

Candidate Young Stellar Objects in the S-cluster

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Candidate Young Stellar Objects in the S-cluster: The Kinematic Analysis of a Sub-population of the Low-mass G-objects close to Sgr A*

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Multi-Wavelength Observations of the Galactic Center Object G1

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work in progress

The Galactic Center

...in the Milky Way in optical wavelengths



Image: ESO/Serge Brunier

The Galactic Center

...in infrared



Image: NASA, JPL-Caltech, Spitzer Space Telescope, Susan Stolovy et al.;
Judy Schmidt

The Galactic Center

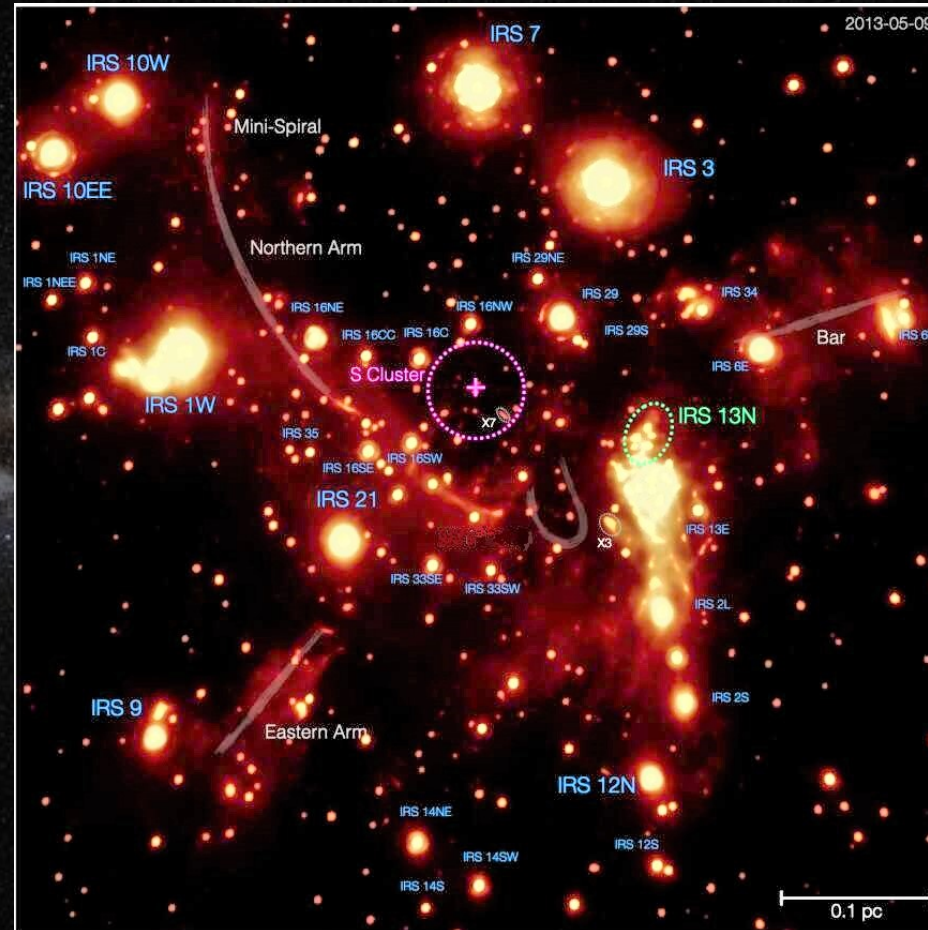


Image: ESO and Lauritz Thomkins

The S Cluster

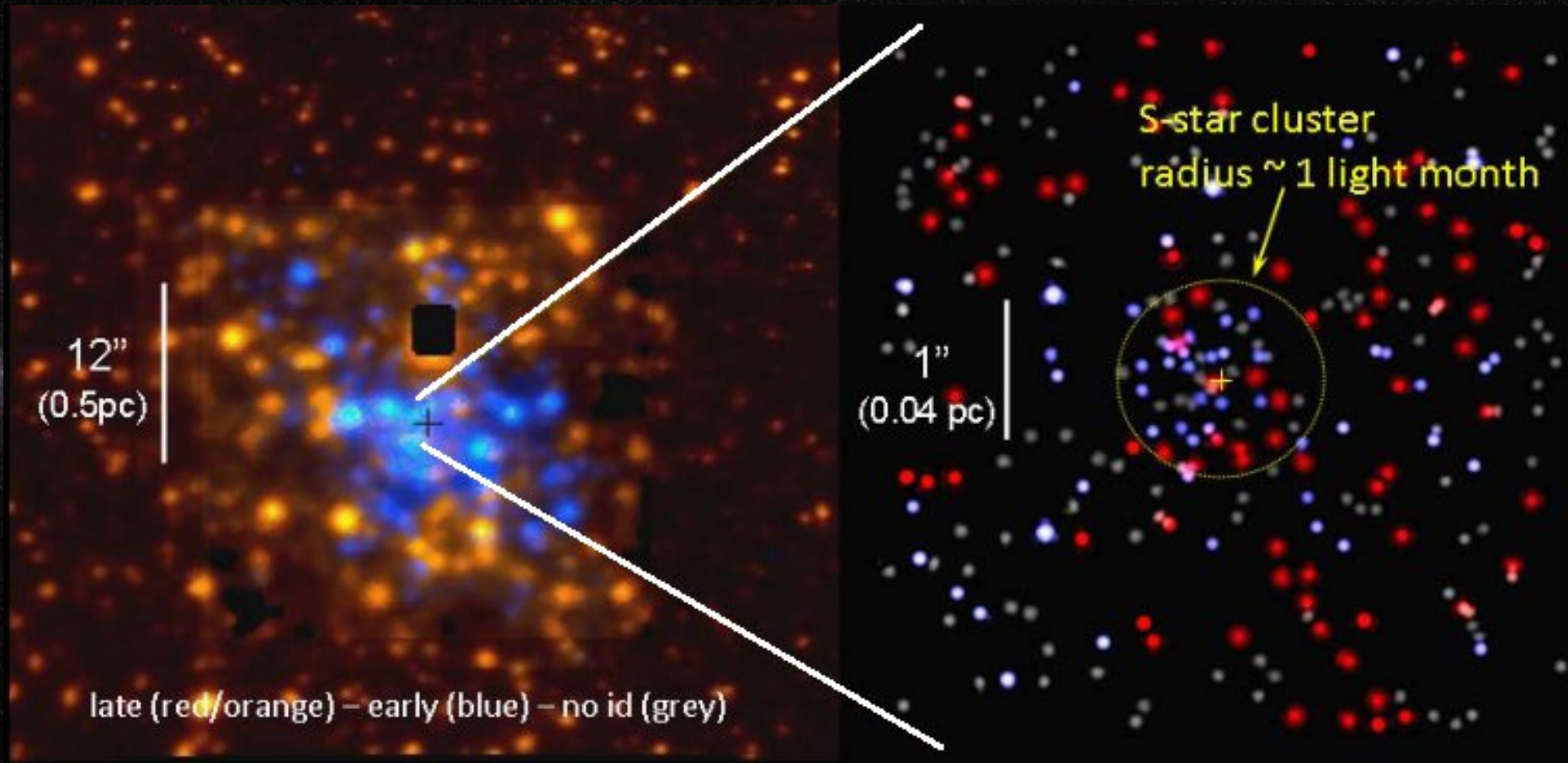
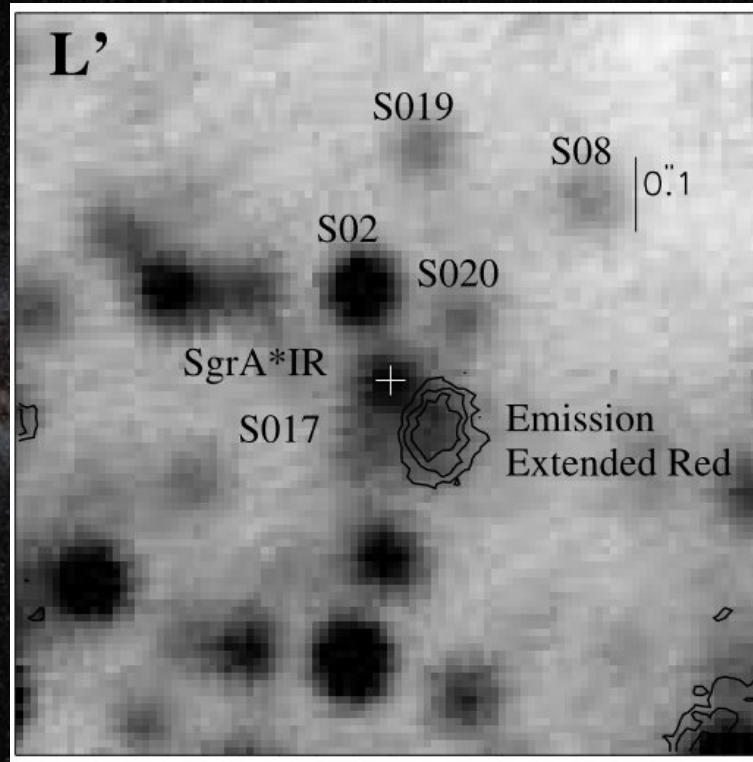


Image: Genzel et al. (2010)

G1

first reported by
Clénet et. al. (2004, 2005)



L'-band in July 2004
Image: Ghez et al. (2005)

