

Young Star Caught Speeding



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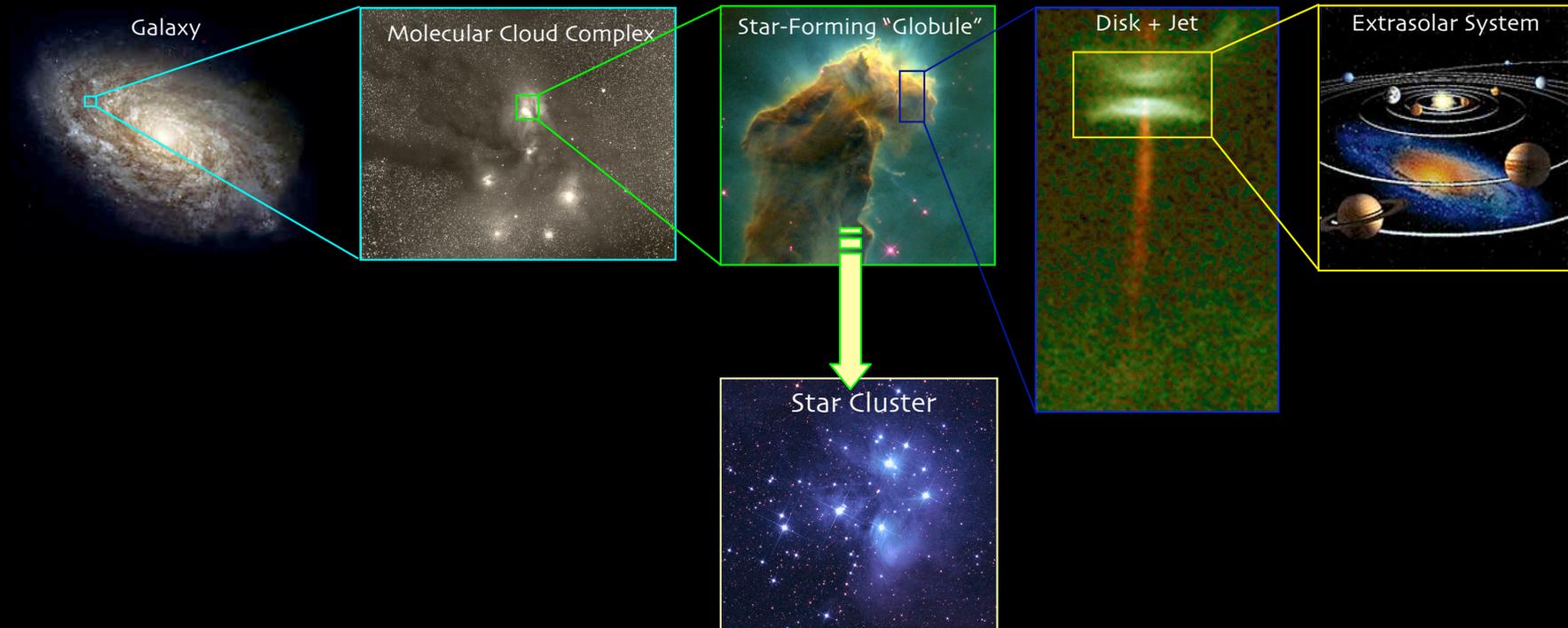
Héctor G. Arce

