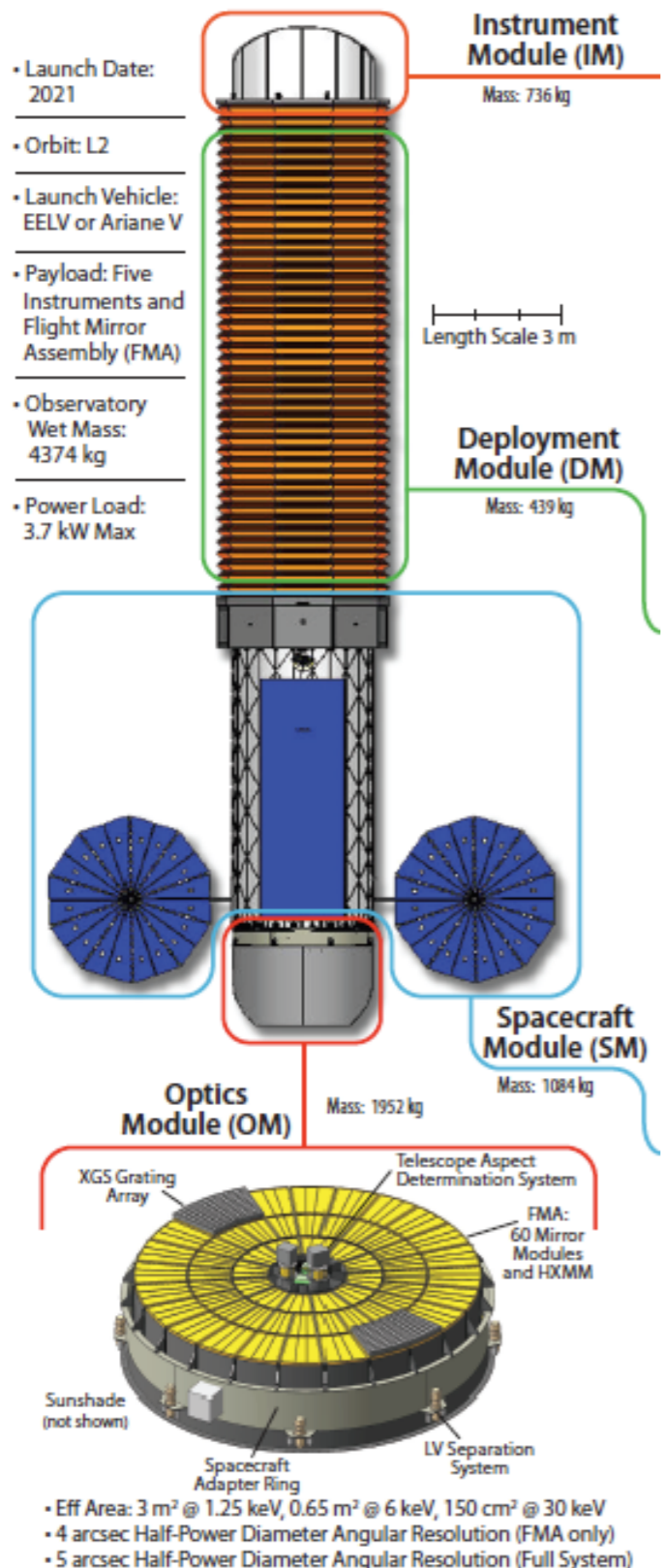




Chris Tenzer / HTRS system team
IAAT - University of Tübingen

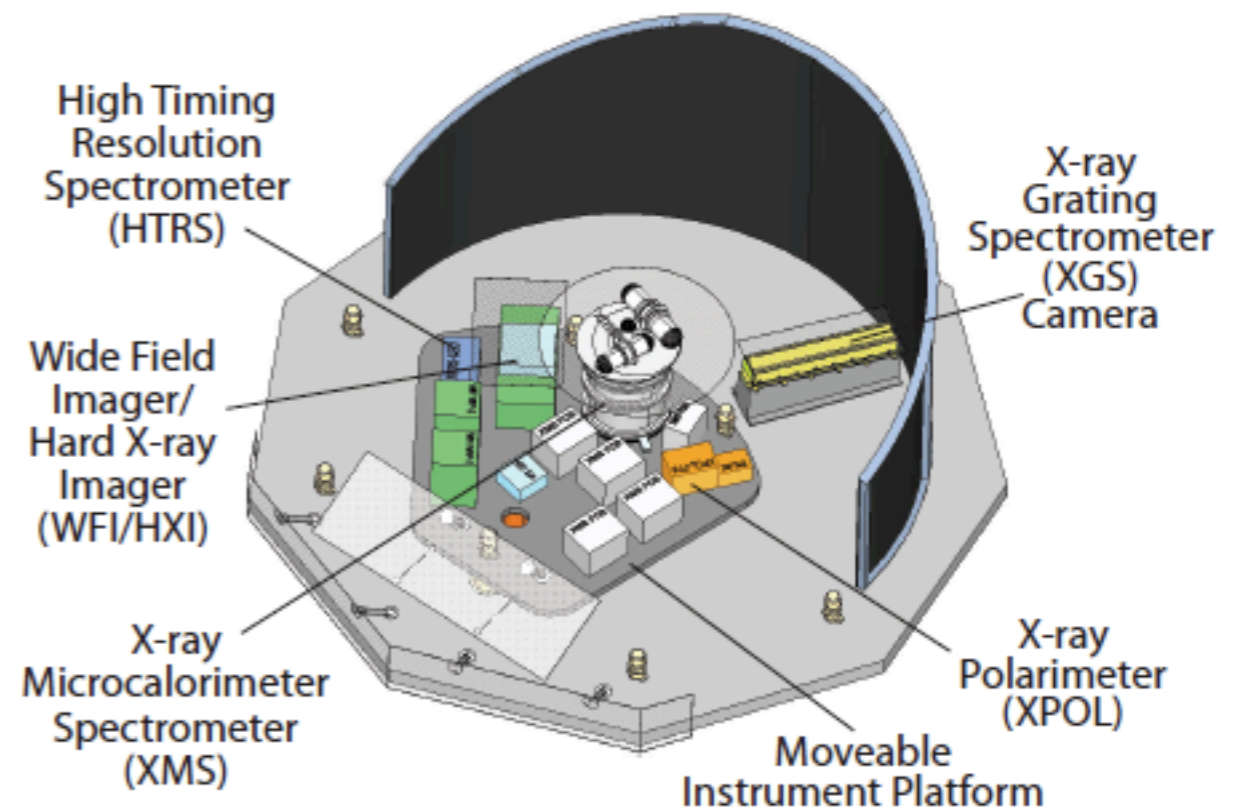
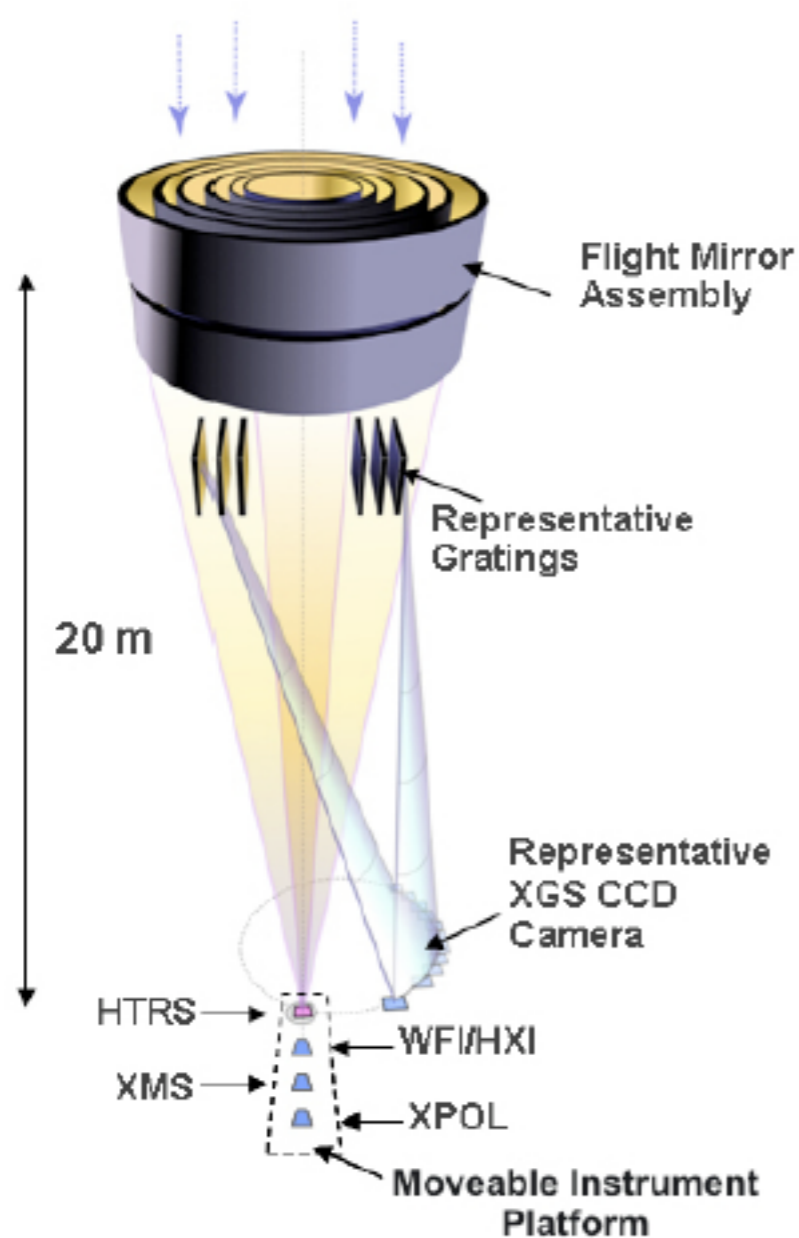
The International X-ray Observatory IXO



Instrument	Bandpass [keV]	FOV [arcmin]	Energy Resolution [eV@keV]
XMS core	0.3–12	2 x 2	2.5@6
XMS outer		5.4 x 5.4	10@6
WFI/HXI	0.1–15/10–40	18 diam/8 x 8	150@6/1000@30
XGS	0.3–1	N/A	E/ΔE = 3000
HTRS	0.3–10	N/A	150@6
XPOL	2–10	2.5 x 2.5	1200@6

credit: ESA/NASA

IXO - position of the instruments



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Science Goals

- Black Holes and matter under extreme conditions:
 - extreme densities (neutron stars)
 - extreme gravity (black holes and neutron stars)
 - extreme magnetic fields (neutron stars)
- Formation and evolution of galaxies, clusters and Large Scale Structures
- Life cycles of matter and energy

Science Goals

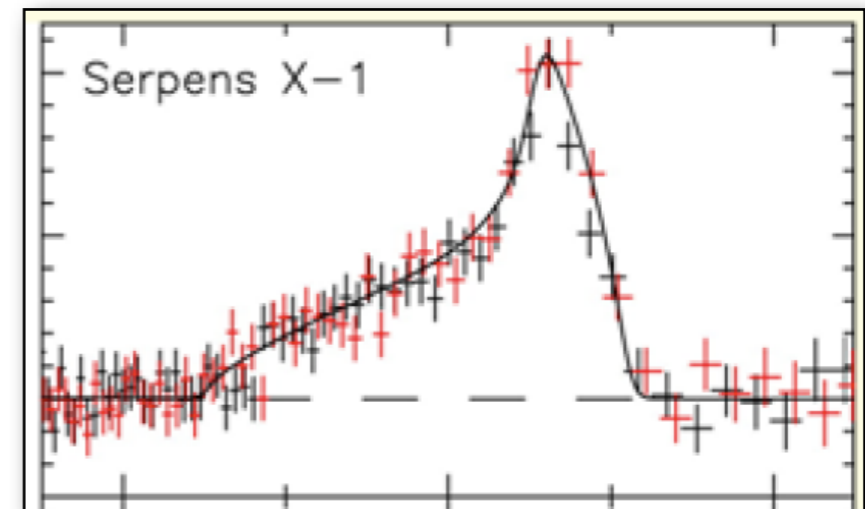
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HTRS Science Goals

Two possible ways to measure the ISCO using
properties of matter in orbital motion

