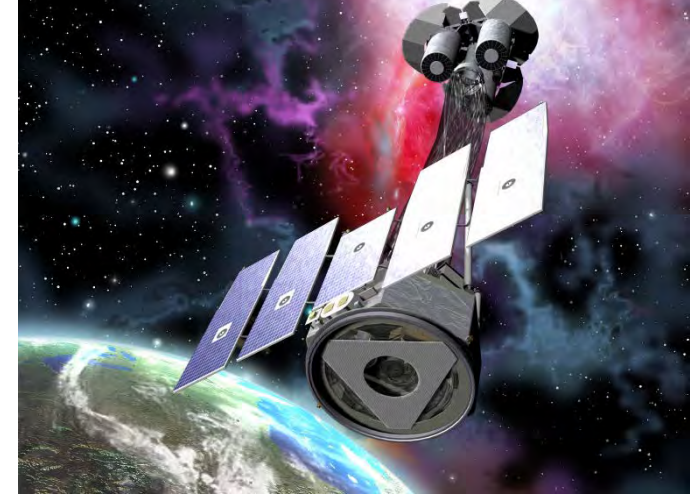


P-023: X-ray Polarimetry Mission IXPE (X線偏光観測衛星IXPE)



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X-ray polarimetry is a powerful probe to investigate emission mechanisms and geometries of astrophysical sources. The Imaging X-ray Polarimetry Explorer (IXPE), to be launched as a NASA Small Explorers (SMEX) mission in early 2021, will carry out imaging- and spectro-polarimetry in 2-8 keV and open new dimensions in X-ray astrophysics. The Japanese group provides key devices of the instruments and will contribute to scientific activities. Here we introduce the overview, current status, and future prospect of the IXPE.

Introduction: Crab Nebula (Ref: [1][2])

First (and only) positive result in soft X-ray

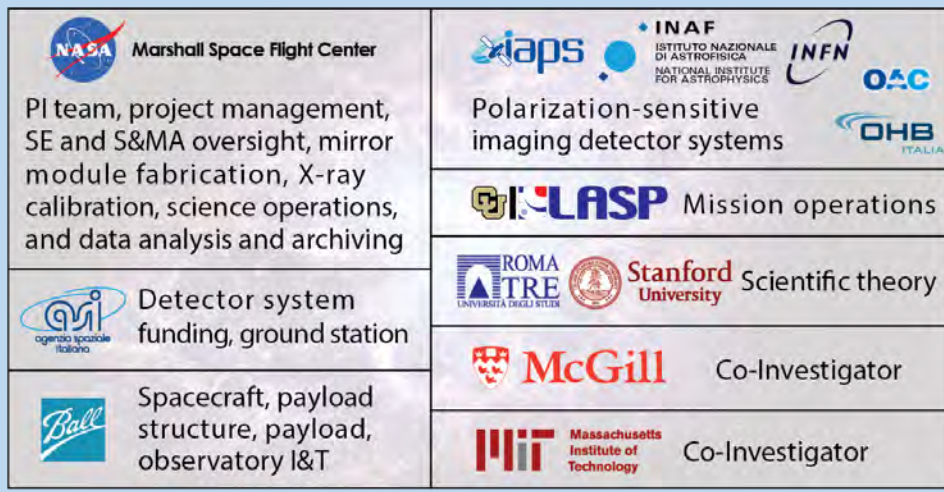
Aerobee-350 rocket (1971) OSO-8 satellite (1975-)



- Lithium (scattering) & Crystal (reflection)
 - Graphite Bragg crystal
 - Crab nebula+pulsar: $PD^* = 15\% \pm 5\%$
 - Crab nebula (w/o pulsar): $PD = 19\% \pm 1\%$
 - $PA^* = 156^\circ \pm 10^\circ$
 - $PA = 156^\circ \pm 2^\circ$
- PD : polarization degree
 PA : position angle

We need high sensitivity polarimetry to open new window in astrophysics

IXPE mission (Ref: [3]-[5])



