

A Hypervelocity L Subdwarf Passing Through the Solar Neighborhood

AAS 244 iposter 406.01, Thursday 9:10am – under review by ApJ Letters

Adam Burgasser (UC San Diego)

Co-authors: Roman Gerasimov (U. Notre Dame), Kyle Kremer (Caltech-->UCSD), **Hunter Brooks** (NAU), **Efrain Alvarado III** (UC Berkeley), Adam Schneider (USNO), Aaron Meisner (NOIRLab), Christopher Theissen (UCSD), **Emma Softich** (UCSD), **Preethi Karpoor** (UCSD), **Thomas Bickle** (Open U), **Martin Kabatnik** (BYW), **Austin Rothermich** (CUNY), Dan Caselden (AMNH), Jacqueline Faherty (AMNH), J. Davy Kirkpatrick (Caltech/IPAC), & Marc Kuchner (NASA Goddard)

contact: aburgasser@ucsd.edu

students & citizen scientists



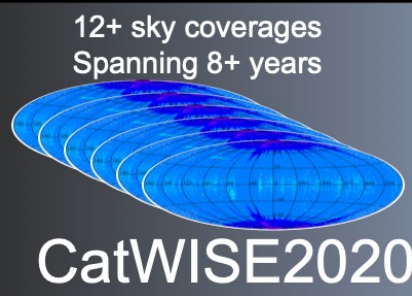
The Backyard Worlds: Planet 9 Search for Nearby Neighbors

Kuchner et al. 2017; <http://backyardworlds.org>

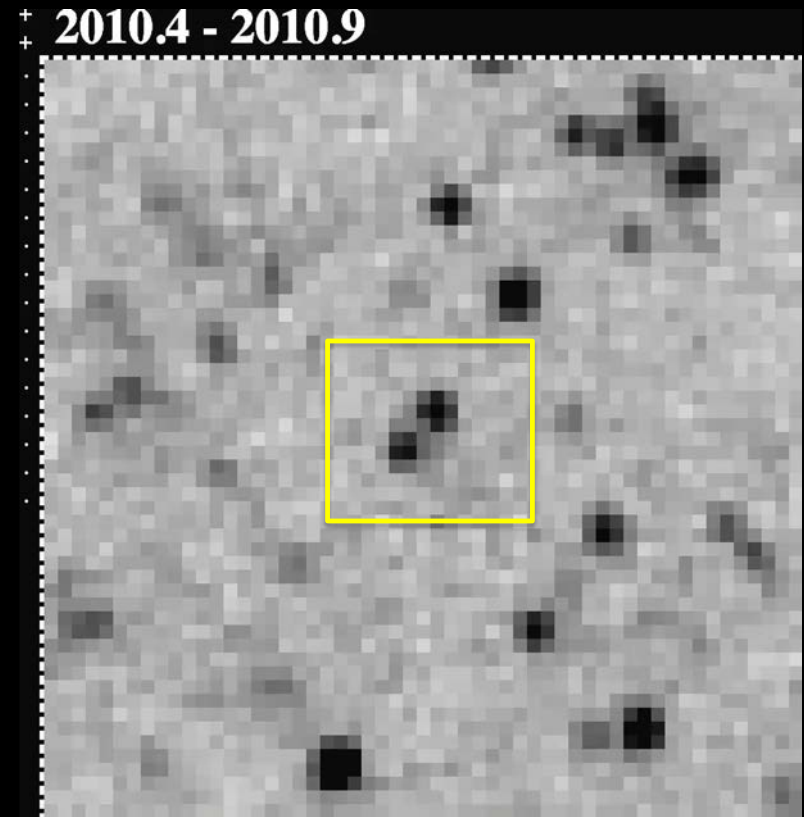
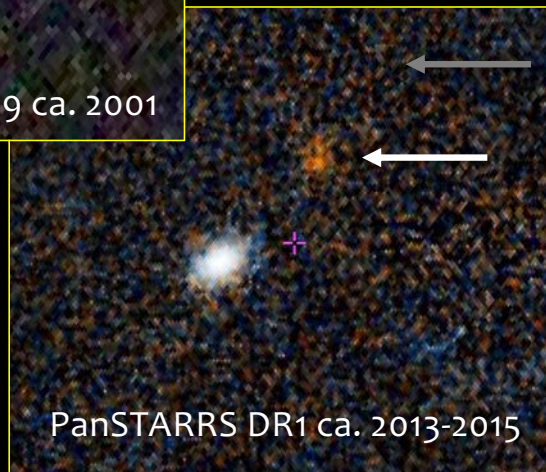
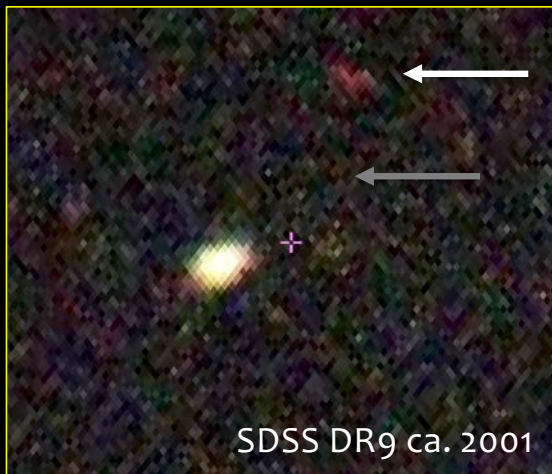
This citizen science program has engaged **nearly 100,000 citizen scientists** to discover hundreds of faint moving sources in multi-epoch mid-infrared data from WISE/NeowISE



