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Optical Emission Studies of Laser Produced Lead Plasma: Measurements of Transition Probabilities of the 6P7S → 6P2 Transitions Array

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Abstract : We present new data on the optical emission spectra of the laser produced lead plasma using a pulsed Nd:YAG laser at 1064 nm (pulse energy 400 mJ, pulse width 5 ns, 10 Hz repetition rate) in conjunction with a set of miniature spectrometers covering the spectral range from 200 nm to 720 nm. Well resolved structure due to the 6p7s → 6p2 transition array of neutral lead and a few multiplets of singly ionized lead have been observed. The electron temperatures have been calculated in the range (9000 - 10800) ± 500 K using four methods; two line ratio, Boltzmann plot, Saha-Boltzmann plot and Morrata method whereas, the electron number densities have been determined in the range (2.0 – 8.0) ± 0.6 ×1016 cm-3 using the Stark broadened line profiles of neutral lead lines, singly ionized lead lines and hydrogen Hα-line. Full width at half maximum (FWHM) of a number of neutral and singly ionized lead lines have been extracted by the Lorentzian fit to the experimentally observed line profiles. Furthermore, branching fractions have been deduced for eleven lines of the 6p7s → 6p2 transition array in lead whereas the absolute values of the transition probabilities have been calculated by combining the experimental branching fractions with the life times of the excited levels The new results are compared with the existing data showing a good agreement.

Keywords : LIBS, plasma parameters, transition probabilities, branching fractions, stark width
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