G2/DSO

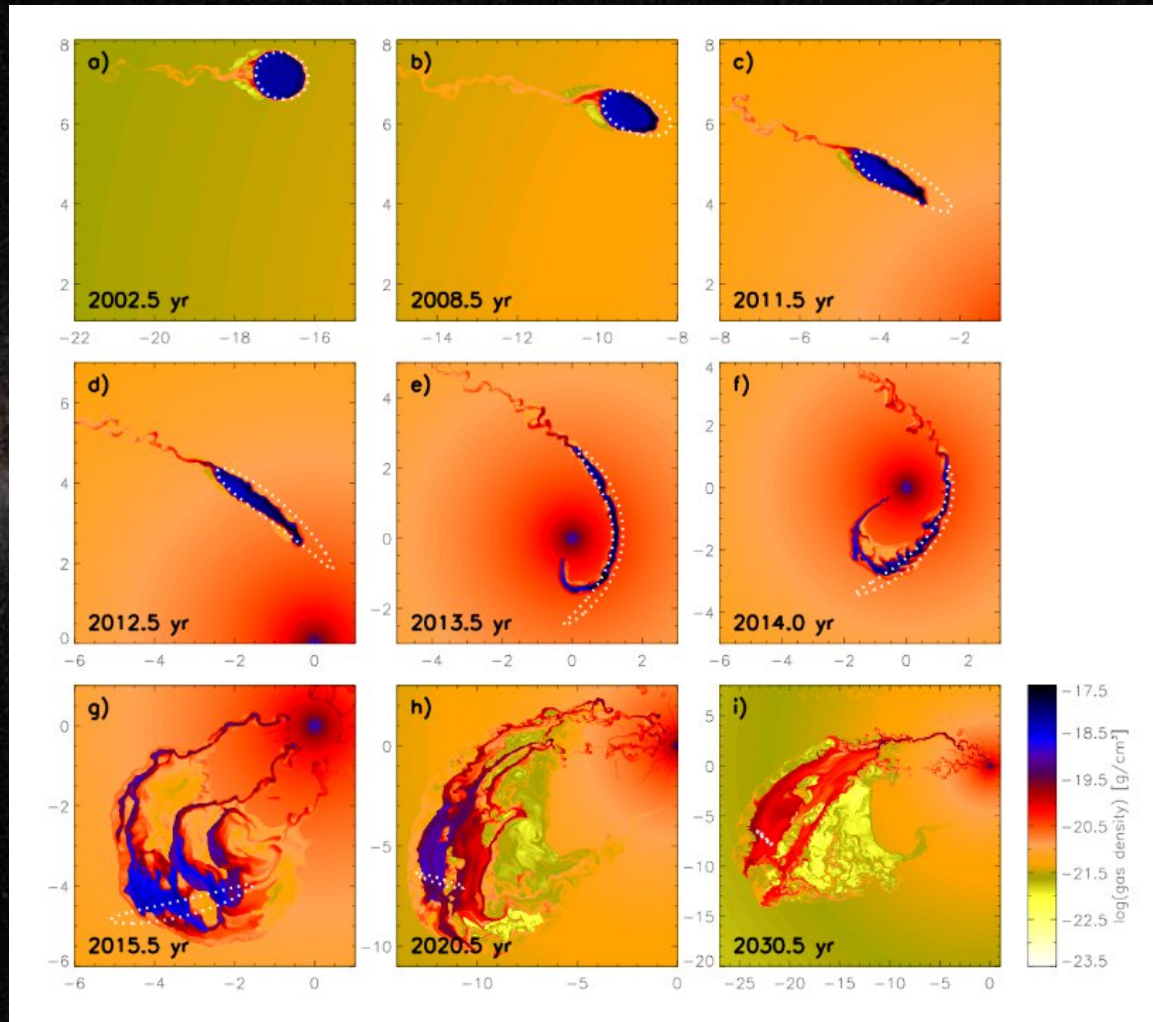
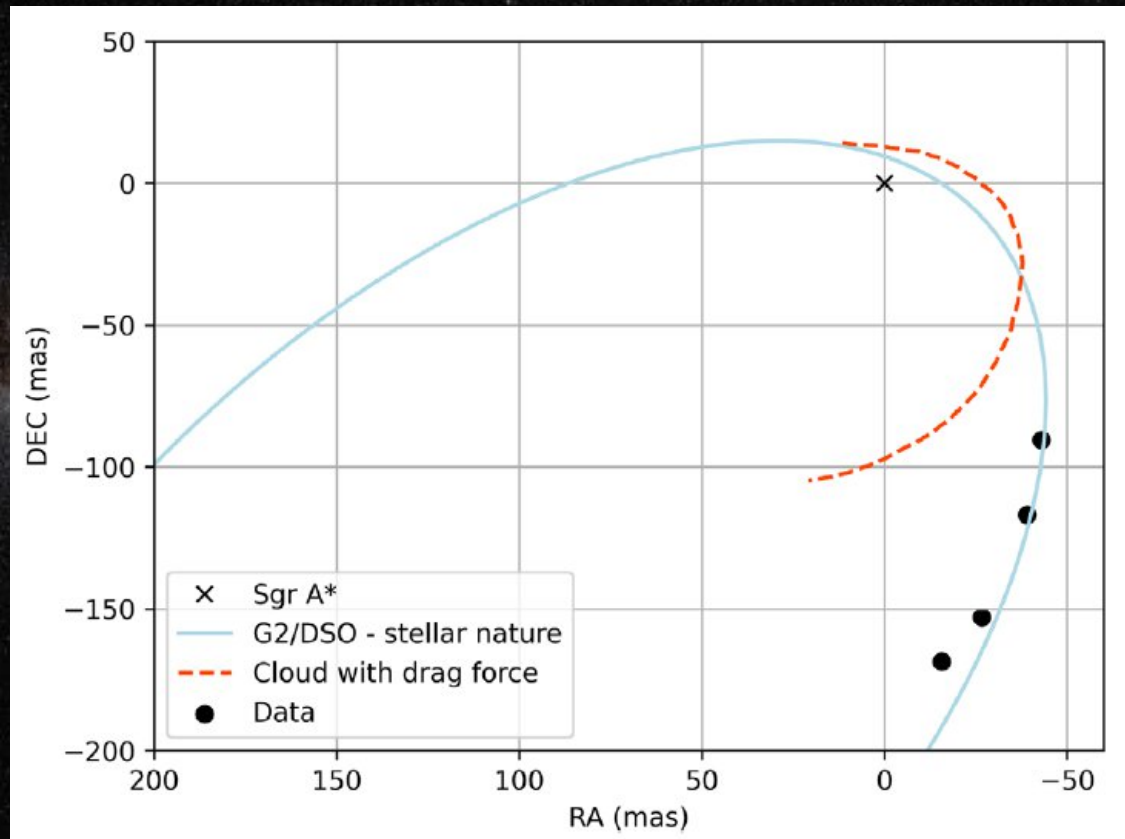


