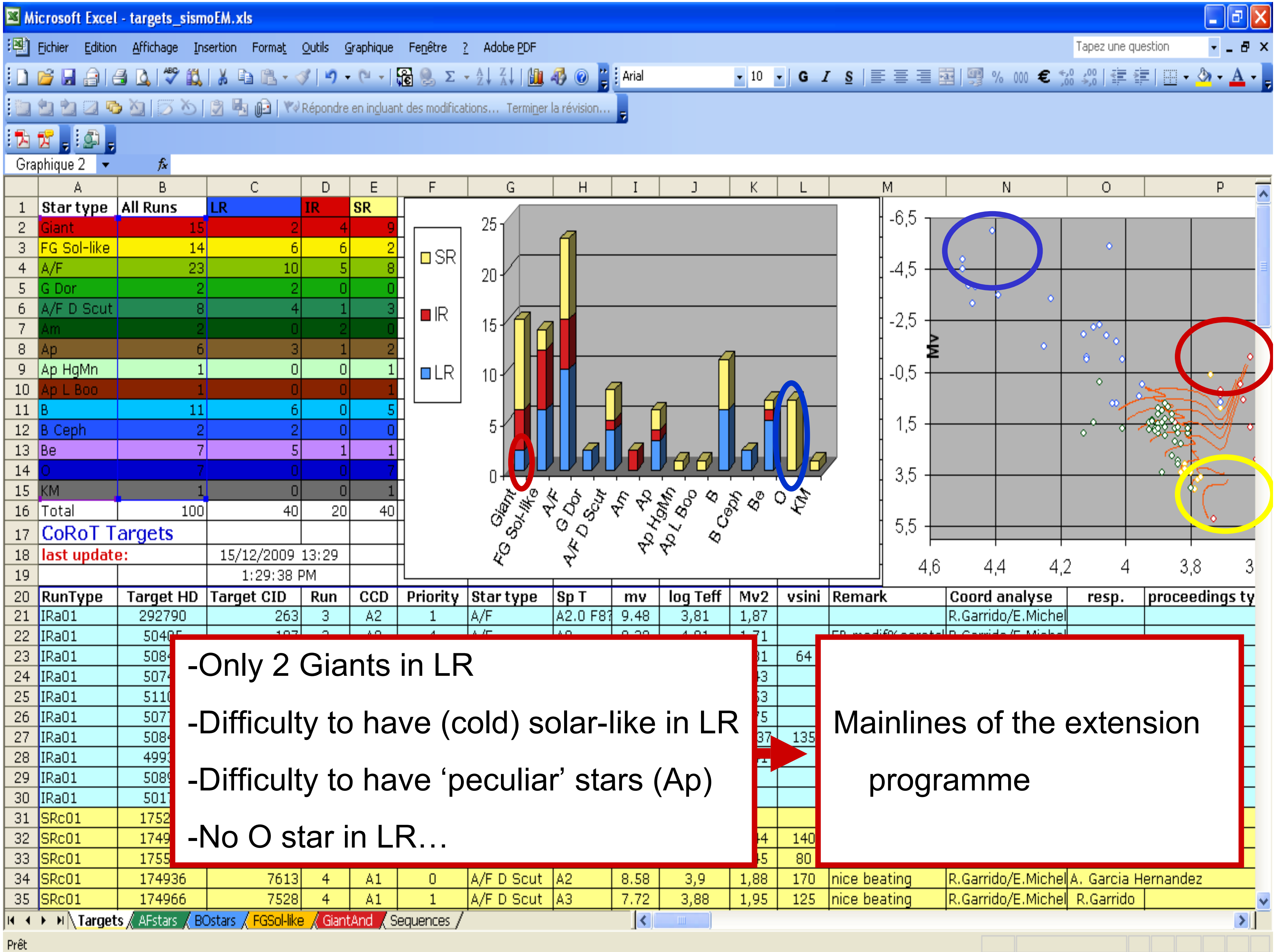
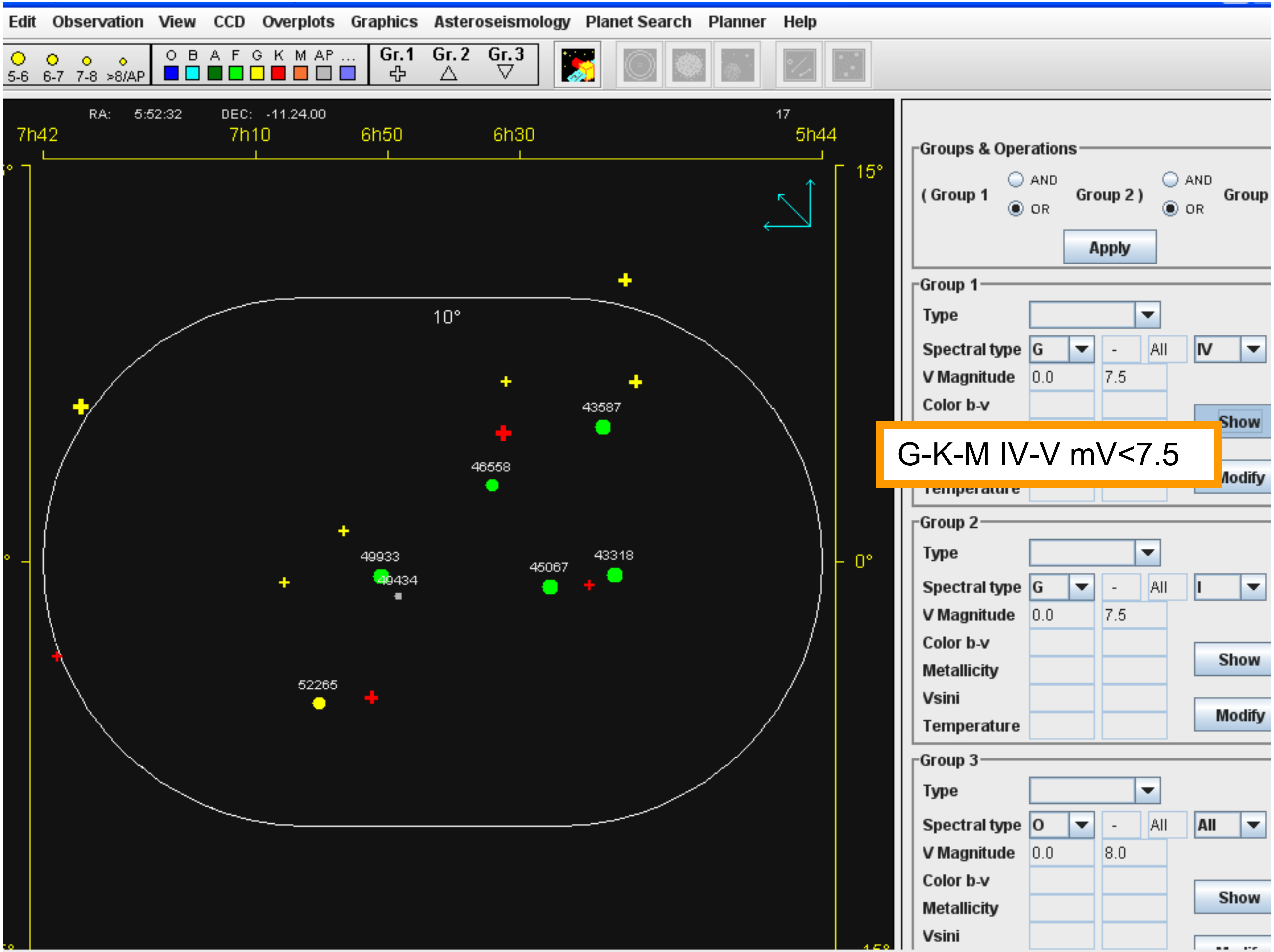


Star type	All Runs	LR	IR	SR
Giant	15	2	4	9
FG Sol-like	14	6	6	2
A/F	23	10	5	8
G Dor	2	2	0	0
A/F D Scut	8	4	1	3
Am	2	0	2	0
Ap	6	3	1	2
Ap HgMn	1	0	0	1
Ap L Boo	1	0	0	1
B	11	6	0	5
B Ceph	2	2	0	0
Be	7	5	1	1
O	7	0	0	7
KM	1	0	0	1
Total	100	40	20	40