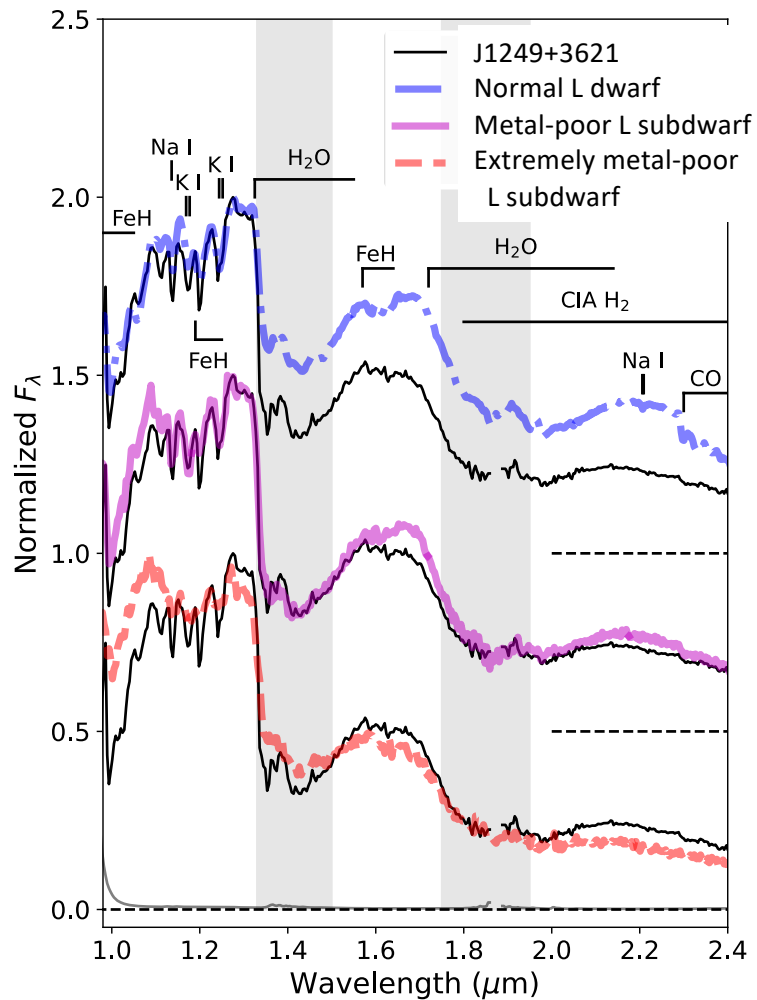
WISE spacecraft



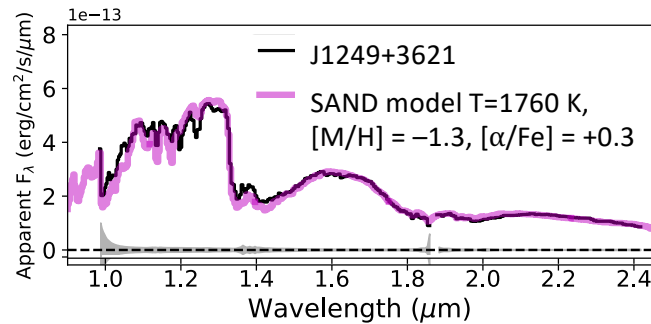
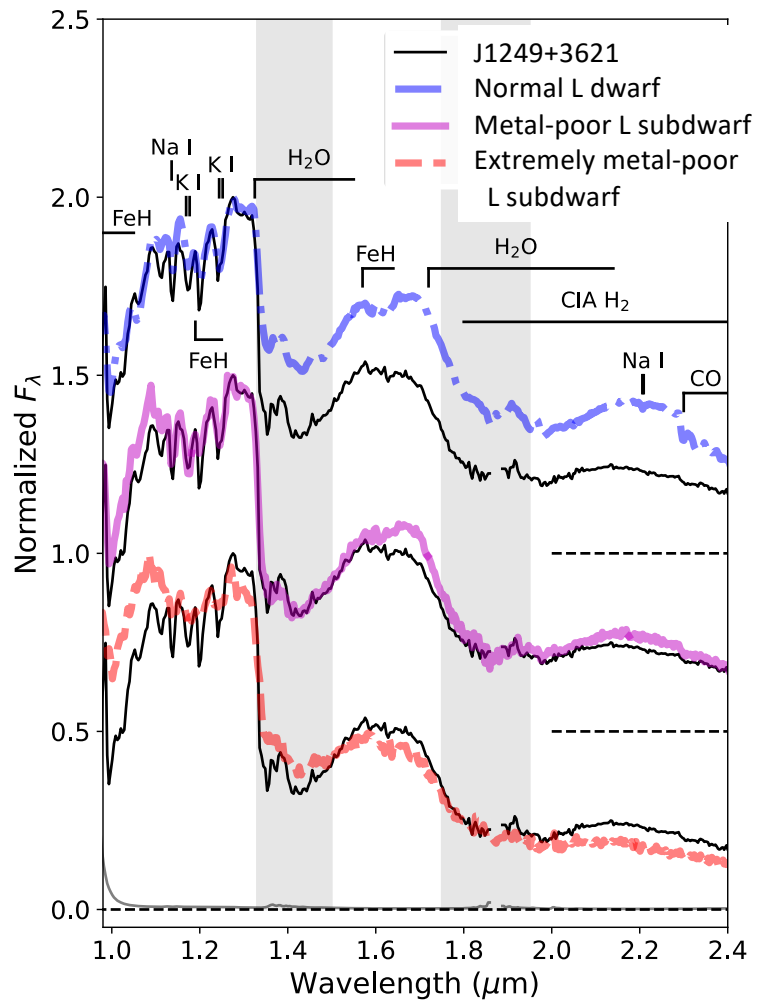
A new faint red moving source: WISE J124909.08+362116.0



