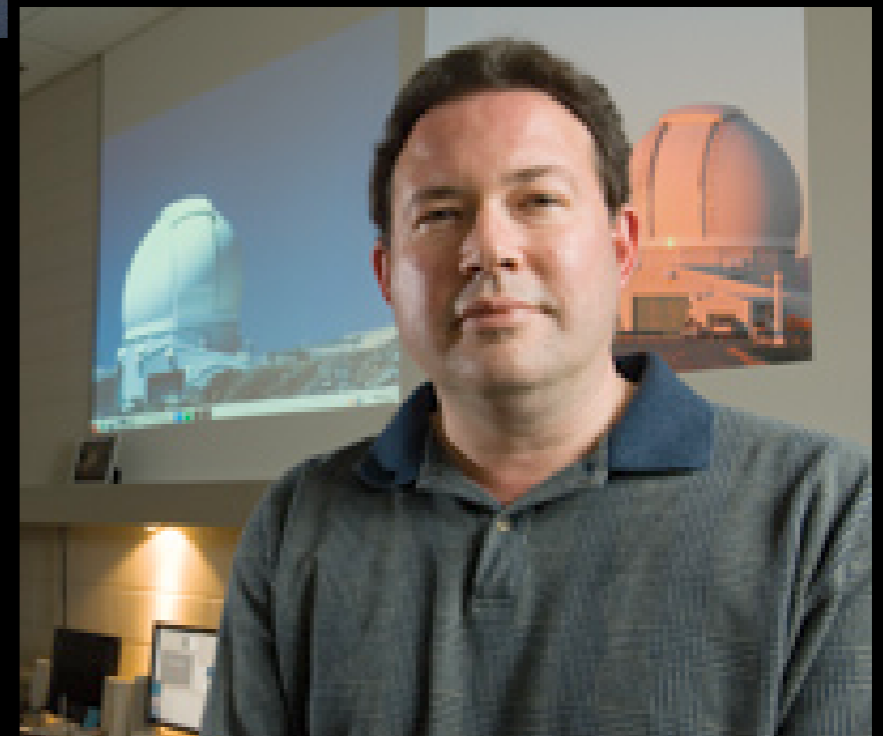


High-velocity Cloud Distances

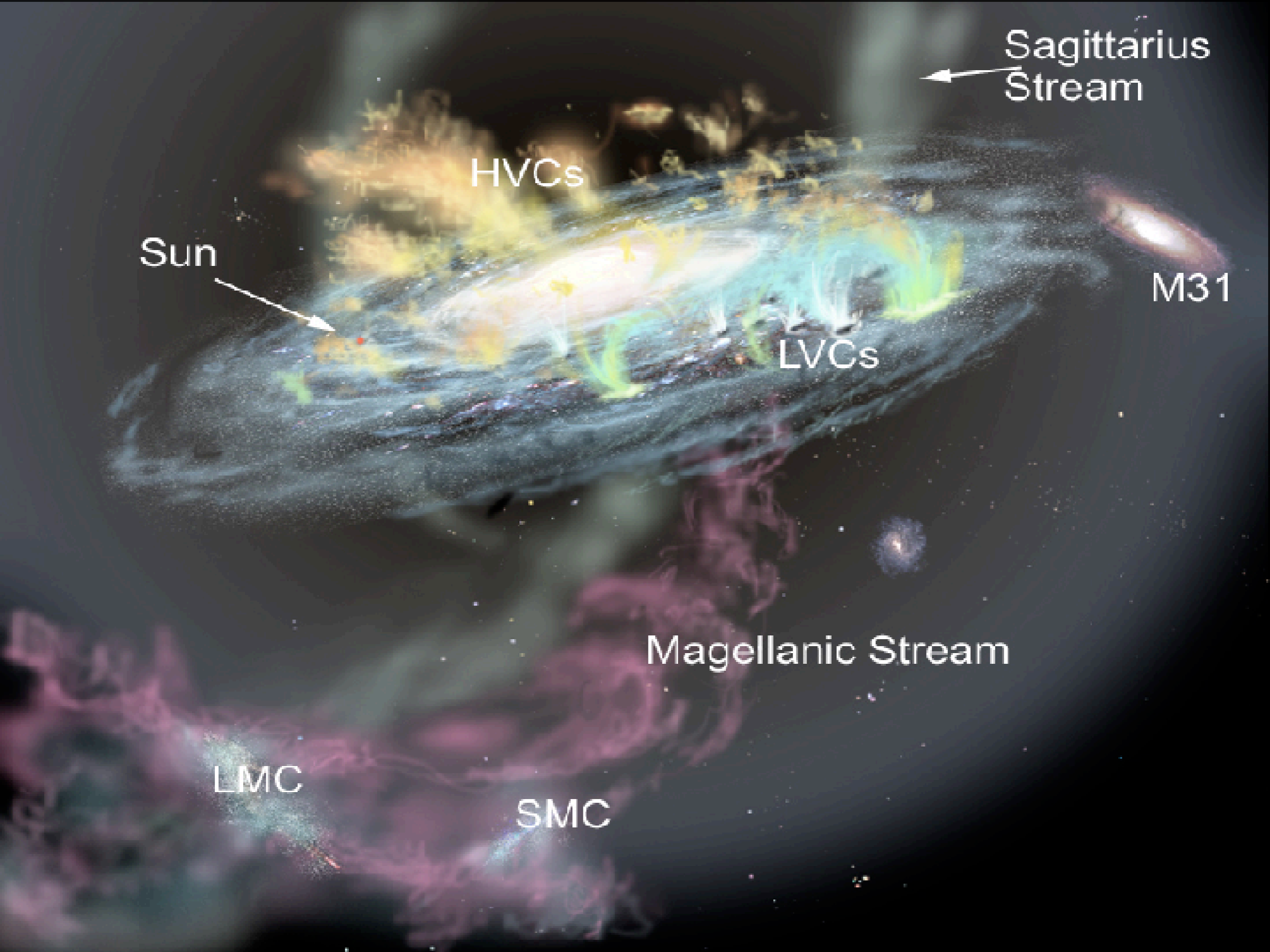
Christopher Thom
University of Chicago
w/ Hsiao-Wen Chen

Rest of the gang...



Definitions

- “HI clouds with velocities which are inconsistent with a simple model of galactic rotation”
- $|v_{\text{LSR}}| \geq 90\text{-}100 \text{ km s}^{-1}$
- $v_{\text{dev}} > 50 \text{ km s}^{-1}$
- Cover $\sim 30\%$ of the sky at 21cm
- Where did they come from?
- Physical Properties?
- What is their role in MW evolution?



