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A Review of State-of-the-Art Ion Source Plasma Diagnostics

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There are a huge variety of ion source types employed to produce charged particle beams for discovery physics and accelerator applications such as neutral beam heating of thermonuclear fusion plasmas and spallation neutron sources. In most ion sources the ion beams are extracted directly from a plasma sustained by a DC or RF energy source. What is common to all ion sources is the need for diagnostics to quantify their performance and develop them further. The purpose of this review paper is to describe the state-of-the-art plasma diagnostic methods used for ion source development, operations, and monitoring. We present examples of diagnostics techniques, such as optical emission spectroscopy and x-ray diagnostics, applied to negative and positive ion sources highlighting similarities of the diagnostic needs and individual diagnostic challenges pertaining to specific types of ion sources, e.g. microwave sources (including ECR ion sources), RF-driven sources, and arc discharges. The overarching message is that further advances in ion source performance, deeper understanding of the underlying physics, and validation of novel ion source concepts require complimentary plasma diagnostics.

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Yes

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