

# Equipping the eICE with a precise and versatile gas mixing systems

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## Abstract

Photoelectric X-ray polarimetry is a vital research area for studying astrophysical sources, requiring precise calibration and control of gas mixtures in detectors. INAF's research program has developed and installed two ternary gas mixing systems for filling polarimeters with noble gases, electronegative gases and hydrocarbon quenchers. These systems aim to study and calibrate future gas detectors for polarimetry at low (<2 keV) and high energies (>10 keV) by optimizing the use of quenchers, electronegative and noble gases. The mixing systems are equipped with all necessary test gas mixture bottles, and gas content is controlled using three high-precision Bronkhorst mass flow meters and a digital controller. Such gas system can also be coupled with gas X-ray detectors for different scopes (e.g. Axions search-BabyIAXO).

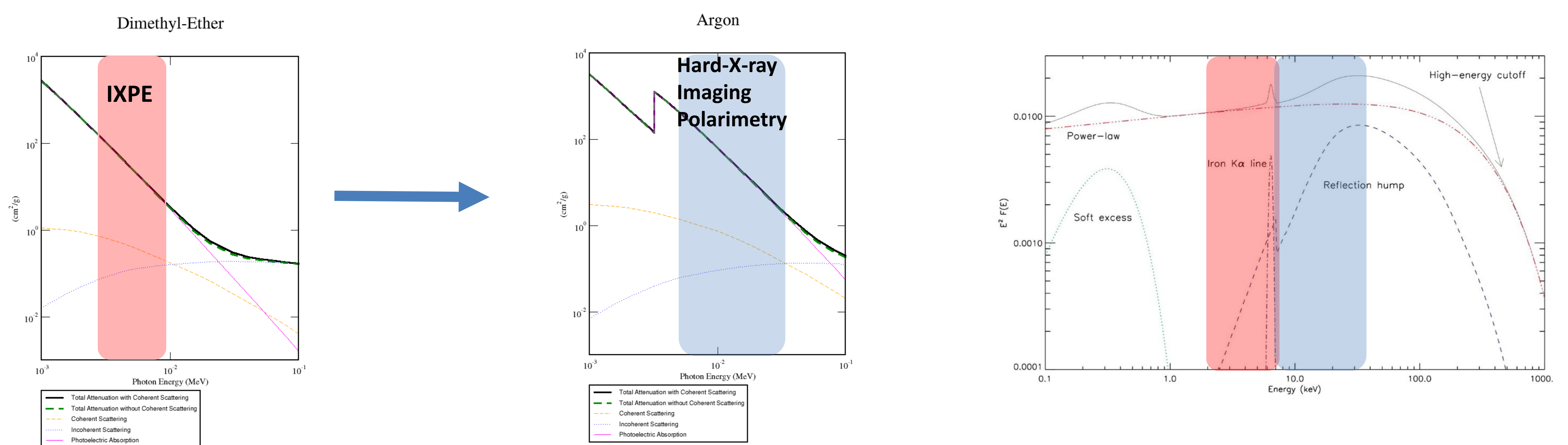


Fig. 1: **Left:** The 2-8 keV IXPE energy band. IXPE opened the X-ray polarimetry window in astrophysics. **Center:** The energy band of the future imaging hard X-ray polarimeter which coupled with the IXPE polarimeter will allow to study new phenomena such as those related to the presence of reflection in Active Galactic Nuclei, X-ray binaries and molecular clouds. **(Right).** Two energy bands overlapped to the reflection and the primary coronal emission from radio quiet AGNs.

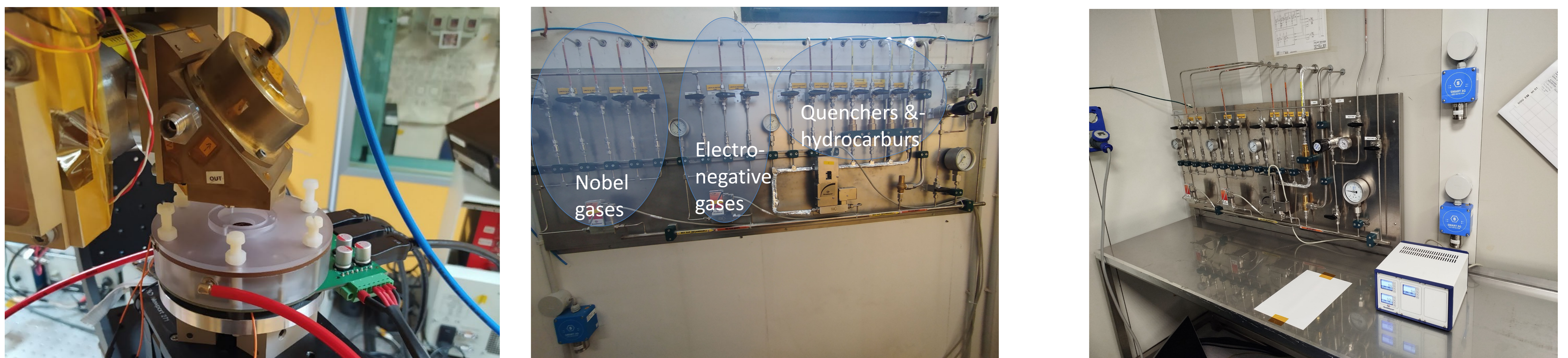


Fig. 2: **Left:** The GridPix detector at the prototype calibration facility at INAF-IAPS. GridPix was tested with various gas mixtures, including helium-carbon dioxide (He-CO<sub>2</sub>), neon-carbon dioxide (Ne-CO<sub>2</sub>), argon-carbon dioxide (Ar-CO<sub>2</sub>), and pure carbon dioxide (CO<sub>2</sub>). Additional gases available for testing include isobutane, dimethyl ether (DME), methane, propane, carbon tetrafluoride (CF<sub>4</sub>), and sulfur hexafluoride (SF<sub>6</sub>). **Center:** The complete ternary gas mixing system. **Right:** The reduced ternary gas mixing system in the clean room.



Fig. 3. The four gas cabinet hosting the 12 bottle of different gas to prepare the detector filling.



Fig. 4. The ternary gas system interfaced to the prototype X-ray room for testing and calibrating detectors.