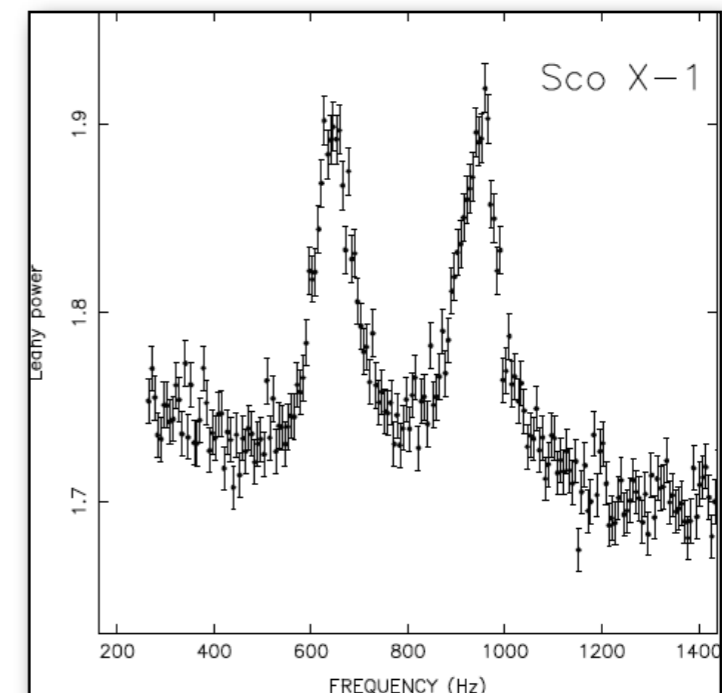
Spectroscopy

- Relativistic Iron Line

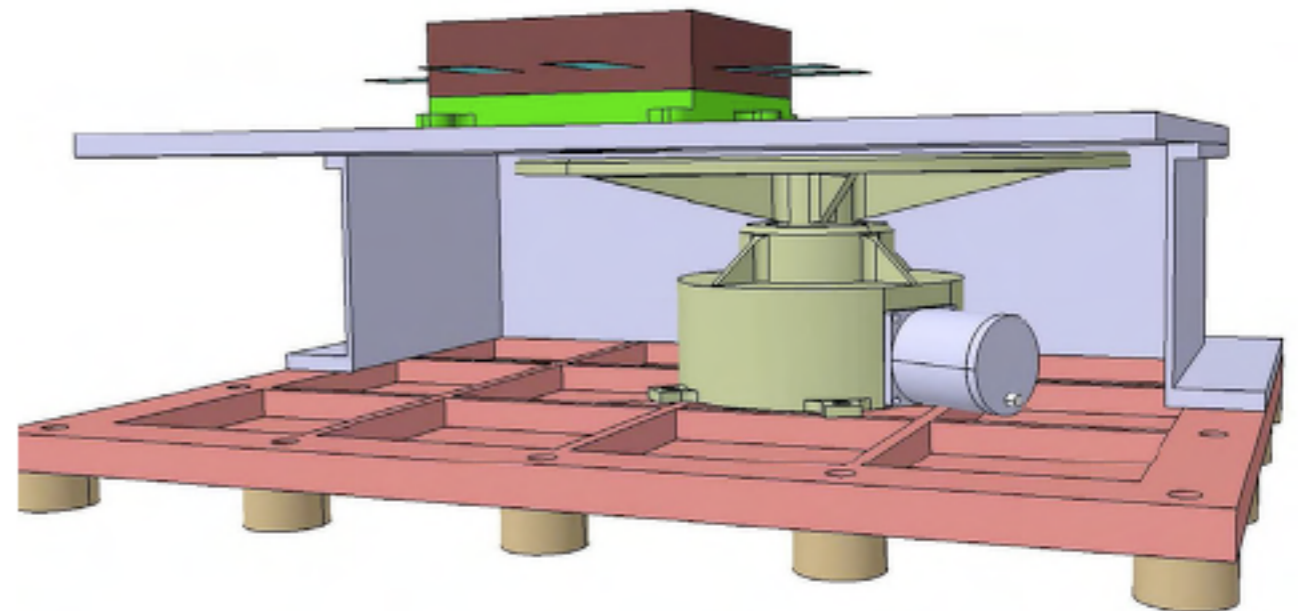
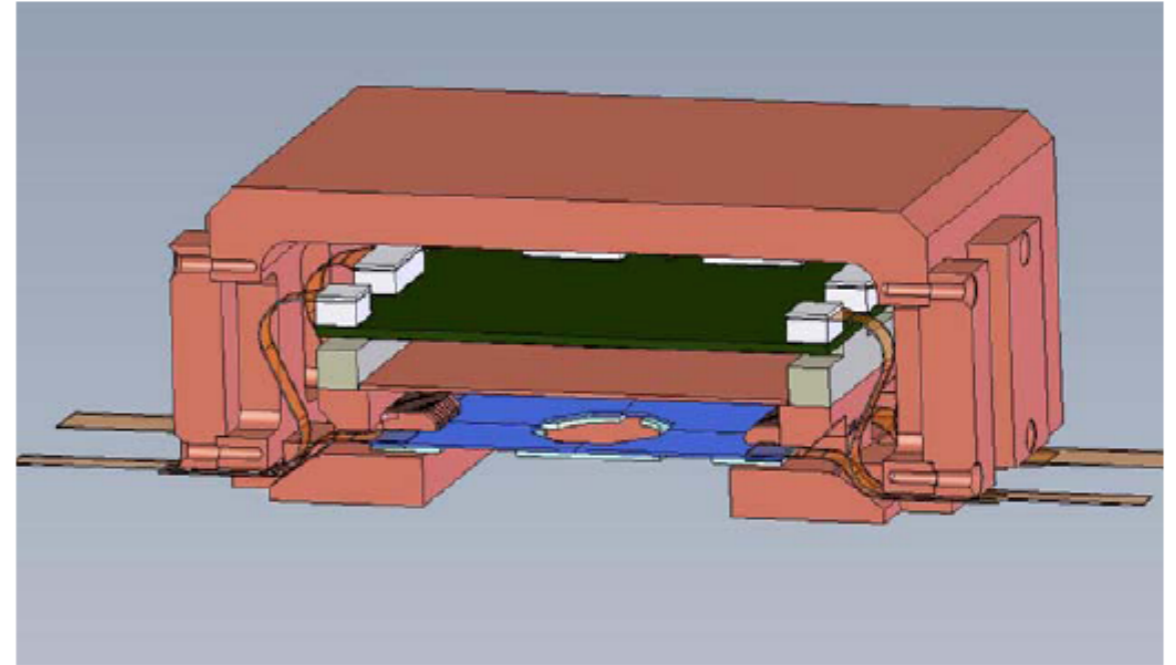


Timing

- Quasi-Periodic Oscillations



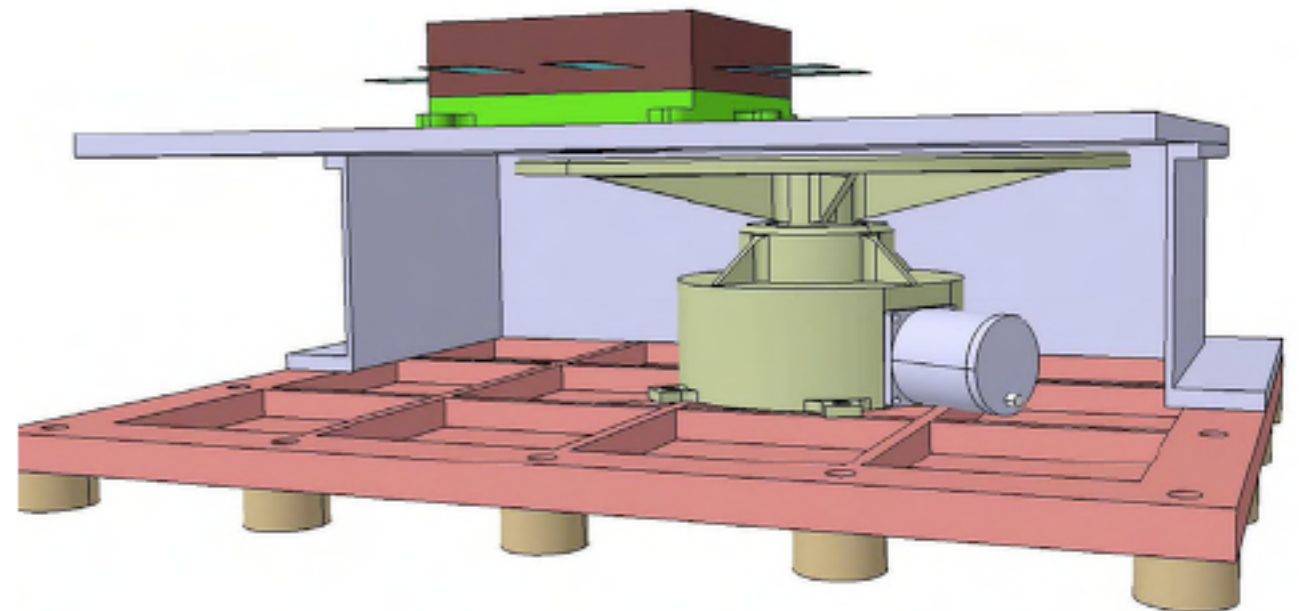
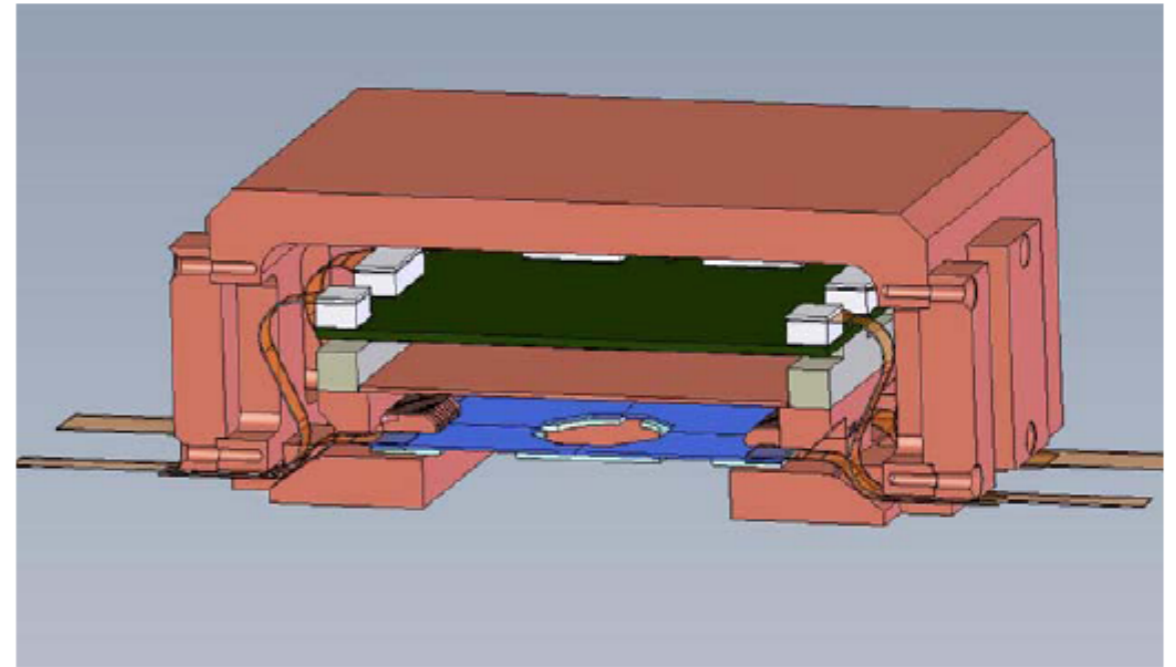
HTRS overview



HTRS overview

HTRS science requirements:

- observe very bright sources ≥ 1 Crab without pile-up
- Energy band: 0.3 - 15 keV
- $\Delta E < 150$ eV at 6 keV
- 10 μ s time resolution, low deadtime



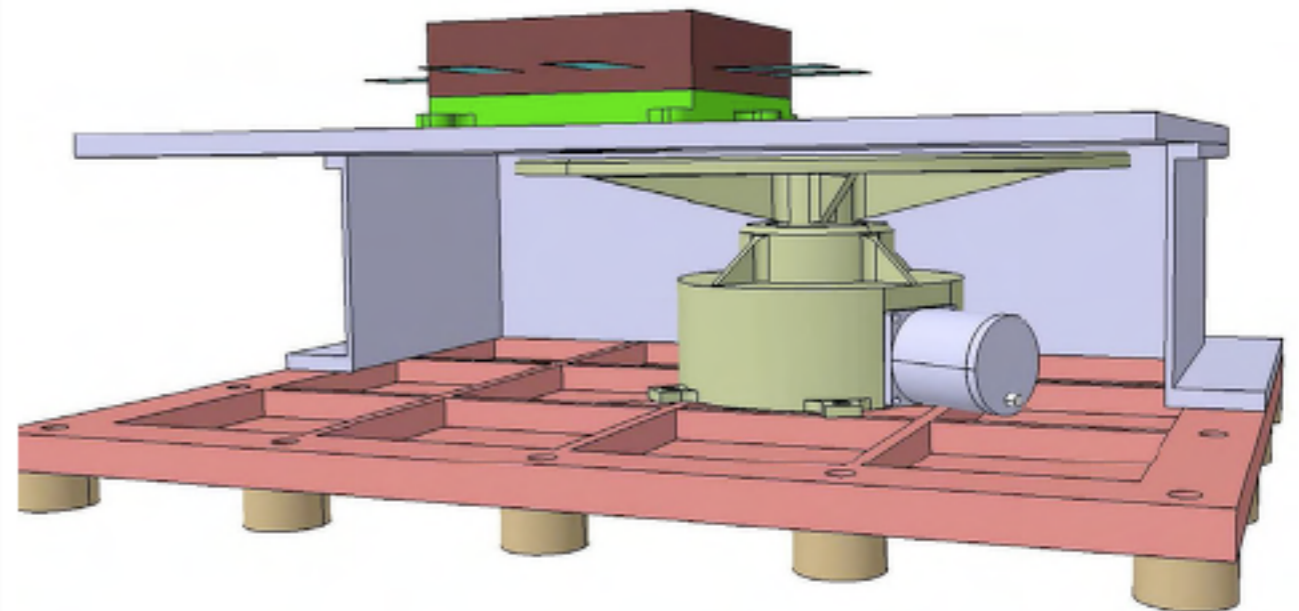
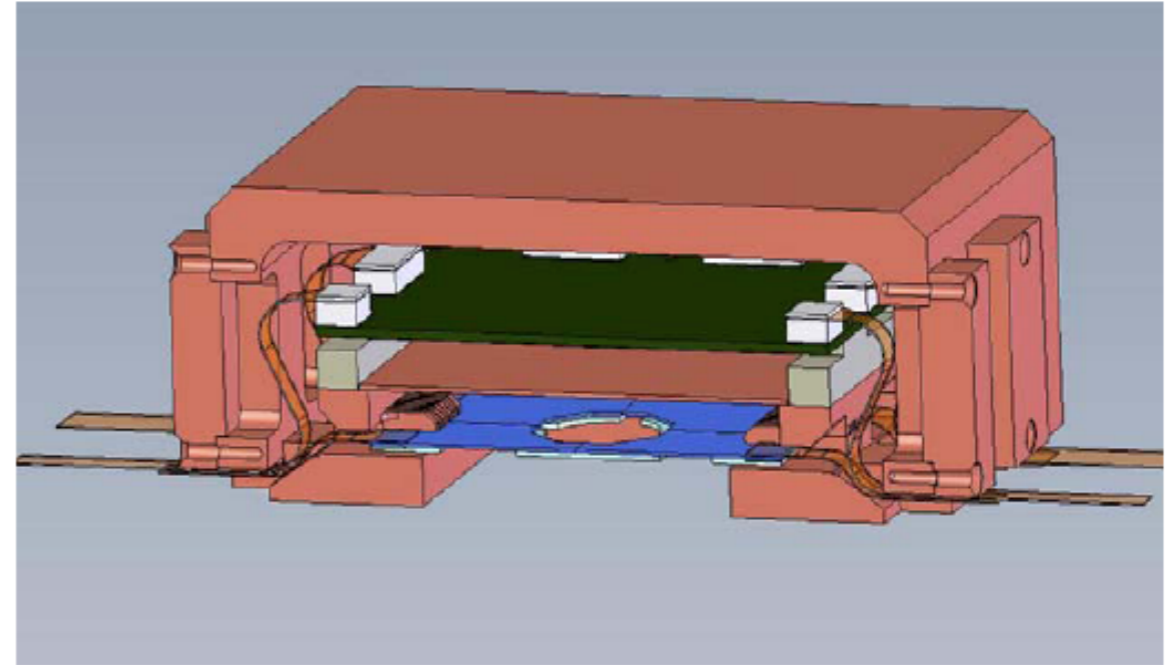
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HTRS detector specs:

- array of 31 Silicon Drift Detectors (SDD)
- 450 μ m silicon thickness
- low leakage current
- out-of-focus position, high throughput



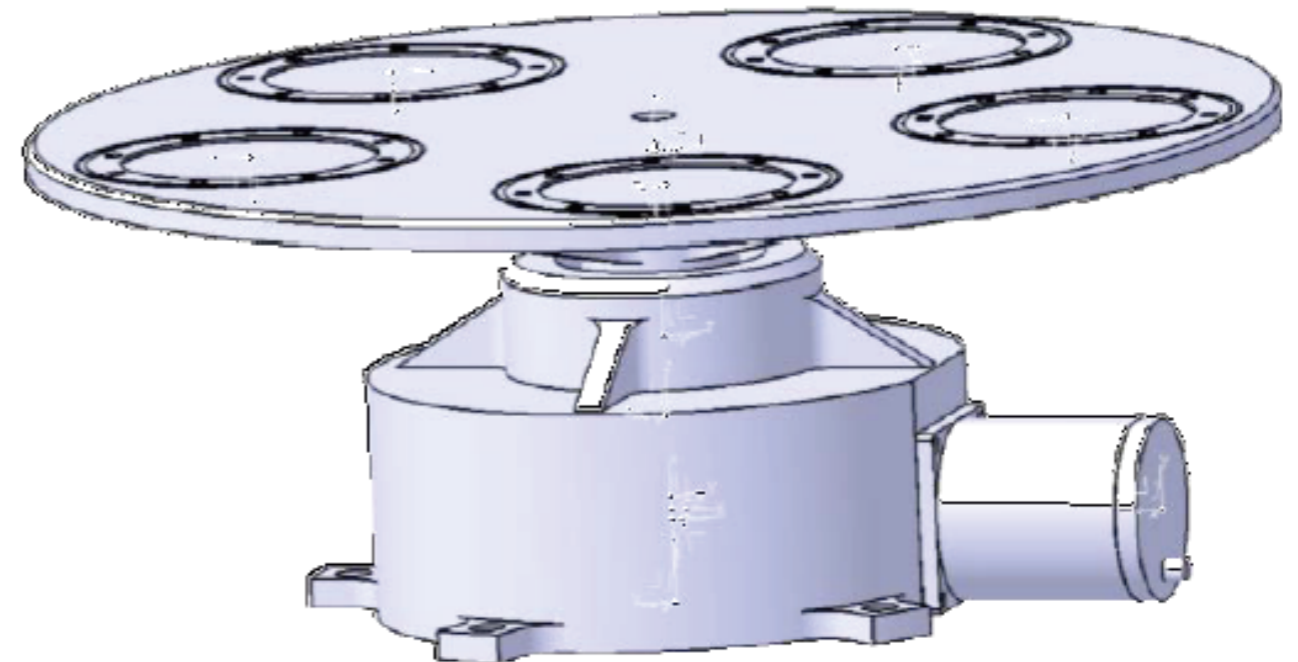
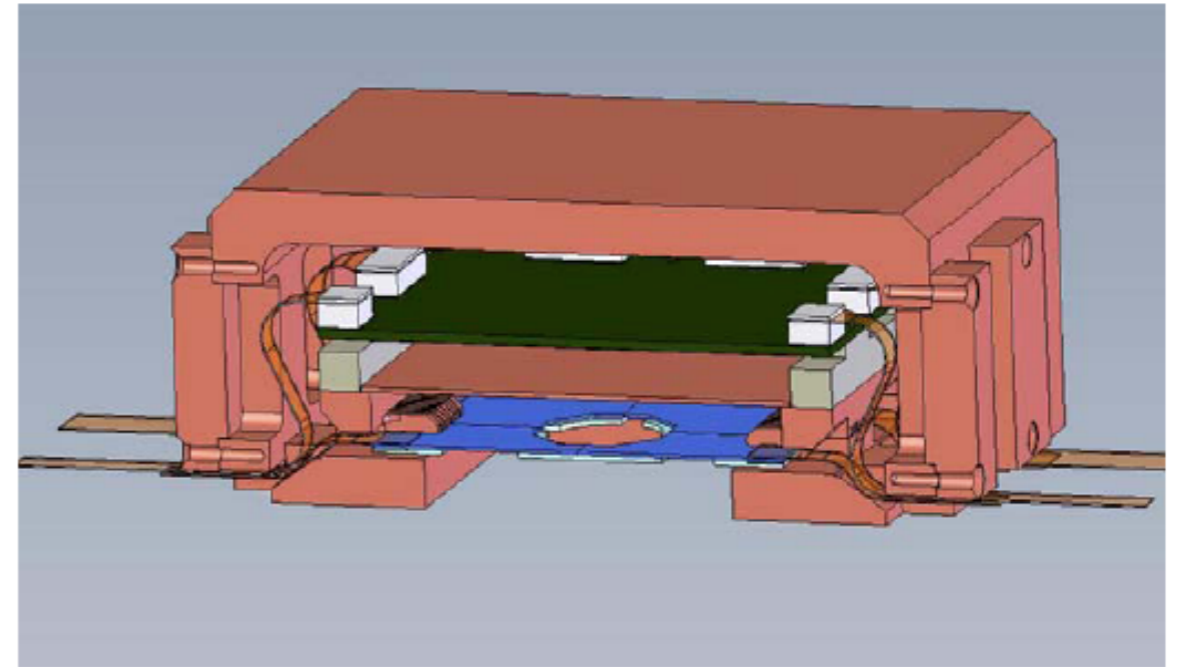
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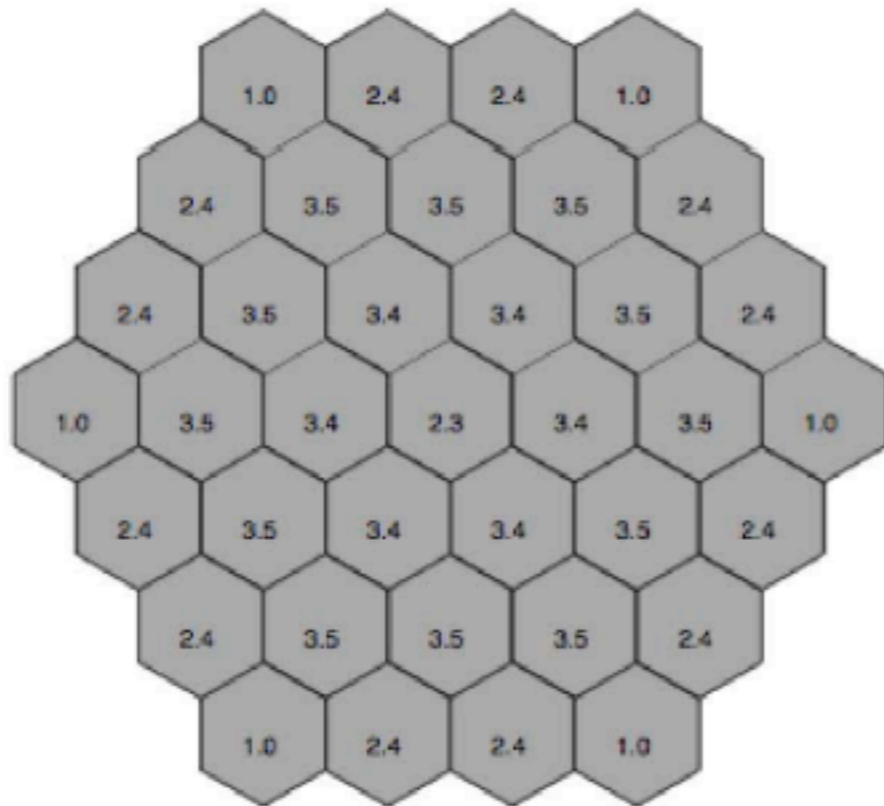
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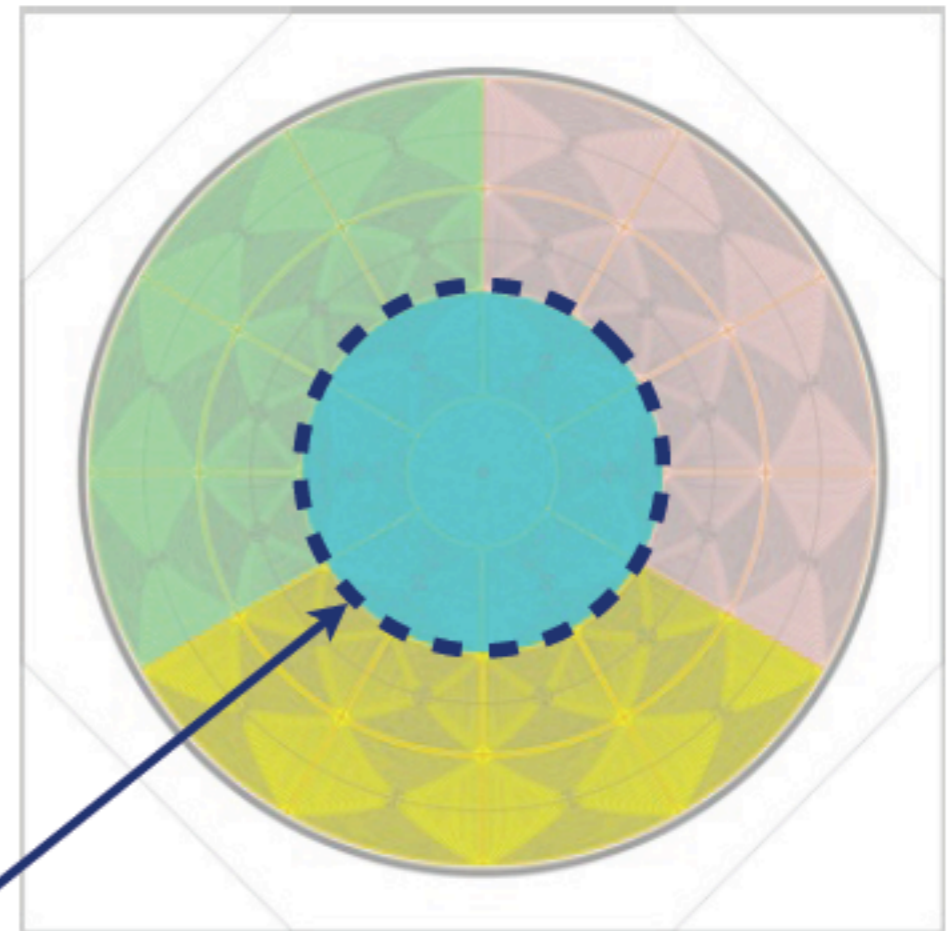


Detector array topology

Hexagonal, 37 diodes
(design presented in PDD)