Sagittarius Stream

HVCs

Sun

M31

LVCs

Magellanic Stream

LMC

SMC

Motivations

Size \propto dist

Mass \propto dist²

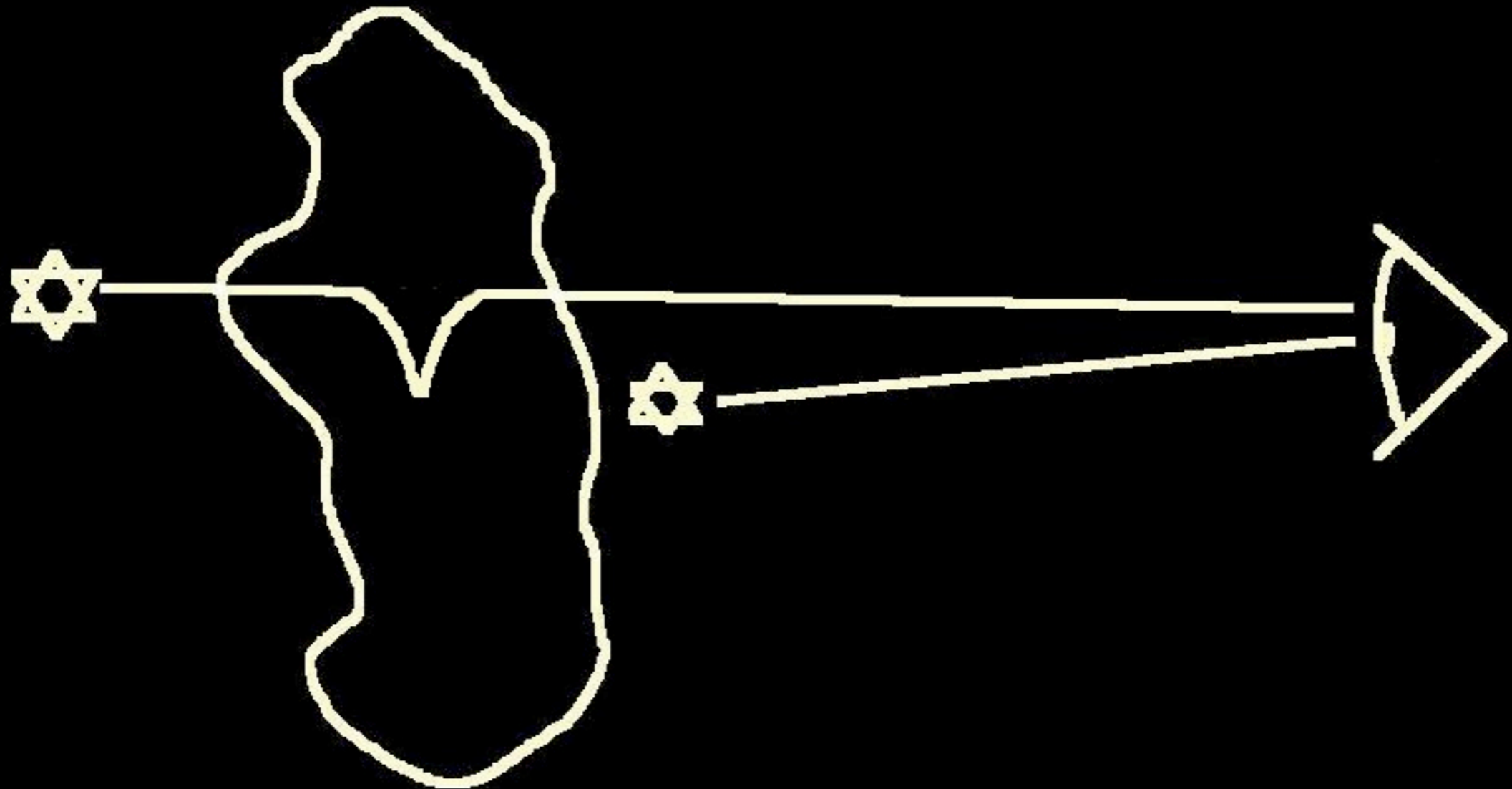
Density \propto dist⁻¹

Pressure \propto dist⁻¹

Distance is the key

Direct distances

This is the only direct, model-independent distance method!



Pioneering Efforts

A PROGRAMME FOR DETERMINING DISTANCE INFORMATION FOR THE HIGH-VELOCITY CLOUDS

MARGARET E. KEPNER

Received 6 May 1968

A SEARCH FOR INTERSTELLAR Ca II AND Na I LINES IN STARS NEAR HIGH-VELOCITY H I CLOUDS

STEPHEN PRATA

Berkeley Astronomy Department
University of California

AND

GEORGE WALLERSTEIN

Department of Astronomy
University of Washington, Seattle

Received February 7, 1967

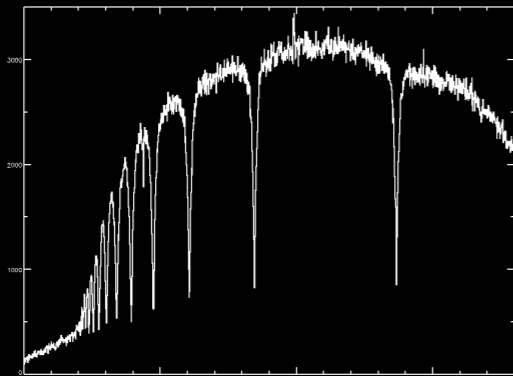
Suitable stars

- Luminous
- Hot (clean spectra)
- Distant ($d > \sim 10$ kpc)
 - And we can get distance
- Appropriate radial velocity
- Lots of them

Field Horizontal Branch

Hamburg/ESO Survey

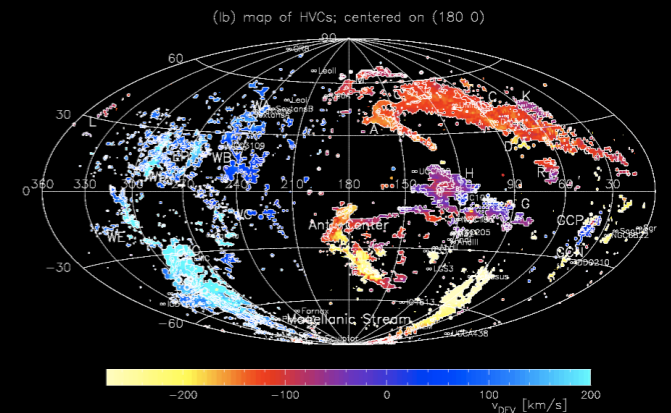
(Christlieb et al. 2005)



+

HIPASS

(Putman et al. 2002)

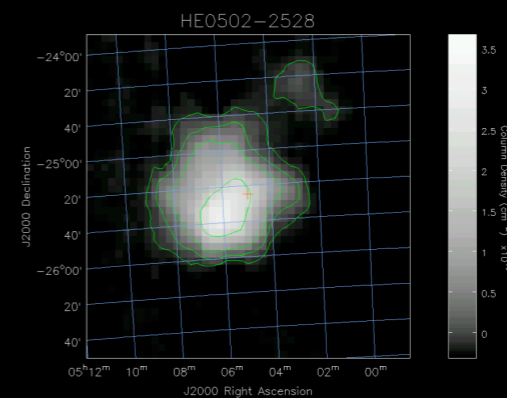


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FHB/HVC Catalogue

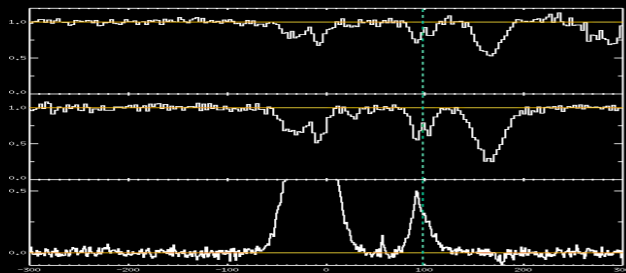
(Thom et al., 2005, ApJS, 161, 147)