Caltech



00s 21h04m00s 21h00m00s 20h56m00s 20h52m00s 20h48m00s 20h44m00s 20h40m00s

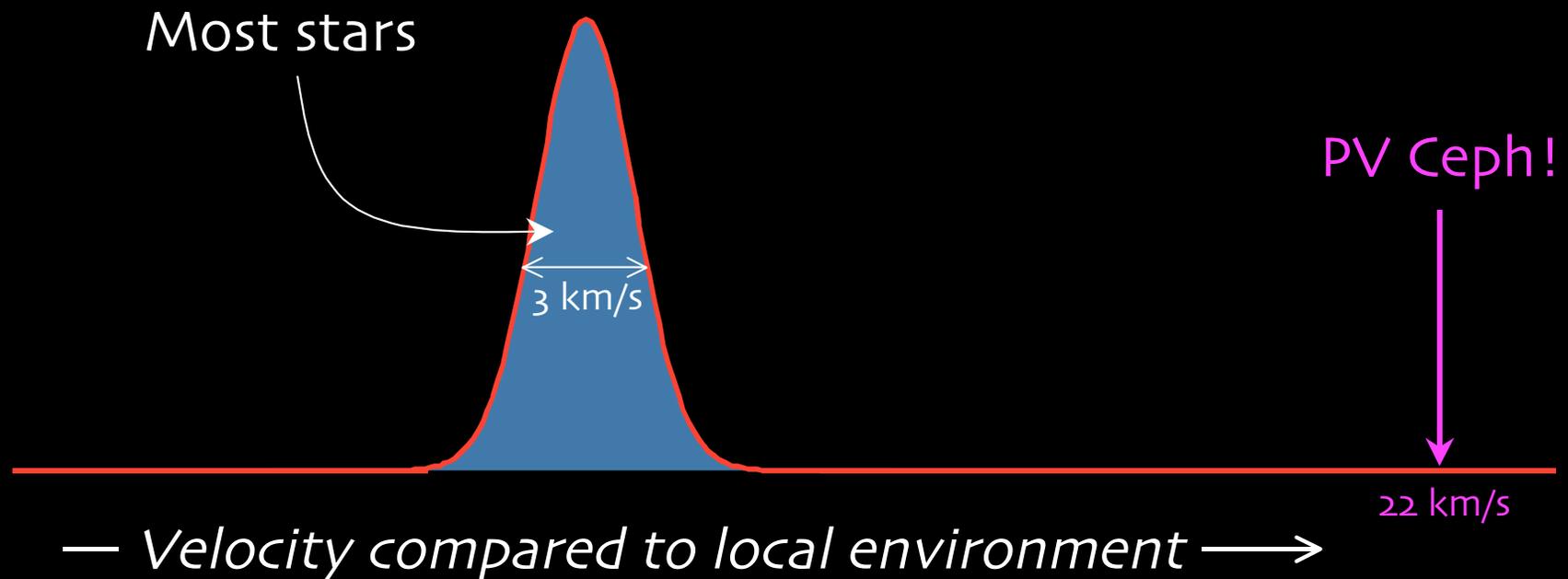
Star & Planet Formation



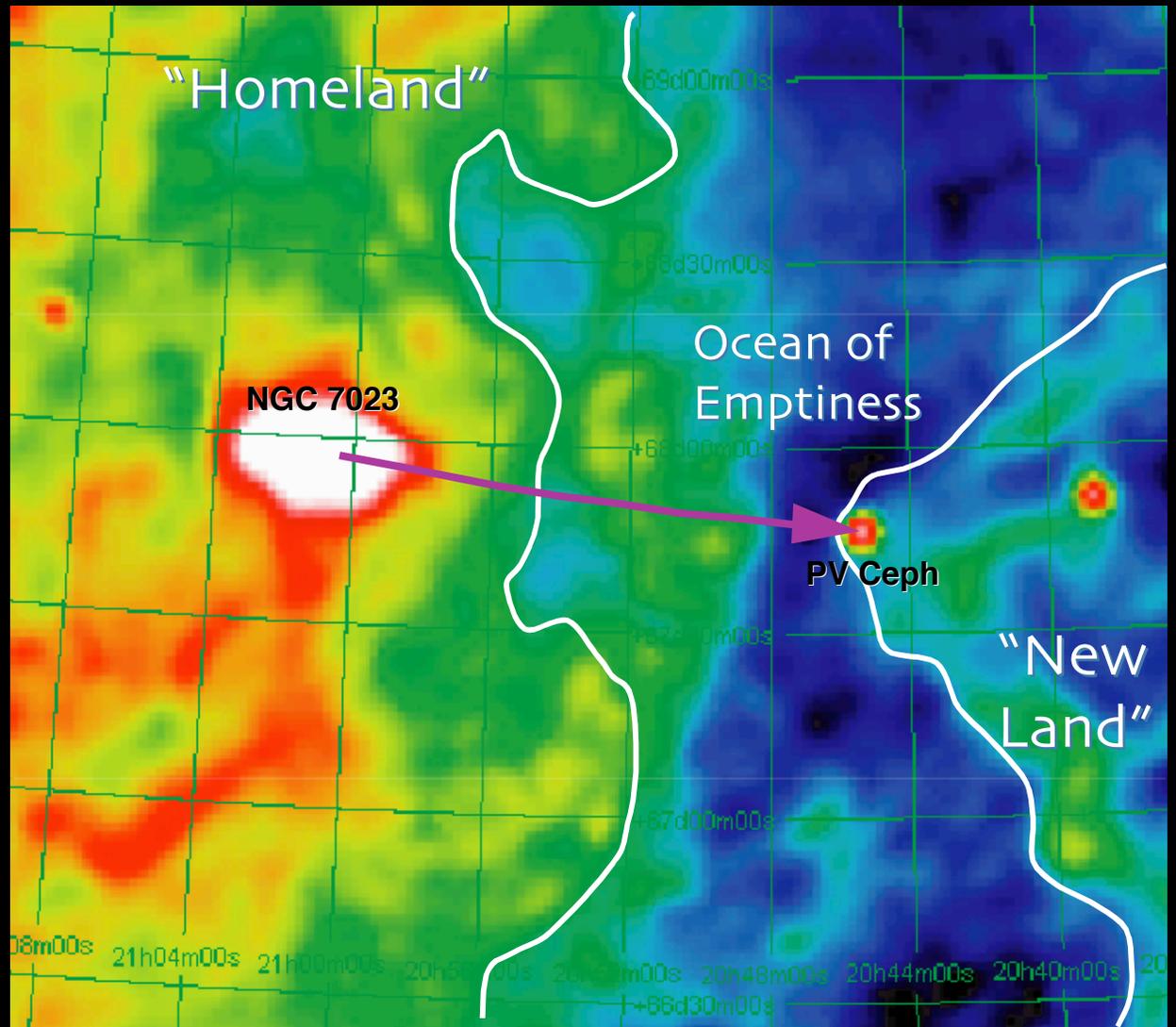
How fast is “22 km/s”?

45,000 miles per hour (45 x a speeding bullet)

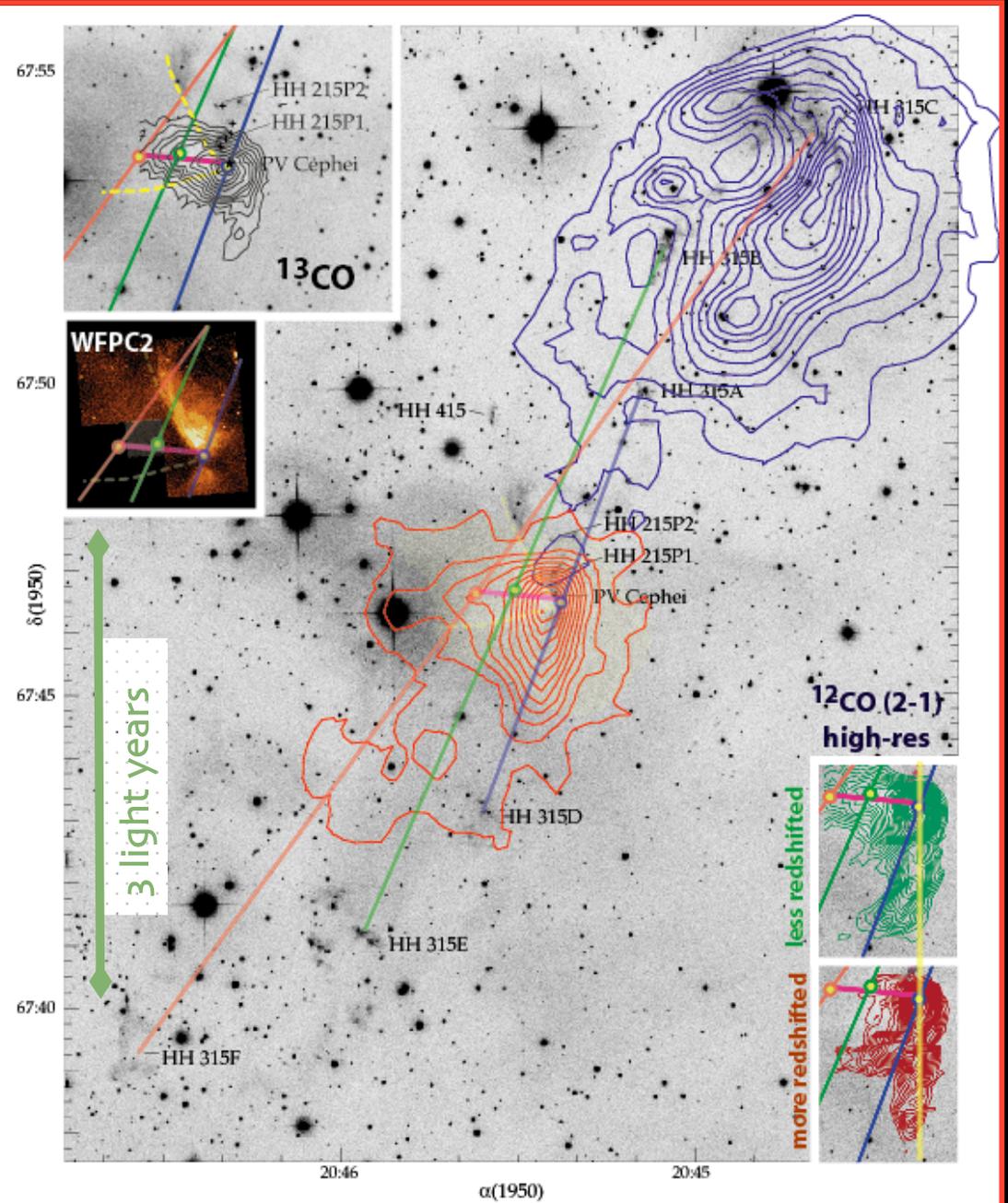
10-20 times faster than “most” stars move



