Publ. Astron. Obs. Belgrade No. 102 (2022), 156 *Invited Lecture*

MEASUREMENTS OF RF PLASMA RE-IGNITION: RF-IV AND PROES

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Abstract. The re-ignition of a capacitively coupled RF plasma (CCP) is complicated and difficult to measure. Changes in the plasma state occur on times scales from less than the rf-period (~75 ns) to several hundreds of microseconds. The manner in which energy is deposited into the electrons can change over just a few rf periods while the DC bias voltage can take a few hundreds of microseconds to establish. The electron density build up is accompanied by a peaking in the electron temperature and subsequent build down. The numbers of electrons capable of producing optical emission by impact with neutrals varies substantially within each RF period as well. Plasma "left over" from a prior pulse can dramatically affect each of these! We have made measurements of the RF voltage and current to a pulsed CCP with single RF period time resolution. We compared these measurements with Phase Resolved Optical Emission Spectroscopy (PROES) measurements during the re-ignition. Combining the two enables us to propose why Ar CCPs can exhibit a bright flash of light during turn-on even though the electron density is smaller and the RF power is still rising. The lower electron density at turn-on allows the electron heating mechanism to change from primarily stochastic heating at the sheath edge and primarily during local sheath expansion to a mixed stochastic and ohmic heating mechanism throughout the plasma volume and throughout the RF period. I intend to present the details of the measurement techniques as well as the results we have obtained.