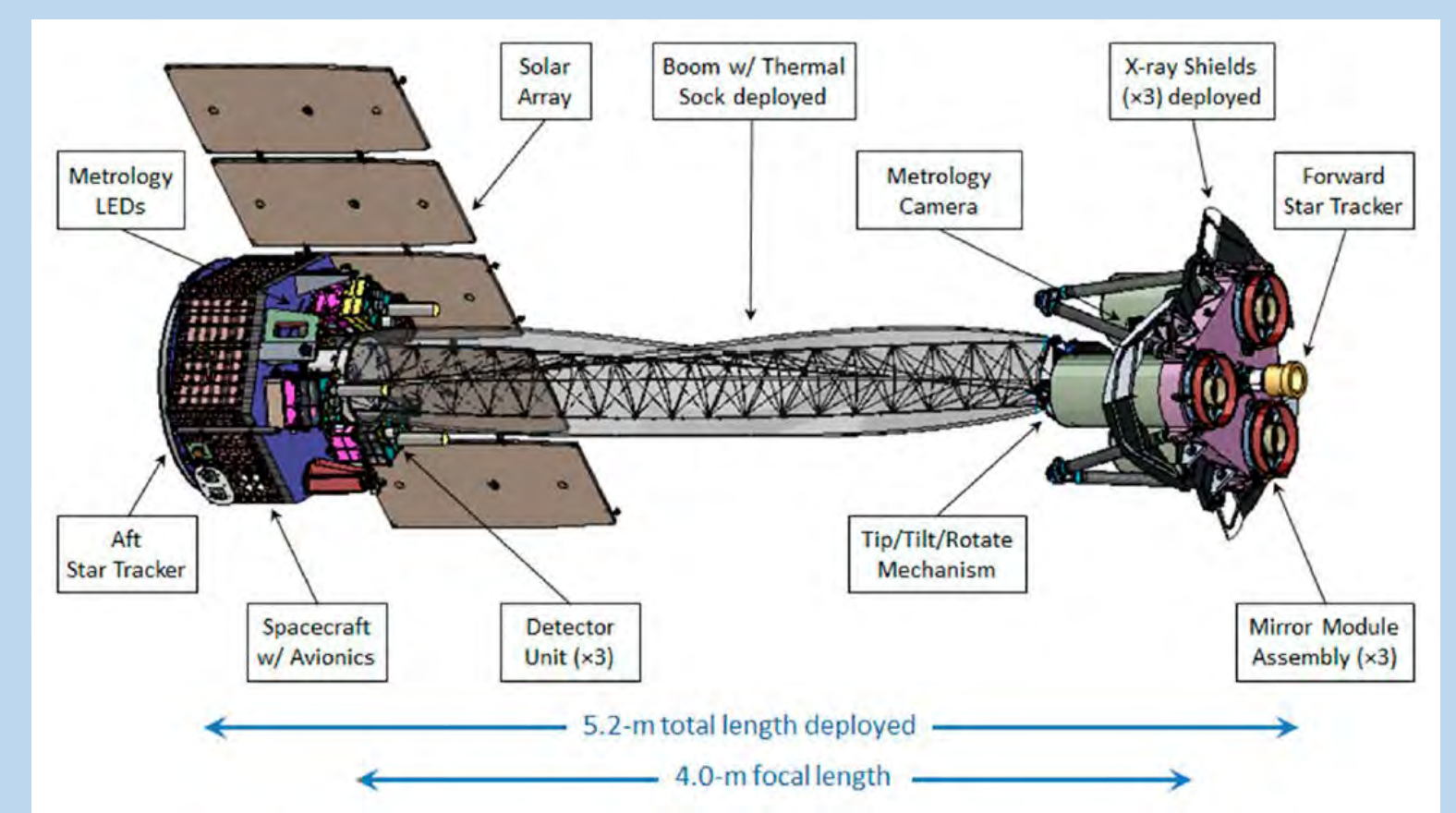
PI: Martin Weisskopf
(NASA Marshall Space Flight Center)

Parameter	Value
Launch Planning (Pegasus XL baselined)	21 day launch period Can launch on any day on or after 04/20/2021
Mission Duration	25 months including 1 month commissioning/payload verification
Initial Orbit State	Low Earth orbit (LEO) Altitude = 540 km, circular Inclination = 0 degrees
Ground Stations	Malindi, Kenya (primary station) Singapore NEN station (backup) TDRSS (early mission operations, contingency)
Communications	2.0 Mbps downlink via S-band LGA (to ground) 1 kbps downlink via S-band LGA (to TDRS) 2 kbps uplink via S-band LGA (from ground)
Fault Management	Autonomously places observatory in a safe configuration, Ground control used for recovery