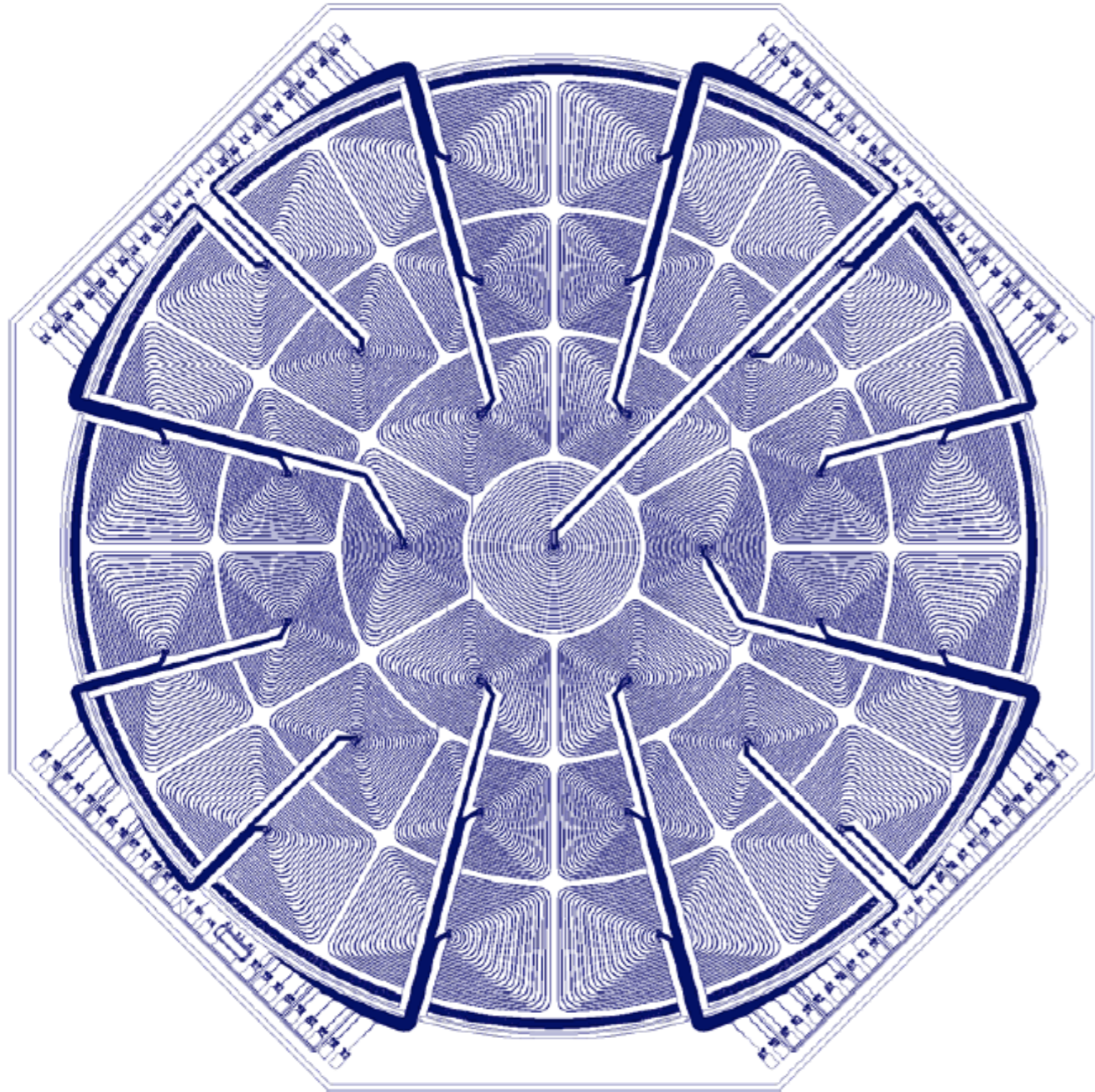


Circular, 31 diodes
(design presented at IDR)



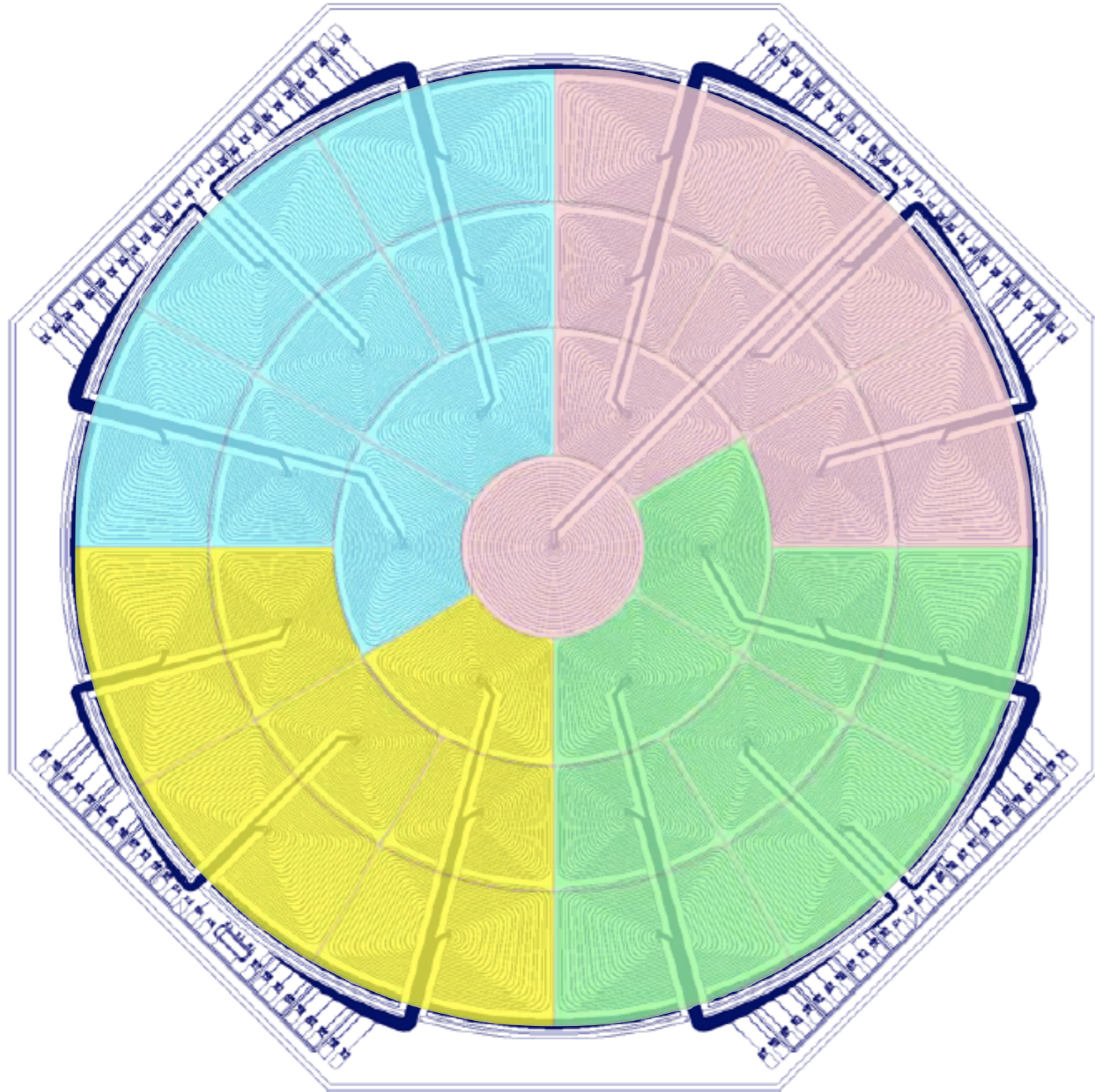
Phase A development

HTRS detector



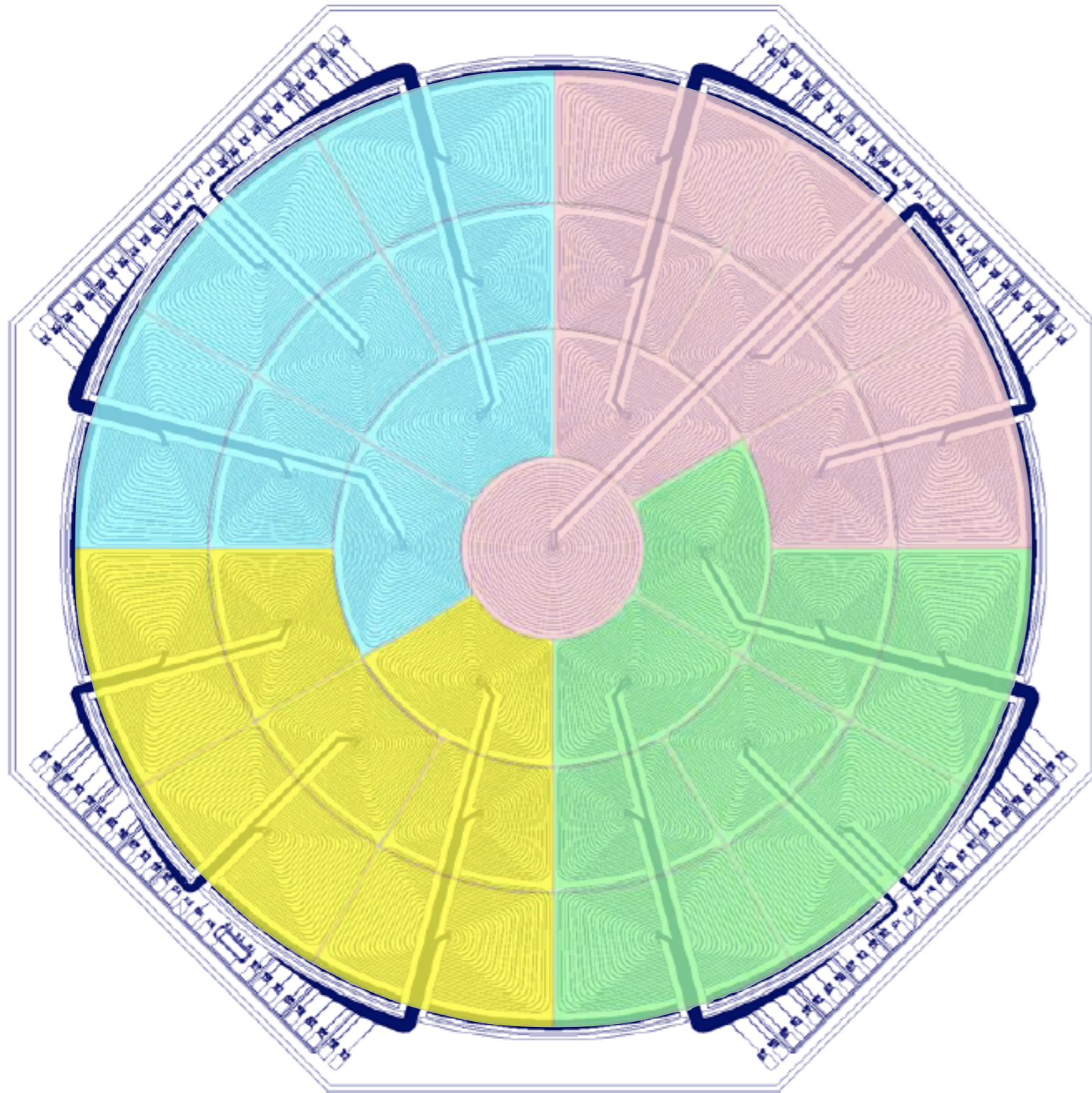
images: Peter Lechner, HLL

HTRS detector

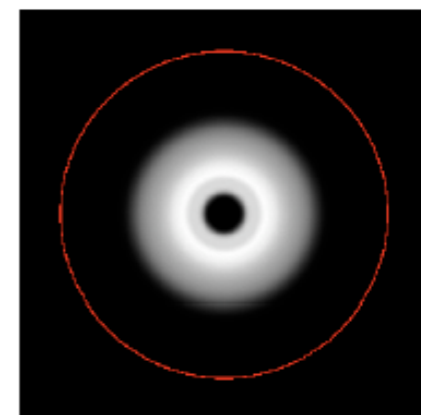
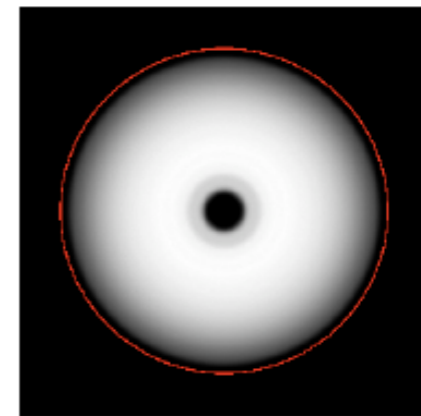
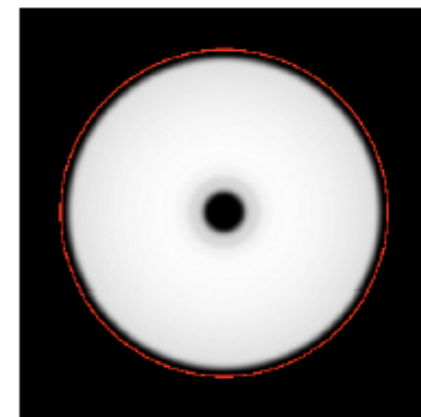