430 targets



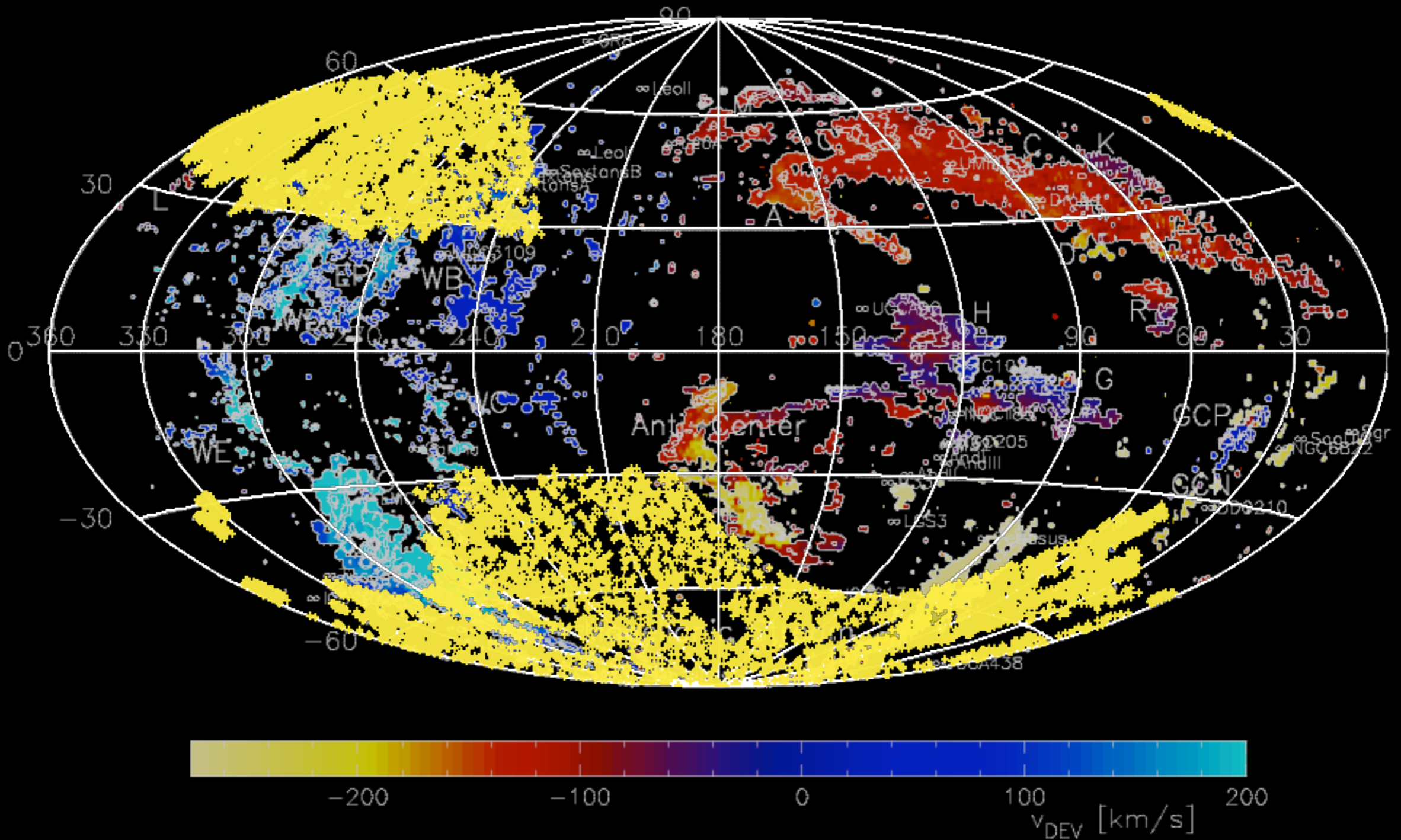
Echelle Spectroscopy

(Thom et al., 2006, 2007)

