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High-resolution CRIS and the secrets of 206Fr

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The Collinear Resonance Ionization Spectroscopy (CRIS) experiment at the ISOLDE facility, CERN, combines laser spectroscopy and nuclear-decay spectroscopy to provide nuclear-structure measurements of exotic isotopes. At CRIS, the high resolution innate to collinear laser spectroscopy is combined with the high efficiency of ion detection to provide a highly sensitive technique to probe an isotope's hyperfine structure. In addition to hyperfine-structure studies, ionization of the isotope of interest allows the (ground state or isomeric) ion beam to be deflected to a decay-spectroscopy station for alpha-decay tagging of the hyperfine components.

The first measurements of the neutron-deficient francium isotopes achieved a linewidth of 1.5 GHz, allowing the structure of isotopes down to 202Fr to be studied [1,2]. Recently, high-resolution laser spectroscopy with linewidths as low as 20 MHz have been achieved, without a significant reduction in experimental efficiency [3]. This has allowed the measurements of electric quadrupole moments, in addition to magnetic moments and isotope shifts.

Here we report on the latest results from the francium experimental campaign: the achievement of high-resolution laser spectroscopy and the nuclear structure insights this resolution provides in the case of the low-lying states of 206Fr [4].

[1] K.T. Flanagan et al., PRL 111 (2013) 222501
[2] K.M. Lynch et al., PRX 4 (2014) 011055
[3] R.P. de Groote et al., In preparation
[4] K.M. Lynch et al., In preparation

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