Method for reconstruction of volume density distribution in dynamic targets from their proton radiography images

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Using proton microscopy facilities PUMA [1] at ITEP and PRIOR [2] at GSI, series of experimental investigation of extreme states of matter in dynamic processes were performed. An important task in such experiments is to restore volume density distribution in the target from a single proton radiography image. Recurrence algorithm of inverse Abel transform was implemented in Matlab to solve this problem. During the tests it was found that the algorithm is very sensitive to distortions in the original data. In this regard a number of distortion compensating techniques were implemented. Noise suppression effected by multilevel wavelet thresholding and an exponential averaging filter. To compensate blur of images Lucy–Richardson deconvolution algorithm applied. Fitting of beam intensity profile by asymmetric Gauss function is used to compensate instability of proton beam. Demonstration of developed tools was performed with results of underwater electrical wire explosion experiments at PRIOR facility at GSI and investigation of detonation of TNT at PUMA facility at ITEP. Additionally, results of abnormal compression in docosane experiment at future 247 MeV facility, which is modeled in Geant 4, were processed.