Creating the Hab-Ex "Story":

Hopefully Detecting/Characterizing Some Planets

vs.

Exploring Our Unique and Amazing Neighboring Planetary Systems

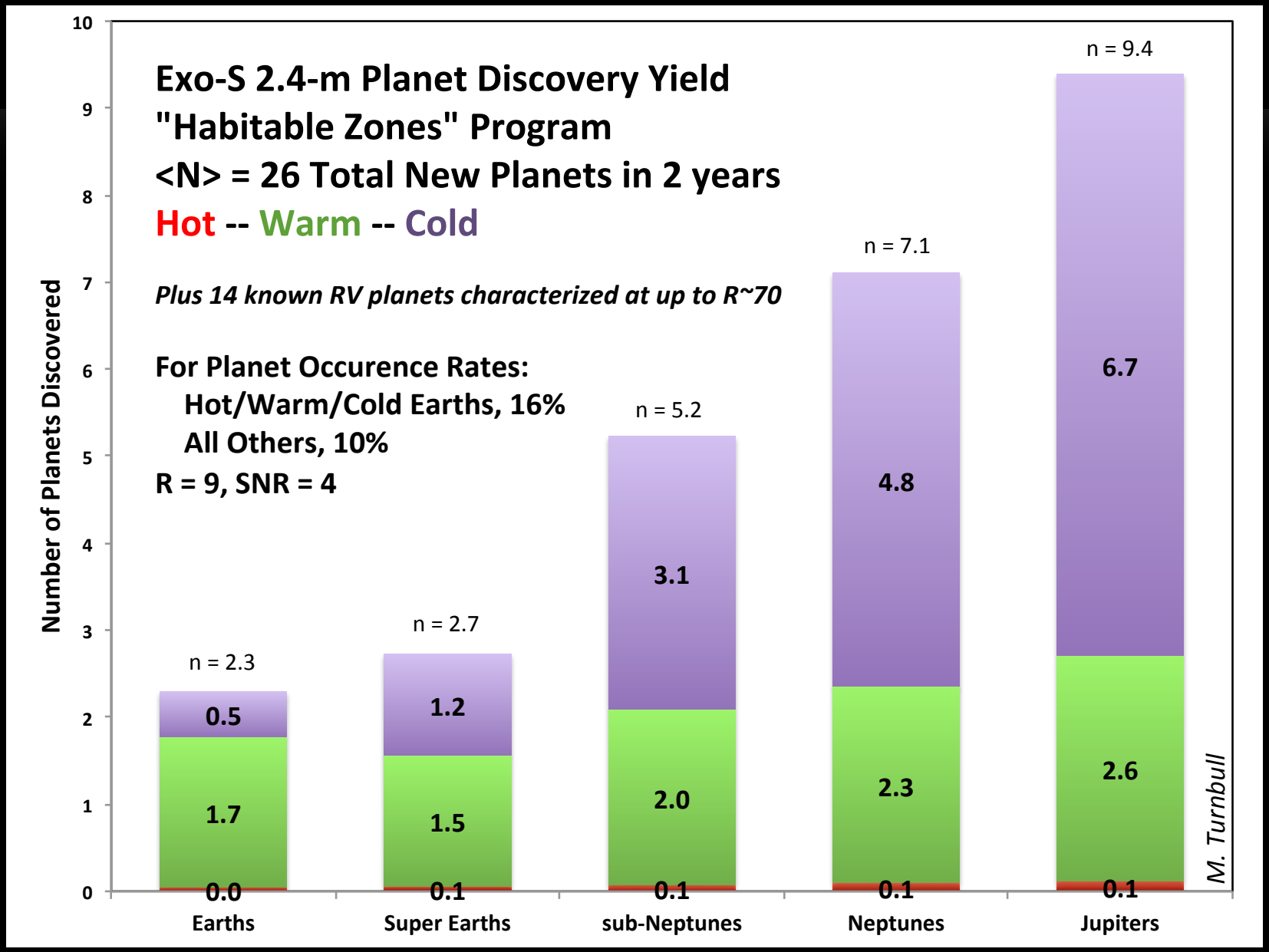
Dr. Margaret Turnbull
SETI Institute
Carl Sagan Center for the Study of Life in the Universe

