CRIRES Science Verification Proposal

μ Leonis: a calibrator for super metal-rich populations

Investigators	Institute	EMAIL
Elena Valenti	ESO	evalenti@eso.org
Manuela Zoccali	PUC - RCH	
Bengt Gustafsson	UPPSALA	
Elena Pancino	INAF - Bologna Observatory	

Abstract:

We propose to execute a single, short Observing Block, to obtain a high S/N spectrum of the nearby K2 giant μ Leonis. This is a very well studied giant, with a metallicity about three times solar ([Fe/H]=+0.3) and as such it is a classical reference calibrator for the study of (super) metal rich stars. Many of the CRIRES approved programmes for the next observing period will benefit from a high S/N spectrum of this star, but it will not be visible anymore after the first couple of months of P79.

Scientific Case:

One of the main use of CRIRES will certainly be the study of metal rich stellar populations. When measuring chemical abundances in metal rich stars, one of the main problems is to handle systematics properly. In particular, many of the well-studied lines with high-quality laboratory gf-values are saturated; one should select lines that are rather weak even in the Sun, but their gf-values are often not well determined. A common procedure in this case is to measure *relative* abundances with respect to some reference star, e.g., to derive the *effective* gf-values needed to obtain the known abundance in the reference star. A classical reference star is Arcturus, with [Fe/H]=−0.45, or the Sun, but more recent studied of very metal rich populations such as the galactic bulge have used the giant μ Leonis, with [Fe/H]=+0.3. His high metallicity and range of parameters (T=4540K, logg=2.3) make this star a very good representative of the red giants that will most likely be the main targets for CRIRES. μ Leonis is certainly very bright (V=3.88, H=1.33) and a near IR spectrum could be observed also with a smaller telescope, however, given the very little time needed with VLT, we believe that it would be very useful to observe it with CRIRES, in order to minimize other possible systematics due to a different spectral resolution, pipeline reduction, etc.

The spectrum of μ Leonis is a perfect target for this run of Science Verification. The star is visible now, and for a couple of months still, but will not be visible anymore after June, when most of the observations of the galactic central regions will be carried on. At least programmes P79.D-0605 and P79.B-0338 (that we know of) will highly benefit from this spectrum. Obviously, this is the kind of data that should go public right away, as SV requires.

Finally we note that other commonly used calibrators for metal rich populations, all of them visible in february, are the following:

Target	RA	DEC	V	K	ST
β Gem (Pollux)	07:45:18.95	+28:01:34	1.15	–0.936	K0IIIb
α Hya (Alphard)	09:27:35.24	–08:39:31	2.00	–1.127	K3II
α Tau (Aldebaran)	04:35:55.24	+16:30:33	0.85	–3.044	K5III

However they would saturate even with the shortest available DIT. Should the SV team judge it useful for the community, one might consider either defocusing or turning the tracking off. We, personally, would certainly benefit from a good near-IR spectrum of these stars for our forthcoming approved programmes, but realizing the rather extreme requirements for these observations we leave the decision to the SV team.

Required observing time

Target	RA	DEC	Wavelength Band	Magnitude	DIT	NDIT
μLeonis	09 52 45.8	26 00 25	2.2993 - 2.356	H=1.33	5	20
μLeonis	09 52 45.8	26 00 25	2.1223 - 2.1747	H=1.33	5	20
μLeonis	09 52 45.8	26 00 25	1.6623 - 1.6991	H=1.33	5	20
μLeonis	09 52 45.8	26 00 25	1.5326 - 1.5705	H=1.33	5	20
μLeonis	09 52 45.8	26 00 25	1.5275 - 1.5614	H=1.33	5	20

We select the 24/-1/i, 26/-1/i, 34/1/i, 36/-1/i and 37/1/i setups to derive accurate Fe, C (and its isotopes), N, Na, Al, F, O and other α-element lines. Accordingly to CRIRES ETC with no AO correction, for μLeo (H=1.33, T$\simeq$4540K), and seeing=0.8", airmass=1.1, DIT=5s, slit=0.4", an average on source integration time of 2 min is needed to get S/N$\approx$ 250 - 400 per pixel, in all the setups. In summary by including overheads we require about 30 min.