Charge densities in polarized deuterons

The study of the space distribution of quarks inside hadrons is a fundamental issue in hadron physics. This paper tackles the problem of extracting information on the spatial distribution of the quark charges inside longitudinally and transversely polarized deuterons, in a model independent way, exploiting available experimental information on the electromagnetic form factors. The authors develop a general formalism for spin-1 particles and apply it to the deuteron; a formalism for the nucleons had been presented previously.
The results are very interesting; in the figure it is shown the quark transverse charge density for longitudinally polarized deuterons, with helicity 1 (upper panel) and 0 (middle panel). The lowest panel compares the two cases (for the density along the y-axis), showing how the charge density for zero helicity states exhibits a dip at the center of the deuteron. ■

▮▮▮ **C.E. Carlson** and **M. Vanderhaeghen**,
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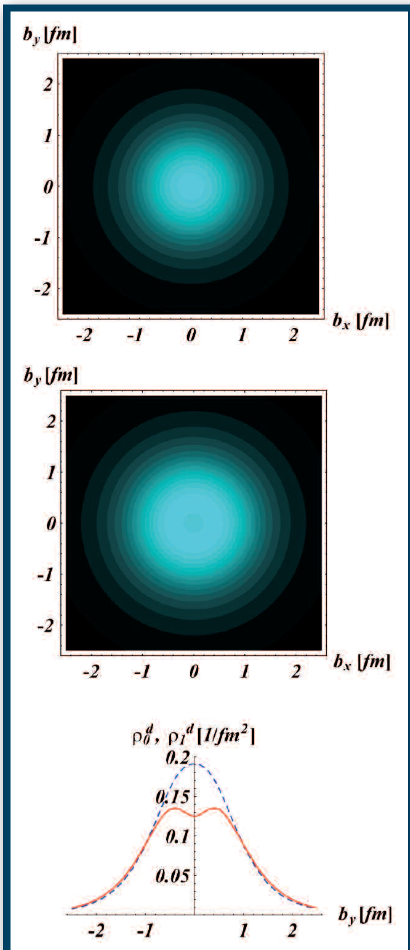
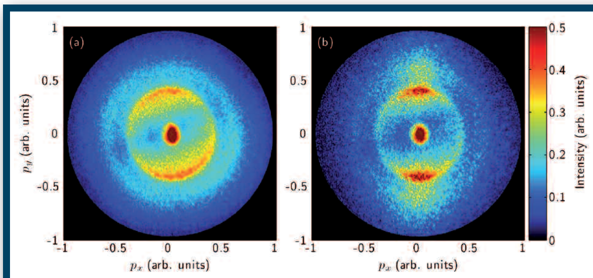


◄ Quark transverse charge density for longitudinally polarized deuterons, with helicity 1 (upper panel) and 0 (middle panel). The lowest panel compares the two cases, for the density along the y-axis.

Field-free molecular alignment robed by FLASH

One of the main driving forces behind the development of high-flux extreme ultraviolet (XUV) and x-ray free-electron lasers (FELs) is the possibility to perform diffractive imaging of small objects. One of the prospects of x-ray FELs is to image isolated bio-molecules by reconstruction starting from single-shot photon diffraction patterns. Alternatively, one may employ diffraction of electrons emitted as a result of photo-ionization by the FEL as a probe of molecular structure. Due to the shorter electron wavelength, this will allow for Ångström resolution already at the XUV FEL sources available today, like the FEL in Hamburg (FLASH).



▲ O^+ fragment distributions from a randomly aligned (a) and an aligned (b) sample of CO_2. The outer ring corresponds to the Coulomb explosion channel.

In molecular imaging experiments, it is required that the measurements are done in the molecular frame, meaning in a coordinate system that is fixed with respect to the molecular axis. This can be done by aligning the molecules in the laboratory frame prior to doing the experiment. In a first proof-of-principle experiment we have demonstrated laser-induced molecular alignment at FLASH. A femtosecond infrared laser pulse that was precisely synchronized to FLASH was used to create an aligned sample of CO_2 molecules, and 46 eV photons from FLASH were used to doubly photo-ionize the molecules, leading to a rapid fragmentation by means of a Coulomb explosion. A velocity map imaging spectrometer was used to record the momentum distributions of the O^+ fragments, allowing to deduce the degree of alignment from their angular confinement. Importantly, the alignment was achieved both while the infrared alignment laser was present and subsequently, at regular intervals, under field-free conditions, the latter opening up possibilities for future experiments on time-resolved molecular imaging in the molecular frame. ■

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