Exiled, but
Accepted in
New Land



Coming Soon
PV Ceph: The Movie

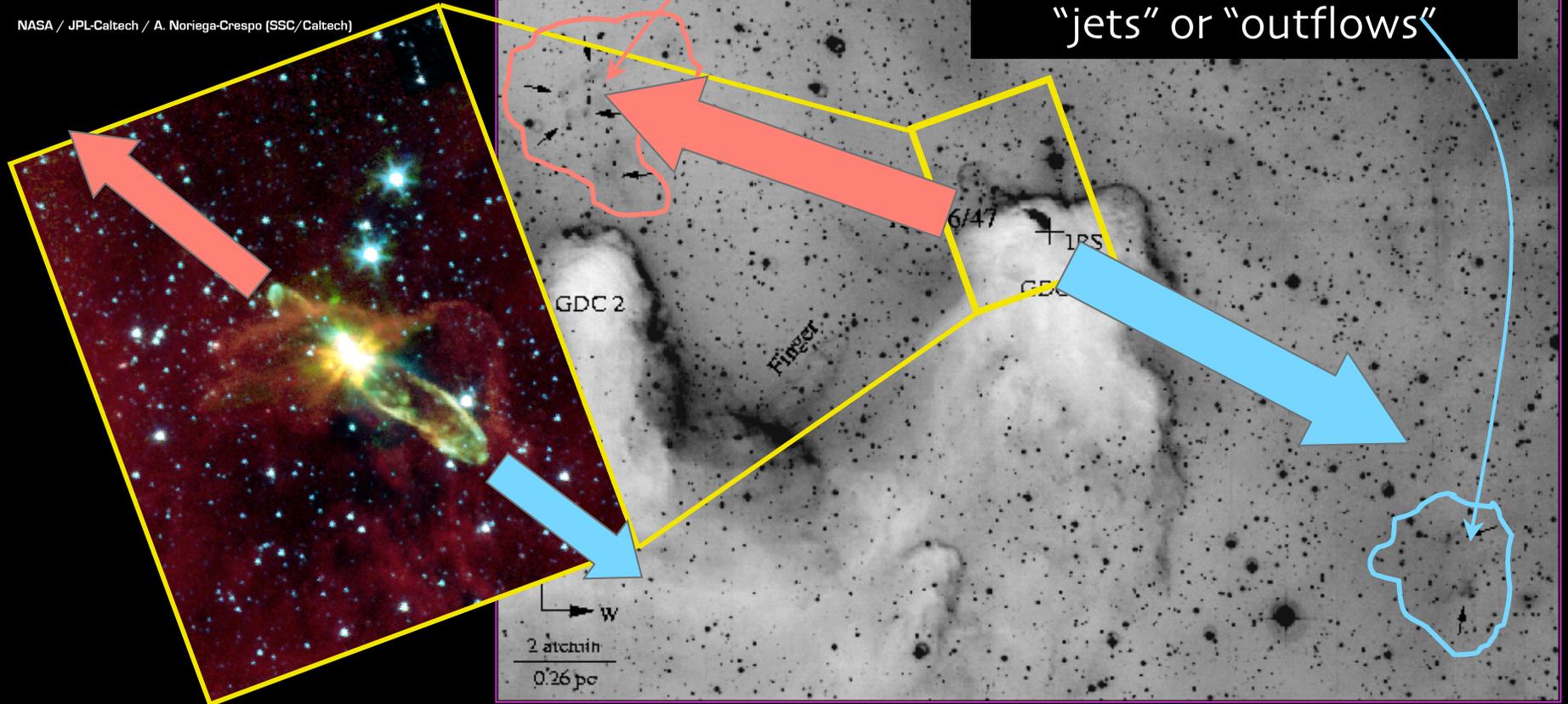


What's an "HH knot"?

HH knots far from source mark the ends of bipolar "jets" or "outflows"

Embedded Outflow in HH 46/47

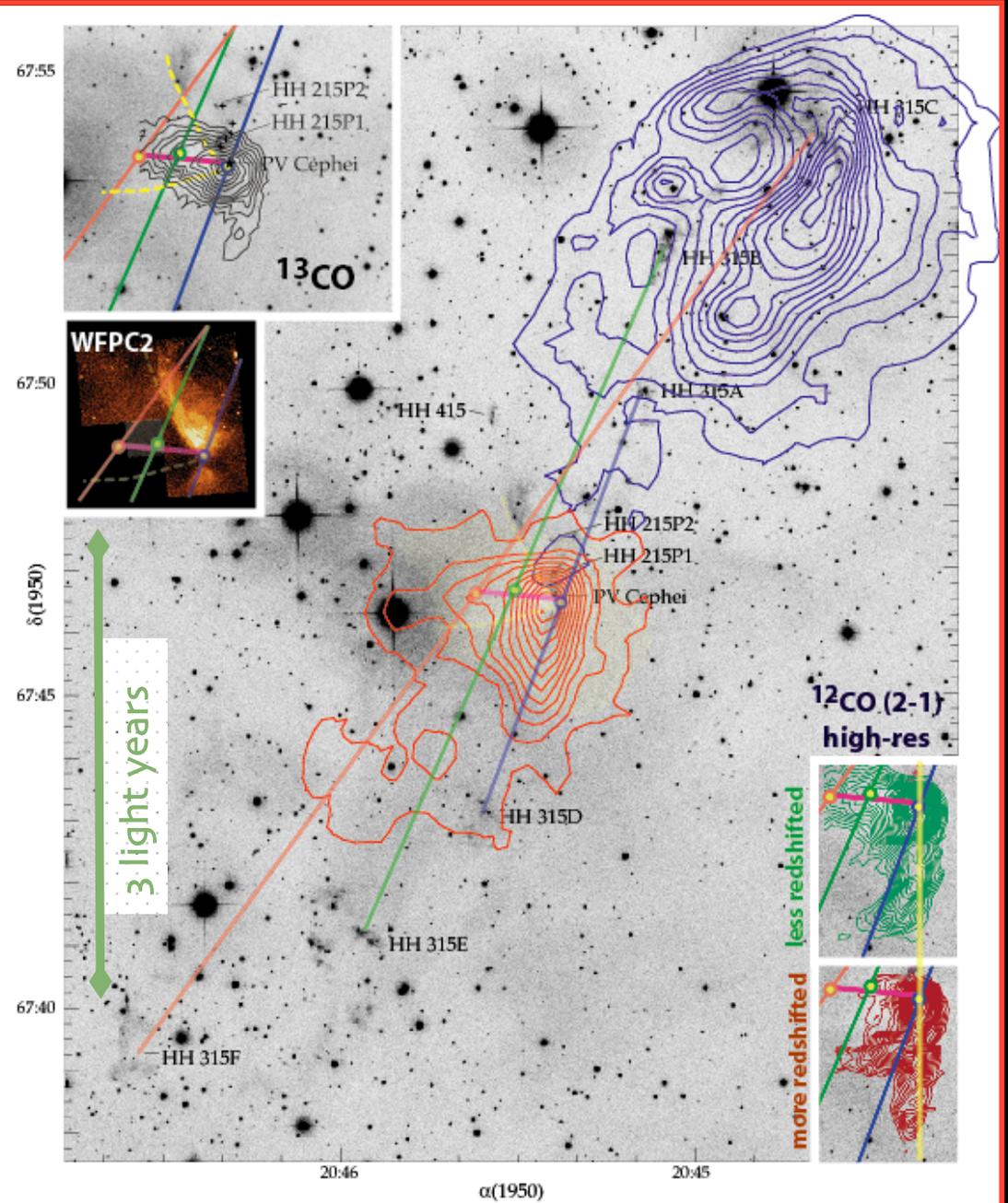
NASA / JPL-Caltech / A. Noriega-Crespo (SSC/Caltech)



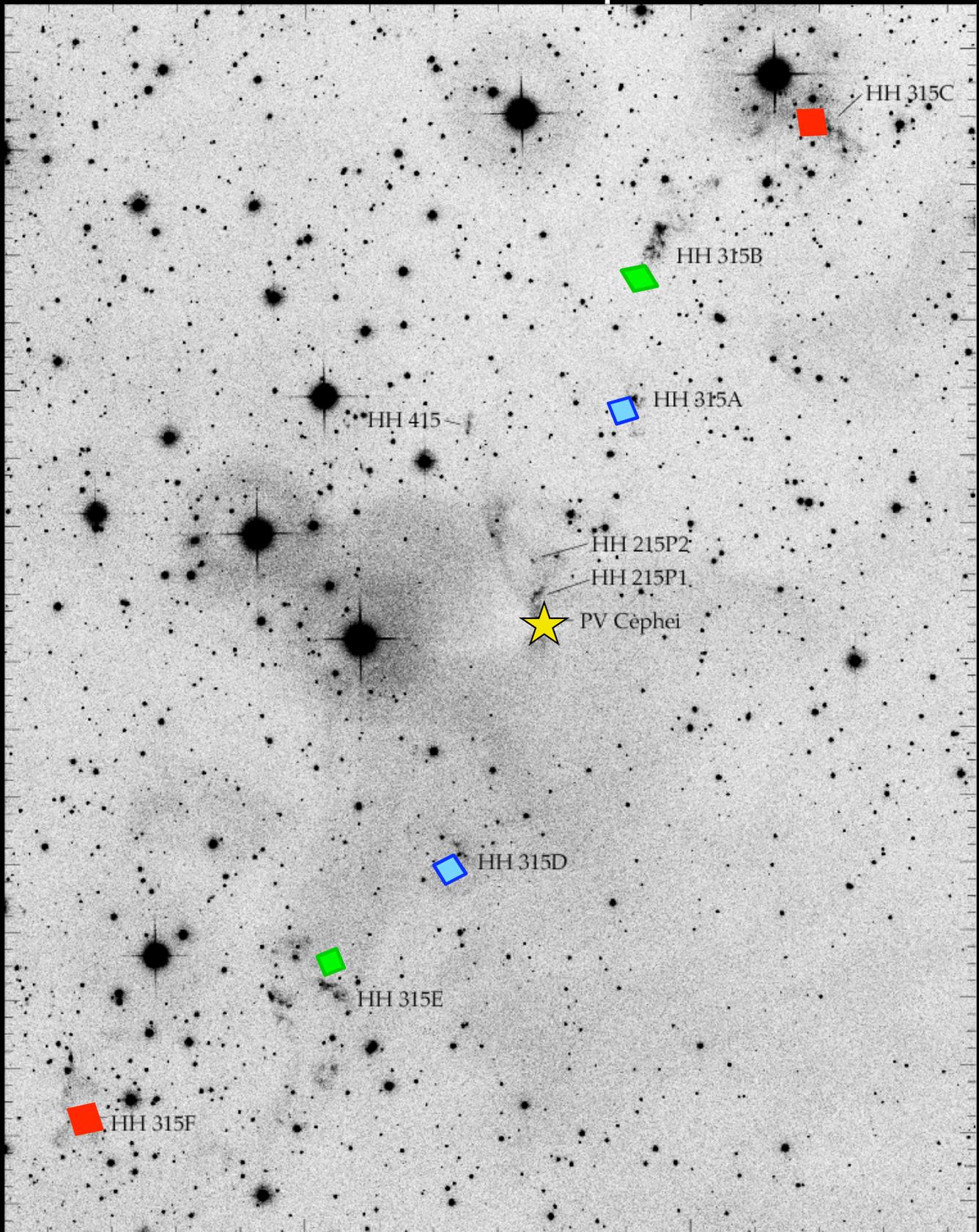
Spitzer Space Telescope • IRAC
Inset: visible light (DSS)
ssc2003-06f