images: Peter Lechner, HLL

HTRS detector



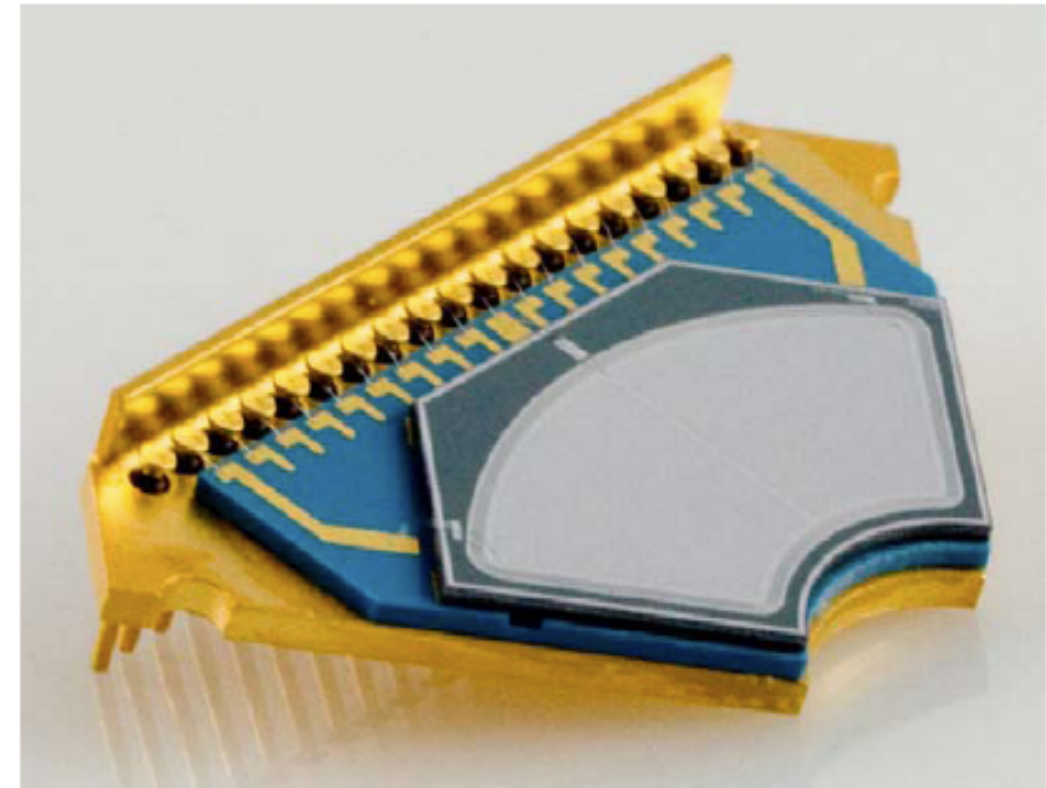
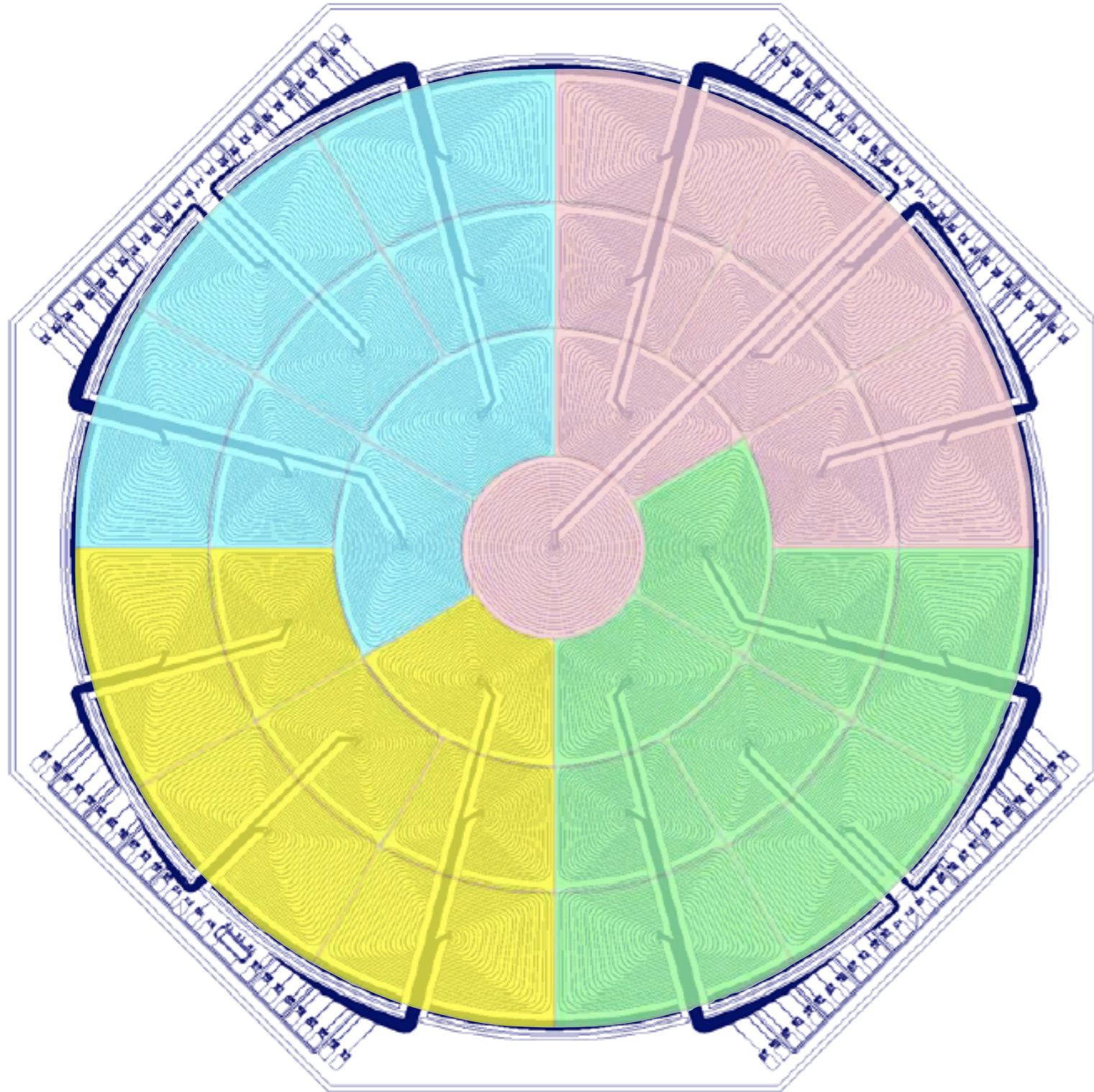
Photon distribution for 12 cm
out-of-focus position
at 1 keV, 2 keV and 6 keV



Christian Schmid, Bamberg

images: Peter Lechner, HLL

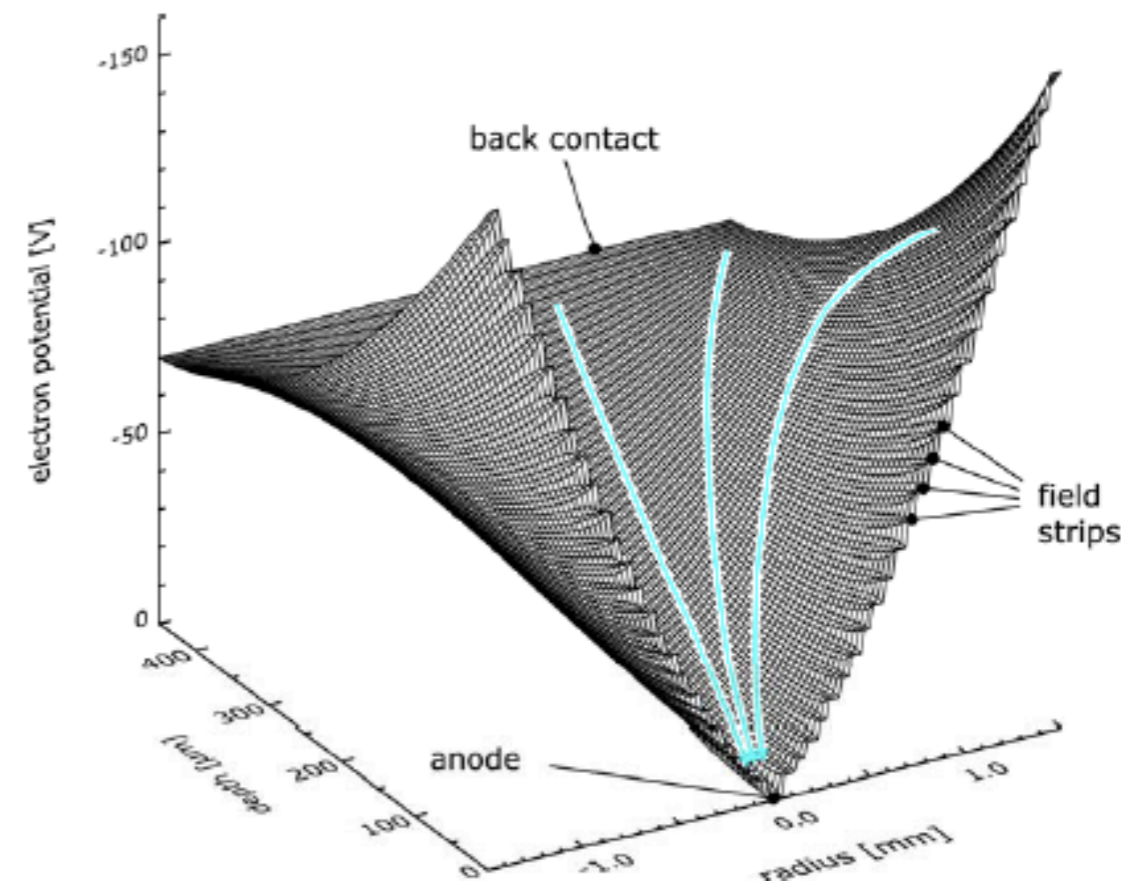
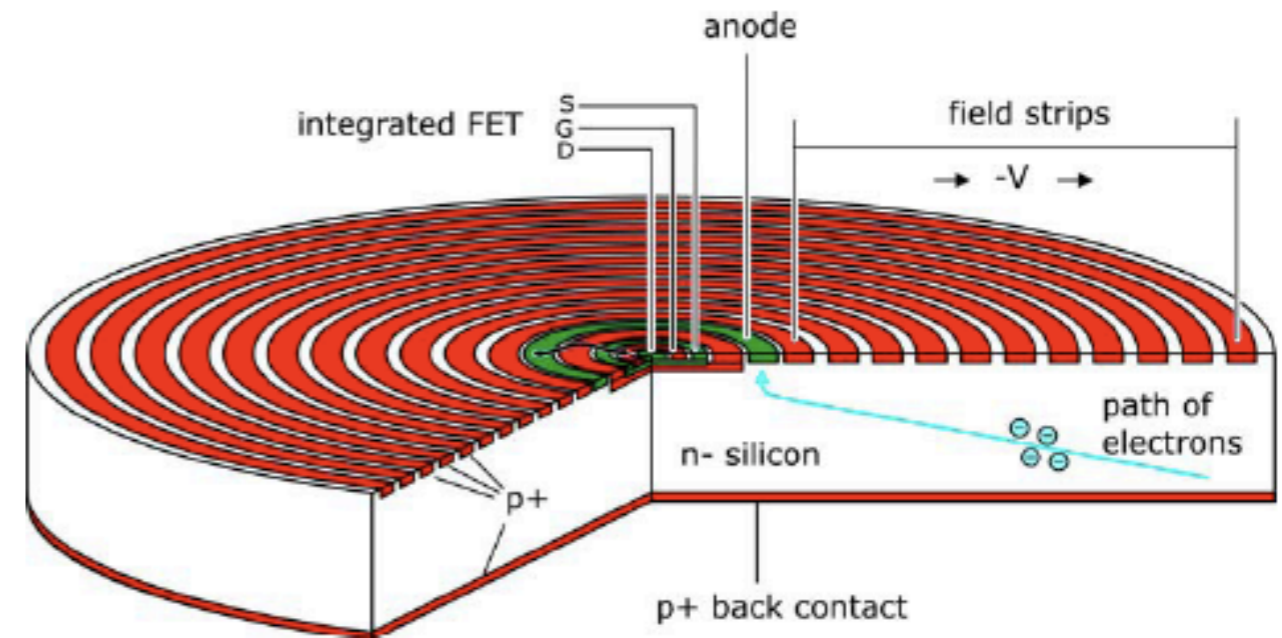
HTRS detector



ring sector shaped SDD for the ExoMars Moessbauer spectrometer (2 x 45 mm²)

