



CONCORSO PER TITOLI ED ESAMI DI CUI AL BANDO N. 23670/2021 PER UN POSTO PER IL PROFILO PROFESSIONALE DI TECNOLOGO DI III LIVELLO PROFESSIONALE, PER ASSUNZIONE A TEMPO INDETERMINATO PRESSO LA SEZIONE DI PISA DELL'INFN

ELENCO QUESITI PREDISPOSTI PER LA PROVA ORALE

BUSTA 1

Il/La candidato/a dopo aver brevemente riflettuto, discuta TUTTI i seguenti punti.

- Elementi base per il disegno di un criostato per  $T < 4K$ .
- Descrizione di una tipica linea di lettura di un segnale criogenico
- lettura dati seriale e parallela

Scelga UNO dei seguenti prodotti della ricerca e ne descriva il contesto, il contenuto e il proprio contributo personale: Prodotti 1 o 6

TESTO DA LEGERE E TRADURRE

From: J. Colosimo et al., Measuring the Soft X-Ray Quantum Efficiency of a Hybrid CMOS Detector, <https://arxiv.org/abs/2204.09126>

Next-generation X-ray observatories, such as the Lynx X-ray Observatory Mission Concept or other similar concepts in the coming decade, will require detectors with high quantum efficiency (QE) across the soft X-ray band to observe the faint objects that drive their mission science objectives. Hybrid CMOS Detectors (HCDs), a form of active-pixel sensor, are promising candidates for use on these missions because of their fast read-out, low power consumption, and intrinsic radiation hardness. In this work, we present QE measurements of a Teledyne H2RG HCD, performed using a gas-flow proportional counter as a reference detector. We find that this detector achieves high QE across the soft X-ray band, with an effective QE of  $94.6 \pm 1.1\%$  at the Mn  $K\alpha/K\beta$  energies (5.90/6.49 keV),  $98.3 \pm 1.9\%$  at the Al  $K\alpha$  energy (1.49 keV),  $85.6 \pm 2.8\%$  at the O  $K\alpha$  energy (0.52 keV), and  $61.3 \pm 1.1\%$  at the C  $K\alpha$  energy (0.28 keV). These values are in good agreement with our model, based on the absorption of detector layers. We find similar results in a more restrictive analysis considering only high-quality events, with only somewhat reduced QE at lower energies.



BUSTA 2

Il/La candidato/a dopo aver brevemente riflettuto, discuta TUTTI i seguenti punti.

- Elementi di superconduttività utili alla realizzazione di un rivelatore criogenico per radiazione.
- Misure di temperatura nei sistemi criogenici.
- strumenti di condivisione documenti e dati

Scelga UNO dei seguenti prodotti della ricerca e ne descriva il contesto, il contenuto e il proprio contributo personale: Prodotti 2 o 7

TESTO DA LEGGERE E TRADURRE

From: R. Abbasi et al., First Search for Unstable Sterile Neutrinos with the IceCube Neutrino Observatory, <https://arxiv.org/abs/2204.00612>

Longstanding anomalies in short-baseline (SBL) neutrino experiments have been interpreted in the standard oscillation framework of three known flavors and one or more hypothetical sterile neutrinos, referred to as "3+N" models. The "3+1" model, which involves only one sterile neutrino, has been extensively studied through global fits to data sets sensitive to vacuum oscillations involving a dominant mass splitting of  $\sim 1 \text{ eV}^2$ . These fits find a strong preference for 3+1 over the three neutrino hypothesis. However, the allowed regions from these fits suffer from internal inconsistencies between datasets, referred to as "tension". In particular, no experiment has found evidence of  $\nu_\mu$  disappearance, which is expected in a 3+1 model. This is one motivation to reconsider the 3+1 model; another is to evade cosmological bounds on light sterile neutrinos and possibly resolve the Hubble tension

BUSTA 3

Il/La candidato/a dopo aver brevemente riflettuto, discuta TUTTI i seguenti punti.

