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## 12.41 Instrumentation for the Upgrade to the JET Core Charge-Exchange Spectrometers

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Charge-exchange spectroscopy on JET has become particularly challenging with the introduction of the ITER-like wall. The impurity spectra are weaker and contaminated by many tungsten lines. We have therefore upgraded the instrumentation to allow the simultaneous measurement of impurity and fuel-ion charge exchange by splitting the light between two pairs of imaging spectrometers using dichroic beam splitters. Imaging instruments allow us to stack 11x1 mm fibres on the entrance slits without crosstalk. CCD cameras were chosen to have 512x512 pixels to allow frame transfer times <0.2 ms which with shortest exposure times of 5 ms gives tolerable smearing even without a chopper. The image plane is optically demagnified to 0.5x to match the sensor size of these cameras. Because the image plane of the spectrometer is tilted, the CCD must also be tilted to maintain focus over the spectrum (Scheimpflug condition). To avoid transverse keystone causing tilting of the spectra the configuration is furthermore designed to be telecentric by a suitable choice of the lens separation. The lens configuration is assembled almost entirely from commercial off-the-shelf components, which allowed it to be assembled and aligned relatively rapidly to meet the deadline for installation.

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