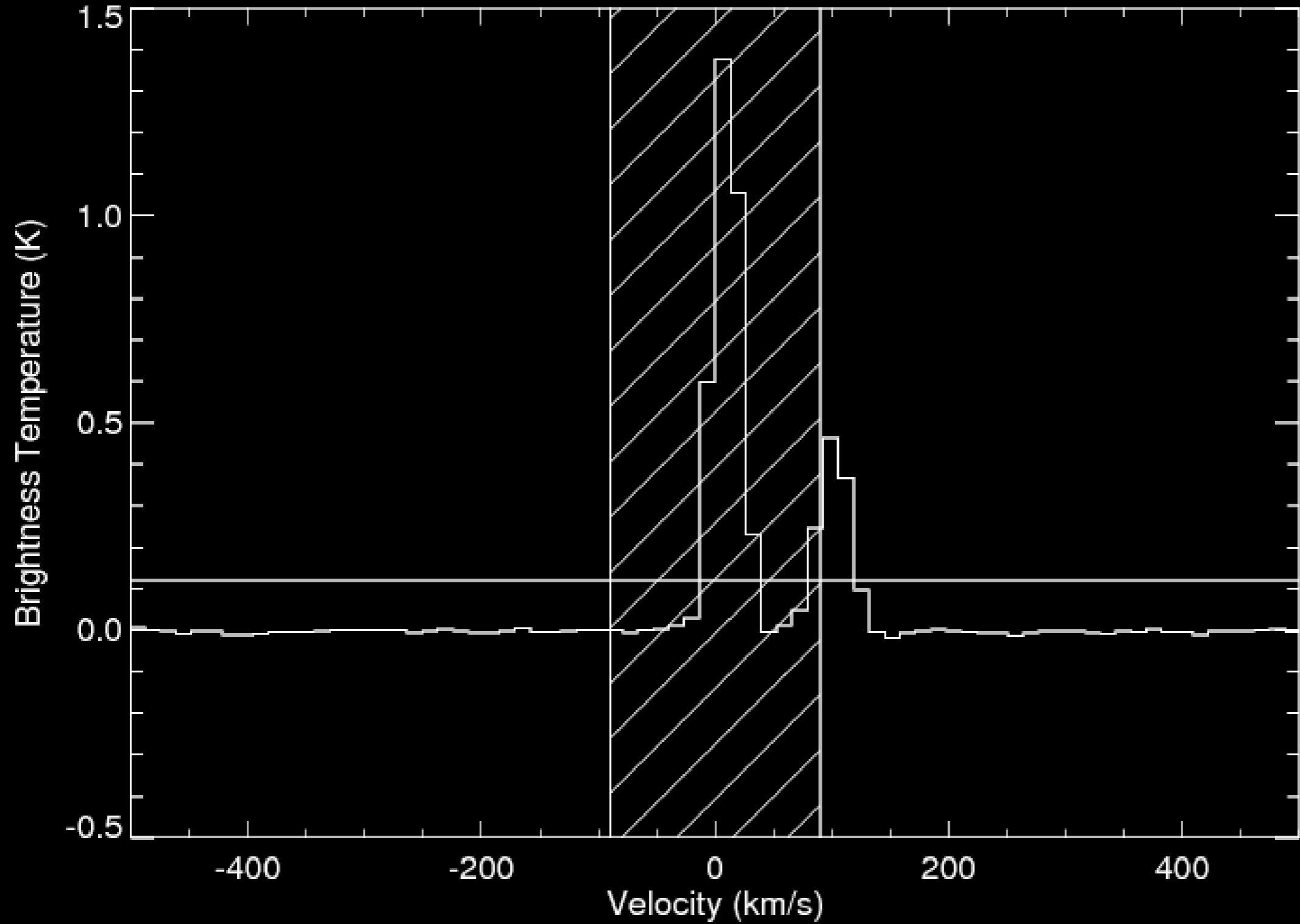


8321 HES FHB stars

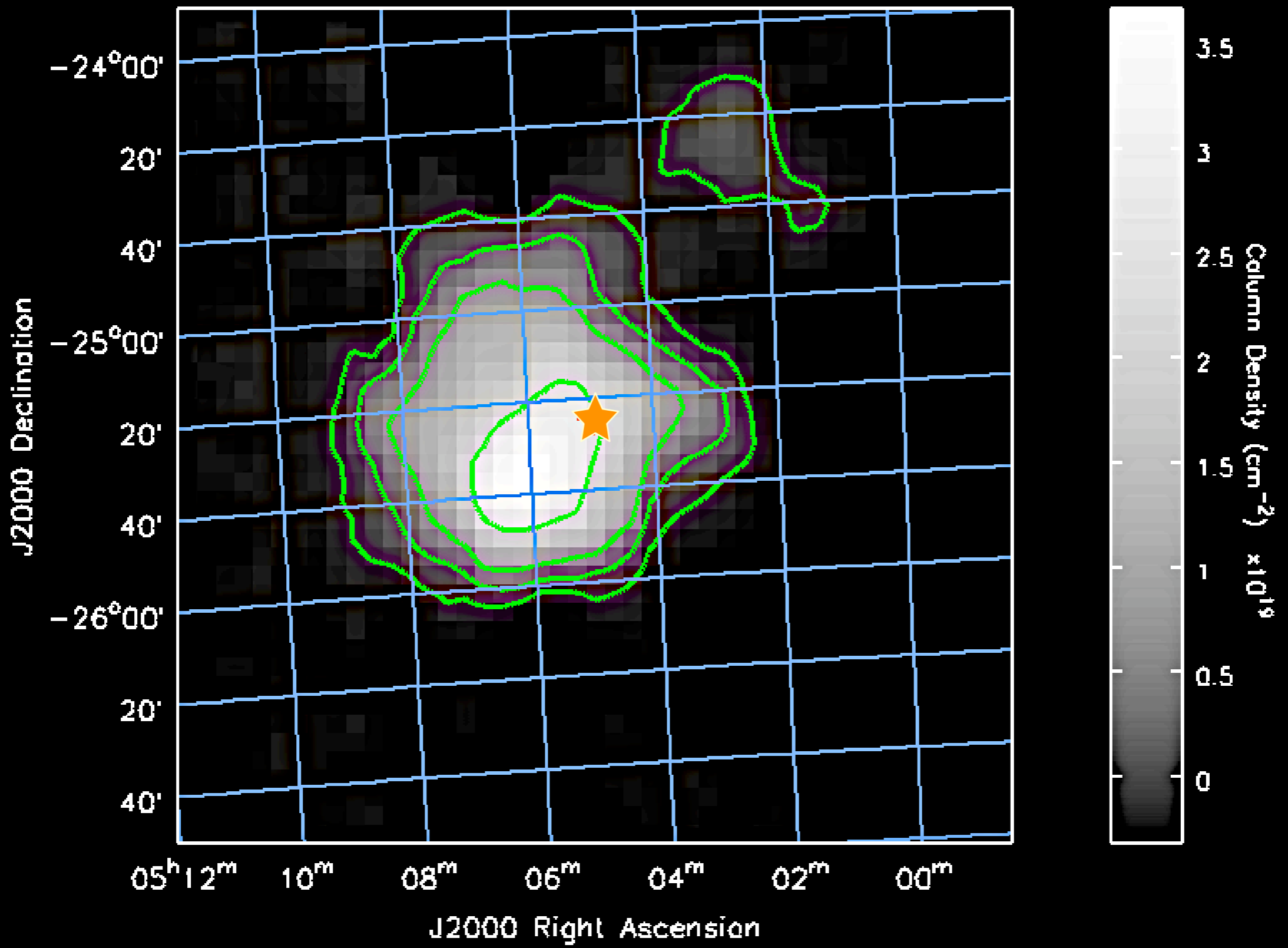
(lb) map of HVCs; centered on (180 0)



HE0502-2528

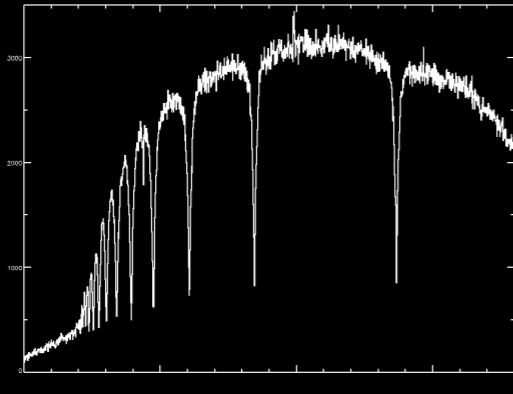


HE0502-2528



Hamburg/ESO Survey

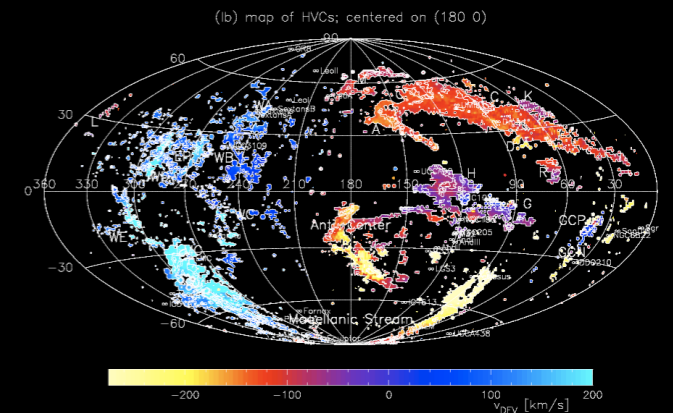
(Christlieb et al. 2005)



+

HIPASS

(Putman et al. 2002)

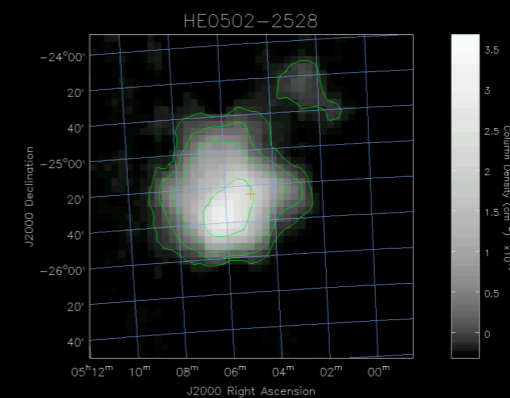


||

FHB/HVC Catalogue

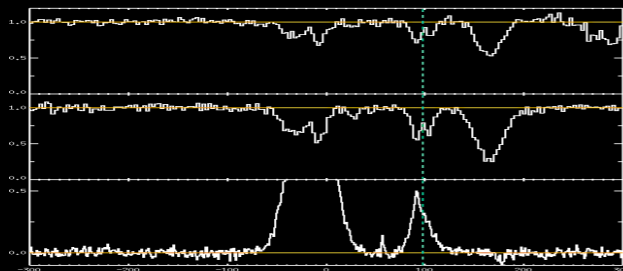
(Thom et al., 2005, ApJS, 161, 147)