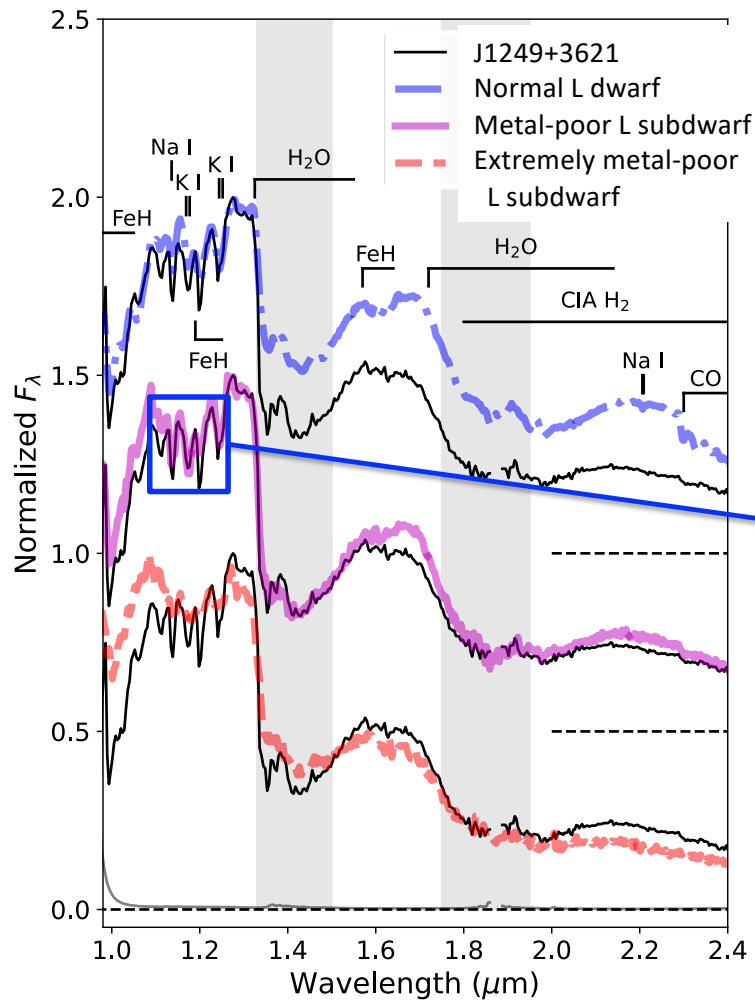
WISE/Neowise images ca. 2010-2021
Wiseview developed by Dan Caselden and Paul Westin
<http://byw.tools/wiseview>