RunType	Target HD	Target CID	Run	CCD	Priority	Star type	Sp T	mv	log Teff	Mv2	vsini	Remark	Coord analyse	resp.	proceedings ty
IRa01	292790	263	3	A2	1	A/F	A2.0 F8?	9.48	3,81	1,87			R.Garrido/E.Michel		
SRc01	174936	7613	4	A1	0	A/F D Scut	A2	8.58	3,9	1,88	170	nice beating	R.Garrido/E.Michel	A. Garcia Hernandez	
SRc01	174966	7528	4	A1	1	A/F D Scut	A3	7.72	3,88	1,95	125	nice beating	R.Garrido/E.Michel	R.Garrido	

- Only 2 Giants in LR
- Difficulty to have (cold) solar-like in LR
- Difficulty to have 'peculiar' stars (Ap)
- No O star in LR…

→ Mainlines of the extension programme



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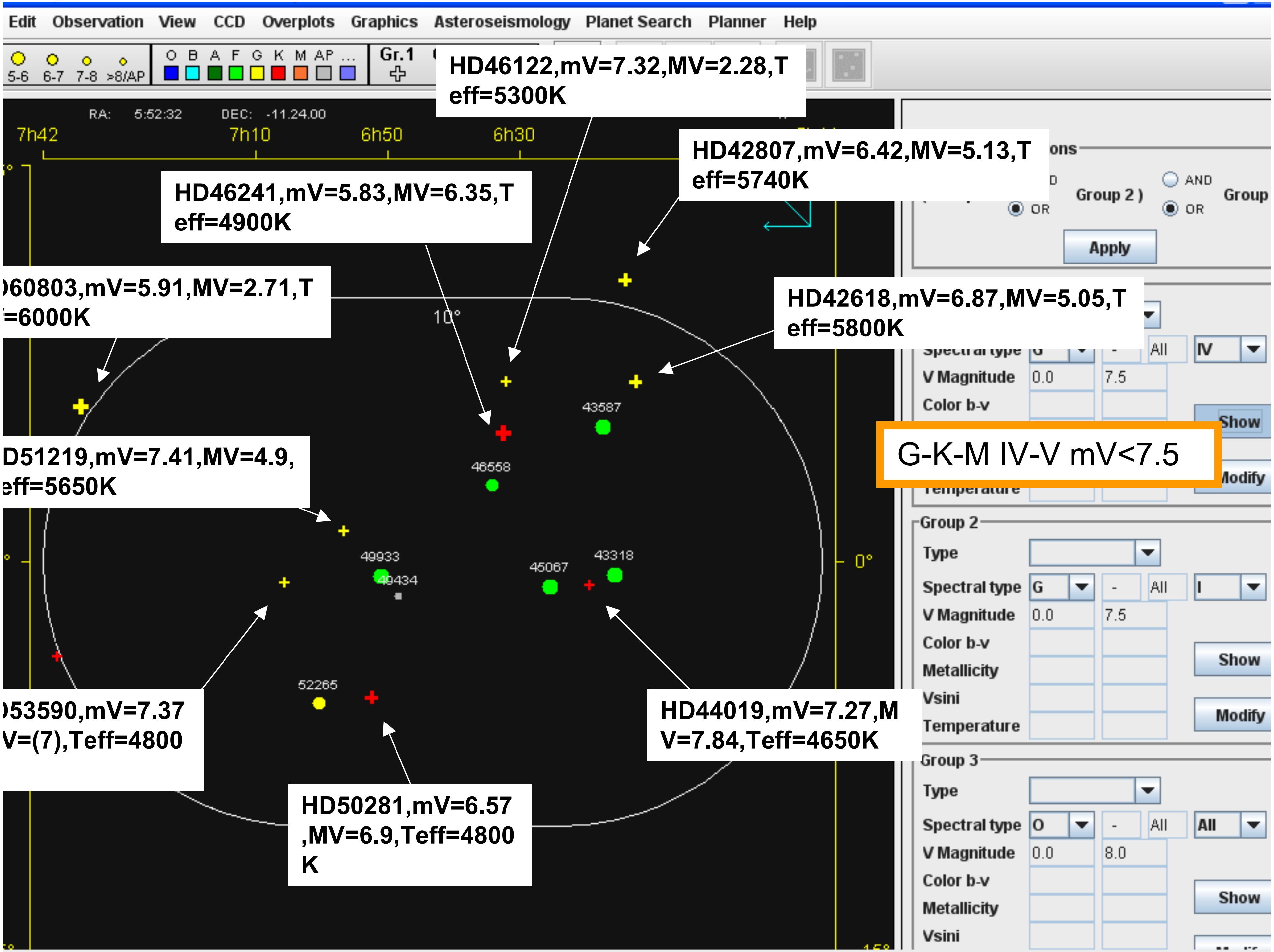

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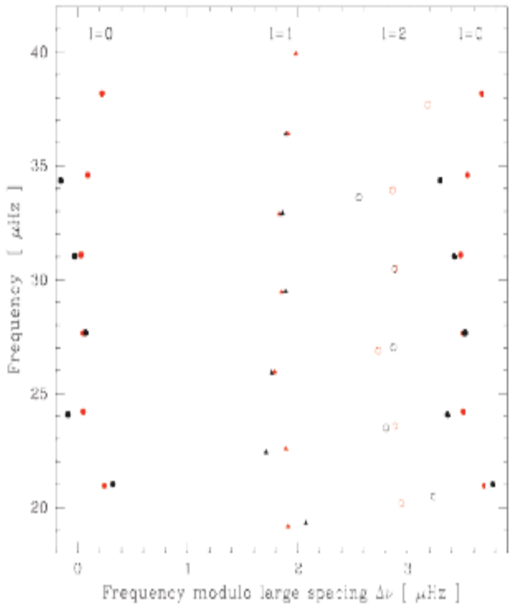
HD46122,mV=7.32,MV=2.28,Teff=5300K
HD42807,mV=6.42,MV=5.13,Teff=5740K
HD46241,mV=5.83,MV=6.35,Teff=4900K
)60803,mV=5.91,MV=2.71,T
=6000K
HD42618,mV=6.87,MV=5.05,Teff=5800K
D51219,mV=7.41,MV=4.9,
eff=5650K
G-K-M IV-V mV<7.5
)53590,mV=7.37
V=(7),Teff=4800
HD44019,mV=7.27,MV=7.84,Teff=4650K
HD50281,mV=6.57,MV=6.9,Teff=4800K

CoRoT Red Giant Working Group: Observing proposal

Prepared by: Joris De Ridder, Andrea Miglio, Fabien Carrier, Josefina Montalbán, Thierry Morel, Arlette Noels, and Ennio Poretti

A **strong** preference for 150 day runs instead of 80 day runs

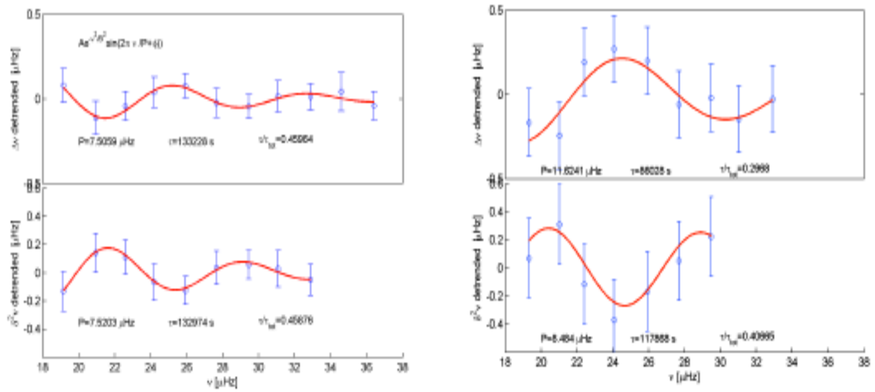
We would like to argue for 150 day runs rather than shorter runs. The scientific quality of the red giants time series would otherwise seriously deteriorate, to the extent that it will basically become no longer possible to compete with Kepler. We illustrate this with a red giant from the seismofield (HR 7349). In the figure below you see an echelle diagram of this star. The red dots are the modes from the full 150 day time series. The black dots are the corresponding modes from only the first 80 days.