430 targets



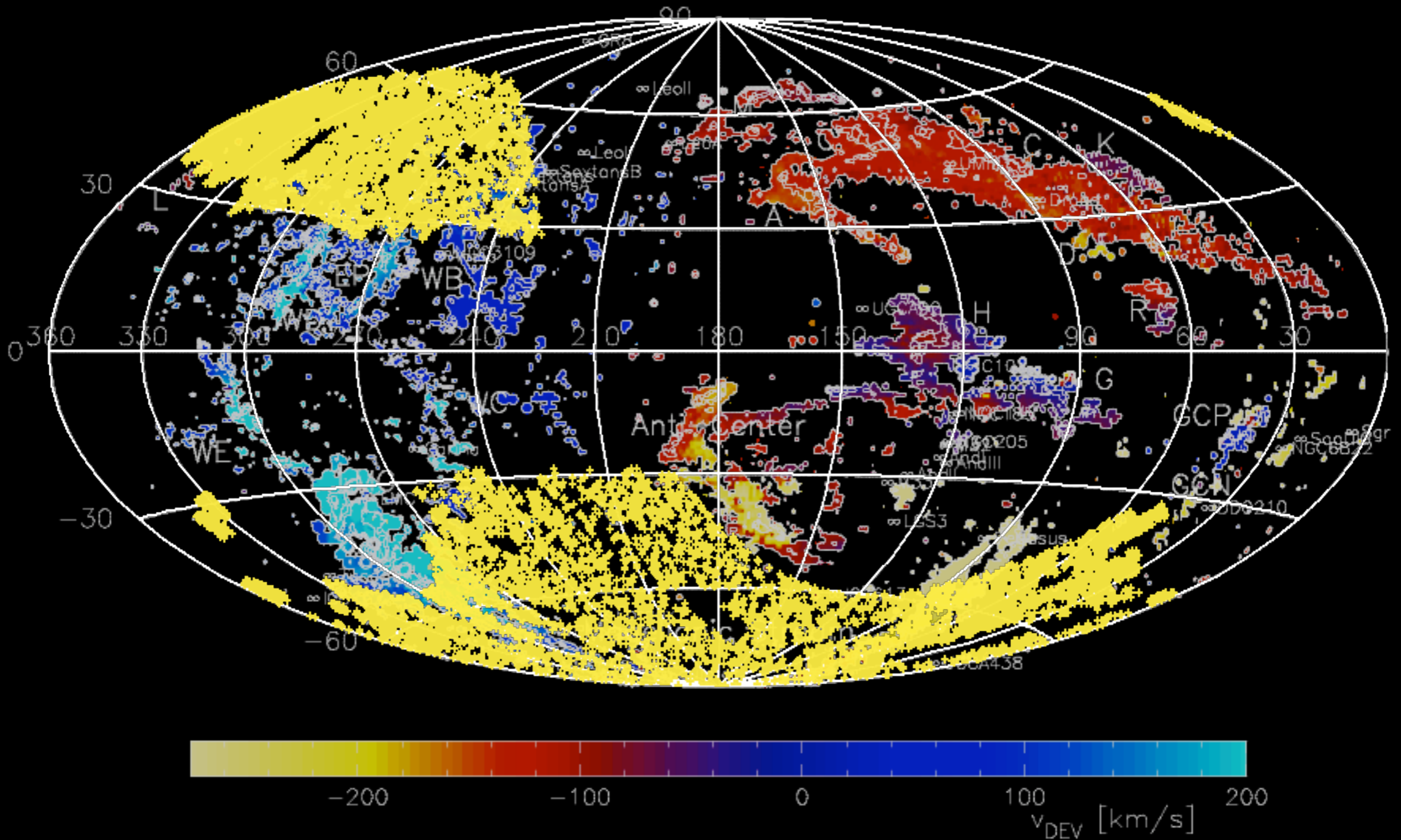
Echelle Spectroscopy

(Thom et al., 2006, 2007)



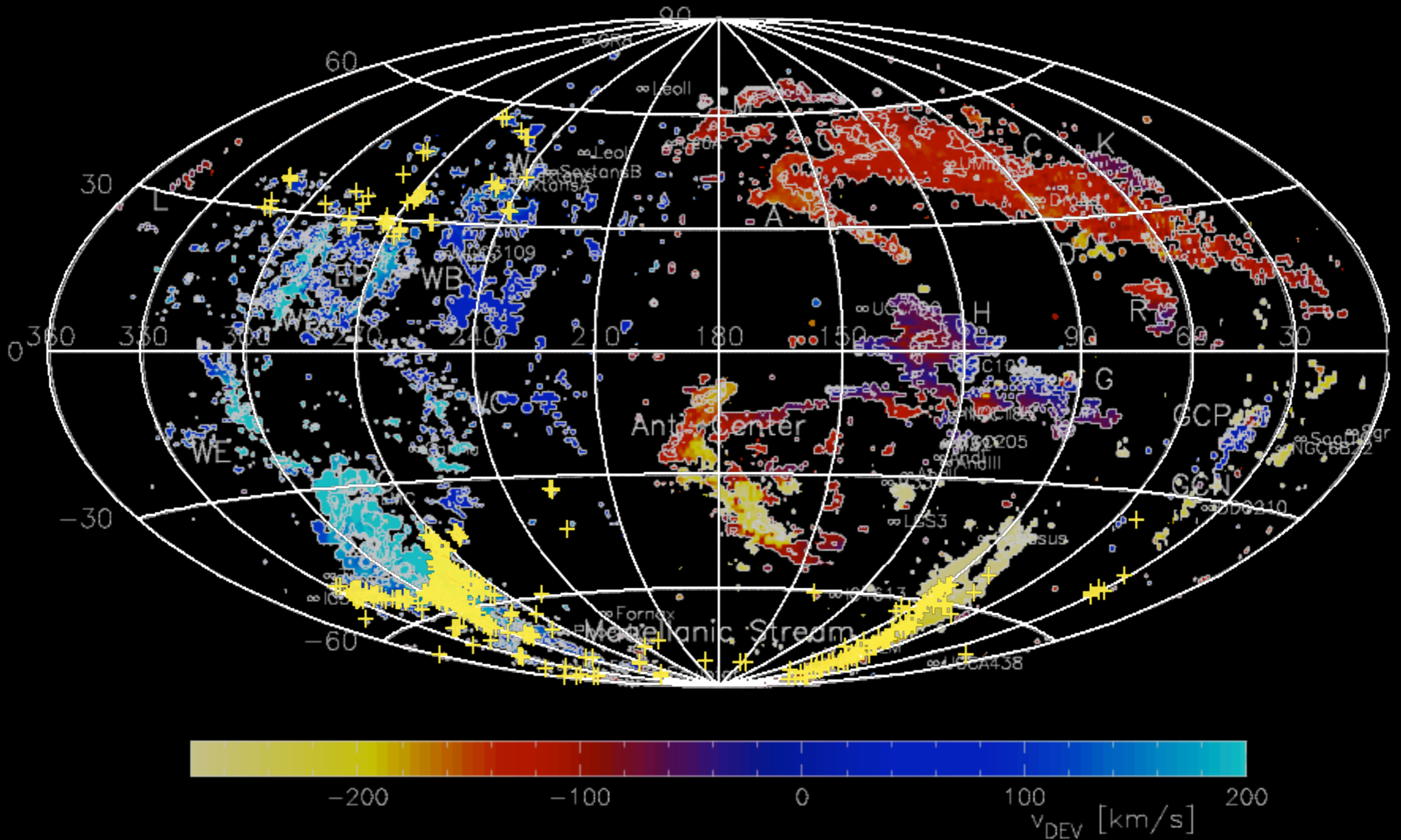
8321 HES FHB stars

(lb) map of HVCs; centered on (180 0)



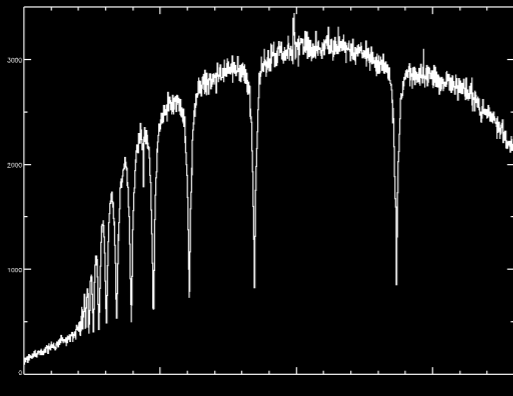
430 HVC Probes

(lb) map of HVCs; centered on (180 0)



