THE DEVELOPMENT OF SUPER-SENSITIVE GLASS TRACK-ETCH DETECTORS

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Working from a barium-phosphate laser filter glass called VG-13, Buford Price and his colleagues at Berkeley developed BP-1 glass track-etch detectors several years ago. BP-1 exhibits spectacular and unparalleled resolution in the measurement of charge of relativistic heavy ions. Since its development, BP-1 has accumulated an impressive track record of successful applications in experimental astrophysics, in the study of nuclear interactions of relativistic heavy ions, in the study of cluster radioactivity, and even in atomic physics at high Lorentz factor. BP-1 was only very crudely optimized for sensitivity and resolution, so there is no reason to expect that BP-1 happens by chance have the optimal composition with respect to sensitivity, even among phosphate glasses with identical sets of components. We have two independent sets of evidence—from the analysis of calibration data from the Trek instrument, and from a search for ^{12}C emission from ^{114}Ba—which strongly indicate that a much more sensitive composition exists. We plan to develop the successor to BP-1, which we will call BP-2, by experimentally exploring the glass composition space near the nominal BP-1 composition to find the true maximum in sensitivity. For minimum-ionizing relativistic heavy ions, BP-1 has a detection threshold at $Z = 68$ when etched in the most sensitive etchant (HBF_4). By optimizing the sensitivity, we hope to lower the threshold to $Z < 50$, which would enable us to reach the astrophysically interesting region around the second heavy abundance peak at Sn–Ba.