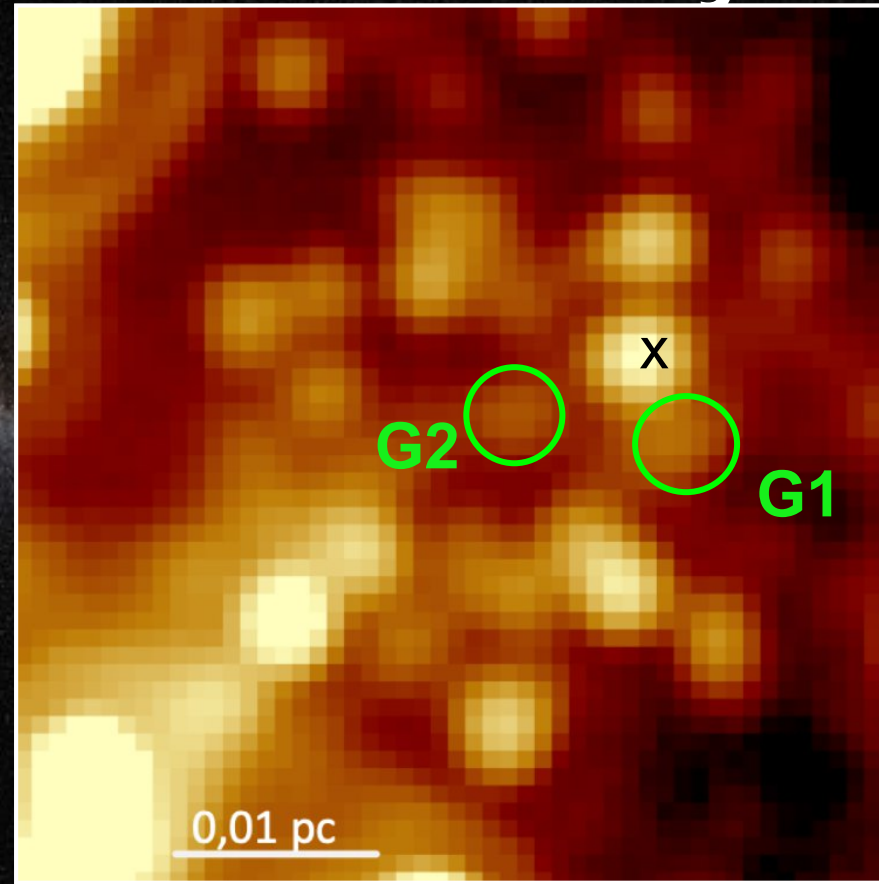
Image: Schartmann et al. (2013)

G2/DSO



Peißker et al. (2021)

And what about G1 and other dusty sources?



L'-band in 2008.4

And what about G1 and other dusty sources?



Used Data

- SINFONI
 - 2005 - 2019
 - H+K band filter
 - Data cubes
- NACO
 - L' band data 2002-2018
 - K band data 2011
 - M band data 2012
- ALMA
 - 100 GHz data 2017
- NIRC2: 2019

