Recent development of LIF diagnostics in ASIPP

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In this talk, recent work on laser induced fluorescence (LIF) diagnostics for ion and neutral VDF measurements performed in ASIPP will be presented.

To validate preliminary design of tokamak-relevant LIF diagnostics for edge and divertor helium ash VDF, signal evaluation has been on a diagnostics-test device (LTS) [1], and the obtained signal strength has been extrapolated to tokamak edge and divertor relevant environment with favorable results. These extrapolations only considered the available solid angle and the plasma density between test device and the design scenario with which the LIF diagnostics will be implemented in a tokamak device. With the higher abundance of energetic electrons in the edge and divertor regions, such estimation is considered conservative.

Automated post-DAQ processing of LIF signal via both "conventional" methods and AI-augmented method has been explored for the purpose of online monitoring of the helium ash VDF in a tokamak environment. Both conventional methods and AI-augmented method produced usable results, however trained AI seemed to provide a faster response which is favorable for the purpose of a real-time plasma diagnostics.

Basic mechanisms of the LIF diagnostics, in particular, the limitation of lock-in modulation of the LIF diagnostics was also investigated [2]. De-modulation and thus degradation of LIF signal was observed as the modulation frequency exceed 1/10th of the fluorescence frequency, giving a typical limit to how much we can benefit from lock-in amplification with increasing modulation frequency.

These works, along with other efforts in the ASIPP, are supposed to serve for future the implementation of LIF diagnostics in a future tokamak device, as well as to promote the LIF diagnostics in LTP fields. These other efforts will also be briefly discussed in this presentation.

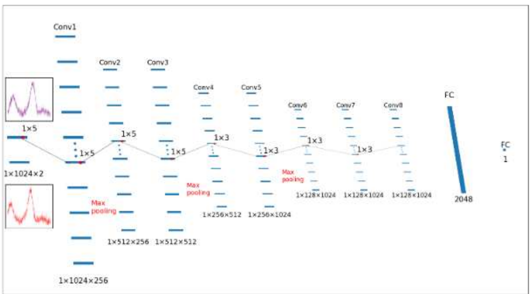

Figure 1. AI augmented online data processing

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[2] D. Jiang, *et al.*, J. Plasma Phys., **88** (2022) 905880307.

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