What we see is the following:

150 days: tau/T=0.46±0.05

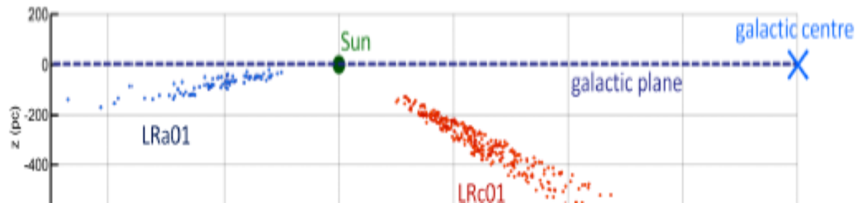
80 days: not enough points, large error bars
tau/T=0.30±0.15 or 0.41±0.15, no info on amplitude



4. Mode line-widths for red giants are small compared to main-sequence stars and lifetimes are near the resolution for a 150d run (Dupret et al. 2009, Baudin et al. 2010 submitted to A&A). Hence, to maximize the scientific exploitation of the CoRoT observations one has to measure mode linewidths: a 150 long run is a necessary condition.

It is therefore clear that CoRoT will lose its cutting edge, and will no longer be able to compete with the Kepler satellite. If we keep the 150 day runs, CoRoT will have the following advantages with respect to Kepler in the coming years:

1. The ability to select very bright giants for which we have a precise parallax.
2. The ability to observe different fields (center & anticenter). Using seismology we can detect which giants are in the red clump. These red-clump giants have almost the same luminosity which can serve as a distance indicator. The following figure illustrates this for LRc01 (red) and LRa01 (blue).



CoRoT Red Giant Working Group: Observing proposal

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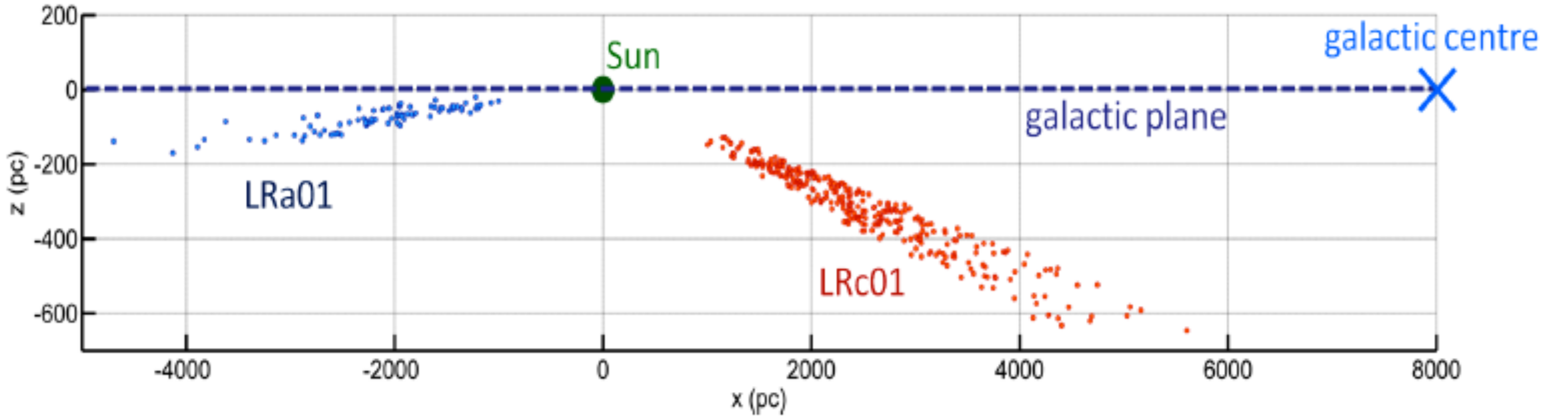

Using exofield red-clump giants populations from FOVs at different galactic latitudes and longitudes will therefore allow to detect gradients along the line of sight, in our Milky Way.

What we see is the following:

Giants in the seismofield

We propose to observe one or more of the following giants in the seismofield:

HIP	V	π (mas)	L/Lsun	Teff (K)	R/Rsun	M/MSun	nu_max (μHz)	vsini
28485	7	4.3(9)	136.77	5048	15.32	3.14	44	?
29575	5.84	10.4(7)	42.85	5018	8.68	2.31	100	3.85
31672	6.18	6.9(9)	76.56	4672	13.38	2.36	45	<1.8
38306	6.38	7.9(9)	108.64	4424	17.77	2.38	26	1.5
86391	6.26	8.4(8)	46.13	4782	9.91	2.18	74	<1.2
87224	6.46	9.5(9)	52	4425	12.29	1.95	45	<1.0
88986	7.41	5.3(9)	61.94	4433	13.37	2.06	40	2.5
96071	6.78	6.5(9)	78.7	4207	16.73	1.63	21	?
96187	7.61	4.6(9)	75.86	4553	14.02	2.29	40	?

Note that the estimates of L,R and, in particular, of M are rather crude.

CoRoT Red Giant Working Group: Observing proposal

Prepared by: Joris De Ridder, Andrea Miglio, Fabien Carrier, Josefina Montalbán, Thierry Morel, Arlette Noels, and Ennio Poretti

150 days: tau/T=0.46±0.05

80 days: not enough points, large error bars tau/T=0.30±0.15 or 0.41±0.15, no info on amplitude

These giants were selected because

1. They are bright, which implies a high S/N
2. The nu_max is higher than of our previous seismofield giant (HR 7349) which will imply less interference with granulation, and a better relative precision of the frequencies. This will allow a more reliable probing of the star (e.g. the He abundance in the envelope).
3. The rotational velocities suggested by the vsini values of HIP 29575 and HIP 88986 should be high enough to detect the rotational splitting for ℓ=2 modes.

In addition, we notice that for such bright targets solar-like oscillations can be detected from radial-velocity measurements that can be planned in the context of the ESO Large Programme LP185.D-056 (two runs of 10 and 5 nights separated by 10 days with HARPS).

These observations will allow to shed light on the velocity-intensity relation, which is poorly known in solar-like pulsators. This ratio is observed for only few stars (the Sun, HD49933, and Alpha Cen A). From a theoretical standpoint it constitutes a major source of uncertainties on the modeling of mode amplitudes because it strongly depends on non-adiabatic processes in the uppermost layers of the stars. Hence, observations of red giants in both photometry and radial velocity are a unique opportunity to obtain direct constraints on this relation as well as to improve the modeling of mode amplitudes.

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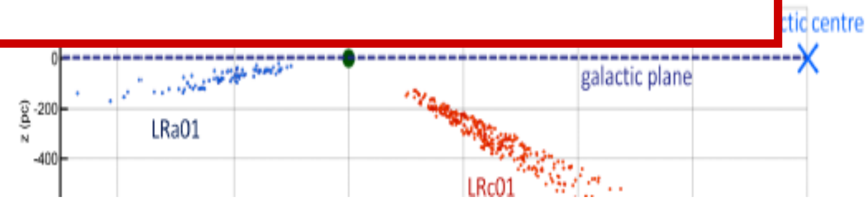

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Prepared by:
Morel, Arlette

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Observing red giants in clusters

We propose to observe giants in a cluster. Suitable cluster candidates are:

ID	Alpha	delta	dist (pc)	log(age)	Field
Berkeley 32	06 58 06	06 26 00	3100	9.53	Exo
NGC 6633	18 27 15	06 30 30	376	8.63	Seismo
NGC 2236	06 29 39	06 49 48	2930	8.54	Exo
NGC 6705	18 51 05	-06 16 12	1877	8.3	Exo

Note that all the proposed clusters are well studied in the literature. In particular, for Berkeley 32 and NGC6633 detailed spectroscopic constraints are available for both MS and RC stars, as well as reliable membership probability (see e.g. Randich et al. 2009, A&A 496, 441, Santos et al. 2009, A&A 493, 309, Bragaglia et al. 2008 A&A 480, 79, Sestito et al. 2006, A&A 458,121).

Here below you find CMDs of the proposed clusters from WEBDA as well as from more detailed/recent studies.