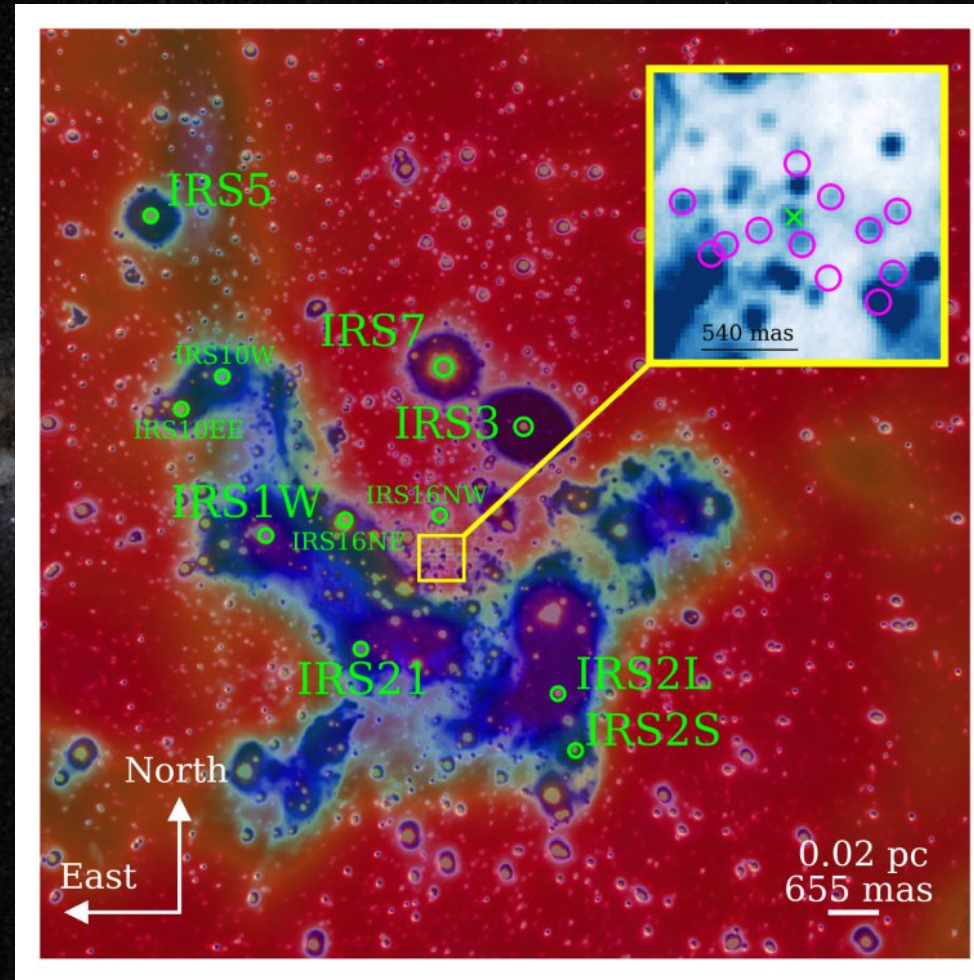
WANTED

G1, G2 (DSO),
D2, D23, D3, D3.1,
D5, D9,
OS1, OS2,
X7, X7.1, X8

PUBLICATION

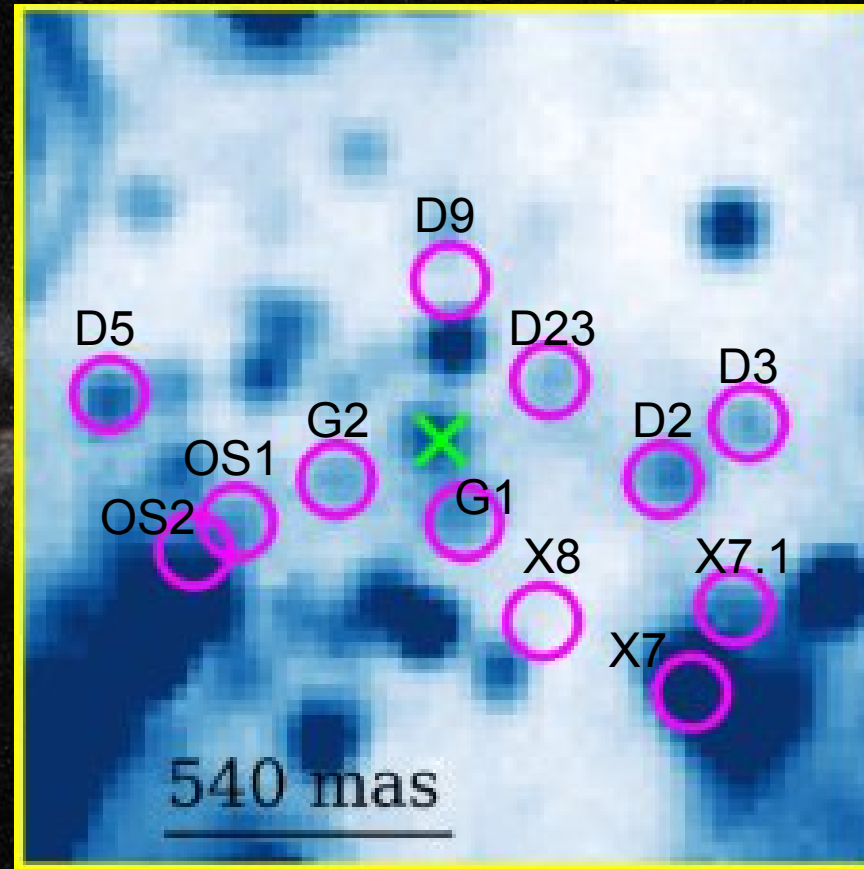
REWARD

Source Identification



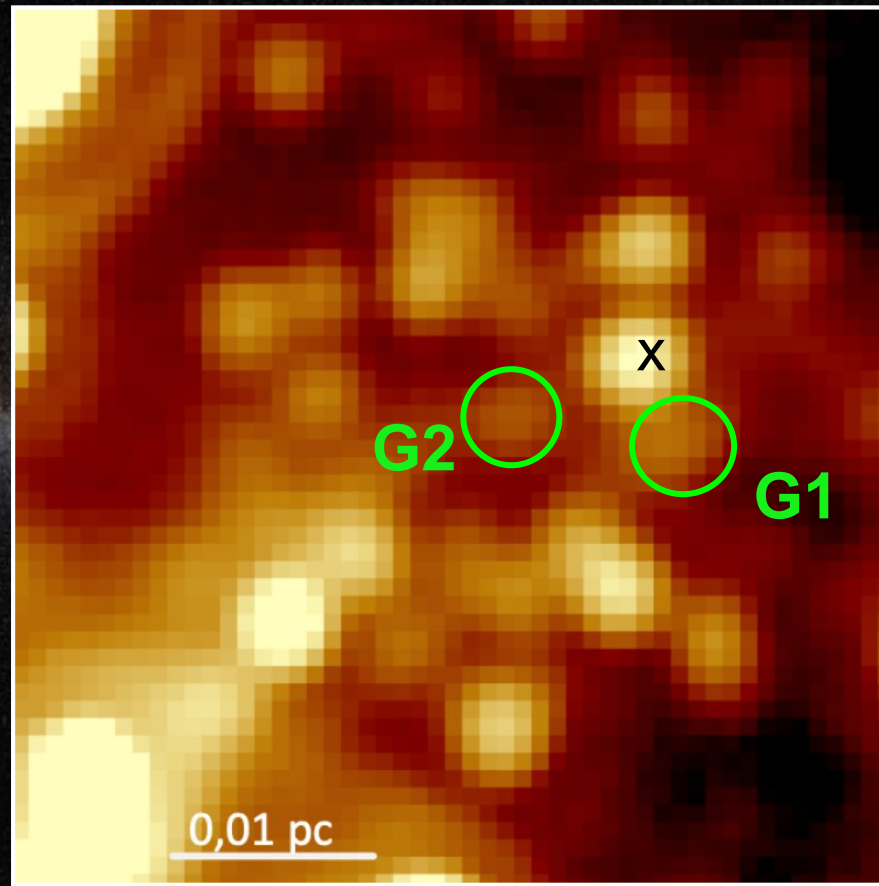
Peißker et al. (2024)