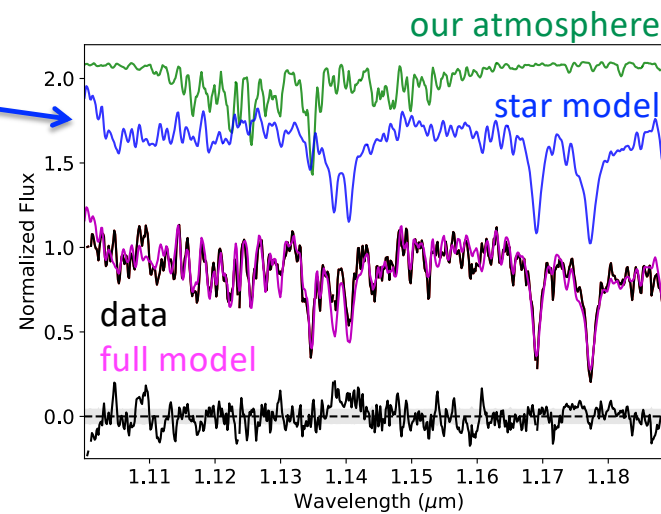
Near-infrared spectroscopy with **Keck/NIRES** allowed us to characterize the object's spectrum as a **metal-poor L-type subdwarf**