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CoRoT Red Giant Working Group: Observing proposal

Prepared by: Joris De Ridder, Andrea Miglio, Fabien Carrier, Josefina Montalbán, Thierry Morel, Arlette Noels, and Ennio Poretti

A strong preference for 150 day runs instead of 80 day runs

We would like t
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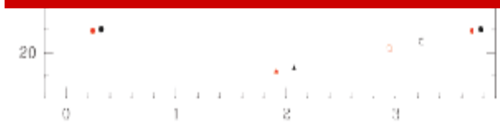
80 days.

The gain would be:

1. Strong constraint of the age, and Metallicity leading to a stringent seismic modeling of the star.
2. Ability to determine the mass of the turn-off point through isochrone fitting, which can be compared with the asteroseismic mass of the giants, to constrain the mass-loss.
3. For NGC 2236, NGC 6633, and NGC6705 the turn-off point is in the mass range where you expect the occurrence of the secondary clump to be sensitive to the overshoot on the MS. The latter could therefore be constrained.
4. A seismic estimate of the He abundance in giants would allow to constrain an otherwise free parameter in isochrone fitting. This will allow to better pinpoint the age of the cluster.
5. Strong constraints on the fundamental parameters are very important to derive accurate scaling laws and validate them.
6. The low metallicity of Berkeley 32 ([Fe/H]=-0.5) coupled to constraints on the mass and luminosity of the cluster members, will allow to check the metallicity dependence of the amplitude of solar-like oscillations (Samadi et al. 2010, A&A, 509, 15 and Samadi et al. 2010, A&A, 509, 16).



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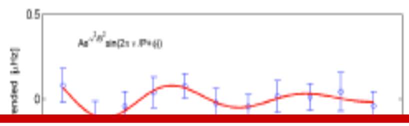

80 days: not enough points, large error bars
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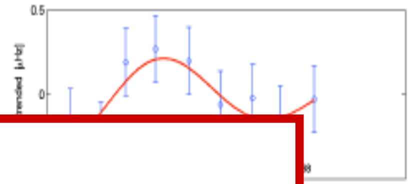

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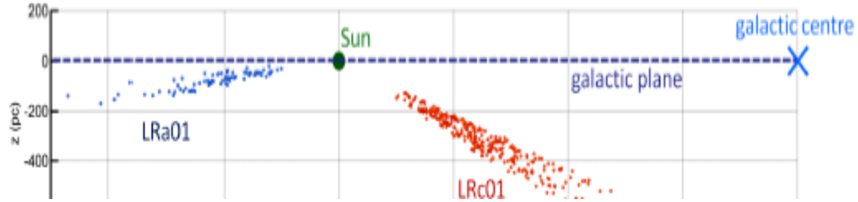

CoRoT Red Giant Working Group: Observing proposal

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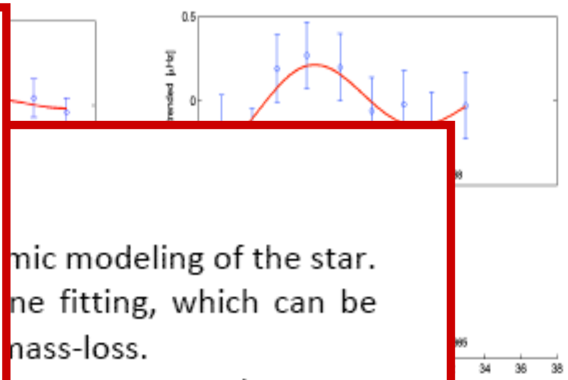

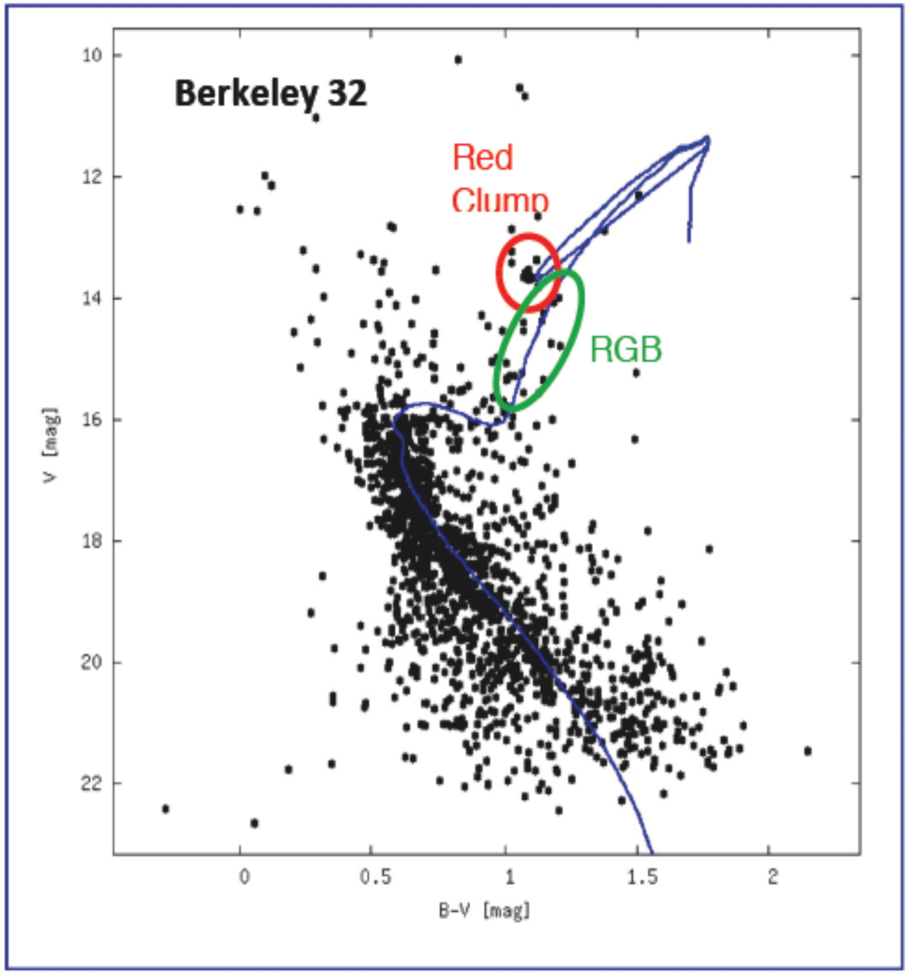

Figure 1 Berkeley 32 CMD + Padova isochrones, [Fe/H]=-0.5, log(Age)=9.6 (WEBDA)

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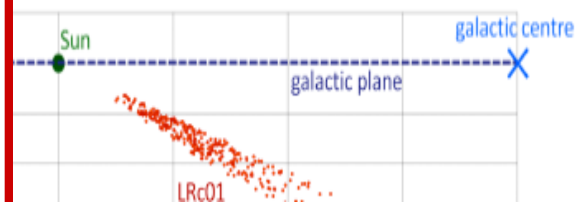