Source Identification



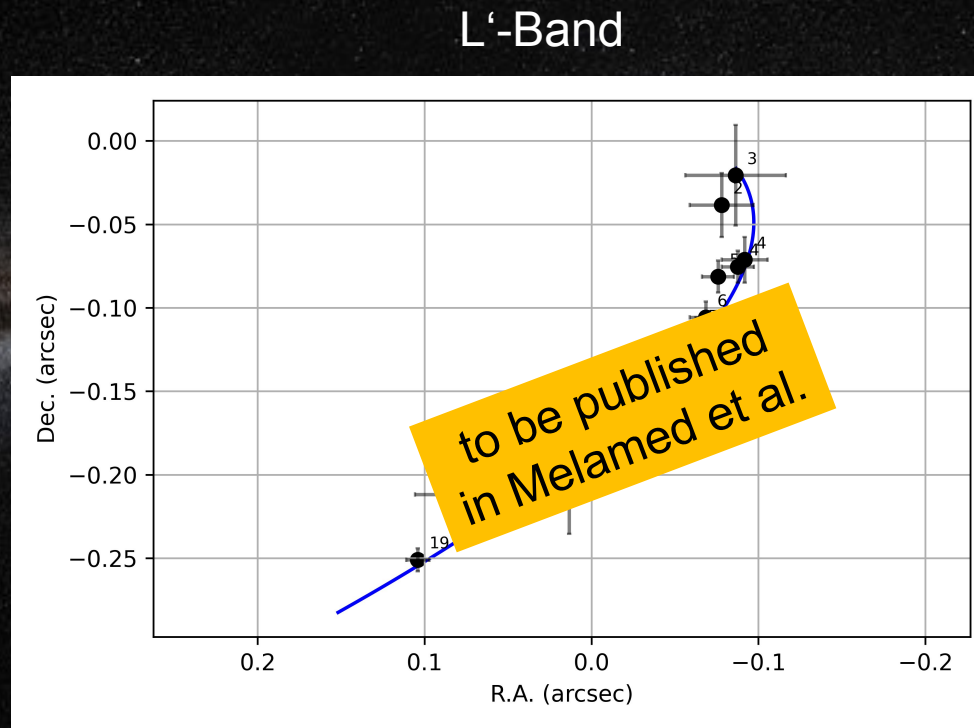
Peißker et al. (2024)