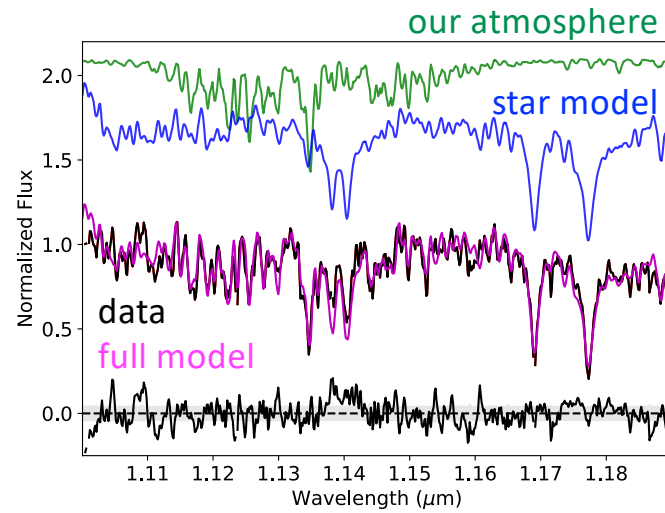
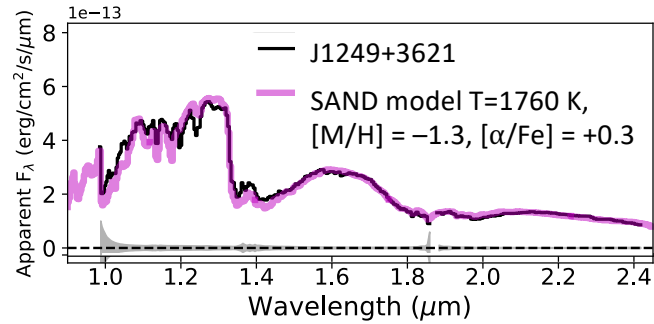
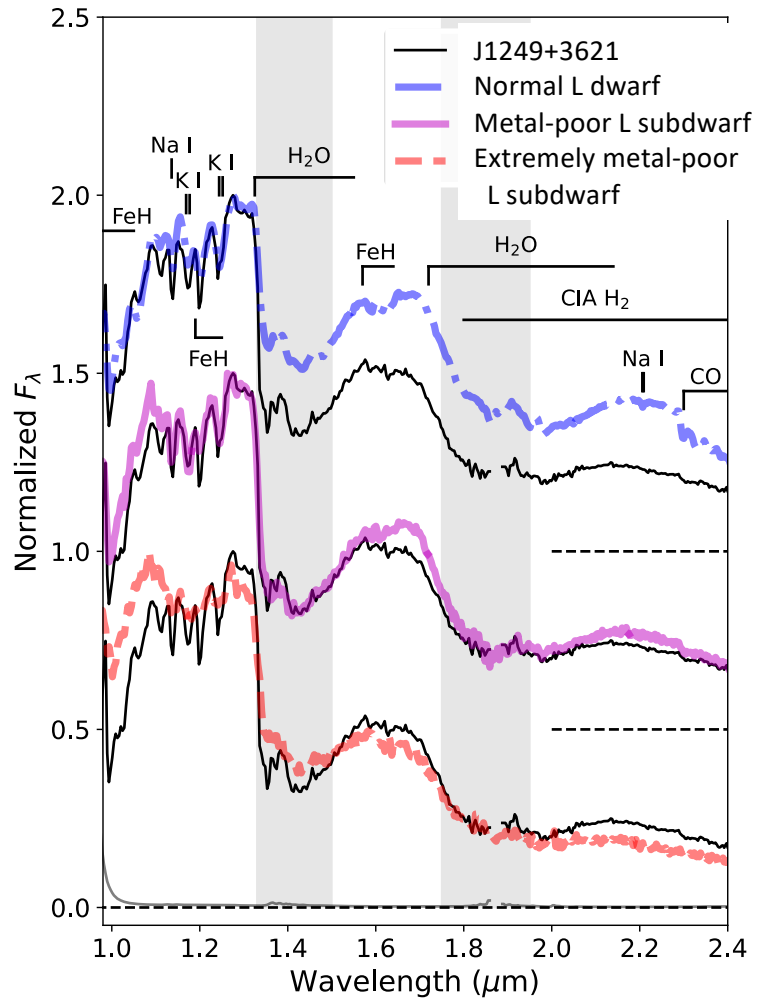


Comparison to new **SAND** atmosphere models (Alvarado+2024; poster 406.04) yielded precise estimates of temperature and element abundances (about 5% solar)



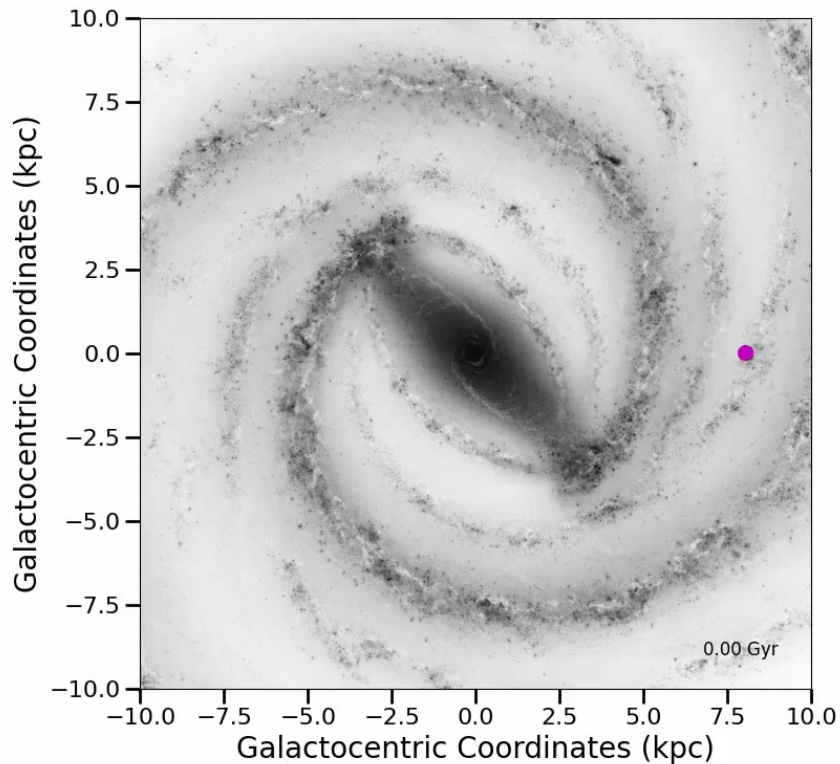
Keck/NIRES spectra also had sufficient resolution to measure the **radial velocity** of J1249+3621