CoRoT Red Giant Working Group: Observing proposal

Prepared by: Joris D

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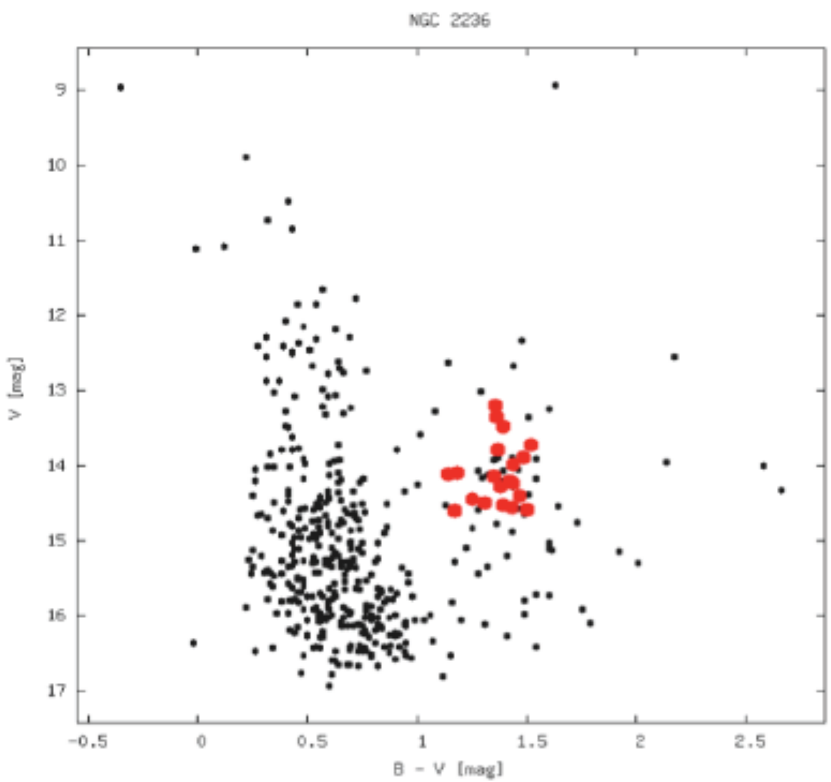
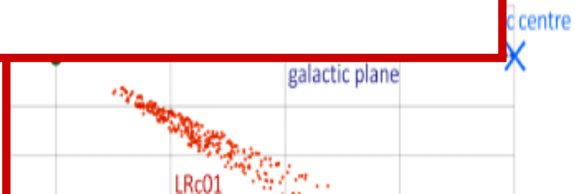


Figura 3 NGC2236 CMD in Washington photometry from Claria et al., 2007 MNRAS 379, 159 (upper panel) and V vs B-V CMD from WEBDA (lower panel)



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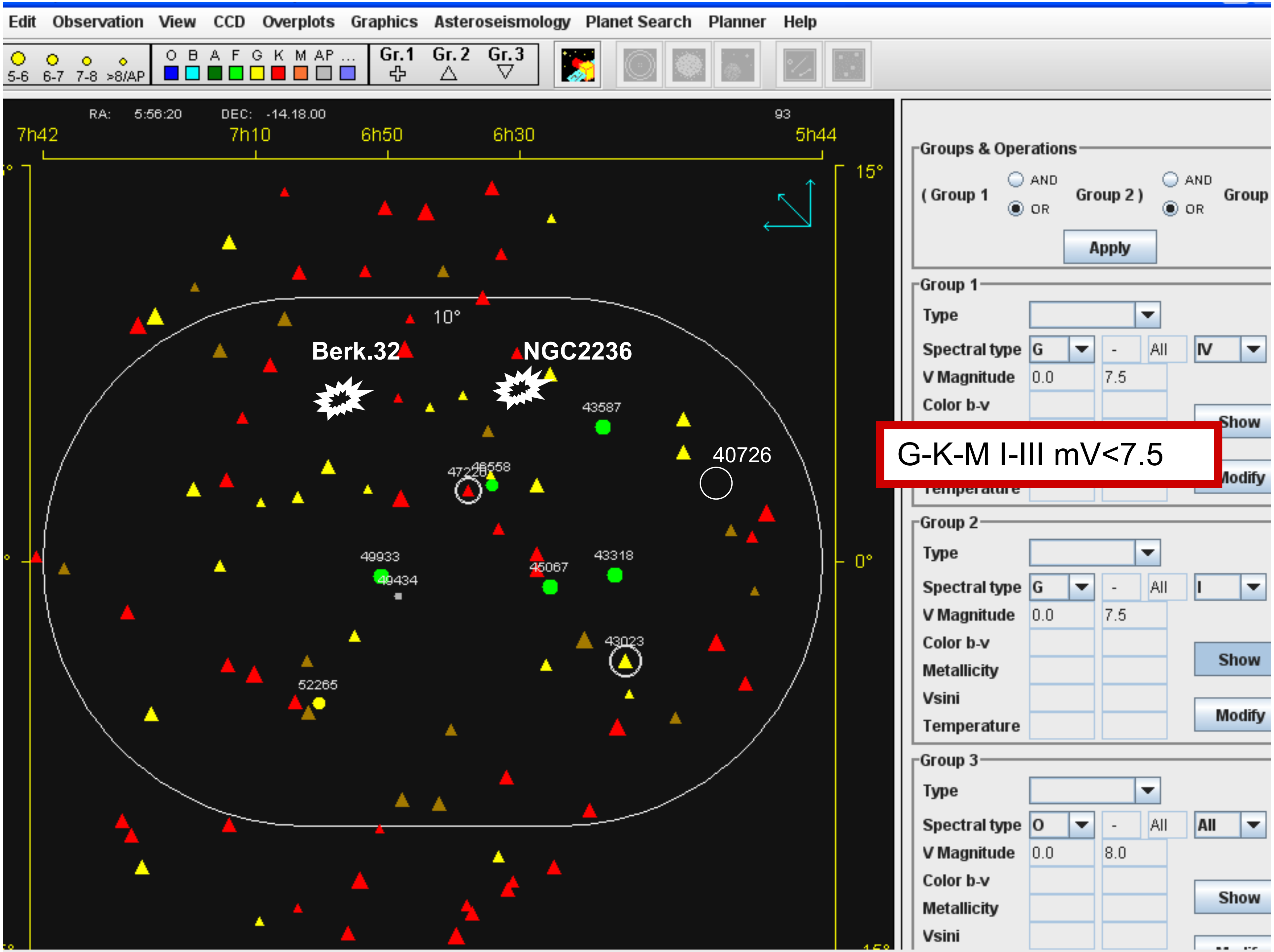
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V Magnitude
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Vsini
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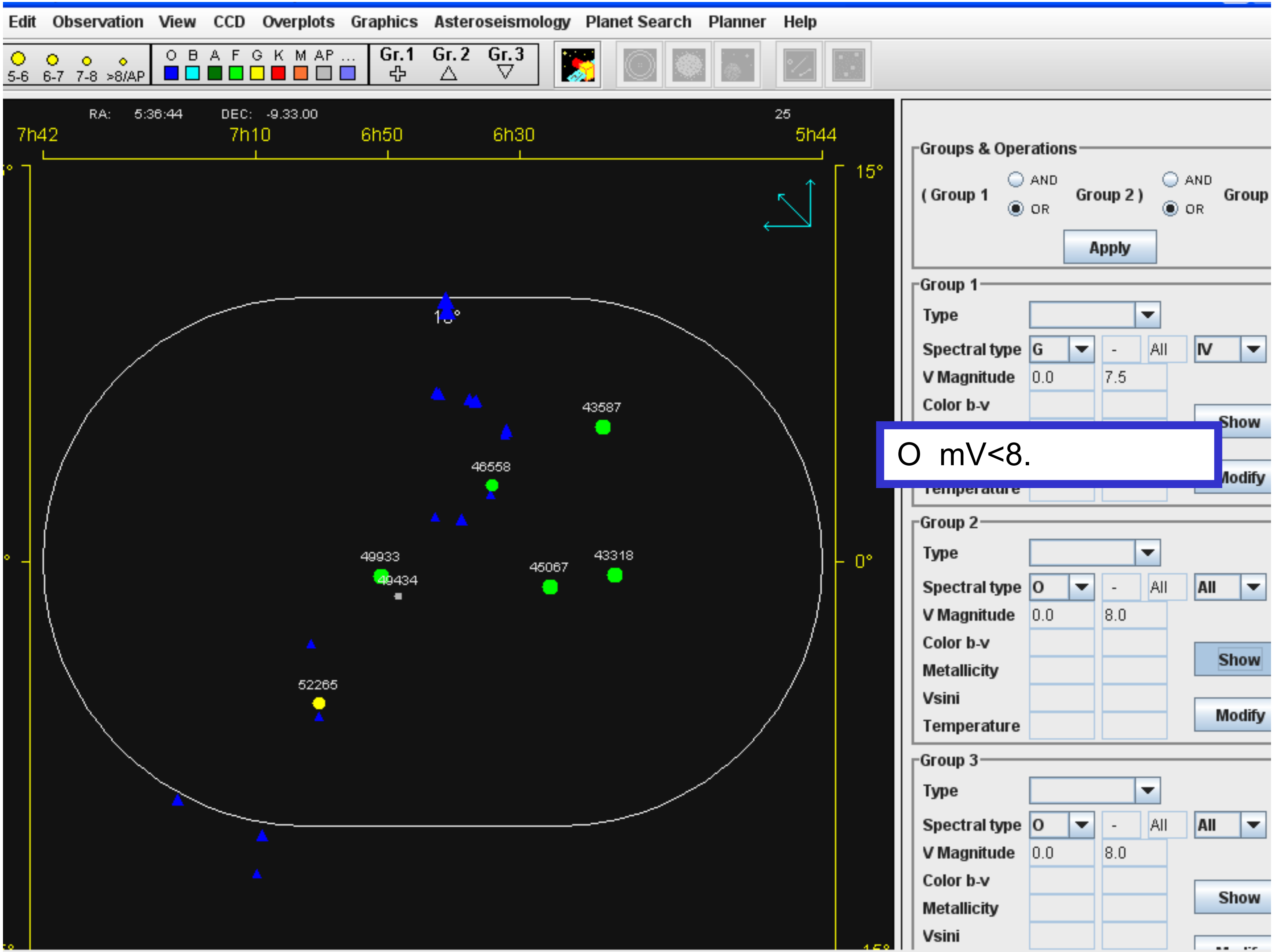