Hamburg/ESO Survey

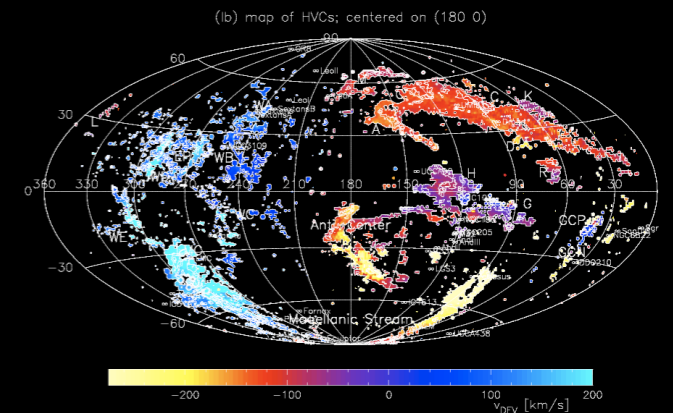
(Christlieb et al. 2005)



+

HIPASS

(Putman et al. 2002)

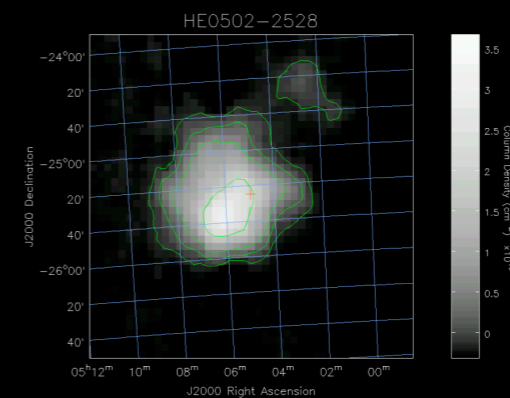


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FHB/HVC Catalogue

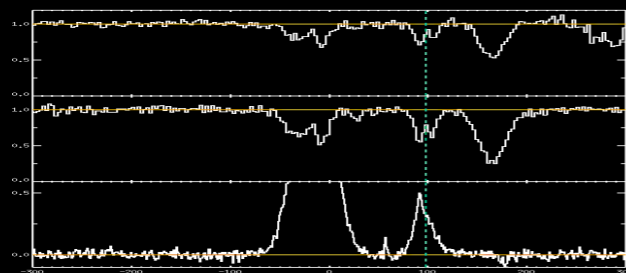
(Thom et al., 2005, ApJS, 161, 147)

430 targets



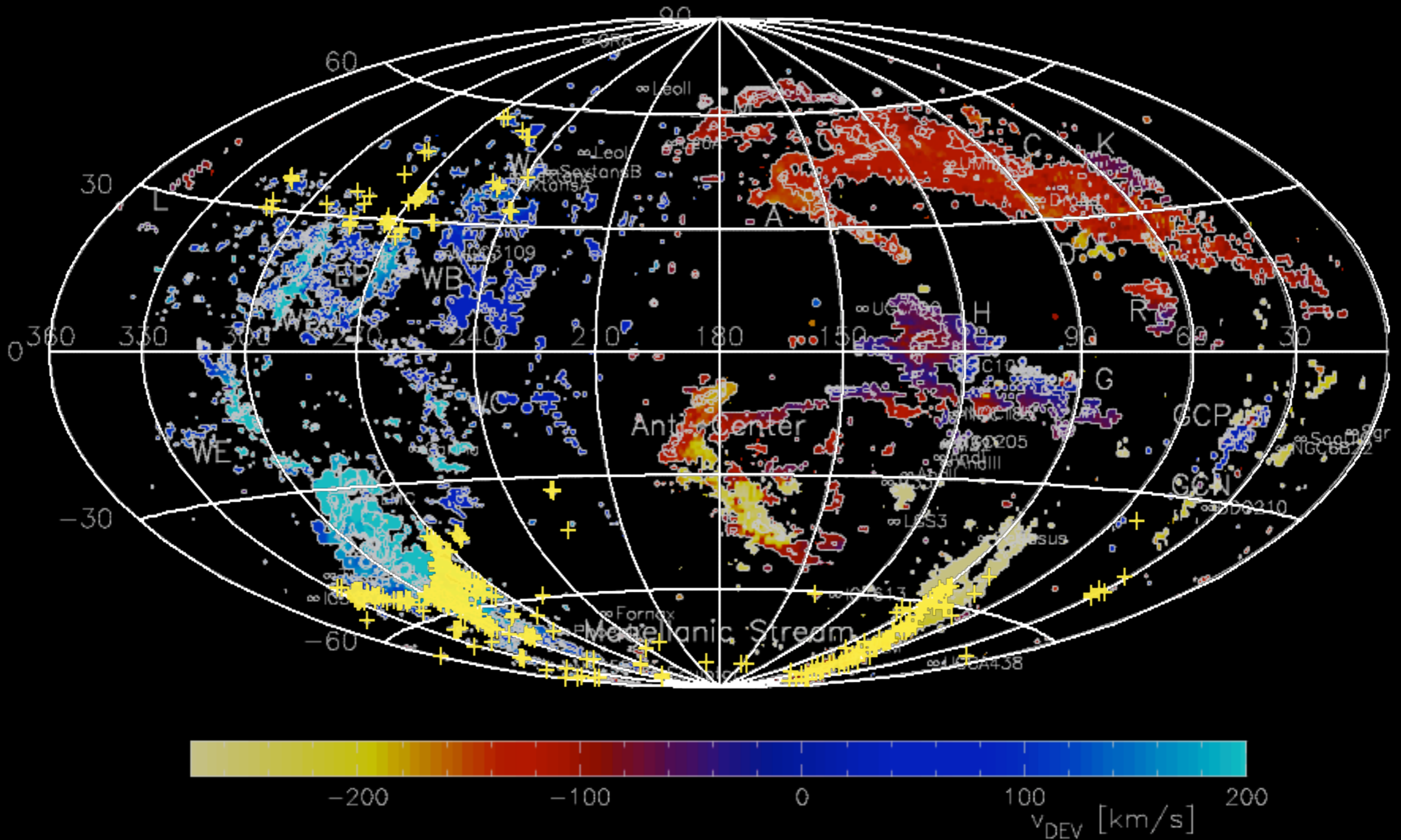
Echelle Spectroscopy

(Thom et al., 2006, 2007)