- La misura del vuoto nei vari regimi.
- lettura di array di rivelatori criogenici
- sistemi di backup dati

Scelga UNO dei seguenti prodotti della ricerca e ne descriva il contesto, il contenuto e il proprio contributo personale: Prodotti 3 o 8

TESTO DA LEGGERE E TRADURRE

From: R. Klanner et al. Study of the band-gap energy of radiation-damaged silicon  
<https://arxiv.org/abs/2204.03288>

The transmission of silicon crystals irradiated by 24 GeV/c protons and reactor neutrons has been measured for photon energies,  $E_\gamma$ , between 0.95 and 1.3 eV. From the transmission data the absorption coefficient  $\alpha$  is calculated, and from  $\alpha(E_\gamma)$  the fluence dependence of the band-gap energy,  $E_{\text{gap}}$ , and the energy of transverse optical phonons,  $E_{\text{ph}}$ , determined. It is found that within the experimental uncertainties of about 1 meV neither  $E_{\text{gap}}$  nor  $E_{\text{ph}}$  depend on fluence up to the maximum fluence of  $1 \times 10^{17} \text{ cm}^{-2}$  of the measurements. The value of  $E_{\text{gap}}$  agrees within about 1 meV with the generally accepted value, if an exciton-binding energy of 15 meV is assumed. A similar agreement is found for  $E_{\text{ph}}$ . For the extraction of  $E_{\text{gap}}$  and  $E_{\text{ph}}$  the second derivative of  $(E)$  smoothed with a Gaussian kernel has been used.



BUSTA 4

Il/La candidato/a dopo aver brevemente riflettuto, discuta TUTTI i seguenti punti.

- Differenze e similitudini fra sistemi a vuoto e a ultra-alto vuoto
- Principali problemi nella misura di piccoli segnali
- acquisizione dati assistita da computer

Scelga UNO dei seguenti prodotti della ricerca e ne descriva il contesto, il contenuto e il proprio contributo personale: Prodotti 4 o 9

TESTO DA LEGGERE E TRADURRE

From: D. Beznosko et al. Probing Fundamental Physics With Multi-Modal Cosmic Ray Events  
<https://arxiv.org/abs/2204.04045>

The Horizon-T experiment in Tien Shan is based on the idea of measuring the time at which EAS (Extensive Air Shower, n.d.r.) disc passes the observation level with nanosecond accuracy. The detector system consists of ten charged particles registration points located at distances of up to several hundred meters from each other. The points are equipped with detectors based on registration of Cherenkov radiation in glass and registration of scintillation light in polystyrene. The detectors register the arrival times of charged particles at the observation level with a resolution of  $\sim 2$  ns, as required to study the spatial and temporal characteristics of the EAS and the structure of the multi-modal events specifically. Over the period of the Horizon-T data taking since 2017 to present, a large number of multi-modal events were detected. The data has presented numerous challenges that show the direction towards the further development of the detector system and of the analysis methods and techniques that could be applied to these multi-modal events.

BUSTA 5

Il/La candidato/a dopo aver brevemente riflettuto, discuta TUTTI i seguenti punti.

- Descrizione del sistema di vuoto di un criostato tipico
- sistemi di amplificazione di segnali molto deboli
- protocolli per trasferimento dati

Scelga UNO dei seguenti prodotti della ricerca e ne descriva il contesto, il contenuto e il proprio contributo personale: Prodotti 5 o 10

TESTO DA LEGGERE E TRADURRE

From: R. Cervantes et al. Search for  $70 \mu\text{eV}$  Dark Photon Dark Matter with a Dielectrically-Loaded Multi-Wavelength Microwave Cavity <https://arxiv.org/abs/2204.03818>

Microwave cavities have been deployed to search for bosonic dark matter candidates with masses of a few  $\mu\text{eV}$ . However, the sensitivity of these cavity detectors is limited by their volume, and the traditionally-employed half-wavelength cavities suffer from a significant volume reduction at higher masses. ADMX-Orpheus mitigates this issue by operating a tunable, dielectrically-loaded cavity at a higher-order mode, which allows the detection volume to remain large. The ADMX-Orpheus inaugural run excludes dark photon dark matter with kinetic mixing angle  $\chi > 10^{-13}$  between  $65.5 \mu\text{eV}$  (15.8 GHz) and  $69.3 \mu\text{eV}$  (16.8GHz), marking the highest-frequency tunable microwave cavity dark matter search to date.