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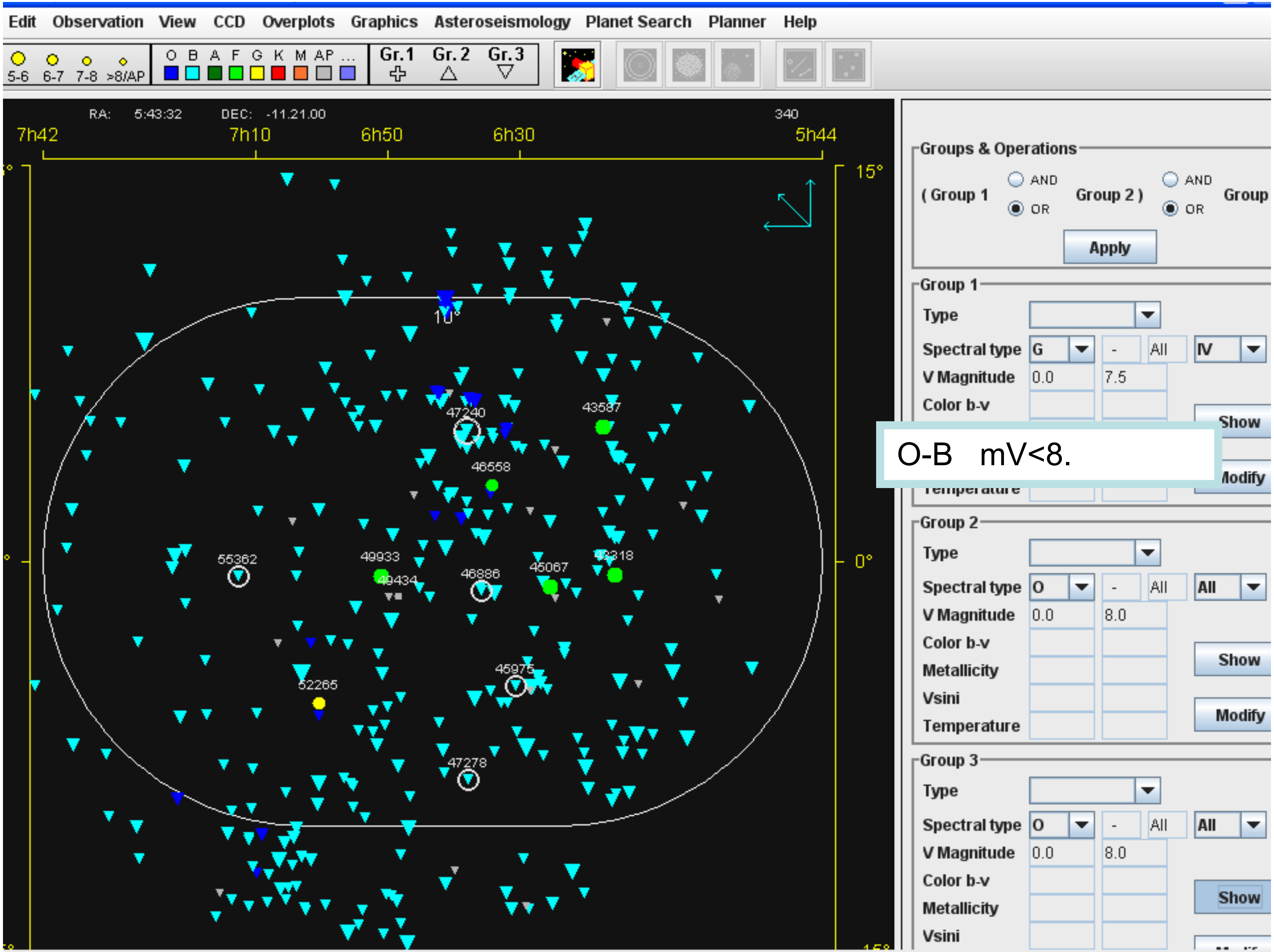

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Proposals for new seismology targets from the B star team

Remarks

- None of these three topics are likely to be done with Kepler. So far, there are no confirmed β Cephei stars, nor B supergiants, among the KASC targets.

- All three topics require a true long run, i.e., a duration of at least 130 days. This has to do with their rather long periods and/or beating pattern. The frequency resolution of CoRoT is a limitation to find rotationally splitted modes in B stars, as it was achieved in long-term ground-based data sets of high-amplitude pulsators in that class. We did not achieve this for the one CoRoT β Cephei star that was monitored so far (HD180642).

- For any of the stars listed below, we will perform a long-term spectroscopy campaign with our HERMES spectrograph at the 1.2m Mercator telescope at La Palma, including simultaneous monitoring with the CoRoT measurements. This instrument is very efficient and is now fully operational since 6 months. We have guaranteed access to it and the magnitudes of the requested stars allow a good S/N ratio of the spectroscopy.

A. Observing a new β Cephei star in the sismo field

Goals

- So far, only one β Cephei star has been observed in the sismo programme of CoRoT. Here, our aim is to perform a second high-precision seismic study of a β Cephei star.

- Another important goal is to check wether solar-like oscillations are common among these stars or if HD180642 is an exception. Whatever the answer, it will provide new insight into the internal structure of these stars.

We selected two stars which are suitable for this project; none of them was known as a β Cephei star when the target selections were prepared prior to the launch. They have been found from the All-Sky-Automated-Survey, which led to one frequency for each of them.

Centre direction:

HD 171305: 1st priority
α = 18 34 15.8451
δ = - 04 48 48.846
V = 8.70, B1V

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Centre direction:

HD 171305: 1st priority
α = 18 34 15.8451
δ = - 04 48 48.846
V = 8.70, B1V

Discovered as new β Cephei star with one frequency:
f = 5.15860 c/d, A_V = 10.0 mmag
(Pigulski & Pojmanski, 2008, A&A 477, 917).

Anticentre direction:

HD 48553: multiple star indication in Simbad, 2nd priority
α = 06 44 09.9406
δ = + 02 23 29.647
V = 9.07, B2III

Discovered as new β Cephei star with one frequency:
f = 5.59806 c/d, A_V =3D 9.1 mmag
(Pigulski & Pojmanski, 2008, A&A 477, 917).

B. Revisiting the CoRoT targets HD 50064 and HD 50230

HD50064 and **HD50230** have already been observed during LRa01. Both stars led to spectacular results: **HD50230** (B3V) turned out to be the first main sequence star in which period spacings of g modes have been detected (Degroote et al., to appear in Nature). **HD50064** (B6Ia) turned out to be the first B supergiant with evidence for the occurrence of a strange mode oscillation and a connection to mass loss changes (Aerts et al., almost on CoRoTpub...).