430 HVC Probes

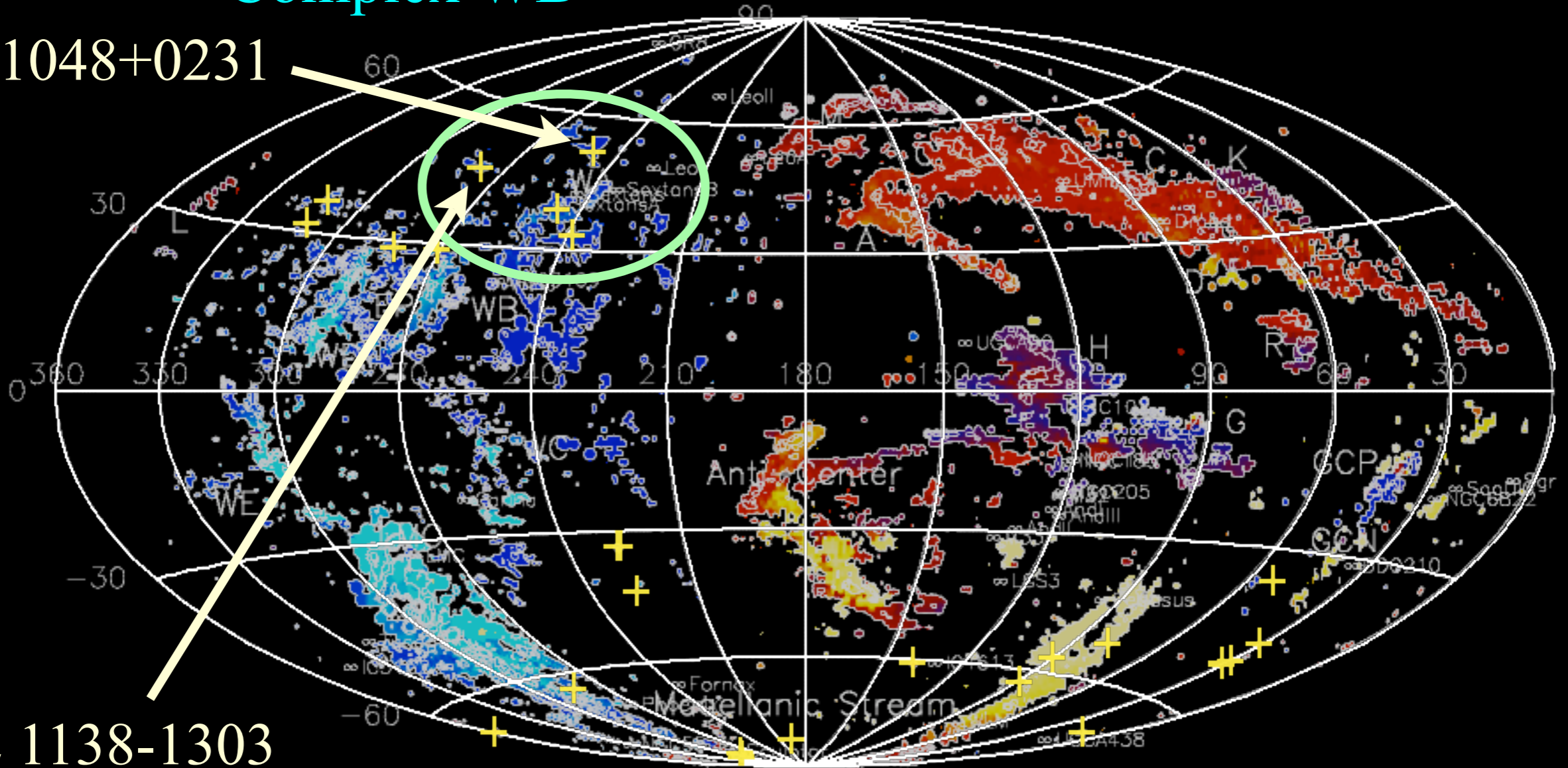
(lb) map of HVCs; centered on (180 0)



Magellan Targets

Complex WB map of HVCs; centered on (180 0)