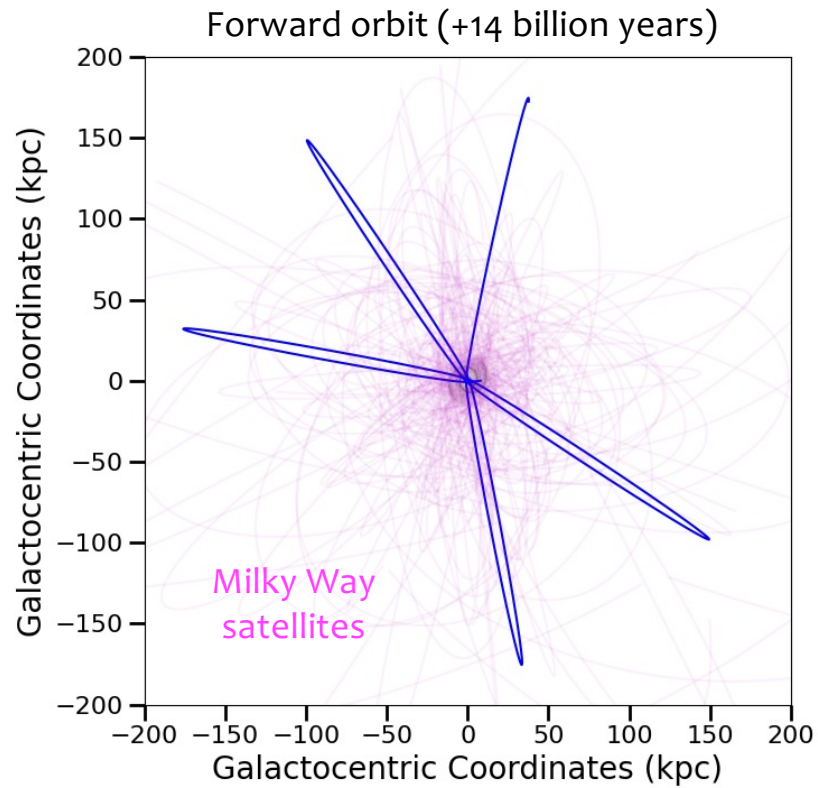
- Temperature
- Element composition
- Radial velocity
- Mass
- Distance
- 3D position
- 3D velocity