Goals:

- to get a long-term variability and frequency behavior for both stars
- to improve drastically the frequency precision for the numerous p and g modes of HD50230; in particular: search for spacings of different degrees
- to check if the light curve morphology of HD50064 has regular amplitude increases or only sporadic ones

C. Asteroseismology of the B1Ib supergiants: HD 47240

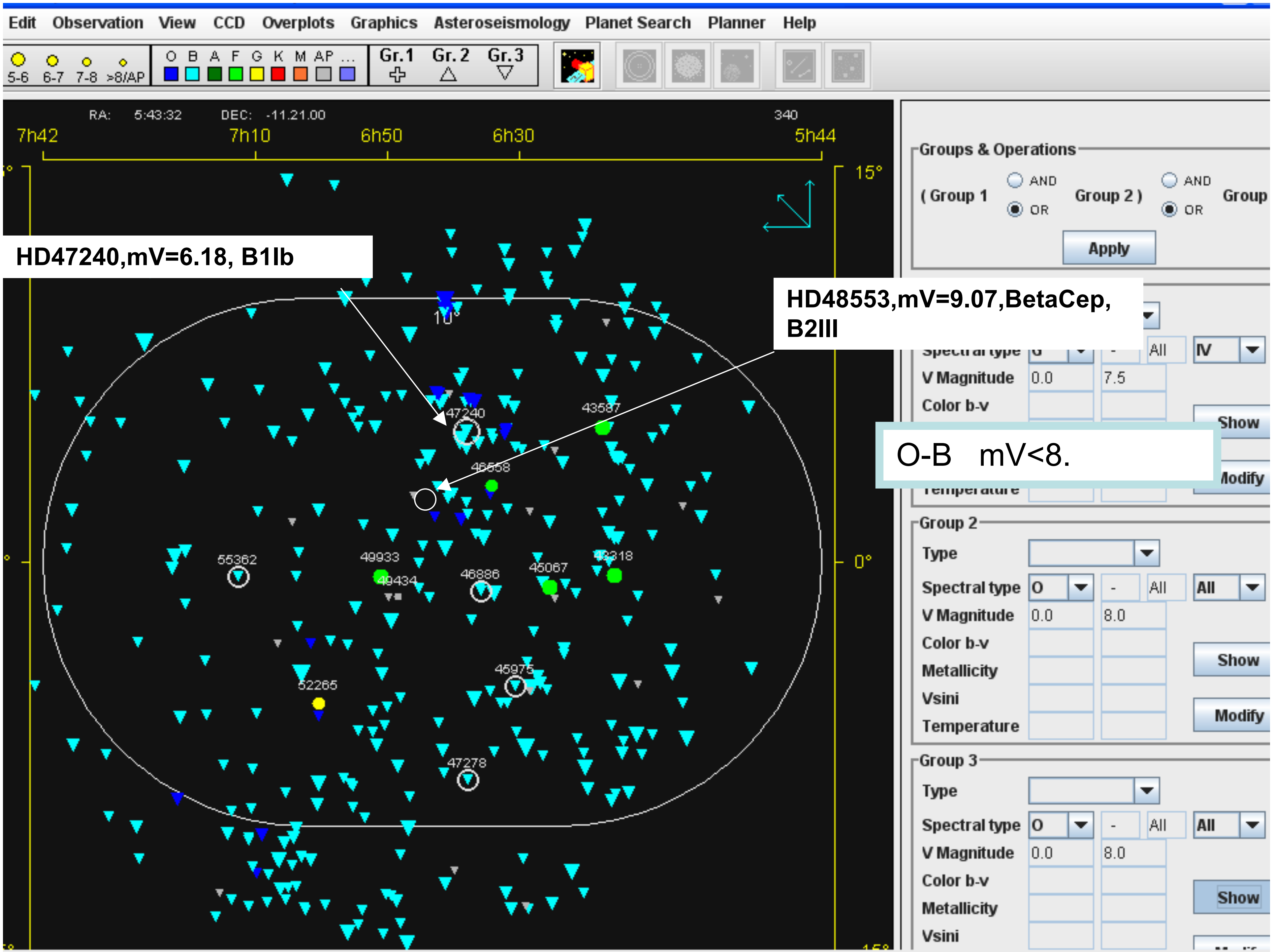
Goals:

- to understand the nature of supergiant oscillations
- to compare gravity mode oscillations with strange mode oscillations (cf. as found for HD50064)
- to understand the connection between strange modes on the one hand, and gravity modes on the other hand, and mass loss of evolved B stars
- to model an evolved B star past the main sequence with a mass ~10 Msun

HD47240: B supergiant with pulsations and moderate mass loss
α = 06 37 52.7041
δ = + 04 57 24.012
V = 6.18, B1Ib

From Lefever et al. (2007):
vsini = 94 km/s, Mdot = 2 x 10^(-7) Msun/year
Teff = 19000 K, log g = 2.48, R = 27 Rsun, log (L/Lsun) = 4.93

one large-amplitude g mode was found in Hipparcos data: P = 1.730d,
Ampl = 29mmag



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HD47240,mV=6.18, B1Ib
HD48553,mV=9.07,BetaCep, B2III
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49933
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47278
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Metallicity
Vsini
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Establishing the existence of pulsations in HgMn stars with *CoRoT*

- **Name and affiliation of proposer:**
  Thierry Morel, Institute of Astrophysics and Geophysics, University of Liège, 17 Allée du 6 Août, B-4000, Liège, Belgium

- **Additional team members:**
  Maryline Briquet, Ewa Niemczura, Conny Aerts, Swetlana Hubrig, Arlette Noels

Science case

Late B-type stars of the HgMn sequence exhibit conspicuous abundance anomalies at their surface with extreme enhancements of mercury and/or manganese. Thanks to favourable conditions (little evidence for turbulent motions in their atmospheres, weak stellar winds and very slow rotation), microscopic diffusion efficiently operates and leads to the segregation of several species at the surface. This makes them ideal laboratories for studying such hydrodynamical processes in detail.

These stars are predicted to present a large iron opacity bump in their interior that may drive pulsations with periods of a few days through the κ mechanism (Turcotte & Richard 2003, Ap&SS, 284, 225). Recent observations with the *CoRoT* satellite have indeed revealed low-amplitude (<1.6 mmag) periodic changes in two faint ($V > 12$ mag) HgMn stars in the exoplanet fields that may be linked to pulsational instabilities (Alecian et al. 2009, A&A, 506, 69). However, spots are ubiquitous in these objects and it remains unclear whether the periodicities detected are related to pulsations or to rotational modulation, given that they operate on similar timescales.

Our aim is to carry out coordinated space and ground-based observations of one of the bright HgMn stars we have recently discovered in the CoRoT eyes to unambiguously confirm the existence of pulsations in these

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Our aim is to carry out coordinated space and ground-based observations of one of the bright HgMn stars we have recently discovered in the CoRoT eyes to unambiguously confirm the existence of pulsations in these objects. This will be done by comparing the period(s) found in *CoRoT* data with the rotational period determined through the monitoring from the ground of the variable spectral features. Strong line-profile variations arising from the rotational modulation of abundance spots are commonplace in HgMn stars (e.g. Briquet et al., A&A, submitted). A thorough analysis of the occurrence of oscillations/rotational modulation (and its possible interaction) is not feasible for the two faint HgMn stars previously observed by *CoRoT* and therefore the detection of pulsations remains questionable.

Theoretical models predict much larger amplitudes than observed (∼10 mmag). Characterizing the pulsational behaviour of these objects would hence constitute an important step forward towards a better understanding of the internal structure of late B-type stars.

Type of observations

SR, Sismo CCDs, 20 days covering ∼6–8 pulsation periods.

Targets

The potential targets have been identified as HgMn stars from our abundance study of a large sample of late B stars in the *CoRoT* field of view (Niemczura et al. 2009, A&A, 506, 213), and are shown in the table below with decreasing priority from top to bottom. *Although all the targets would be suitable, we only request CoRoT observations for the one that can be best accommodated within the overall observing program.*

The relatively high $v \sin i$ values for such objects offer good prospects for detecting rotational modulation from the ground (stars not seen pole on, short rotational periods). All our targets lie well within the SPB instability strip and are therefore expected to exhibit non-radial g-mode oscillations with periods of a few days.

Establishing the existence of pulsations in HgMn stars with *CoRoT*

Table 1: List of possible targets.