Source Identification

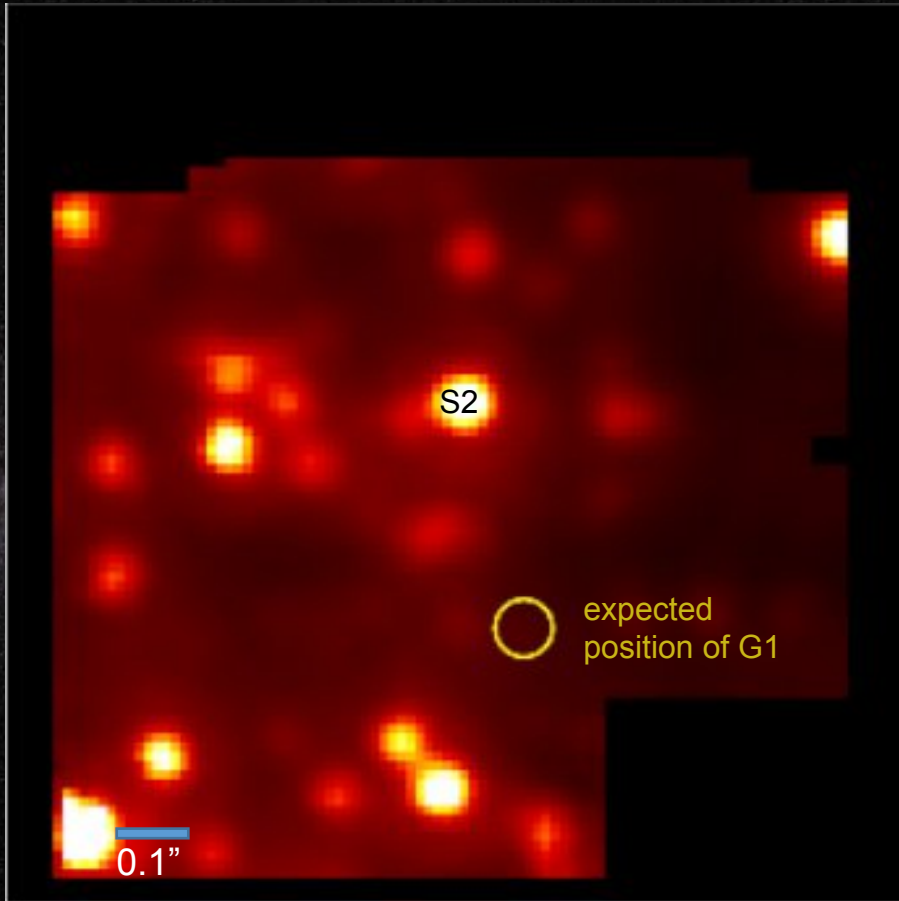


L'-band in 2008.4

The Orbit of G1 in the L'-Band



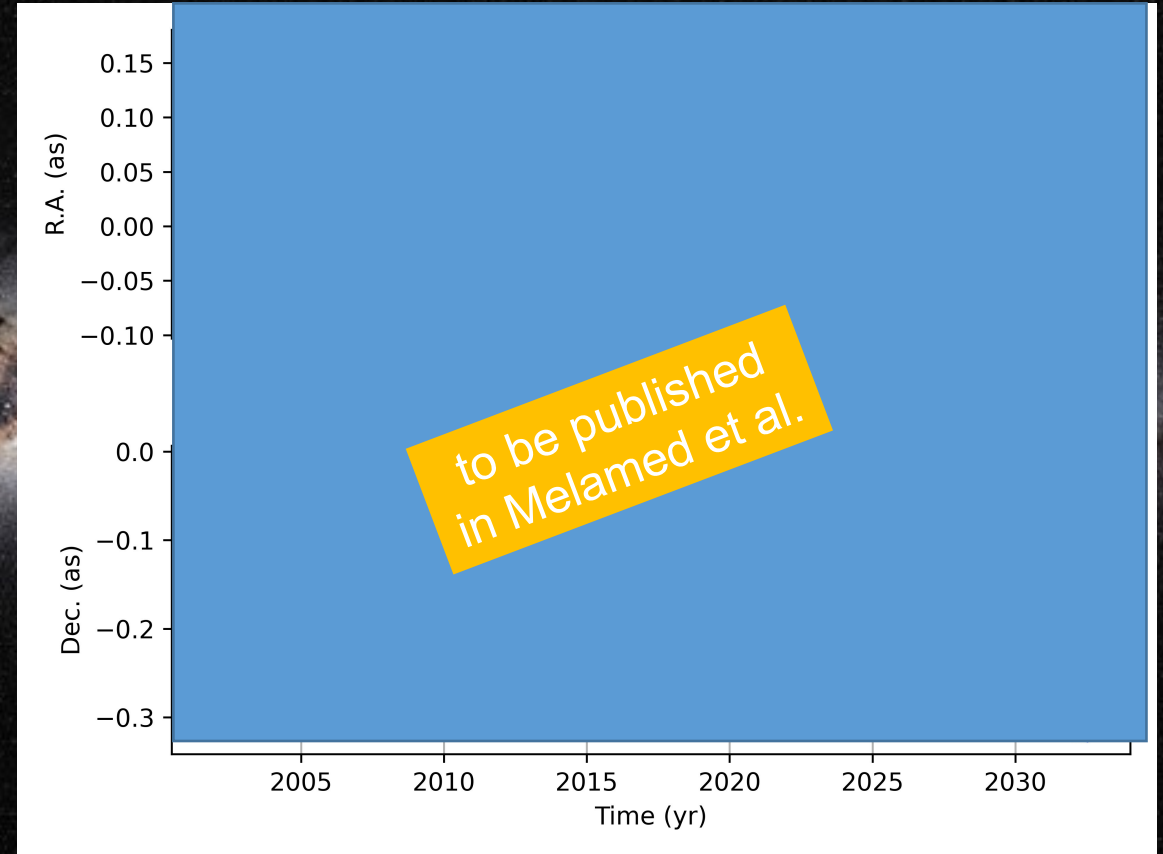
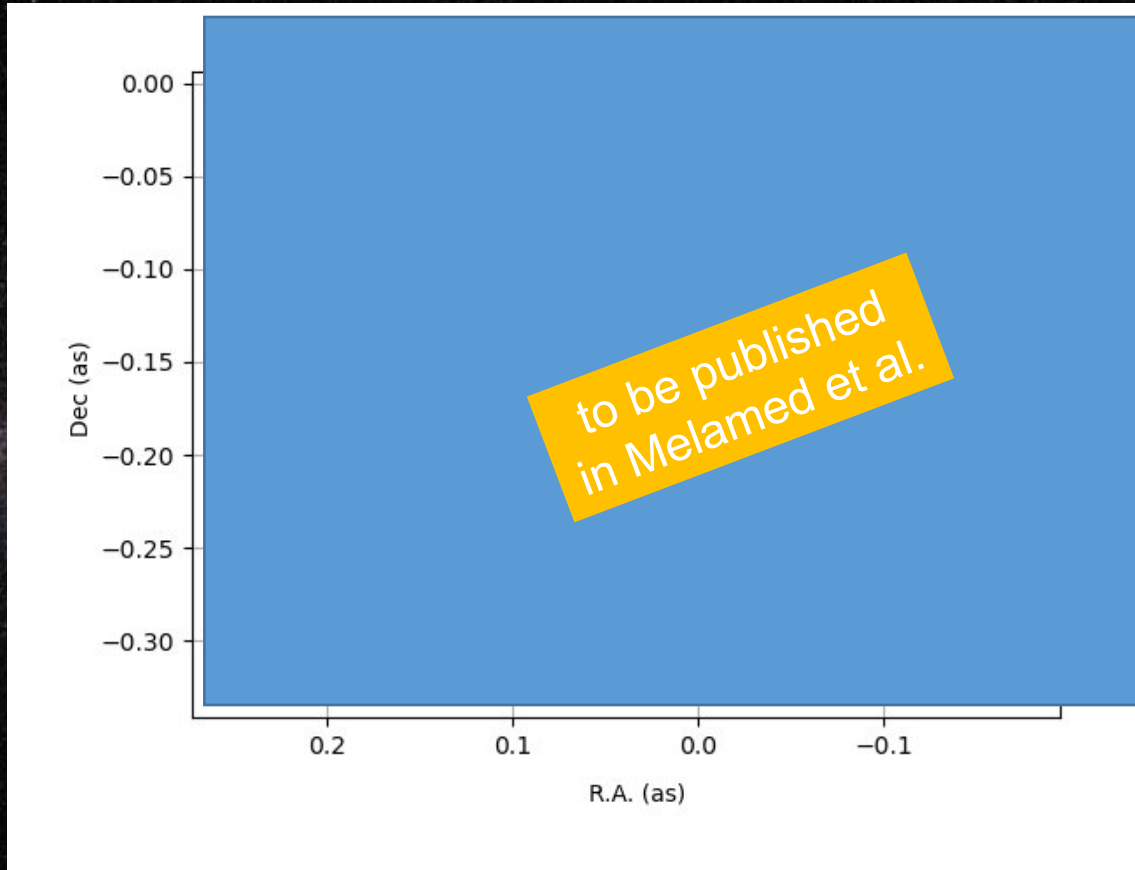
K-Band Data