J1249+3621's Galactic Odyssey

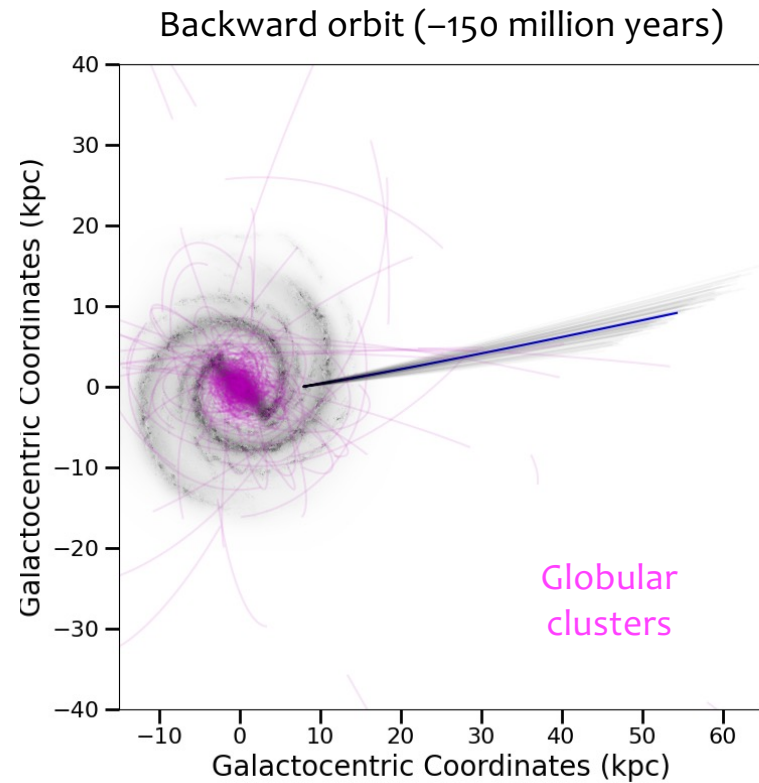


Our observations found that J1249+3621 is moving at a speed of **456 ± 27 km/s** (1 million miles/hour, 0.1% the speed of light) in the galactic rest frame, potentially fast enough to escape the Milky Way

J1249+3621's Galactic Odyssey



orbit simulation by galpy; Milky Way graphic by Robert Hurt

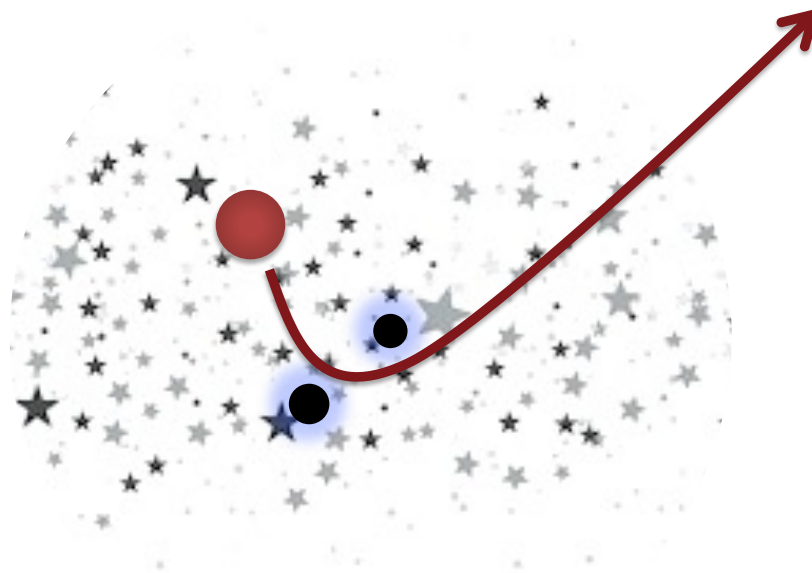


Burgasser et al., Hypervelocity L Subdwarf, AAS 244

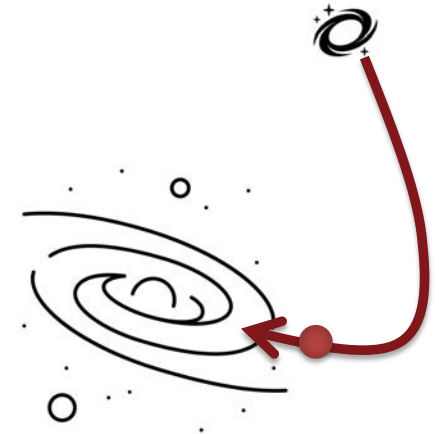
How did J1249+3621 get its kick?