Stanke, McCaughrean & Zinnecker, 1999

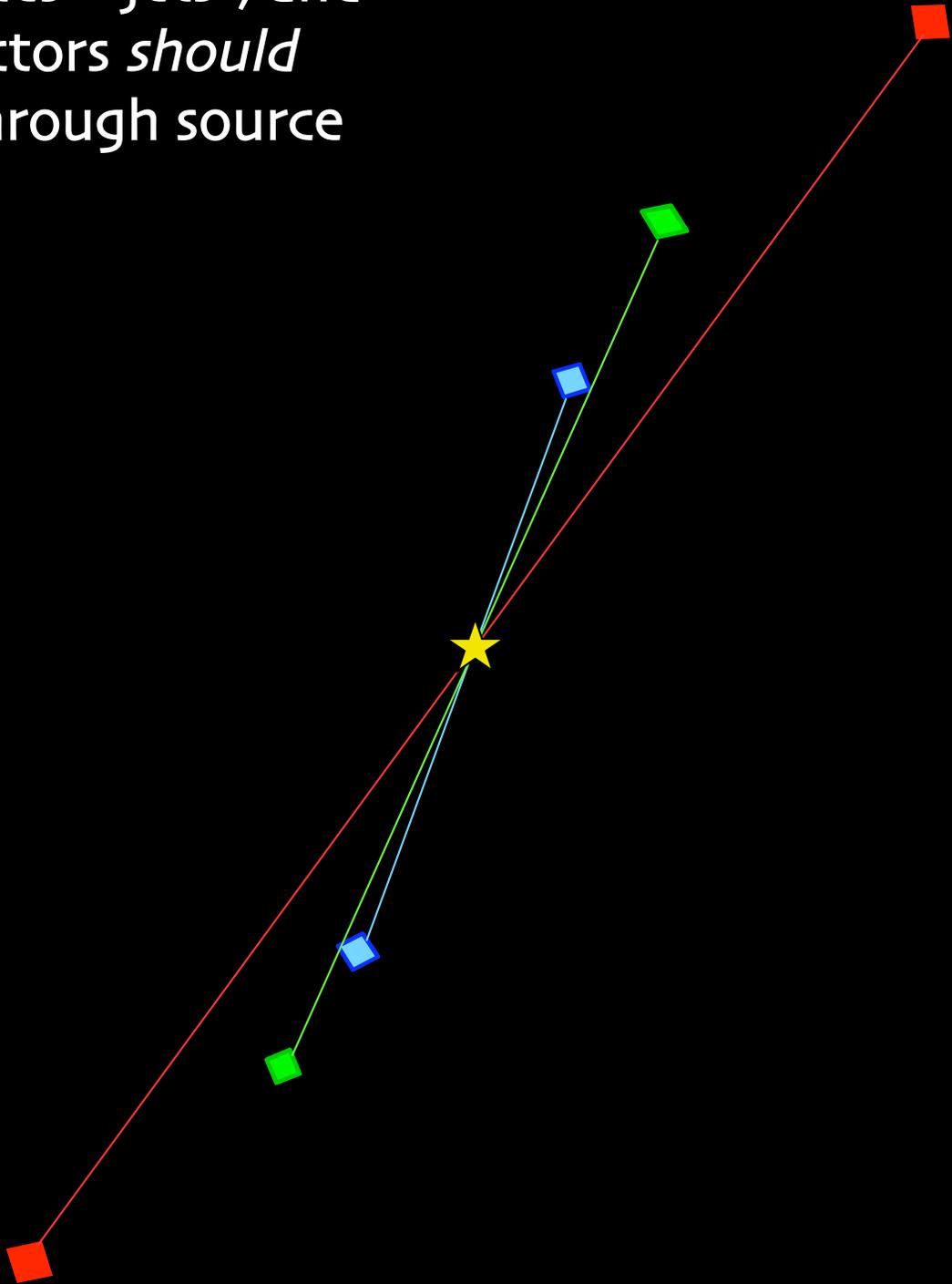
Coming Soon
PV Ceph: The Movie



Pairs of "HH knots" in PV Cep

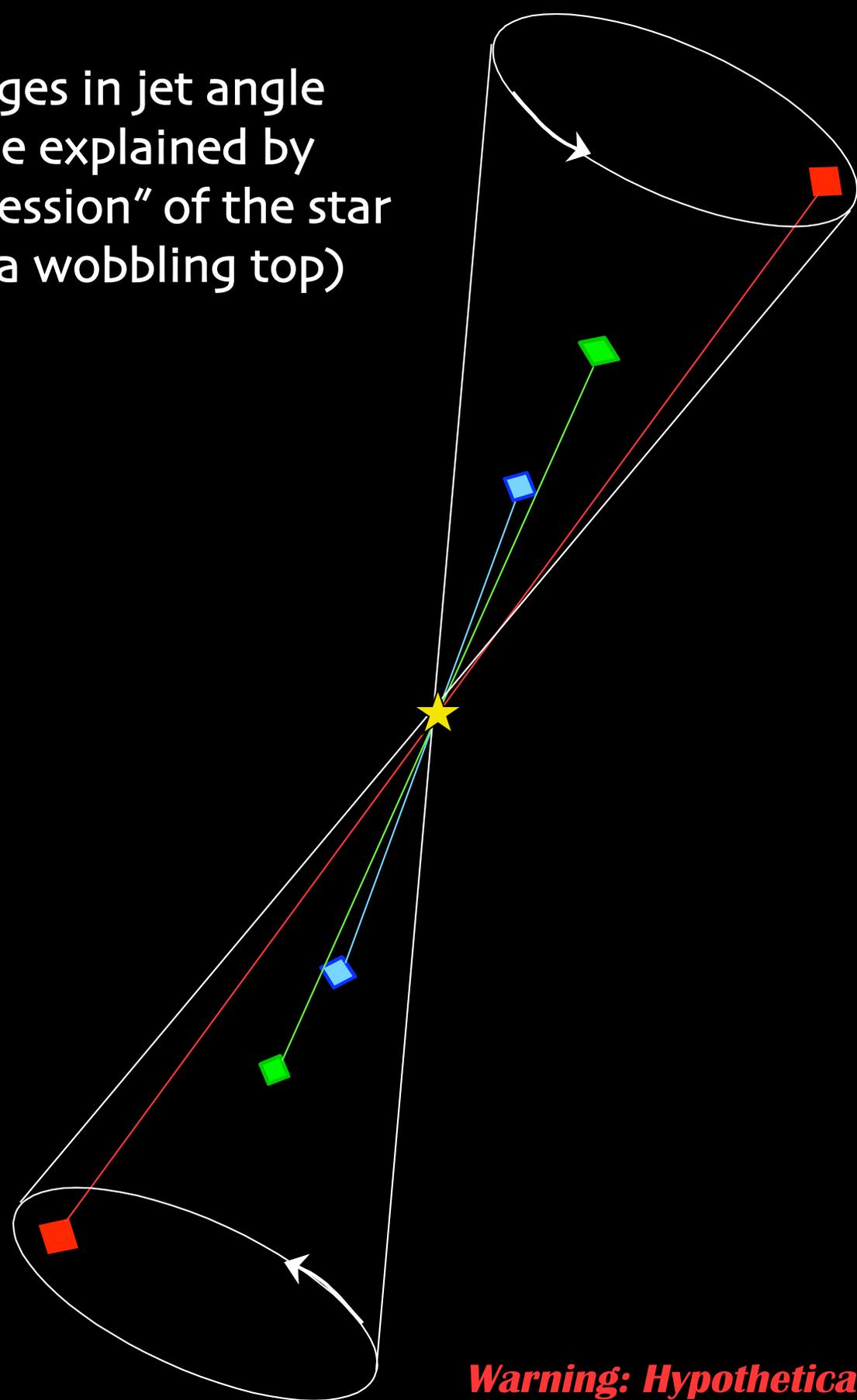


Pairs at similar
distances="jets", and
connectors *should*
