Purpose: To ensure the quality assurance of small field, dynamic radiotherapy, we present and validate a radiation tracking system based on long scintillating fibers that allows for the real-time measurement of the position and energetic fluence of a small incident radiation field.

Method: We aligned 60 parallel scintillating fibers on a thin grooved acrylic slab with a 100-cm source-to-fibers distance. Both ends of each scintillating fiber were coupled to clear optical fibers to enable light collection by a single CCD camera using an f/0.95, 50 mm focal length lens. Using a small, static photon radiation field of 2x2 cm2 of a Varian Clinac iX, we changed the interaction position on the prototype using the linac treatment couch. The interaction position parallel and perpendicular to the scintillating fiber array were deduced using the optical attenuation of the scintillating fibers. The energetic fluence of the incident field was calculated from the fibers light fluxes, corrected for the position dependent optical attenuation and scintillation efficiency.

Results: Considering a treatment couch positioning error of ±0.5 mm, the system was able to measure the field position with a mean error of 0.1 mm perpendicular and 0.8 mm parallel to the scintillating fiber array. The maximum error measured using this setup was of 0.13 mm perpendicular and 3.2 mm parallel to the scintillating fiber array. The energetic fluence was determined with a mean error of 0.5% and a maximum error of 2.2%.

Conclusions: This work demonstrates the capacity of a long scintillating fibers array to detect in real-time both the position and the energetic fluence of an incident small radiation field. Such methodology would allow for the real-time tracking of small field in both photon and particle radiation therapy.