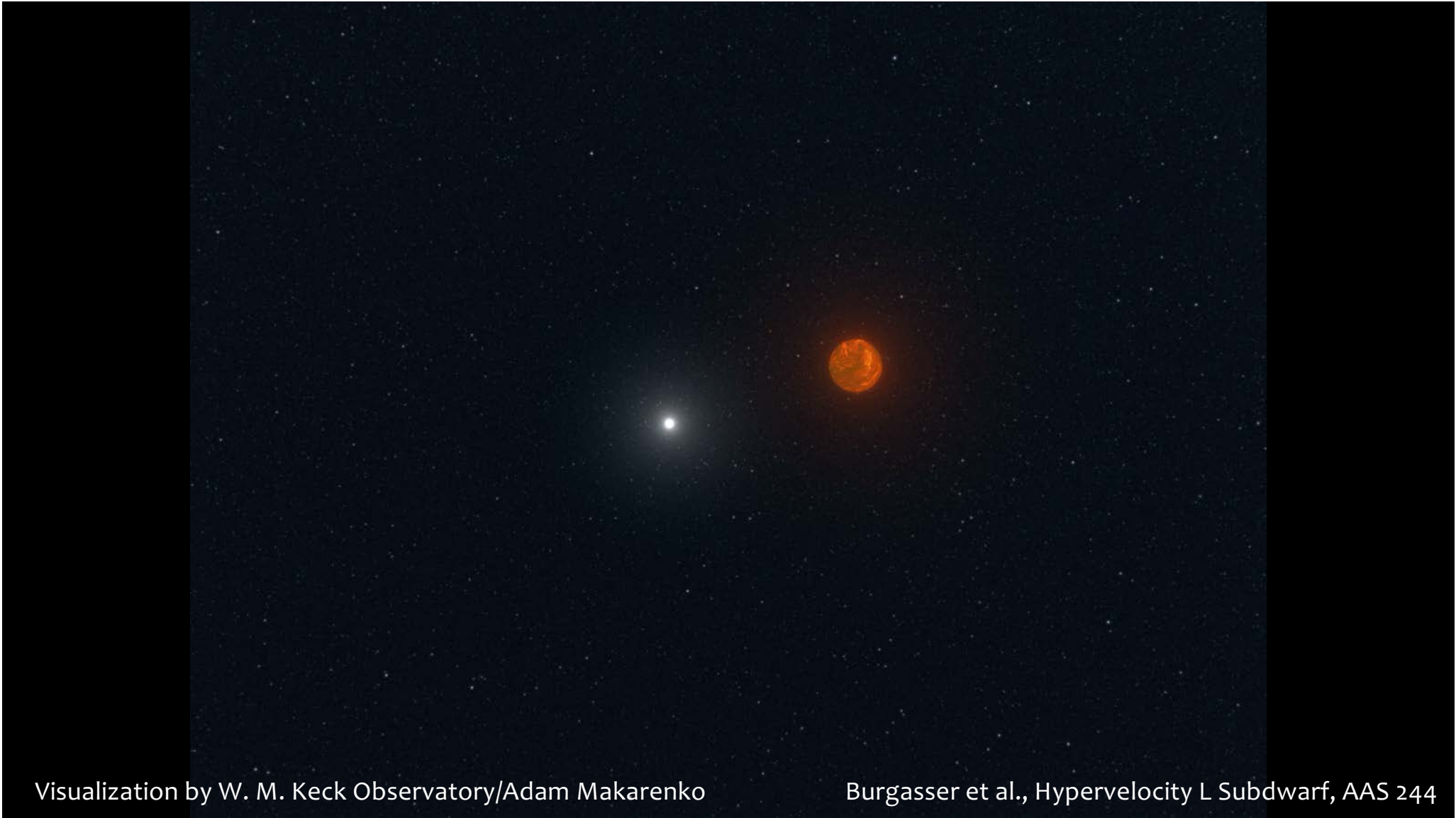
Ejection following
SN Ia explosion



Scattering by a black hole
binary in a globular cluster



Accretion from
Milky Way satellite



Visualization by W. M. Keck Observatory/Adam Makarenko

Burgasser et al., Hypervelocity L Subdwarf, AAS 244



Visualization by W. M. Keck Observatory/Adam Makarenko

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Key results

- J1249+3621 is a nearby (125 pc, 400 light-years) metal-poor, very low mass star discovered by citizen scientists in the Backyard Worlds: Planet 9 project
- It has a speed of 456 ± 27 km/s (1 million miles/hour, 0.1% the speed of light) in the rest frame of the Milky Way, fast enough that it may escape our galaxy
- We explored three possible explanations for its high velocity: (1) an ejected companion of an exploded white dwarf, (2) ejection from a globular cluster after an encounter with a binary black hole system, and (3) accretion from one of the Milky Way's satellite systems; all are feasible but not proven
- Analysis of its elemental abundances may reveal J1249+3621's true origin

• Visit our iposter Thursday morning 406.01

Please also see talk 219.04 (Gerasimov+) and iposter 406.04 (Alvarado+)

Adam Burgasser (UCSD) aburgasser@ucsd.edu <http://www.coolstarlab.org>