• Bilateral collaboration between NASA and Italian Space Agency (ASI), NASA SMEX mission, launch in April 2021, baseline duration 2 years (Japanese group provides key devices of the instruments)

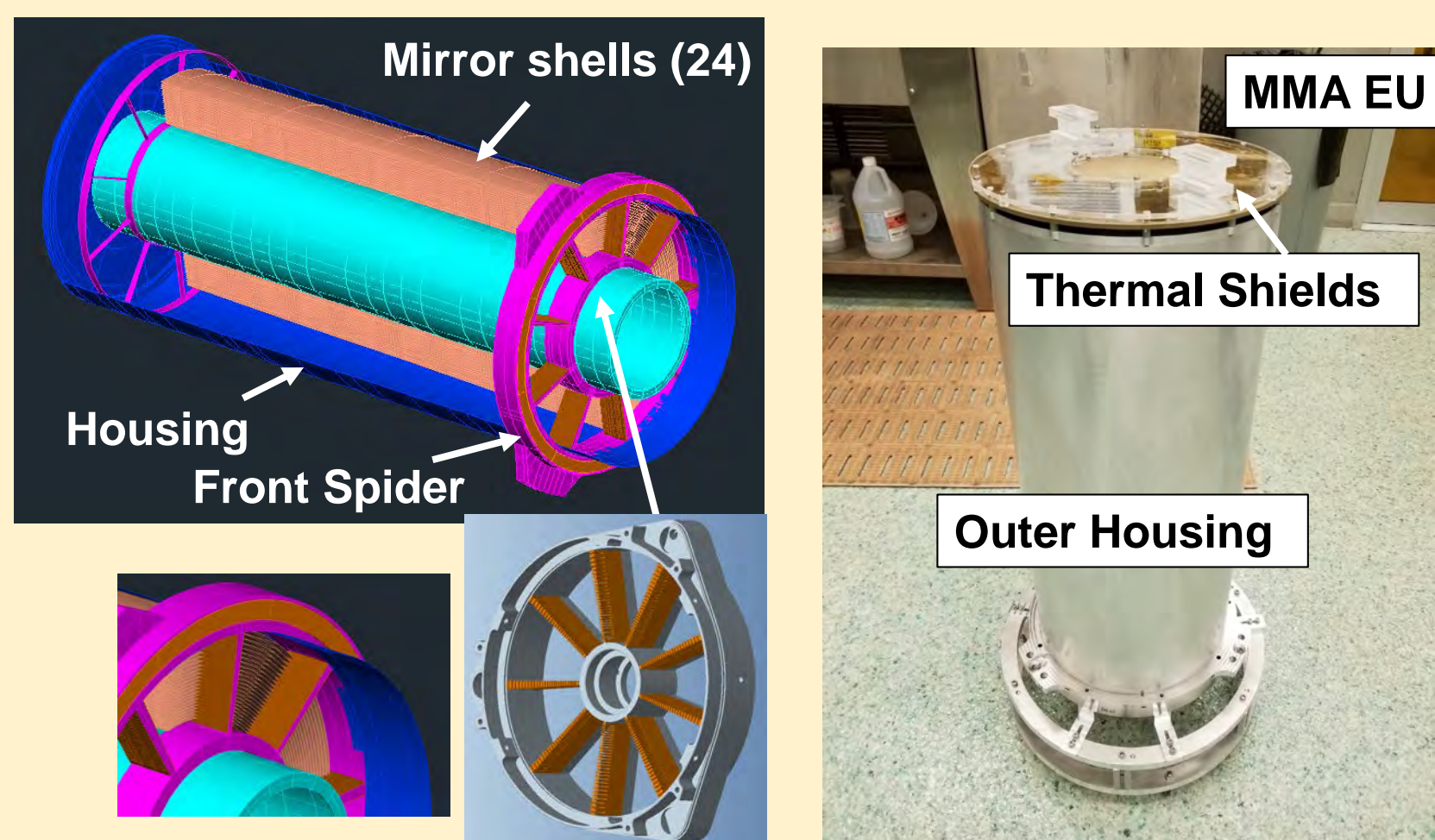
• Imaging- and spectro-polarimetry in 2-8 keV, 3× Mirror Module Assemblies (MMAs) + 3× Detector Units (DUs)