Priority	Target	Sp.T.	α(J2000)	δ(J2000)	V (mag)	$v \sin i$ (km s^{-1})	$T_{\rm eff}$ (K), $\log g$
highest	HD 46886	B9	06:35:44.8	–01:05:48	7.95	18	12 900, 3.8
	HD 45975	B9	06:30:27.5	–04:41:49	7.46	61	12 500, 4.0
	HD 173673	B8	18:46:46.5	–06:41:25	7.66	29	13 000, 3.8
	HD 47278	B9	06:37:32.0	–08:14:08	7.23	38	11 500, 4.1
lowest	HD 55362	B9	07:12:35.9	–00:33:34	7.95	53	13 000, 4.0

Selected publications

- Briquet, M., Korhonen, H., González, J. F., Hubrig, S., & Hackman, T. 2009, A&A, submitted: *Dynamical evolution of titanium, strontium, and yttrium spots on the surface of the HgMn star HD 11753*
- Briquet, M., Morel, T., Thoul, A., et al. 2007, MNRAS, 381, 1482: *An asteroseismic study of the β Cephei star θ Ophiuchi: constraints on global stellar parameters and core overshooting*
- Briquet, M., Uytterhoeven, K., Morel, T., et al. 2009, A&A, 506, 269: *Ground-based observations of the β Cephei CoRoT main target HD 180642: abundance analysis and mode identification*
- Morel, T., & Aerts, C. 2007, CoAst, 150, 201: *An abundance study of the B-type targets for the asteroseismology programme of the CoRoT mission*
- Niemczura, E., Morel, T., & Aerts, C. 2009, A&A, 506, 213: *Abundance analysis of prime B-type targets for asteroseismology II. B6–B9.5 stars in the field of view of the CoRoT satellite*

Establishing the existence of pulsations in HgMn stars with *CoRoT*

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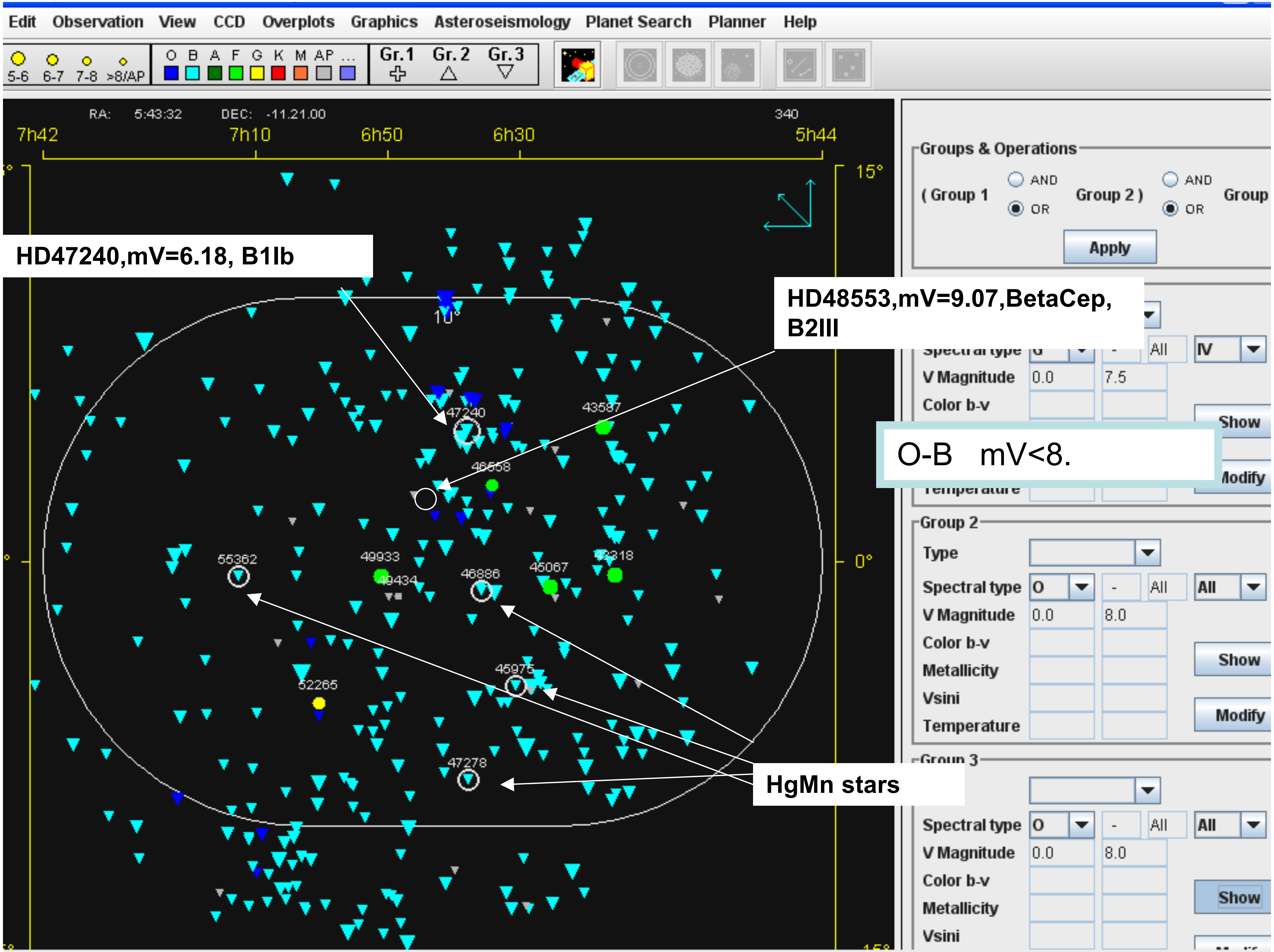
Needed ground-based observations

Time-resolved, high-resolution spectra can easily be gathered for such bright stars (V=7.2–7.9), even on small telescopes. Should the proposal be selected, we plan to carry out intensive, coordinated observations with the HERMES spectrograph attached to the Leuven Mercator telescope on La Palma; we have permanent access to this private telescope. Additional monitoring using other telescopes can also be envisaged (e.g. FIES on NOT). Observations with HERMES are already being collected to better characterise the targets (e.g. line-spectral variations, binarity).



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HD47240,mV=6.18, B1Ib
HD48553,mV=9.07,BetaCep, B2III
O-B mV<8.
HgMn stars
Groups & Operations
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Group 2
Spectral type
V Magnitude
Color b-v
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From: Conny Aerts <conny@ster.kuleuven.be>

I have looked at suitable early-type supergiants to be observed with CoRoT, in view of the results we got for HD50064(B6Ia).
I guess we will get a second supergiant from the short run (HD46769,B8Ib: not sure if this has been fixed, can you confirm this?): this will give us a light curve allowing to determine the overall morphology, and will probably allow to deduce if this star has strange modes and/or nonradial gravity modes,but will not allow to derive the precise frequencies. But one never knows: we tentatively found a Beta Cep-type frequency candidate for this star! if it is real, CoRoT will give sufficient precision in frequency for that one. Moreover, we have its fundamental parameters from spectroscopy (Lefever et al. 2007).

Now, all these stars are later than B5, where strange mode oscillations connected with heavy mass loss are predicted, but also gravity modes can be expected. Strange modes have so far not been found in earlier B supergiants; we think that B4/5 is sort of a "transition" region. This is why, as the best science case, I would like to propose a hotter B supergiant for one of the next long CoRoT runs. In this way, I come again with HD47240, which was already the "prime" target of my proposal during CW9 at ESTEC. Meanwhile we know this star much better, again thanks to Lefever et al. (2007):

SpT=B1Ib
P(Hipp)=1.73 days
vsini=90 km/s
Teff=19000K
log g=2.48
m_V=6.18
M_V=-5.8
R=27 Rsun
log (L/Lsun)=4.93

SpT=B1Ib
P(Hipp)=1.73 days
vsini=90 km/s
Teff=19000K
log g=2.48
m_V=6.18
M_V=-5.8
R=27 Rsun
log (L/Lsun)=4.93
mass loss = 2 x 10^(-6) solar masses per year

I have not found an equally good candidate in the other direction, but I am not saying there are no supergiants there.... Nevertheless, given that we know so much of this star already, and in view of its brightness, this is certainly my favourite.

This is thus my proposal for a supergiant in a long sismo run. Observational analysis and coordinated spectroscopy by the Leuven team, seismic modelling by Melanie Godart in Liege team.