pass through source



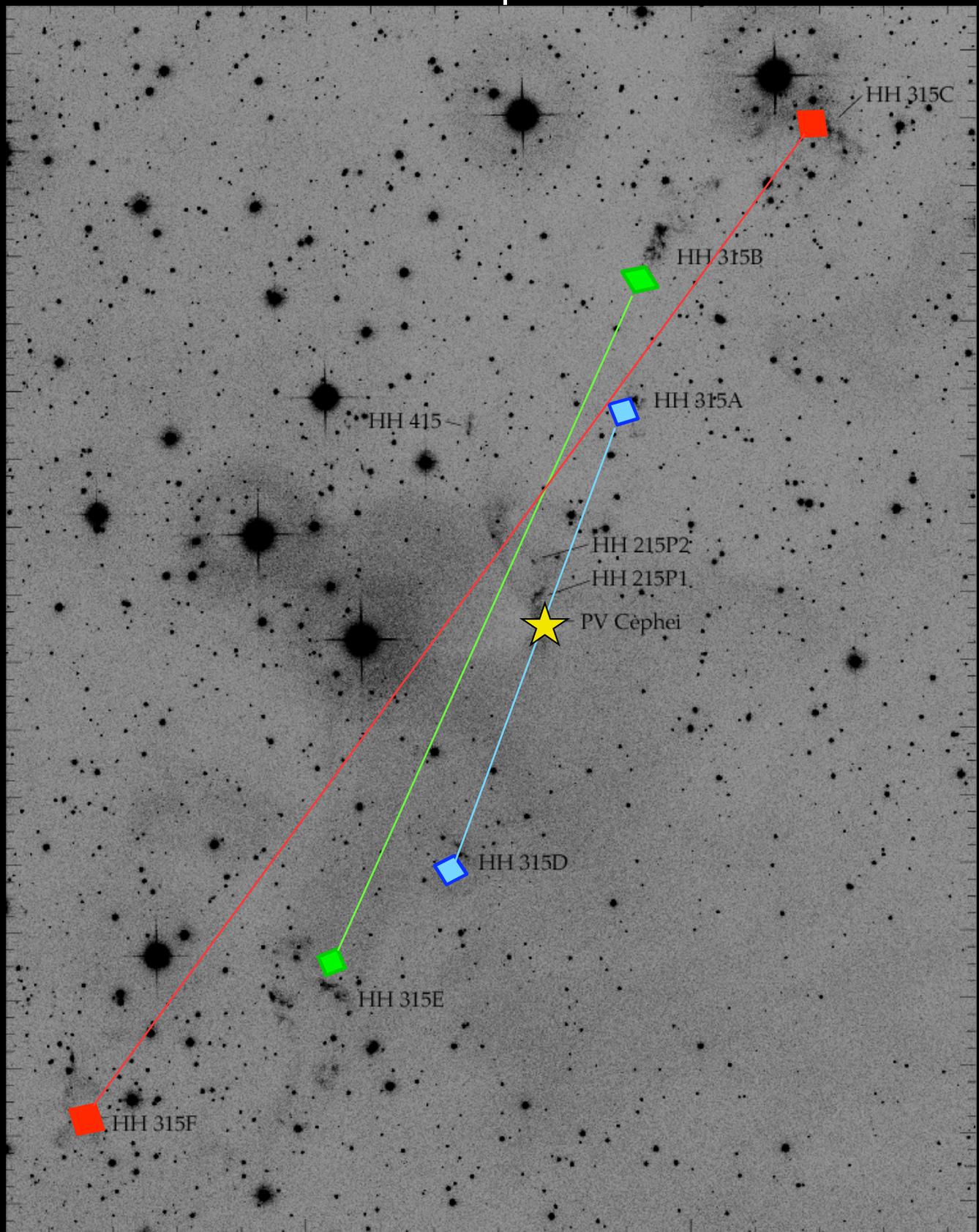
Warning: Hypothetical!

Changes in jet angle
can be explained by
“precession” of the star
(like a wobbling top)



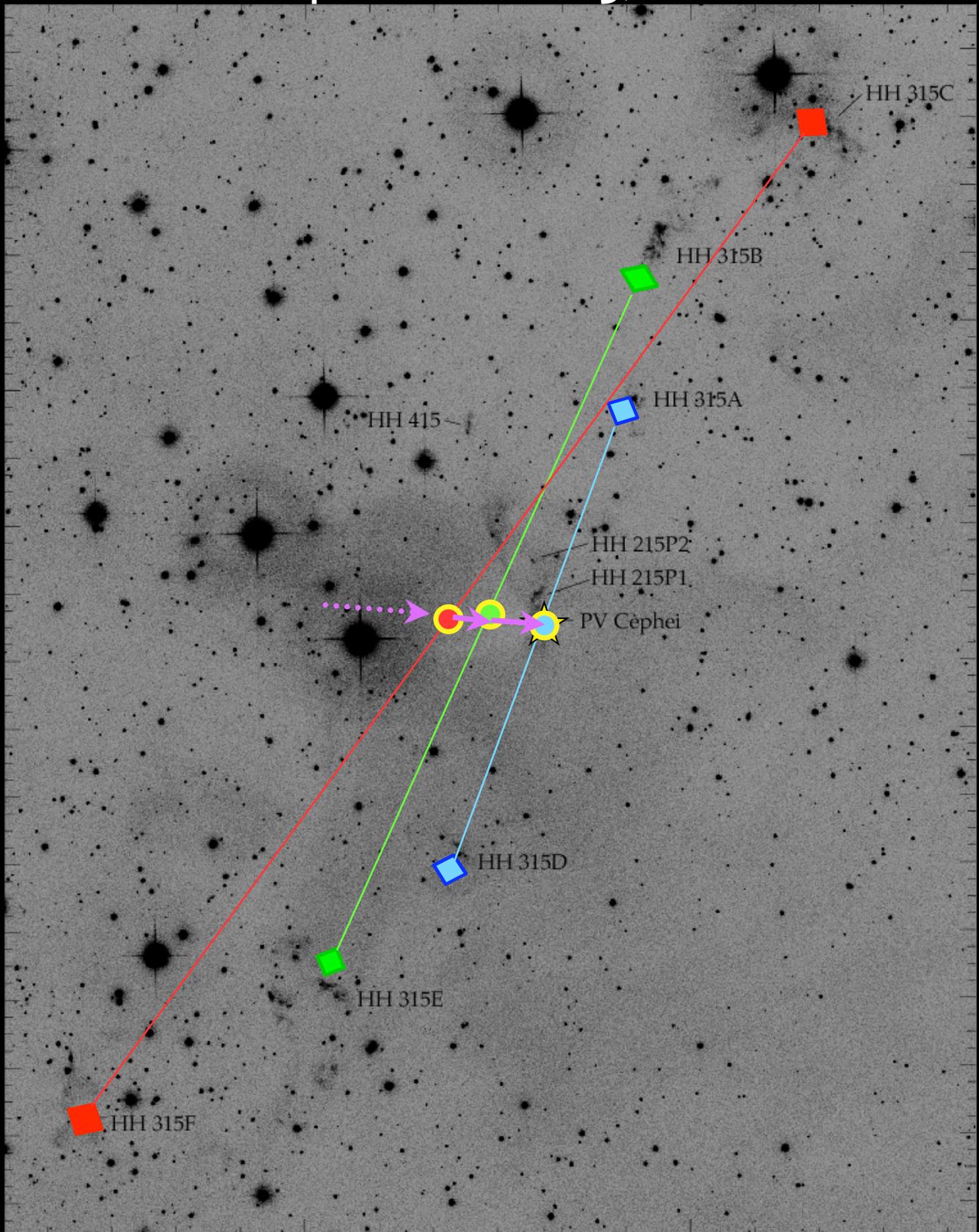
Warning: Hypothetical!