Two Divergent Approaches

1. Yield-based: How many habitable zones can we search for an Earth-sized planet?

   → *numbers game requiring many targets*
   → *requires many assumptions with large errorbars and dozens or hundreds of DRM runs to do it right*
   → *implies we know the first thing about life*
   → *requires many tedious conversations about input assumptions, requires completeness calculations that few people on this planet know how to do*
   → *cannot in any way, shape, or form, compete with LUVOIR, other than in cost. "LUVOIR-Lite" is not a uniquely capable mission given the other options.*
   → *is very sensitive to "eta" – ironically higher eta can lead to lower yield and less "successful" mission*

Two Divergent Approaches

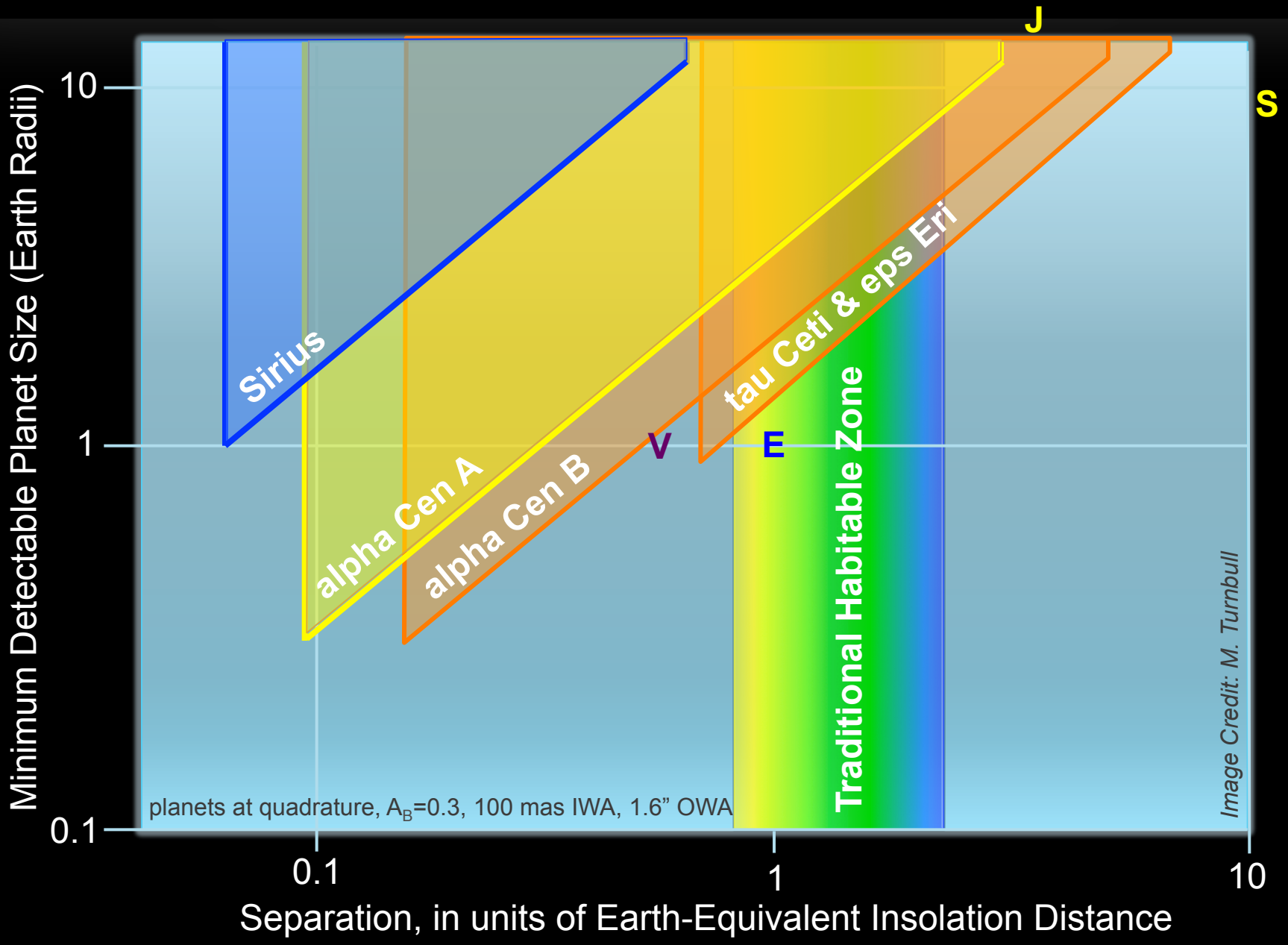


Two Divergent Approaches

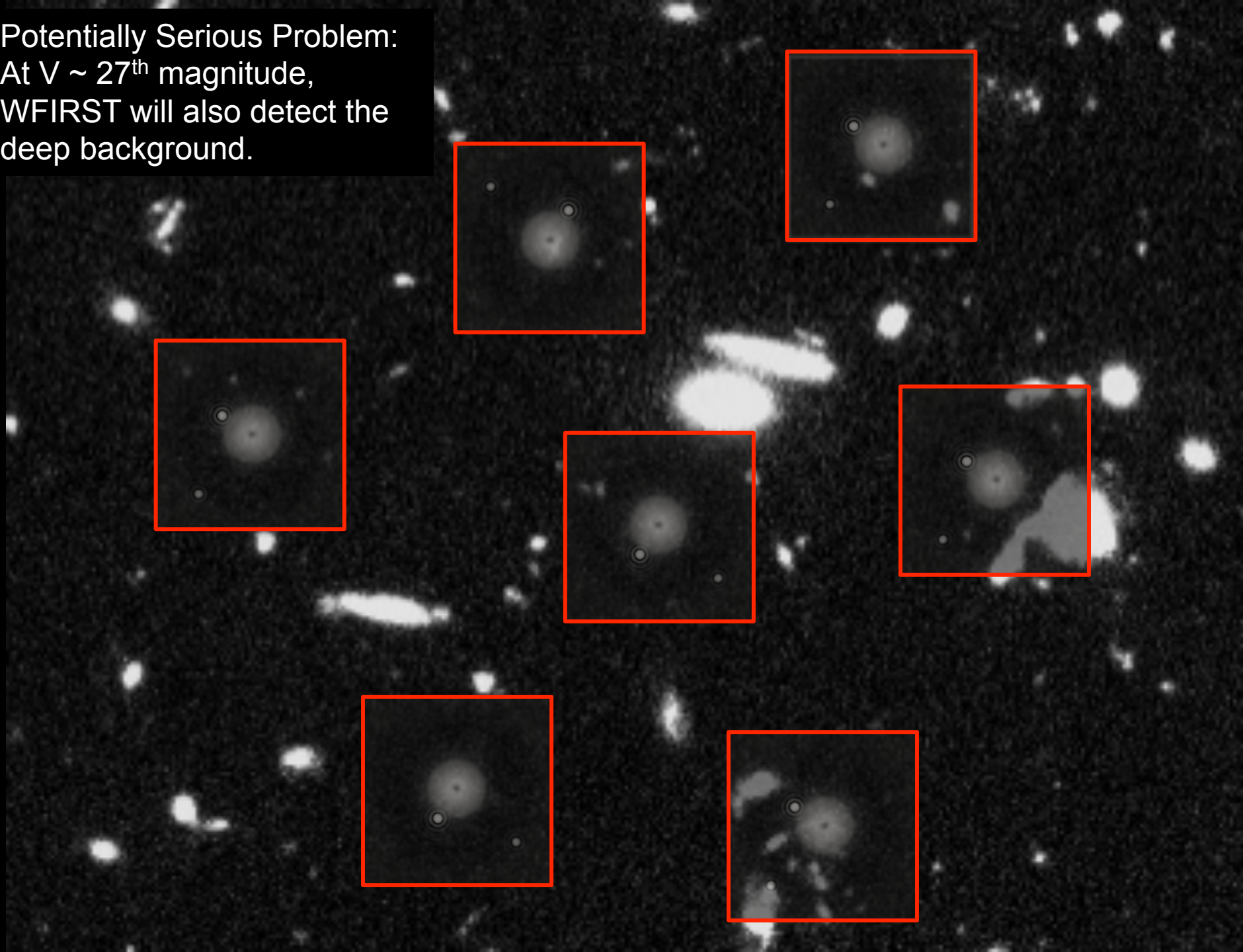
1. Exploration-based: How many totally unique, individual planetary systems can we explore in great detail, and assess their "story," including habitability to life as we know it?

→ Exploring one dozen systems to the greatest depth possible
→ Portrays Hab-Ex as more than just an academic exercise: boldly going into the unknown and embracing the unknown
→ But it still leverages a vast body of "deep" knowledge about individual systems, as opposed to whatever floats to the top in terms of HZ completeness
→ The "unknowns" threat is greatly mitigated.
→ Still requires DRMs, but input list is well-vetted and exciting
→ Only makes sense with a wide FOV – leverages starshade capability, appropriate for Hab-Ex 4-6m telescope size
→ Less "efficient" path might enable more General Astrophysics

Let's Start Talking About Targets



Potentially Serious Problem:
At V ~ 27th magnitude,
WFIRST will also detect the
deep background.



