



Contribution ID: 4

Type: **Poster**

Gamow penetration factor for nuclear fusion reaction in quantum plasmas

Monday, 31 July 2017 18:00 (0 minutes)

The quantum shielding effects on the nuclear fusion reaction process are investigated in quantum plasmas. The closed expression of the classical turning point for the Gamow penetration factor in quantum plasmas is obtained by the Lambert W-function. The closed expressions of the Gamow penetration factor and the cross section for the nuclear fusion reaction in quantum plasmas are obtained as functions of the plasmon energy and the relative kinetic energy by using the effective interaction potential with the WKB analysis. It is shown that the influence of quantum screening suppresses the Sommerfeld reaction factor. It is also shown that the Gamow penetration factor increases with an increase of the plasmon energy. It is also shown that the quantum shielding effect enhances the deuterium formation by the proton-proton reaction in quantum plasmas. In addition, it is found that the energy dependences on the reaction cross section and the Gamow penetration factor are more significant in high plasmon-energy domains.

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Session Classification: Poster Session and Reception

Track Classification: Cosmology and Astrophysics