But... Jets from PV Ceph "Miss" the Source



Can't be (just) precession.

What if PV Ceph was moving, fast?

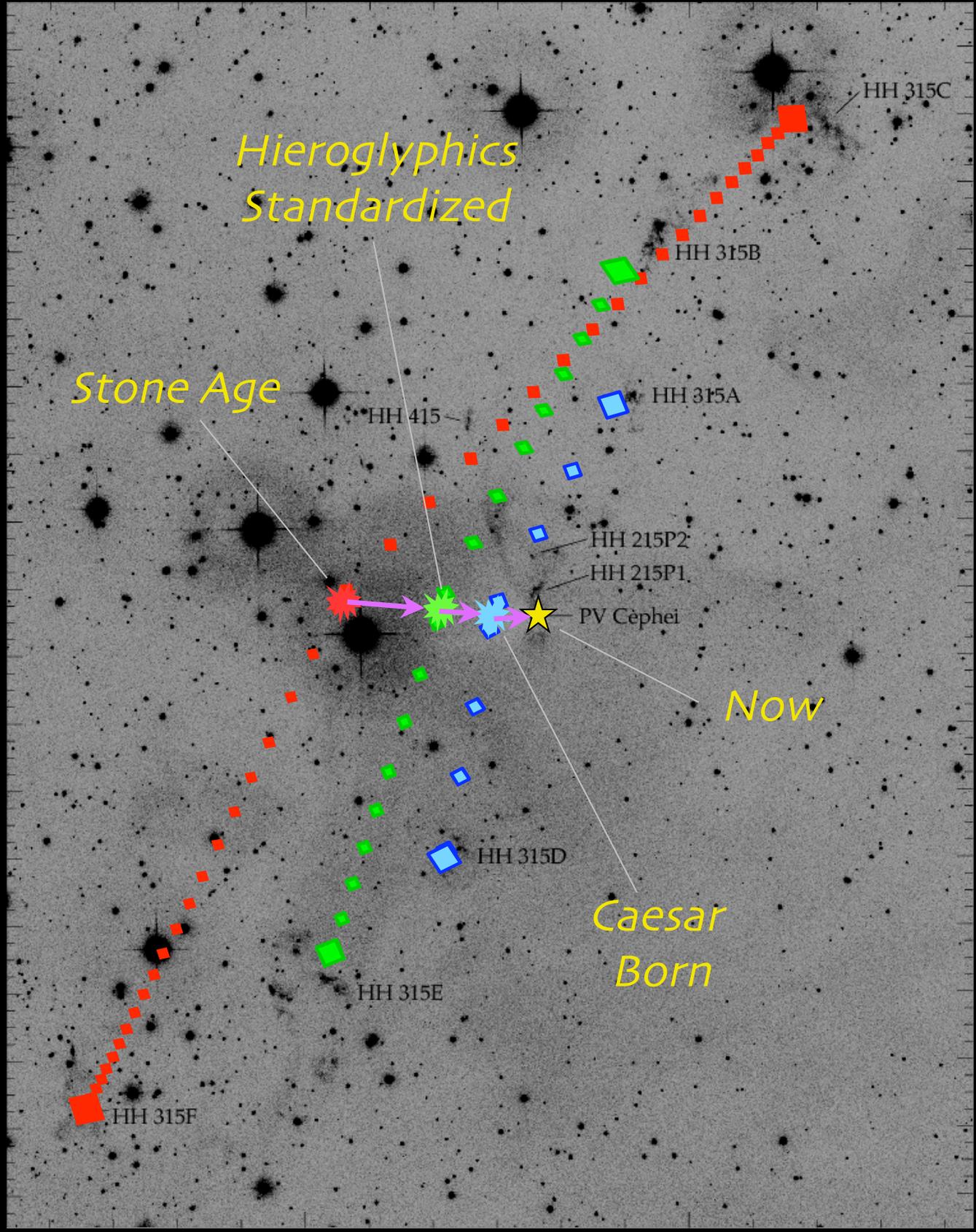


PV Cephei: The Movie

A "plasmon" deceleration model
(Goodman & Arce 2003)

