Challenges to understanding the structure of light nuclei

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One of the greatest challenges in nuclear structure physics is arriving at an understanding of the nature of the strong interaction such that it might be possible to calculate in detail the properties of nuclei from first principles – so–called ab initio. Great progress has been made in terms of theory with leading approaches which include Greens Function Monte Carlo, No-Core Shell Model and Effective Field Theory. Each one of these may most readily be applied to light nuclear systems and some are computationally limited to masses less than A=12. Understanding these highly complex calculations and how they map onto phenomenological models is a challenge in itself. Another challenge is the provision of experimental data which has the requisite precision such that it constrains the calculations, discriminating between approaches. For many of these models reproducing properties of the 7.65 MeV Hoyle state has become the defining challenge, mainly due to its rather unusual experimental characteristics – it has a well–defined cluster structure.

This talk will focus on experimental studies of this state and some of the outstanding challenges in light nuclear systems.