Purpose: Small and narrow field dosimetry in proton beam therapy is difficult due to fluence disequilibrium. Diode detectors could be a suitable choice for high resolution proton dosimetry due to their relatively small size and high sensitivity. Unfortunately, semiconductor detectors are prone to radiation damage due to charged particle interactions. Characteristics of some of the commercial diodes in proton beam dosimetry are investigated in this study specially a prototype diode from PTW.

Methods: The characteristics of several diodes from different vendors were evaluated in proton beams. All diodes were irradiated in a water phantom under reference condition (10cm diameter field, 16cm range, 10 cm SOBP) at various dosages to investigate the signal loss. Based on radiation response, the prototype diode was used for dose, dose rate, depth dose and profile measurements. The results were compared with Markus parallel plate chamber for proton energies in the range of 6cm to 27cm in water.

Results: The initial signal loss in various diode detectors range from 0.4%/Gy to 0.05%/Gy. The PTW prototype exhibited the smallest amount of signal degradation that was investigated up to a dose of 1.4 kGy. Relative dose measurements (depth dose and profiles) are in good agreement with the measured data from Markus chamber. The magnitude of Bragg peaks differed by -2% from the results obtained with Markus chamber for all energies.

Conclusions: Diode reading is a function of pre-irradiation dose, beam energy, dose rate and total dose. Ignoring signal degradation and pre-treatment dose, diodes can be used for relative dose measurements such as depth dose and profile. For absolute dose measurements, especially in small fields, special attention should be given to account for the loss of signal. The LET dependence is minimal for the prototype and can be used in a wide range of beam energy.