PV Ceph

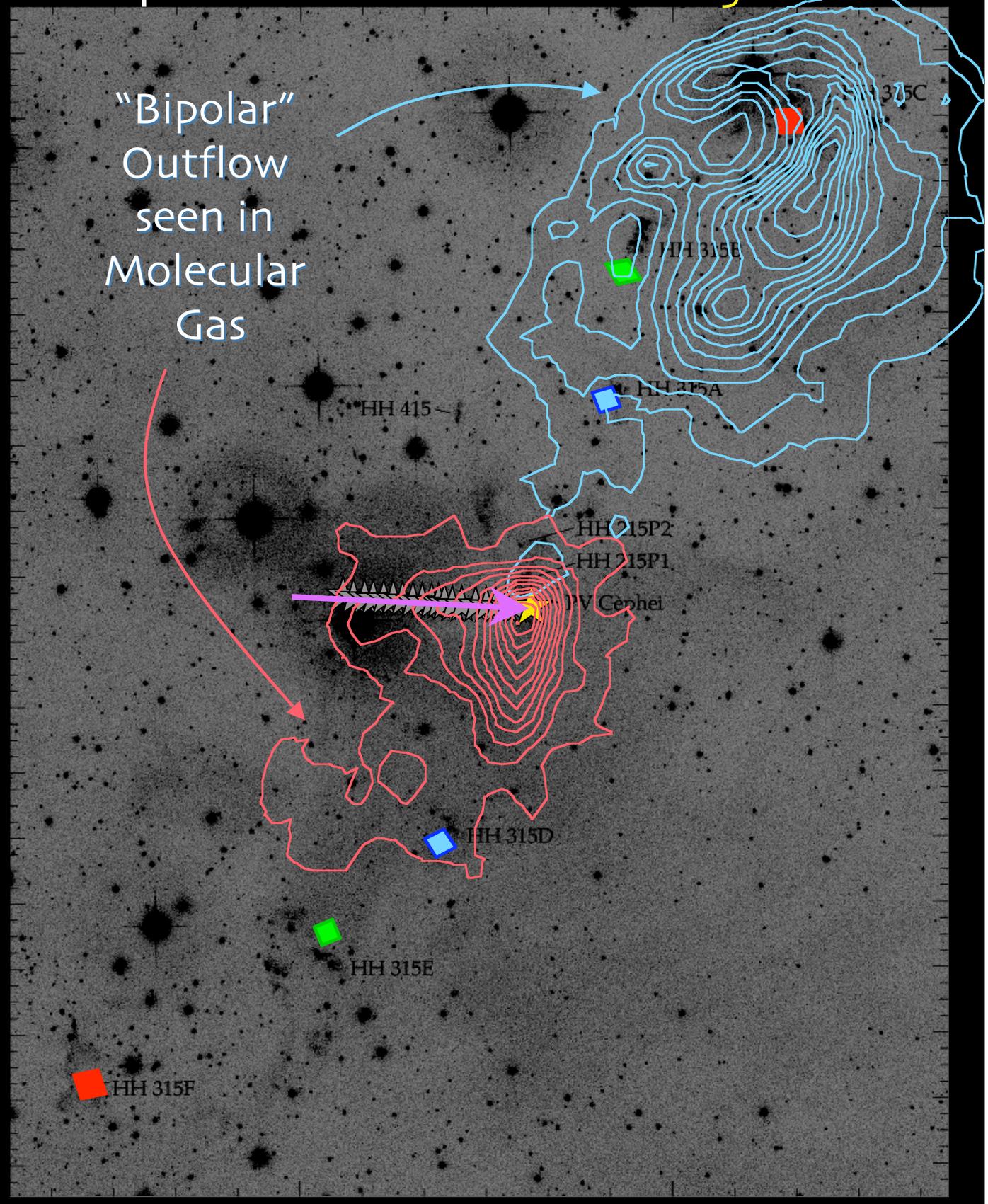
Full History



PV Ceph

Corroborating Evidence

“Bipolar”
Outflow
seen in
Molecular
Gas



HH 415

HH 315E

HH 315A

HH 215P2

HH 215P1

PV Cephei

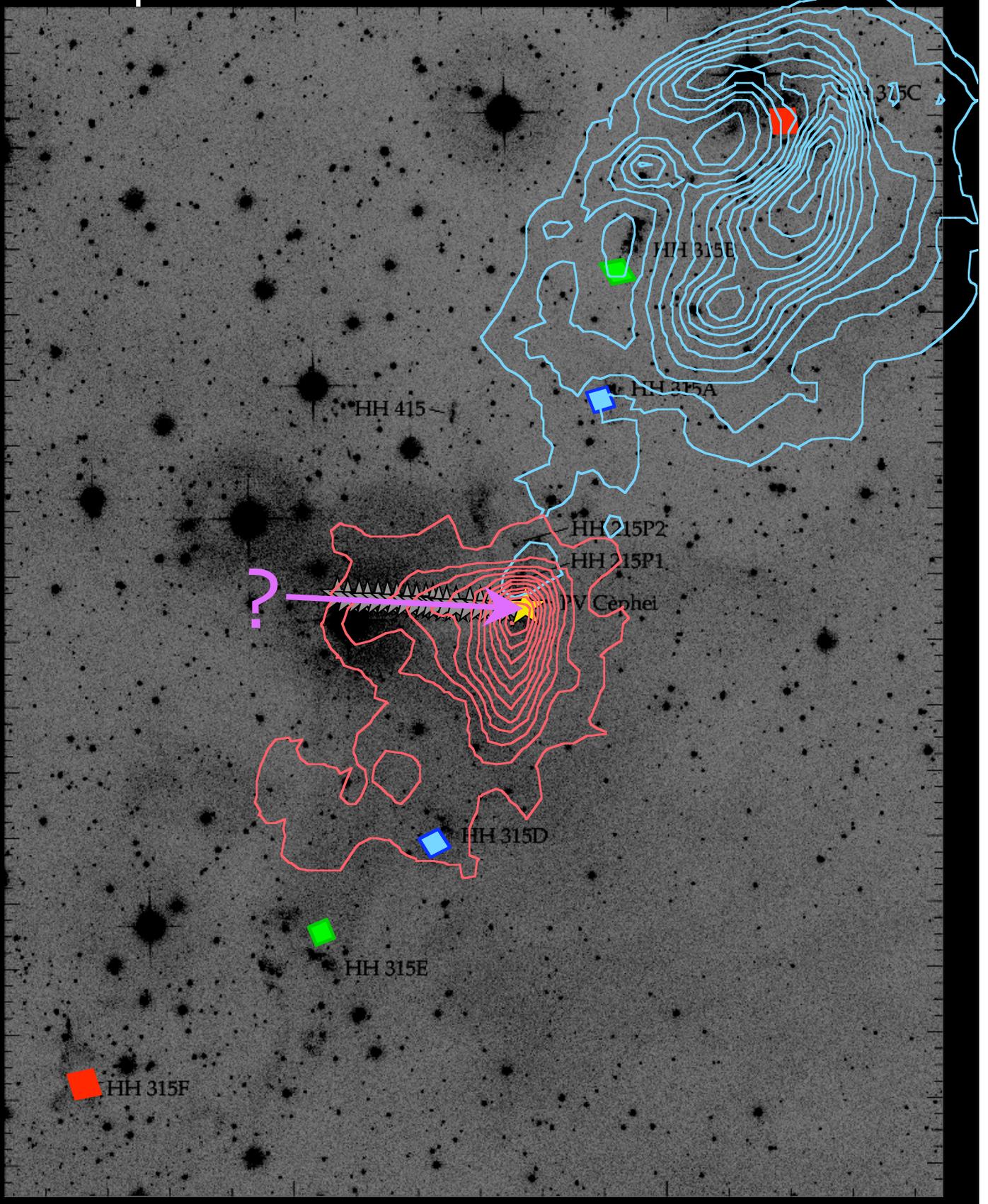
HH 315D

HH 315E

HH 315F

PV Ceph

How did it do this?



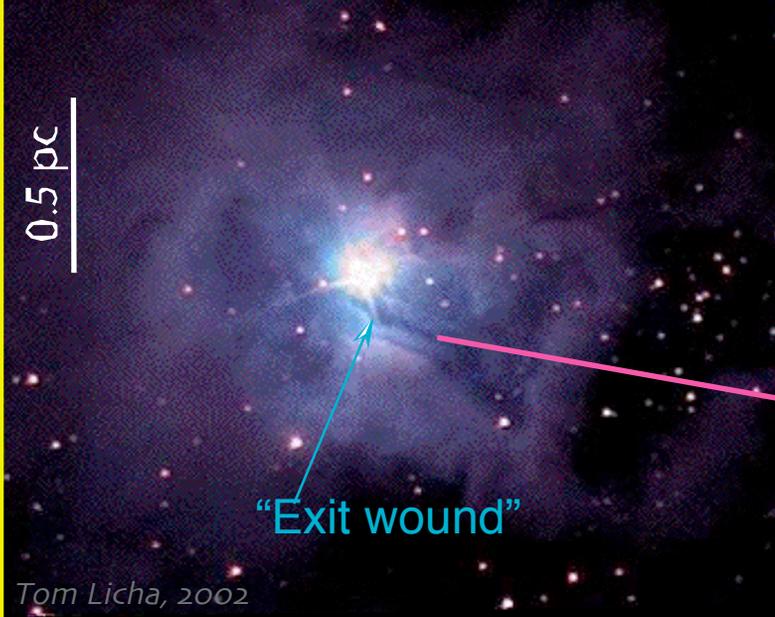
How did it do this?

Must be "gravity"!