• Data are made public after validation



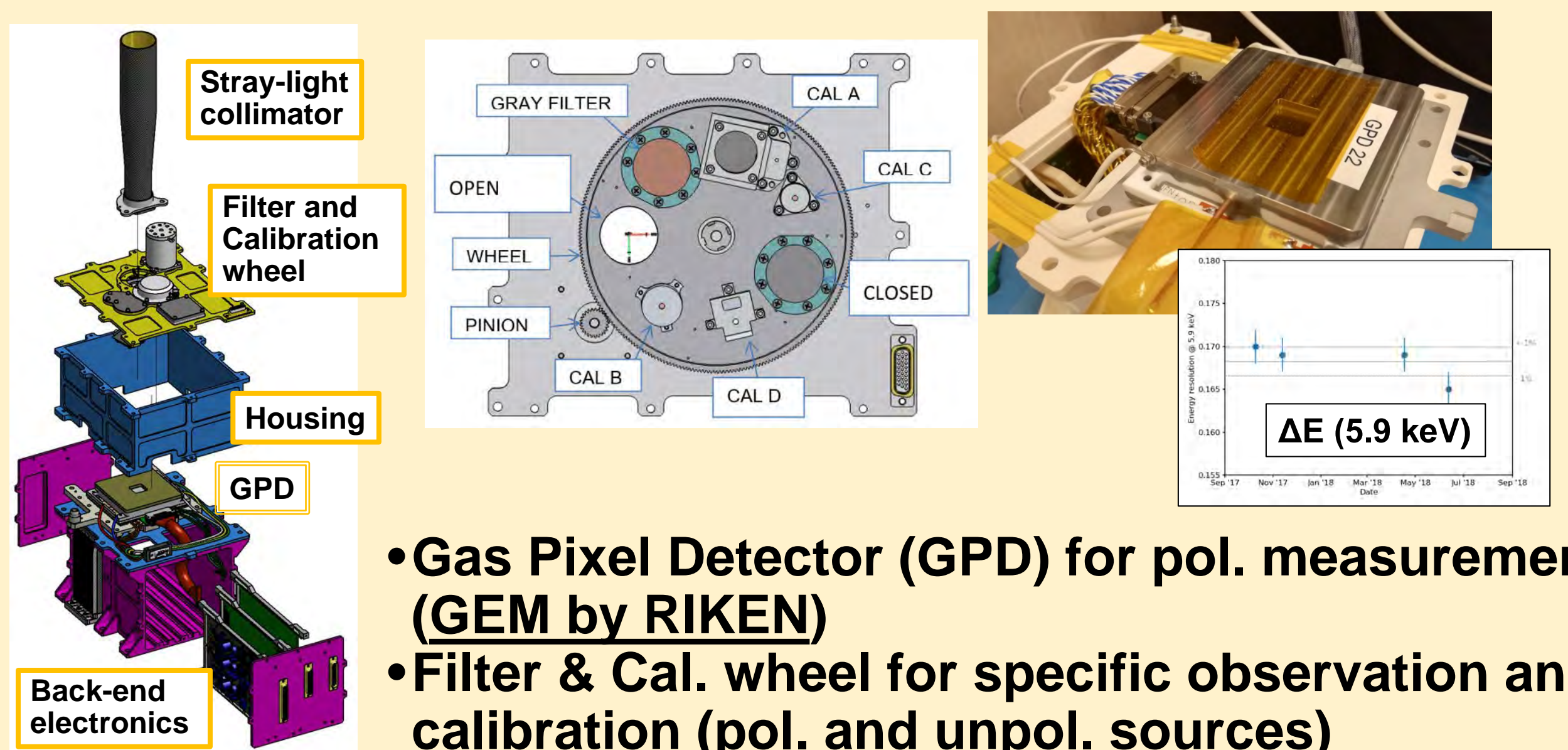
Instruments (Ref: [3]-[7])

Mirror Module Assembly (see also Mitsuishi's poster (P-024))