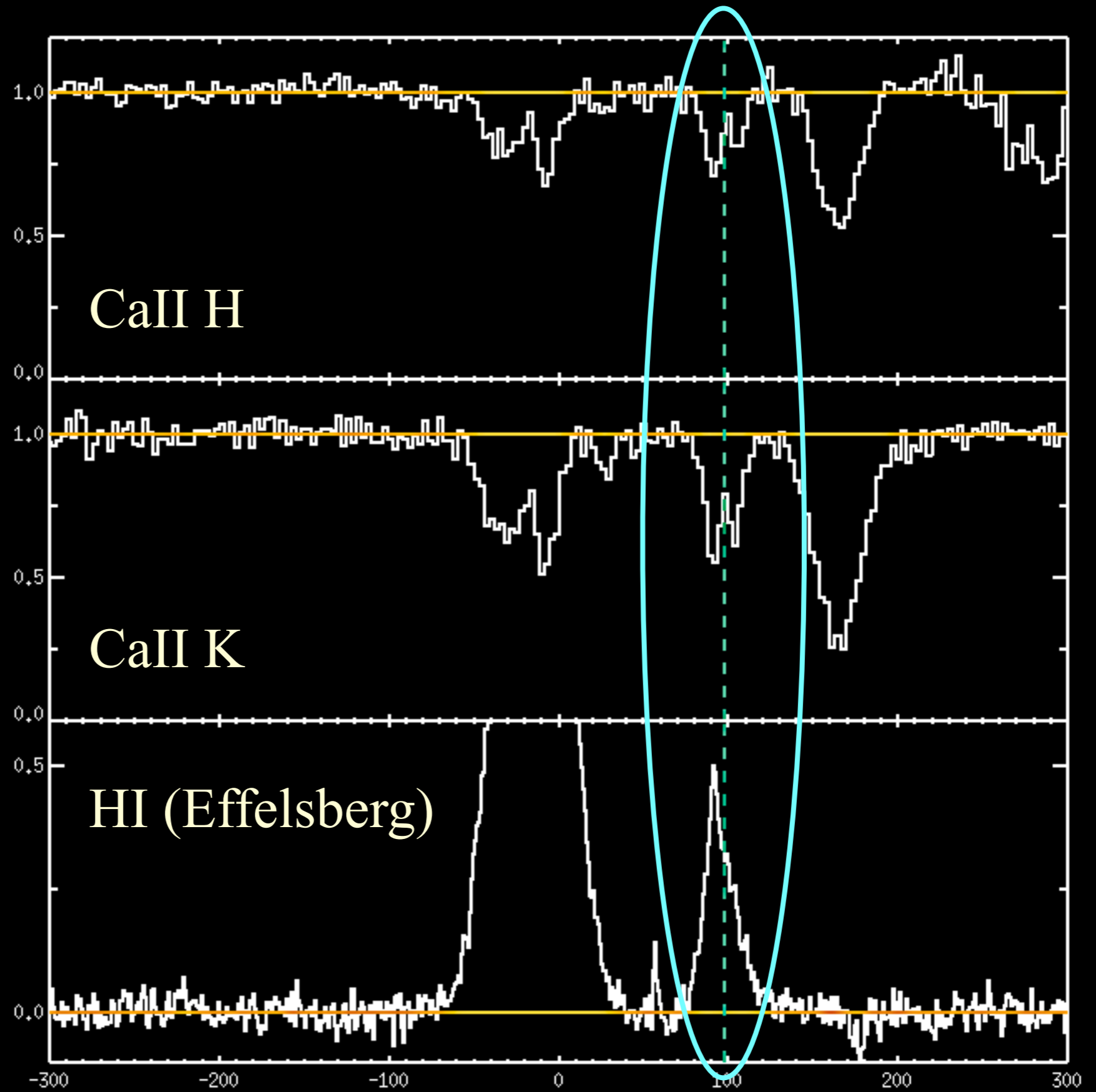
HE 1048+0231



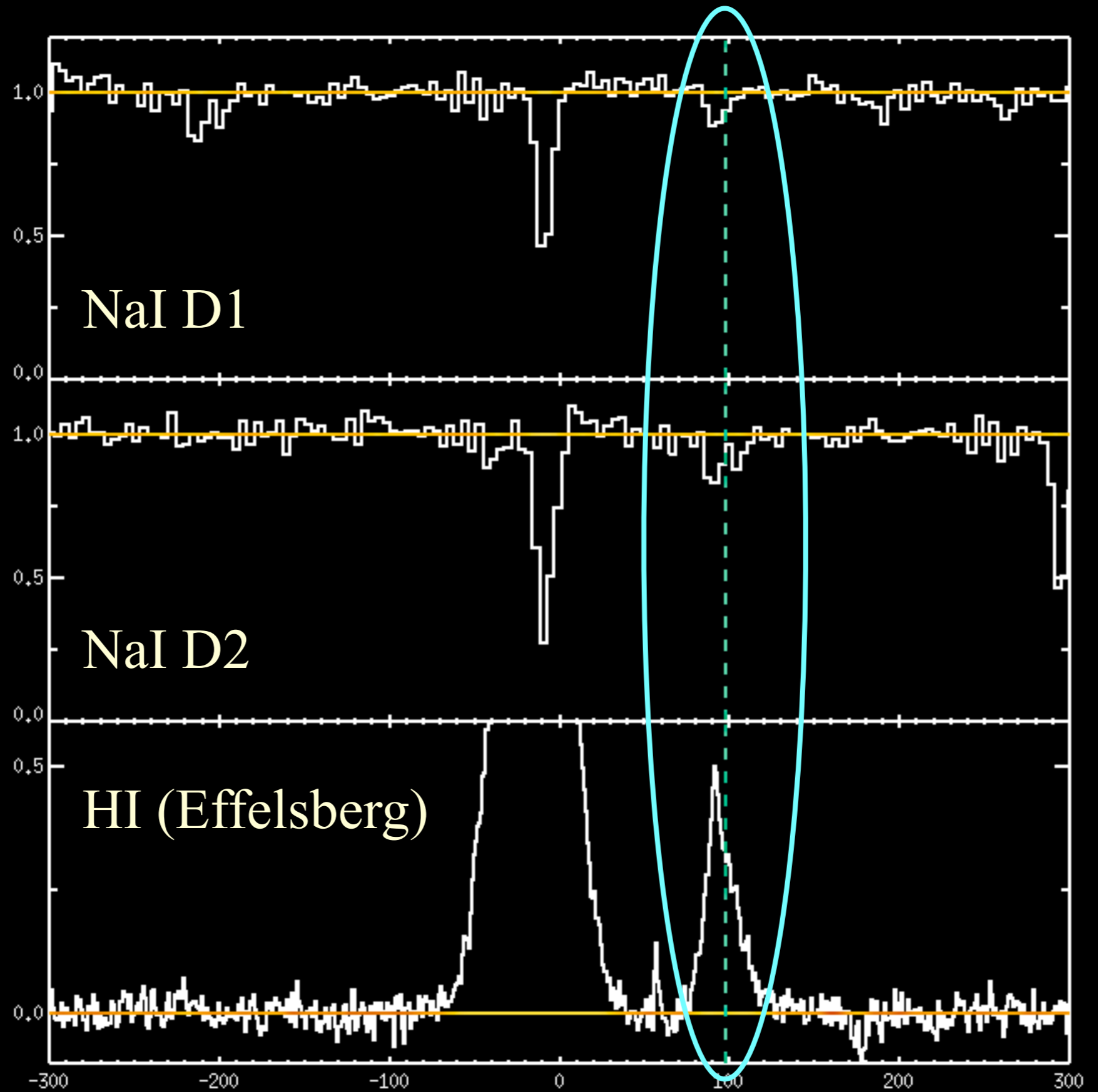
HE 1138-1303



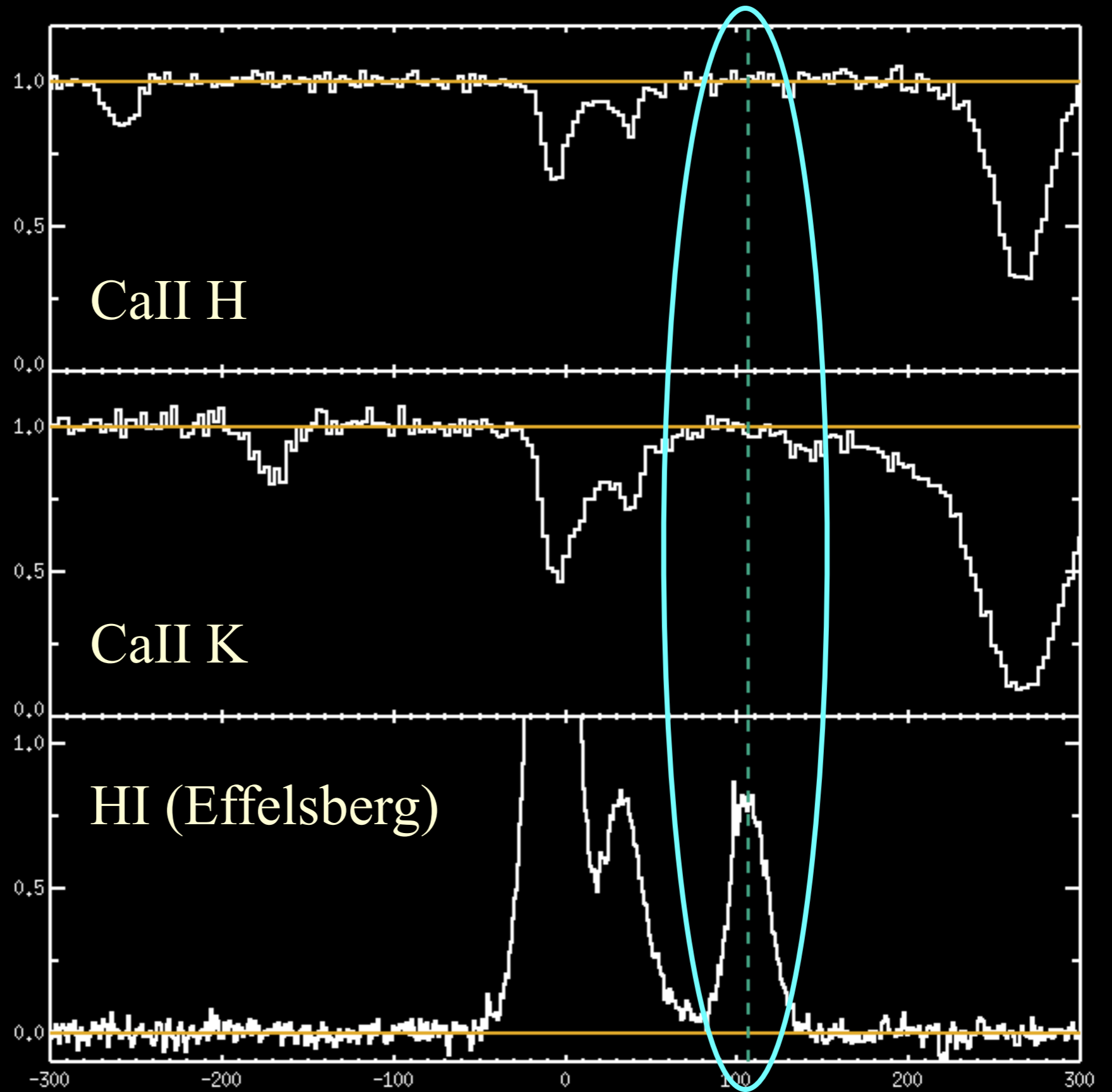
HE 1048+0231



HE 1048+0231



HE 1138-1303



Stellar Properties

	HE 1048+0231	HE 1138-1303
V_0 , $(B-V)_0$	16.51, 0.00	14.87, 0.40
W_λ (CaII K) (mÅ)	114.6 ± 4.4	± 3.5
T_{eff} (K)	9350 - 9750	6000
log g	3.5 - 4.25	2.0
Class	MS (A0)	HB
N(HI) (10^{19}cm^{-2})	1.64 ± 0.31	1.73 ± 0.33
Cloud	WW 35	WW 62
Dist (kpc)	$8.8^{+2.3}_{-1.3}$	7.7 ± 0.2

Complex WB

- $d \sim 8-9 \text{ kpc} \rightarrow z < 7 \text{ kpc}$
- $N(\text{CaII})/N(\text{HI}) = 81 \pm 16 \times 10^{-9}$
- $N(\text{NaI})/N(\text{CaII}) = 0.22 \pm 0.06$
- Infalling ($v_{\text{GSR}} \sim -30 \text{ kms}^{-1}$)
- Complex WB is most likely **galactic** or **circum-galactic**
- $4 \times 10^5 < M(\text{HI}) < 5 \times 10^5 M_{\odot}$