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Direct and Indirect Measurements in Nuclear Astrophysics

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Nuclear astrophysics aims to understand the origin of elements and the energy generation within stars by studying nuclear reactions. Direct experiments attempt to replicate these reactions in laboratory settings, measuring cross-sections at stellar energies. However, these energies are often extremely low, leading to significant experimental challenges. Indirect methods, such as transfer reactions provide alternative routes to extract reaction rates, circumventing the limitations of direct measurements. I will highlight the complementary roles of direct and indirect experiments in advancing our understanding of astrophysical nuclear processes, using the 12C+12C fusion reaction as a key case study. The analysis of this reaction exemplifies the challenges and benefits of both approaches, emphasizing the importance of their combined application for accurate reaction rate determinations crucial for stellar evolution models.

Author: TUMINO, Aurora (UKE)

Presenter: TUMINO, Aurora (UKE)

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