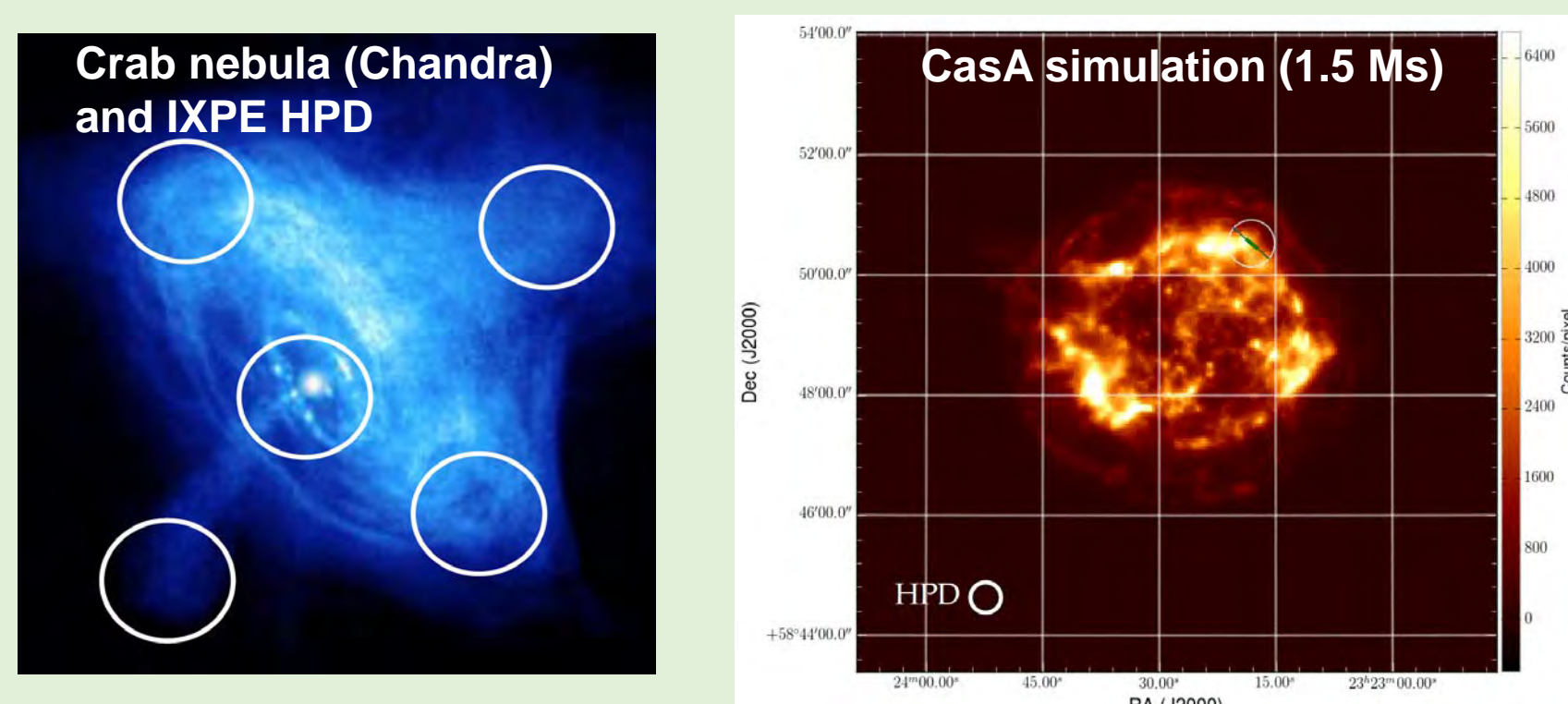
- 3 modules, 24 shells per module, 210 cm² (2.3 keV) each
- Thermal shield by Nagoya (1.4 μm Polyimide)
- Engineering unit (EU) used for exercises/tests

Detector Unit (see also Hayato's poster (P-025))