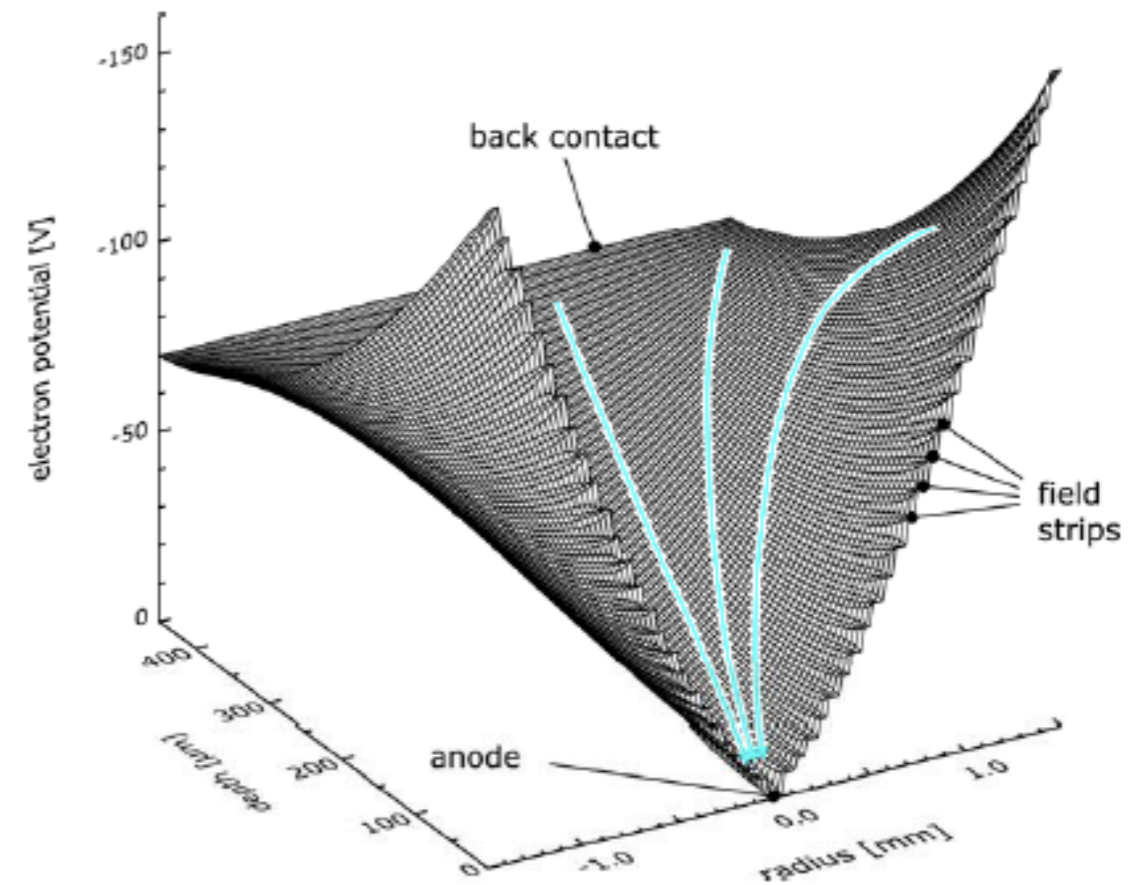
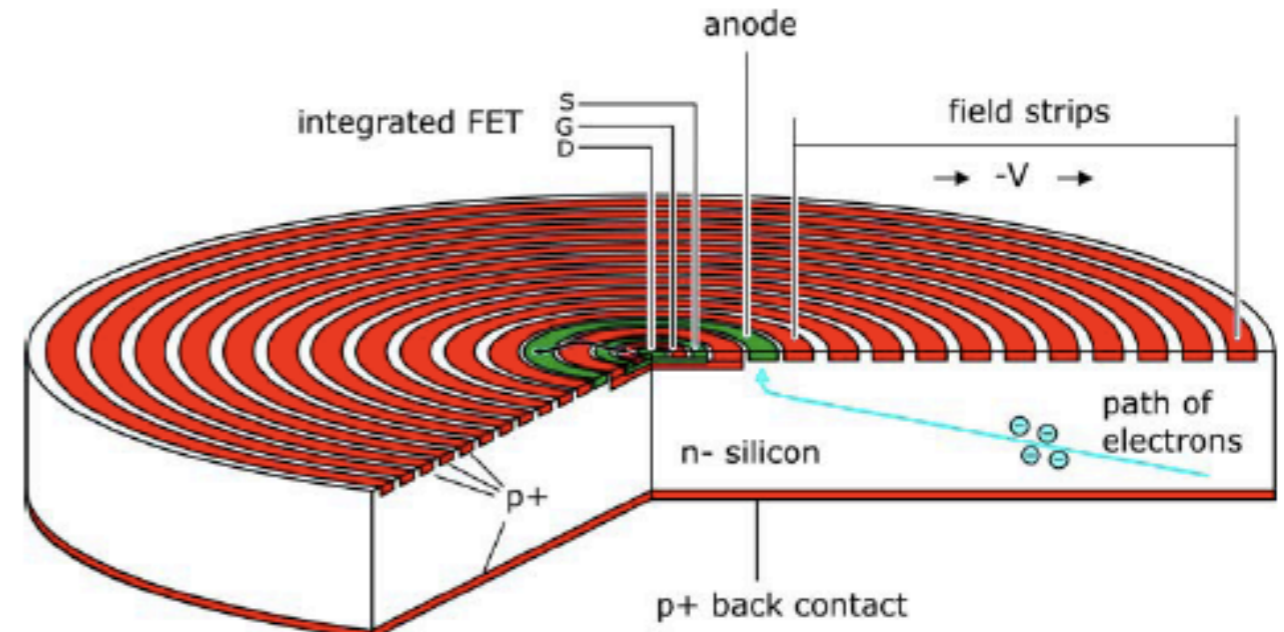
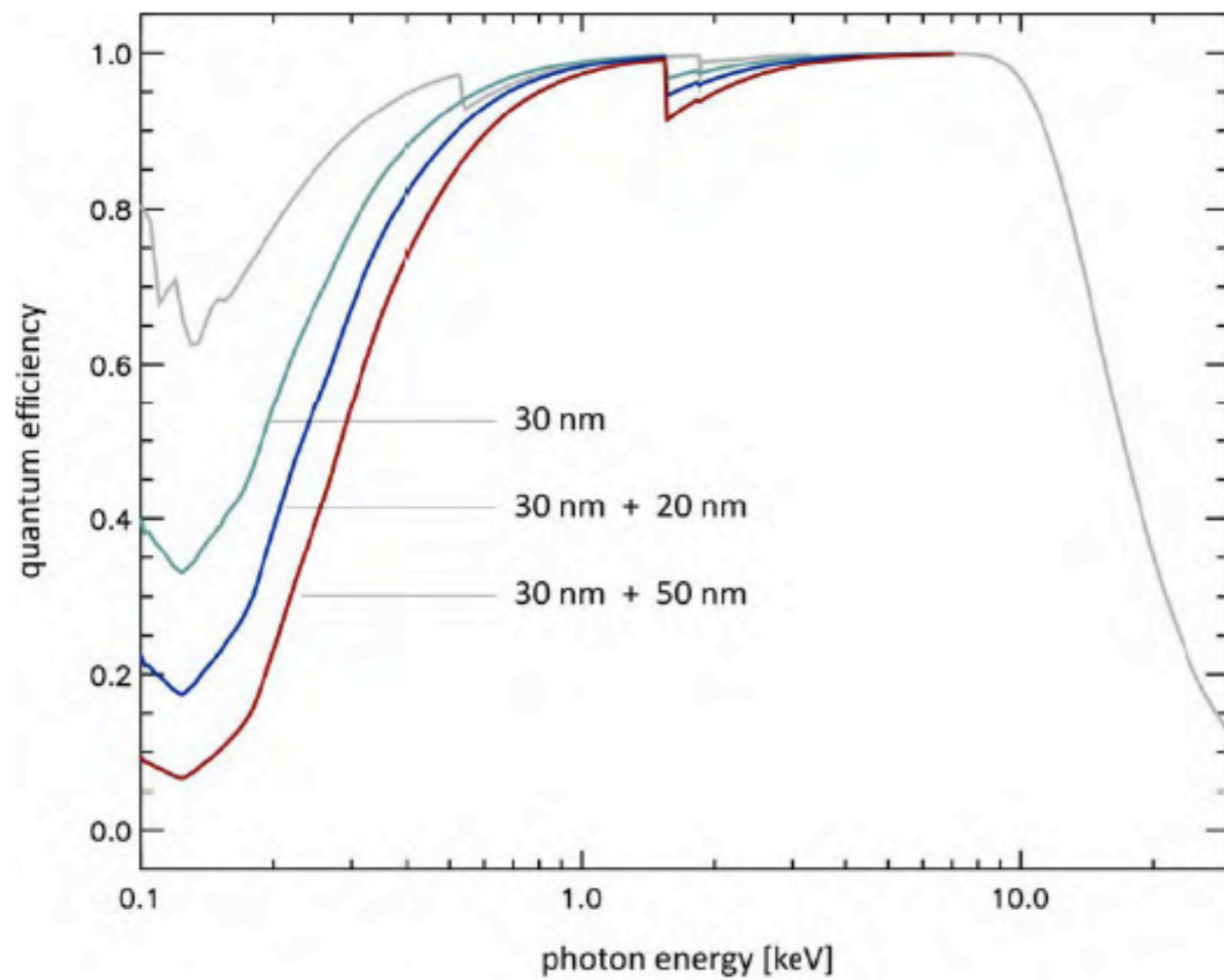
Silicon Drift Detectors

- Large sensitive area
- Small capacitance + integrated FET
 - Low electronics noise
 - Insensitive to pickup
 - High count rate
- Low leakage current level
 - Operation at room temperature or at moderate cooling
- Homogeneous entrance window
 - Backside illumination
- Flexible in shape and size



plots + images: Peter Lechner, HLL

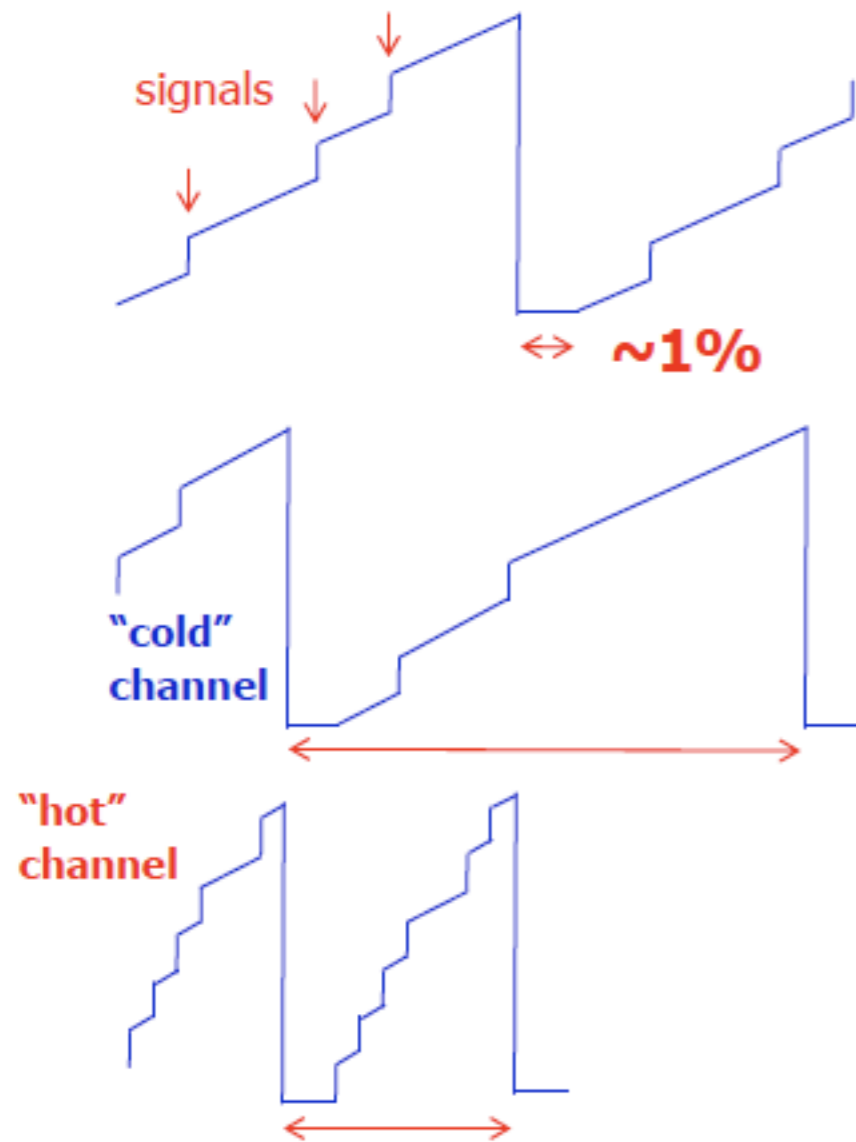
Silicon Drift Detectors



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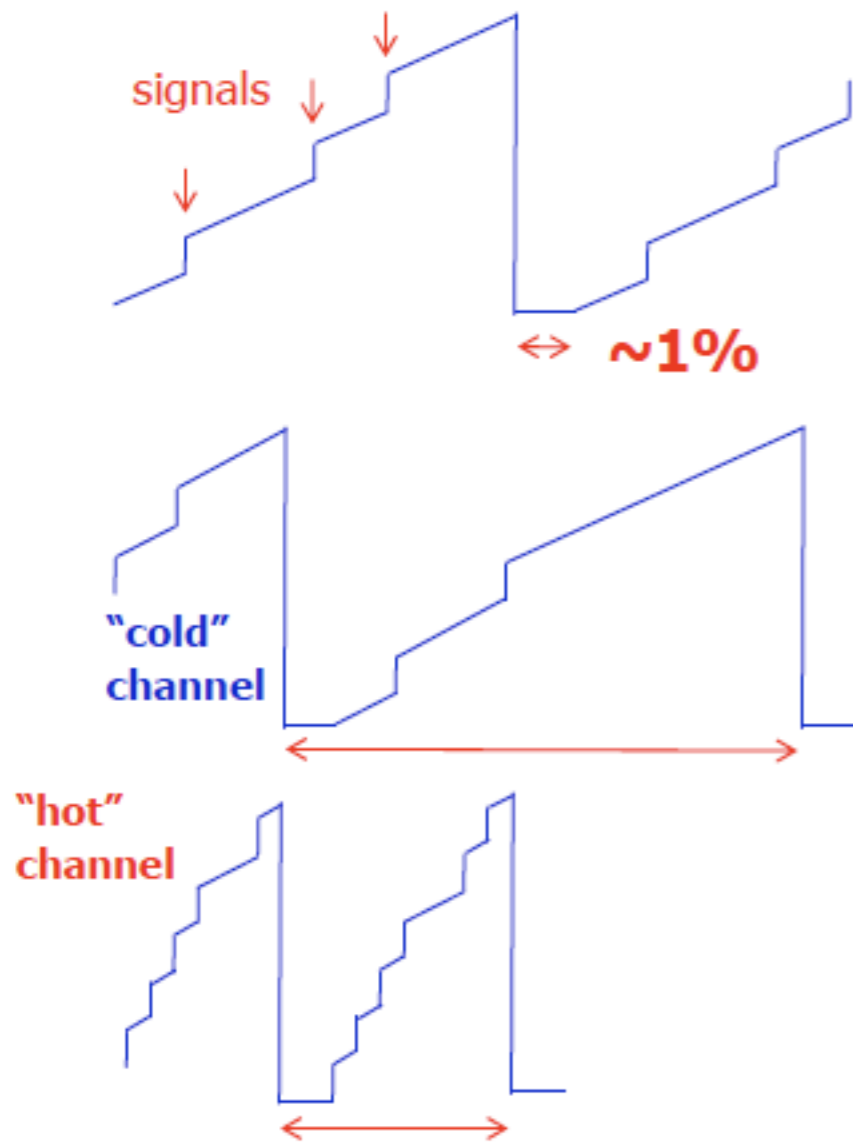
IXO-HTRS - Chris Tenzer