Close encounter with another star

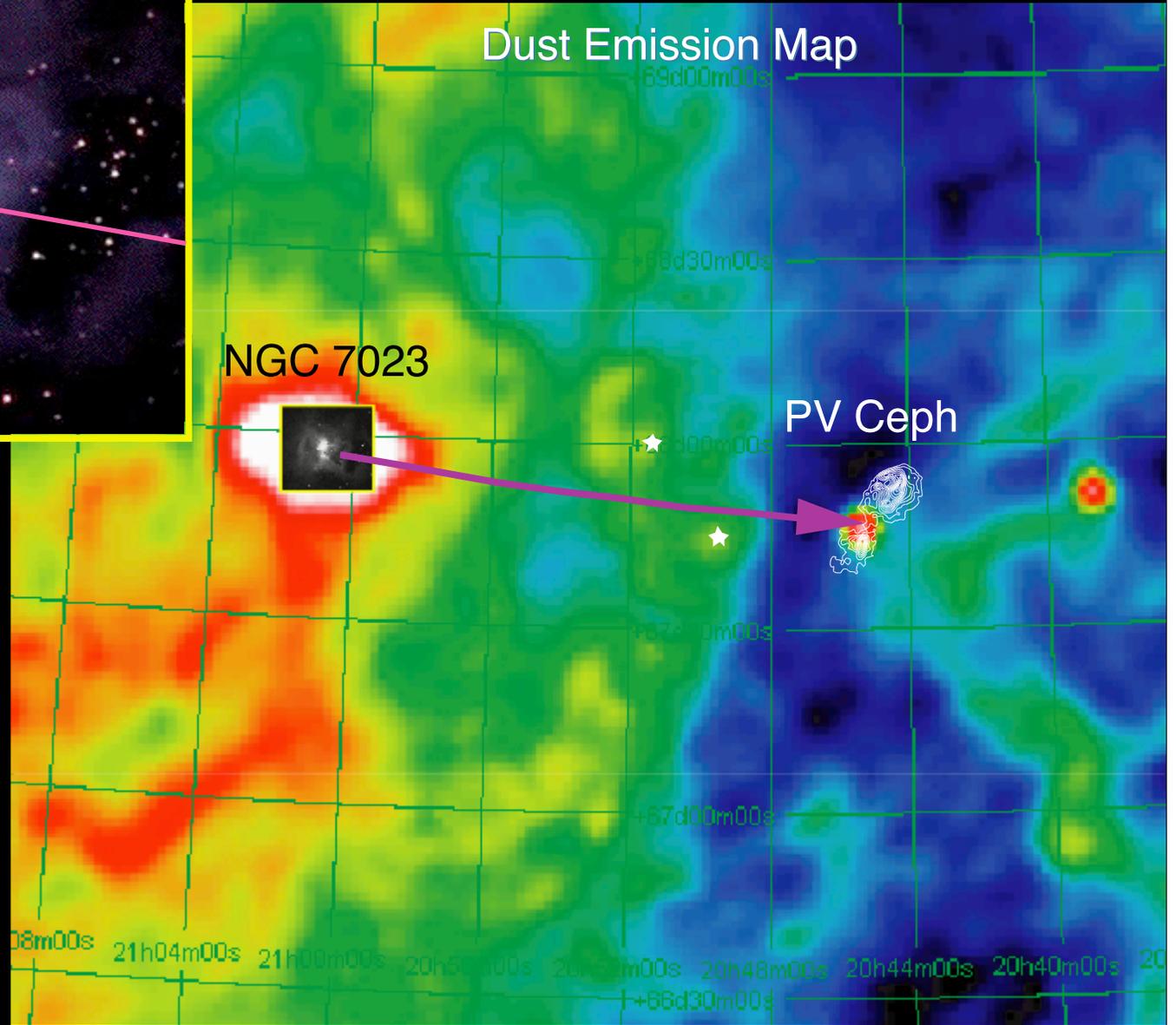
Optical Image of NGC 7023

0.5 pc



Tom Licha, 2002

Dust Emission Map



Young Star
Caught
Speeding
Away from
Home

Goodman & Arce 2003

“Immigration” Happens

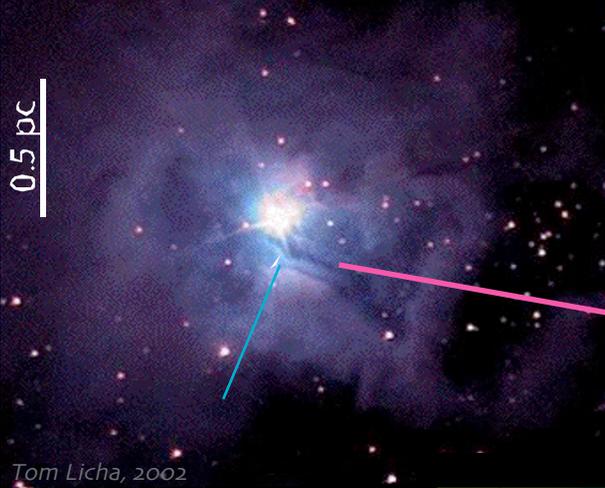
This discovery was a surprise.

Underage stars can run away from home, fast!

A proper “speeding study” is needed to understand what stars formed where, as a function of time.

Optical Image of NGC 7023

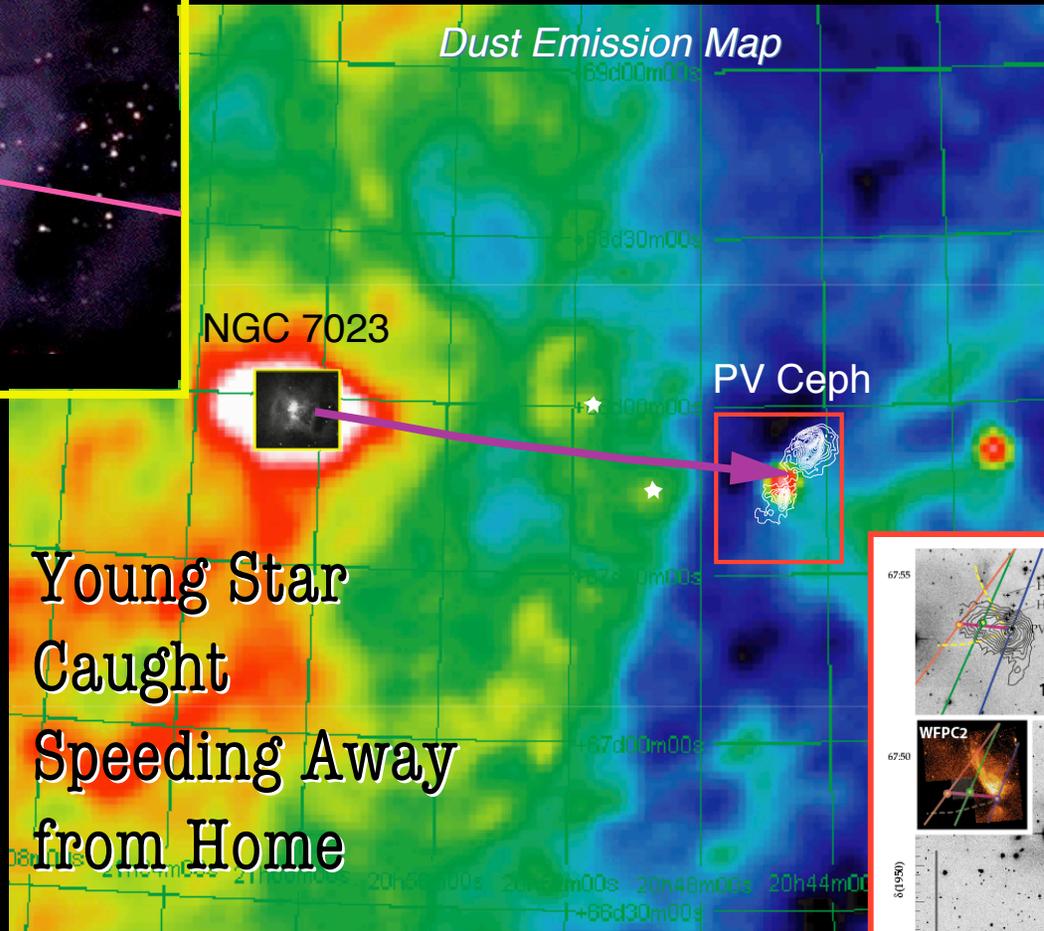
0.5 pc



Tom Licha, 2002

First Evidence for a Young Star moving at such High Speed far from a Cluster

Dust Emission Map



Young Star Caught Speeding Away from Home

Speed = 22 km/s
Age = 0.5 million years

Goodman & Arce 2003