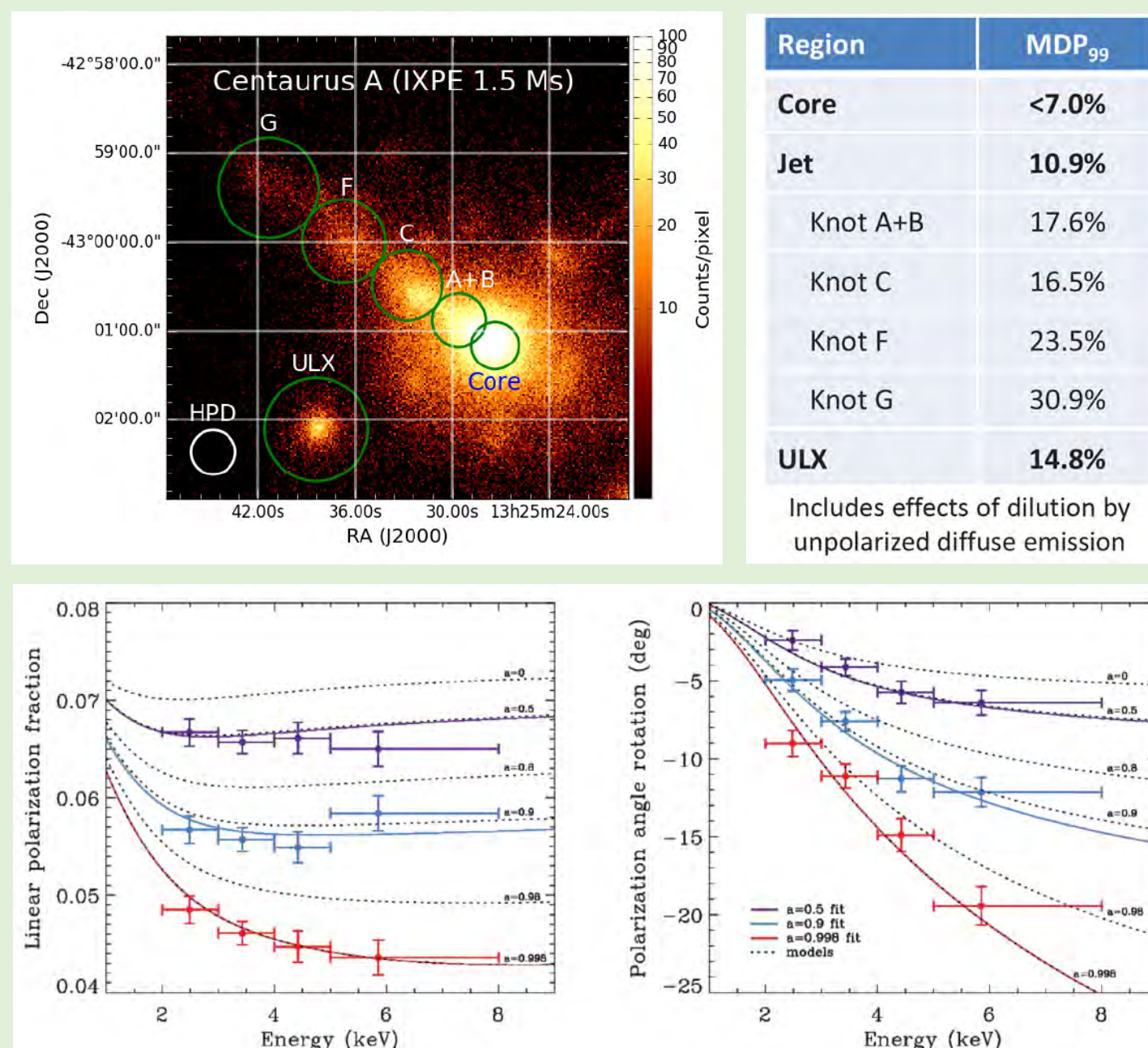


- Gas Pixel Detector (GPD) for pol. measurement (GEM by RIKEN)
- Filter & Cal. wheel for specific observation and calibration (pol. and unpol. sources)
- Fake modulation and resolution stability tested using Engineering Model