HTRS characteristics

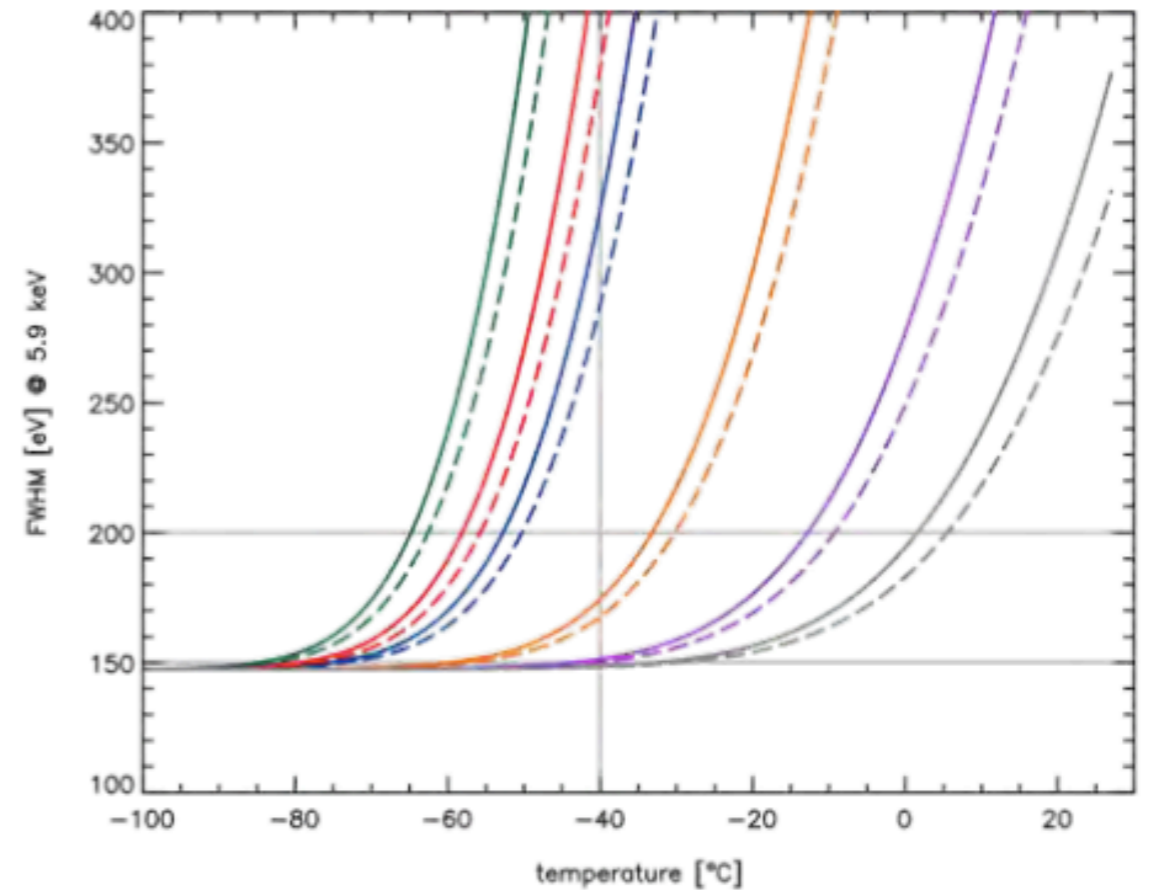


signal and thermal noise integration in
one pixel over time,
adaptive charge clearing

HTRS characteristics



signal and thermal noise integration in one pixel over time, adaptive charge clearing



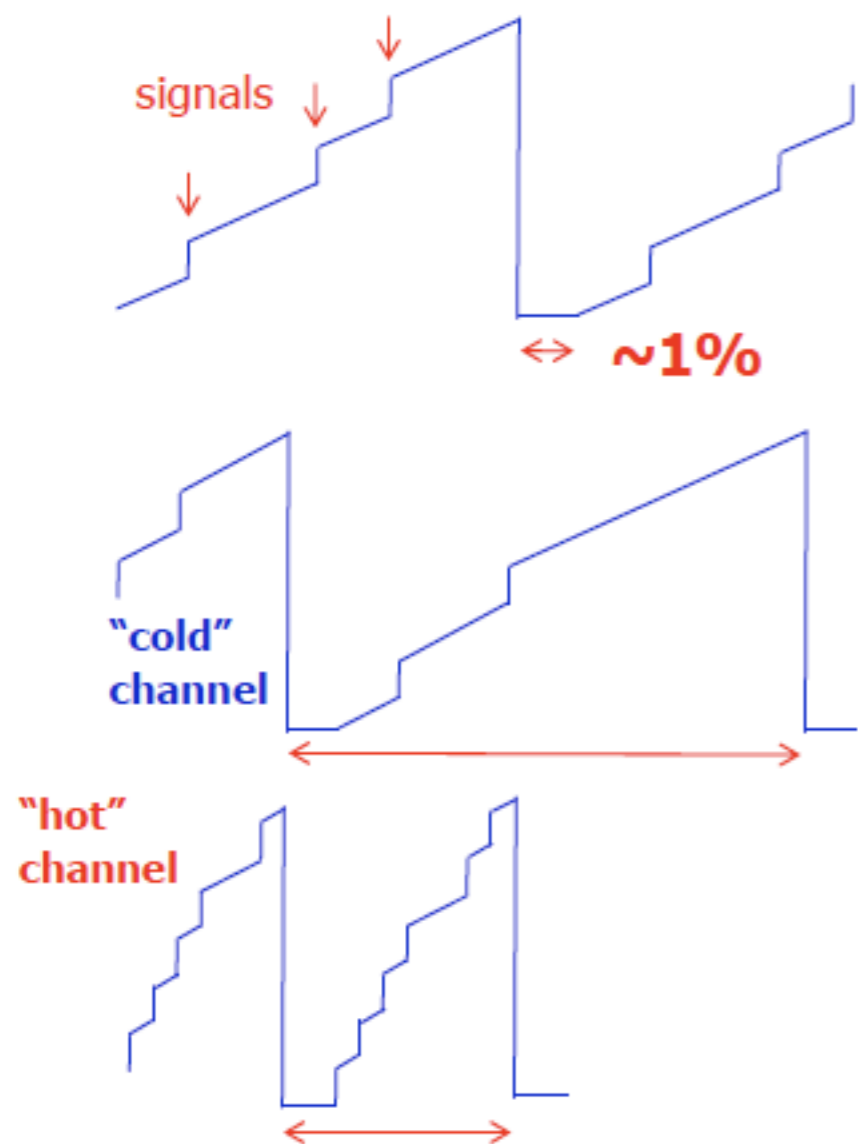
assumptions

signal integration time 600 nsec
 proton effect $2.43e-17$ A/p(10 MeV eq.) @ room temperature
 noise (white & 1/f) 10 el. r.m.s. equivalent noise charge
 leakage current 1 nA/cm² @ room temperature

parameter variations

proton flux 0 p/cm² | $1.e08$ p/cm² | $1.e09$ p/cm² | $1.e10$ p/cm² | $2.e10$ p/cm² | $5.e10$ p/cm²
 largest SDD cell 17.2 mm² ———
 smallest SDD cell 12.6 mm² - - -

HTRS characteristics

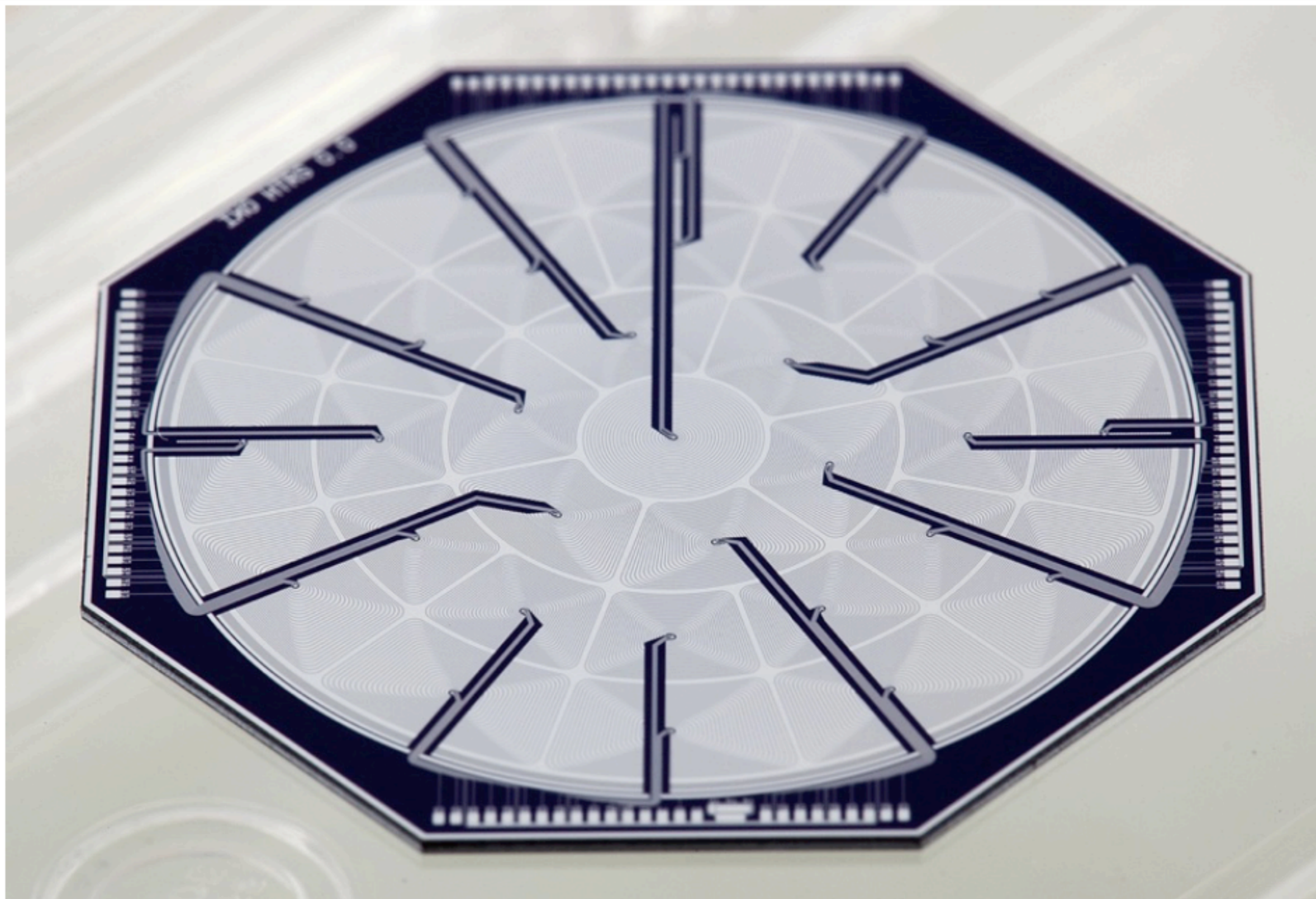


signal and thermal noise integration in one pixel over time, adaptive charge clearing



spider web structure to cover pixel boundaries in order to avoid split events

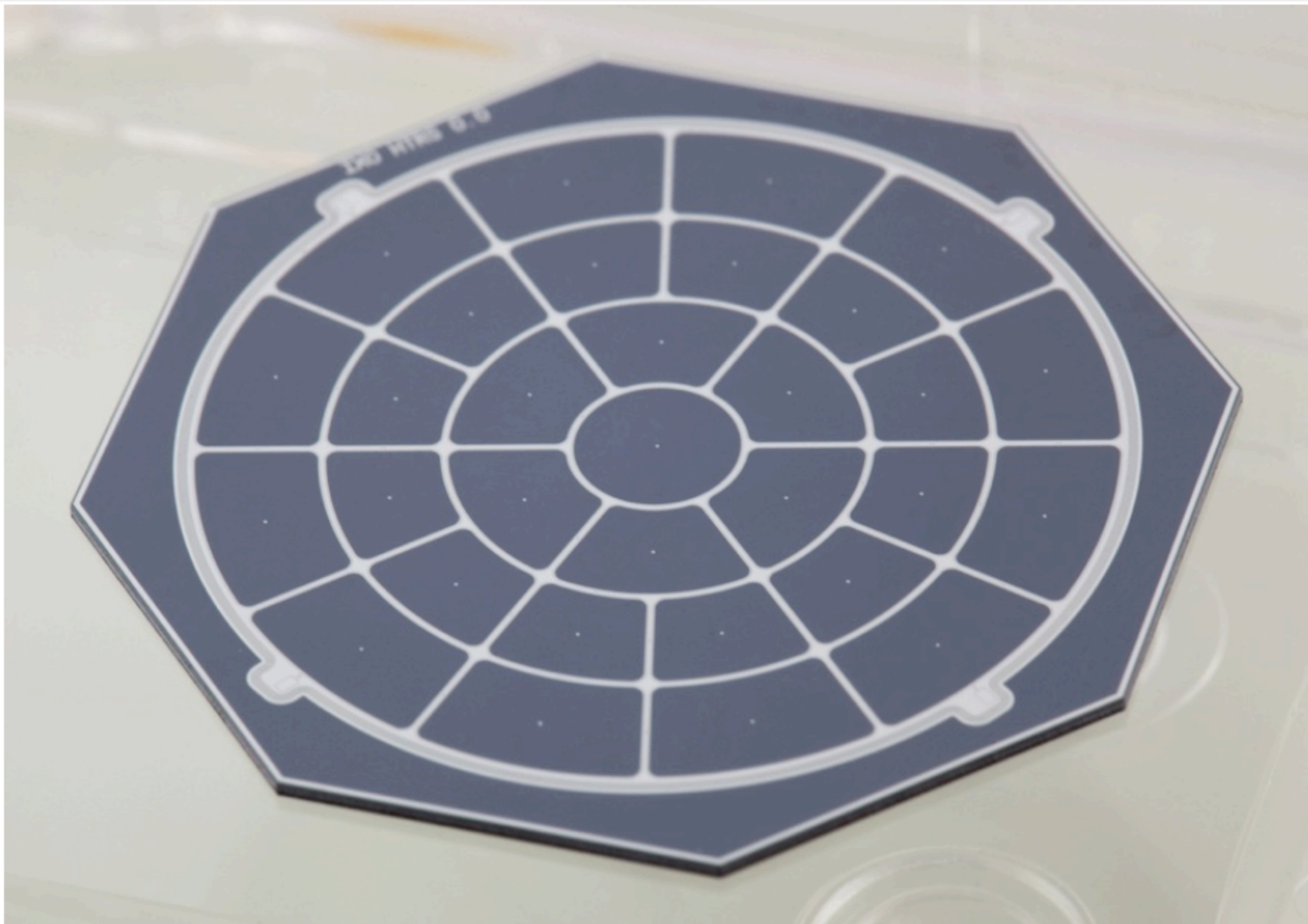
HTRS



(Photography of dummy array - readout side)