Let's Start Talking About Targets

Exo-S Targets (in order of planet brightness)						Temperature Regime of Planets brighter than V = 30 ("priority zero" targets in bold)				
Target	HIP	IWA(AU)	IHZ(mas)	OHZ(mas)	min R_p (Re)	1 Re	1.5 Re	2 Re	4 Re	11 Re
Sirius A	32349	0.26	1574	3714	0.2	hot-warm	hot	hot	hot	hot
Vega	91262	0.77	763	1800	0.5	hot	hot	hot	hot	hot-warm
Procyon A	37279	0.35	571	1347	0.2	hot	hot-warm	hot-warm	hot-warm	hot-warm
Altair	97649	0.51	478	1129	0.3	hot	hot-warm	hot-warm	hot-cold	hot-cold
Fomalhaut	113368	0.77	395	932	0.5	hot	hot	hot-warm	hot-warm	hot-cold
beta Leo	57632	1.10	260	614	0.6	hot	hot	hot-warm	hot-cold	hot-cold
beta Cas	746	1.68	241	569	1.0	hot	hot	hot	hot-warm	hot-cold
alpha Cep	105199	1.50	223	526	0.9	hot	hot	hot-warm	hot-warm	hot-cold
eta Boo	67927	1.14	204	481	0.7	hot	hot-warm	hot-warm	hot-cold	hot-cold
beta TrA	77952	1.24	186	439	0.7	hot	hot-warm	hot-warm	hot-cold	hot-cold
beta Hyi	2021	0.75	193	457	0.4	hot-warm	hot-warm	hot-cold	hot-cold	hot-cold
delta Cap	107556	1.19	183	432	0.7	hot	hot-warm	hot-warm	hot-cold	hot-cold
iota UMa	44127	1.45	165	389	0.9	hot	hot-warm	hot-warm	hot-cold	hot-cold
alpha Cir	71908	1.66	160	378	1.0	hot	hot	hot-warm	hot-cold	hot-cold
tet UMa	46853	1.35	162	382	0.8	hot	hot-warm	hot-warm	hot-cold	hot-cold
Tabit	22449	0.81	161	380	0.5	hot-warm	hot-warm	hot-cold	hot-cold	hot-cold
gamma Cep	116727	1.41	183	432	0.8	hot	hot	hot-warm	hot-cold	hot-cold
detla Aql	95501	1.55	145	342	0.9	hot	hot-warm	hot-warm	hot-cold	hot-cold
mu Her	86974	0.83	150	355	0.5	hot-warm	hot-warm	hot-cold	hot-cold	hot-cold
eta Cep	102422	1.43	161	380	0.8	hot	hot-warm	hot-warm	hot-cold	hot-cold
eta Cassiope	3821	0.59	144	341	0.3	hot-warm	hot-cold	hot-cold	hot-cold	hot-cold
tau Ceti	8102	0.37	148	349	0.2	hot-cold	hot-cold	hot-cold	hot-cold	hot-cold
delta Eridani	17378	0.90	152	360	0.5	hot-warm	hot-warm	hot-cold	hot-cold	hot-cold
delta Pavoni:	99240	0.61	142	334	0.4	hot-warm	hot-cold	hot-cold	hot-cold	hot-cold
beta Vir	57757	1.09	134	315	0.6	hot-warm	hot-warm	hot-cold	hot-cold	hot-cold
gamma Lep	27072	0.89	133	314	0.5	hot-warm	hot-warm	hot-cold	hot-cold	hot-cold
eta Lep	28103	1.49	124	292	0.9	hot	hot-warm	hot-warm	hot-cold	hot-cold
beta Aql	98036	1.37	137	324	0.8	hot	hot-warm	hot-warm	hot-cold	hot-cold
epsilon Erida	16537	0.32	138	326	0.2	hot-cold	hot-cold	hot-cold	hot-cold	hot-cold
iota Peg	109176	1.17	122	288	0.7	hot-warm	hot-warm	hot-cold	hot-cold	hot-cold
alpha Fornac	14879	1.42	121	286	0.8	hot	hot-warm	hot-warm	hot-cold	hot-cold
gam Ser	78072	1.13	118	278	0.7	hot-warm	hot-warm	hot-cold	hot-cold	hot-cold
I Car	50954	1.62	110	259	1.0	hot	hot-warm	hot-warm	hot-cold	hot-cold