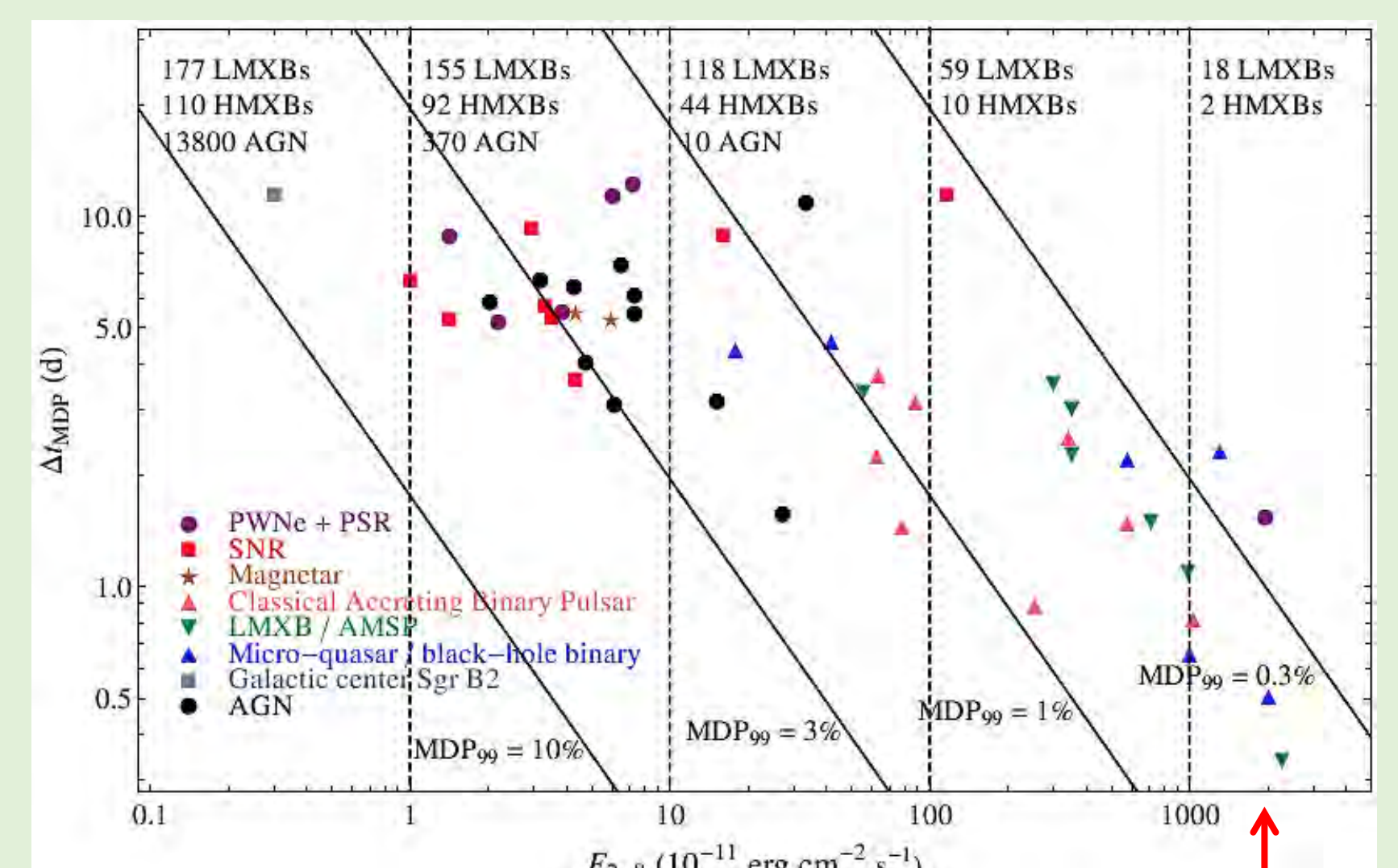
Scientific Capability (Ref: [4][5][8][9])



Position-resolved polarization measurement (configuration of the magnetic field) of pulsar wind nebulae and supernova remnants (e.g., Crab (left) and CasA (right))



(top) Magnetic field configuration of jet from active galactic nucleus (e.g., CenA)
(bottom) Black hole spin of microquasar (e.g., GRS 1915+105)



Time to reach a minimum detectable polarization (MDP) is ~100 times shorter than OSO-8 -> Various classes of X-ray sources accessible in polarimetry

References:

- [1] Novick, R. et al. 1972, ApJL 174, 1
 [2] Weisskopf, M. C., et al. 1978, ApJL 220, 117
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 [9] Dovciak, M., 2008, MNRAS 391, 32