(Courtesy of Peter Lechner)

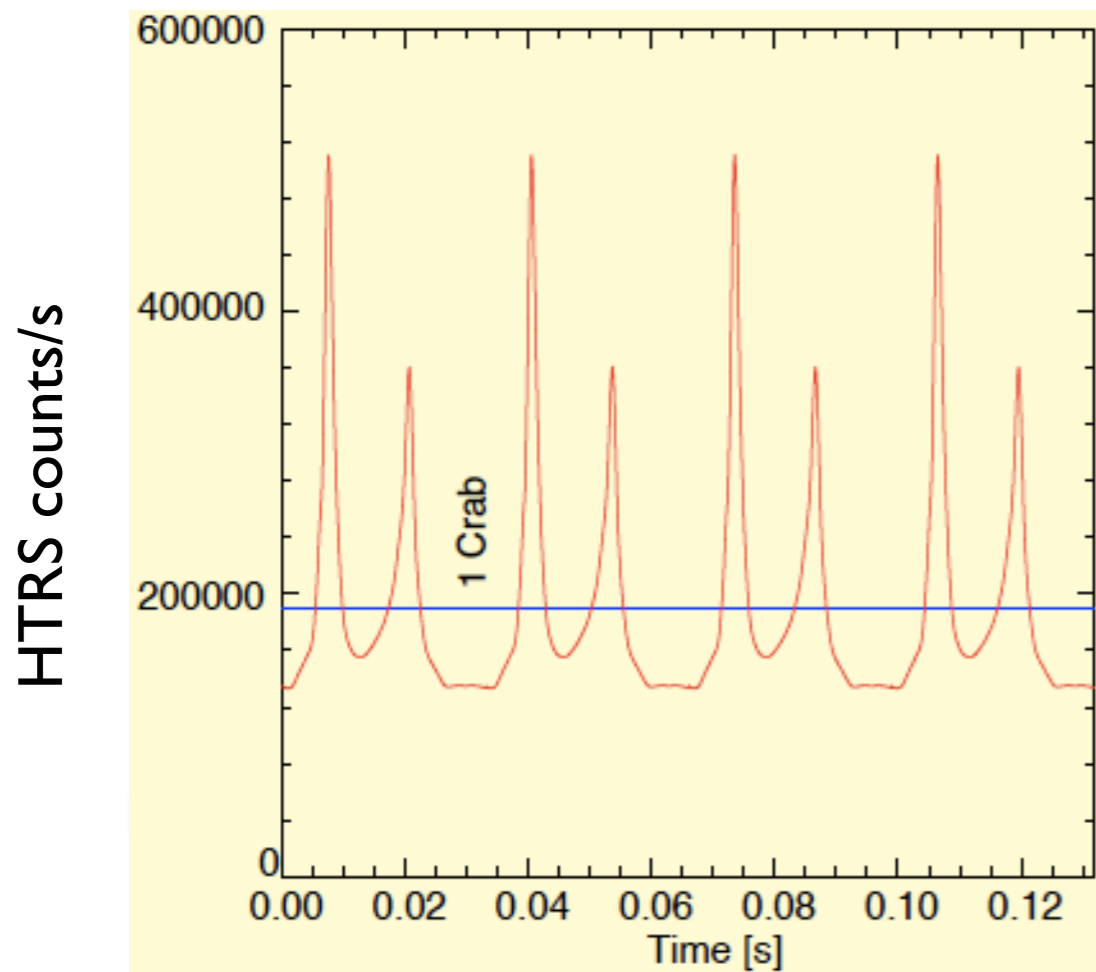
HTRS



(Photography of dummy array - entrance window side)

(Courtesy of Peter Lechner)

Data rates



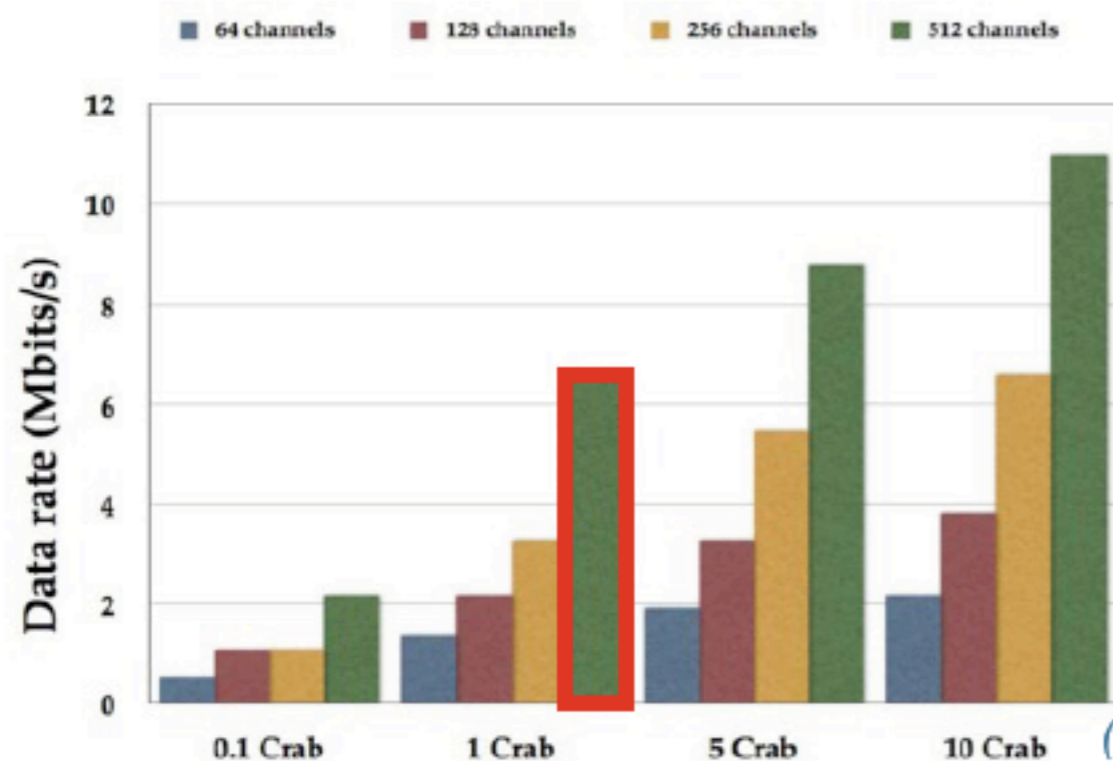
Courtesy of Joern Wilms & Didier Barret

- Raw data rate: 6.6 Mbits/s @ 1 crab / full resolution
- TM allocation: 0.84 Mbits/s when in // with XGS
- Need for an internal Mass Memory
- Can the HTRS rely on additional TM allocation to download the data from its MM?

We are defining Data modes in order to comply with the TM constraints whatever the event rate is and evaluating the impact on the HTRS science:

- Science event mode (transmit E, t for each event)
- Engineering event mode (transmit E, t and the pixel reference for each event)
- Binned data mode (accumulate the events in one spectrum for a given Δt)
- Standard modes (permanent, reduced size, e.g. low resolution light curves)
- Engineering housekeepings (temperatures, voltages, current, status)

Data rates



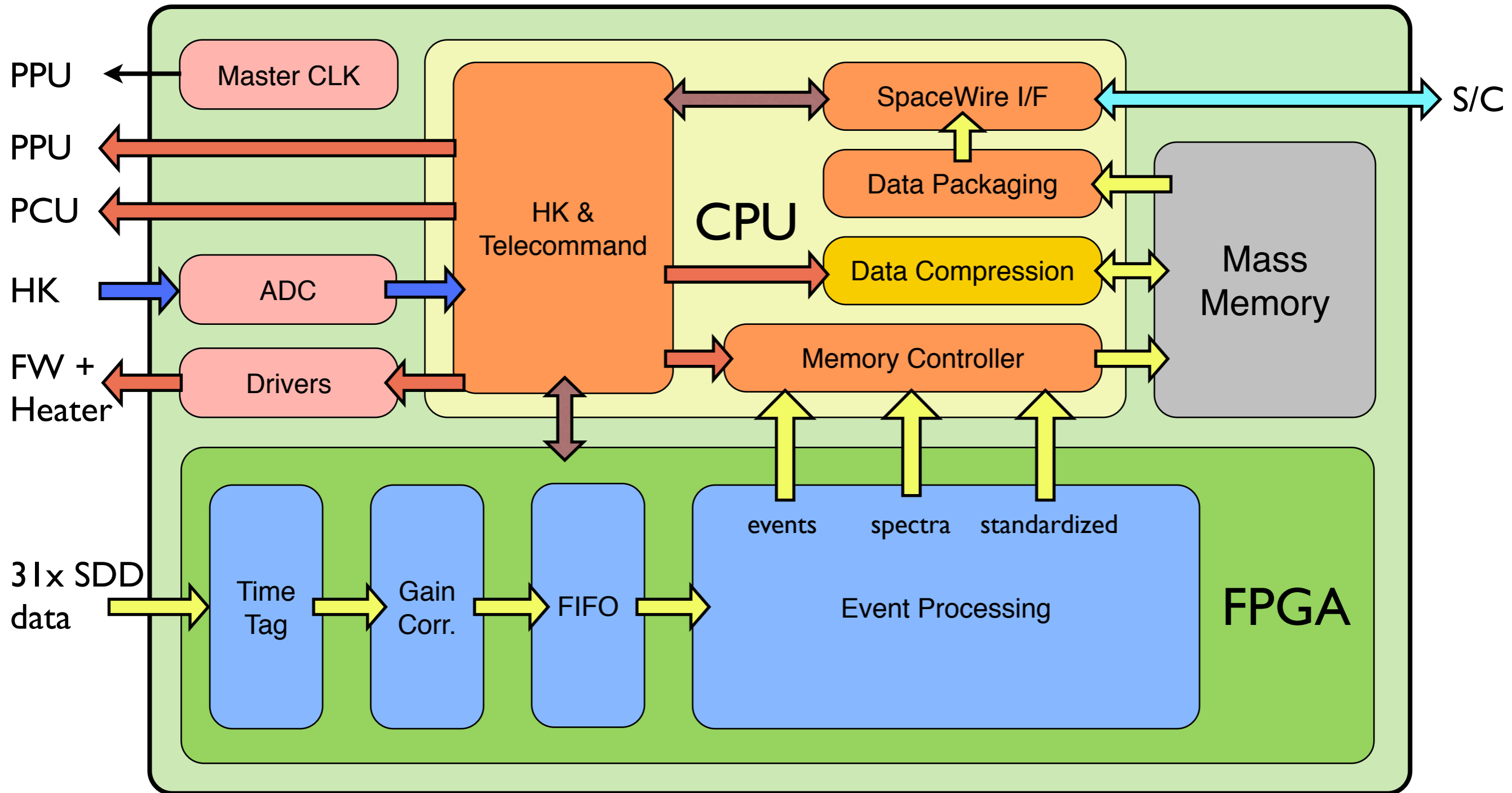
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IAAT hardware contribution for HTRS



Digital Data Processing Unit



IXO Science Meeting



IXO Science definition team meeting
April 27th, 2010 (morning)

IXO general meeting
*April 27th (afternoon) - April 29th, 2010 (up to around
4 pm)*

***Cité Universitaire Paris
Avenue Rockefeller
75014 Paris, France***

IXO Science Meeting



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Cité Universitaire Paris
Avenue Rockefeller
75014 Paris, France

Black holes and neutron stars with high throughput spectra and timing. Science with the HTRS on IXO

7-11 February 2011
Champéry, Switzerland

Topics in the science case of IXO driving the need for HTRS:

- BH Spin: Line, Continuum, QPOs.
- NS EOS: M/R from burst spectra, magnetar QPOs, kHz QPOs.
- Iron line, burst oscillations.
- Strong GR: L-T precessions, Epicyclic frequencies, ISCO, Horizon.

Topics that are not drivers of the HTRS/IXO proposal for ASTRO2010 or the ESA Cosmic Vision:

- NS cooling (but HTRS not primary instrument),
- Accretion discs (accretion in general),
- AMXPs,
- X-ray bursts,
- SGR/AXPs,
- Jets,
- Multiwavelength observations including HTRS for timing

HTRS instrumental talks (including simulations, performance, design, etc.), probably including one on IXO in general.

Scientific Organizing Committee

M. Méndez (chair), D. Barret (co-chair), A. Alpat, M. Gillfanov, M. van der Kils, C. Kouveliotou, S. Merighetti, J. Miller, F. Paerels, S. Paltani, R. Remillard, L. Stella, T. Strohmayer, M. Tagger, J. Tomick, P. Uttley, A. Watts, J. Wilms, S.N. Zhang

Local Organizing Committee

D. Barret, M. Falanga, M. Logossou, S. Paltani, M. Suveges

WEB: www.isdc.unige.ch/htrs2011/
E-MAIL: htrs2011@isdc.unige.ch