2008.2

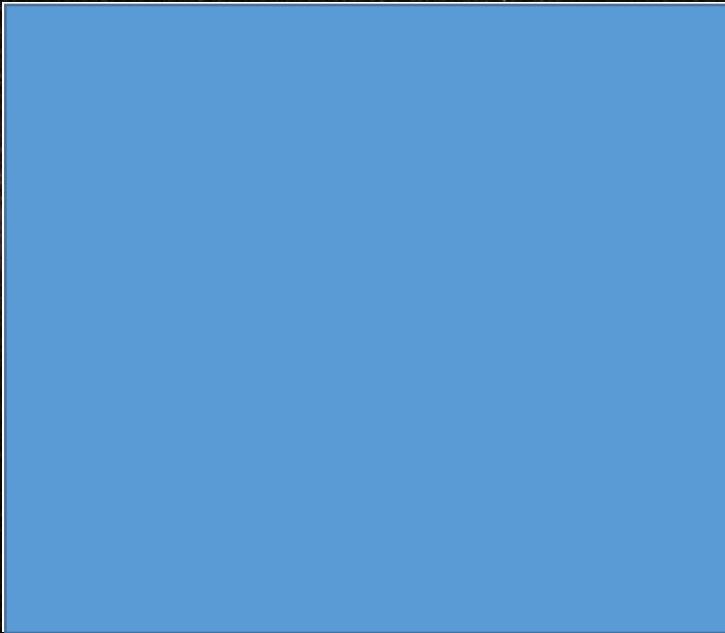
- Wavelength range used here:
2.0 μm - 2.2 μm
- Br- γ line: 2.16612 μm (H I line)

The Orbit of G1 in Br- γ Linemaps



G1 Positions in Brackett- γ Linemaps

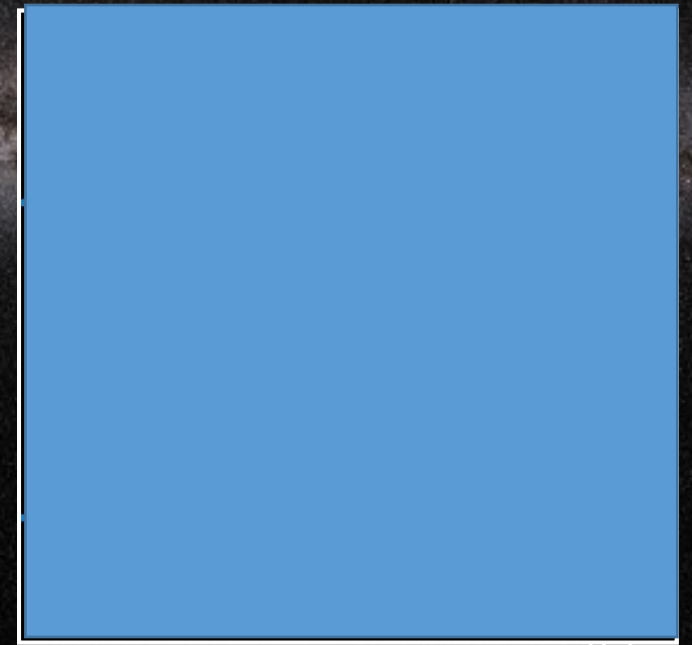
2007.5



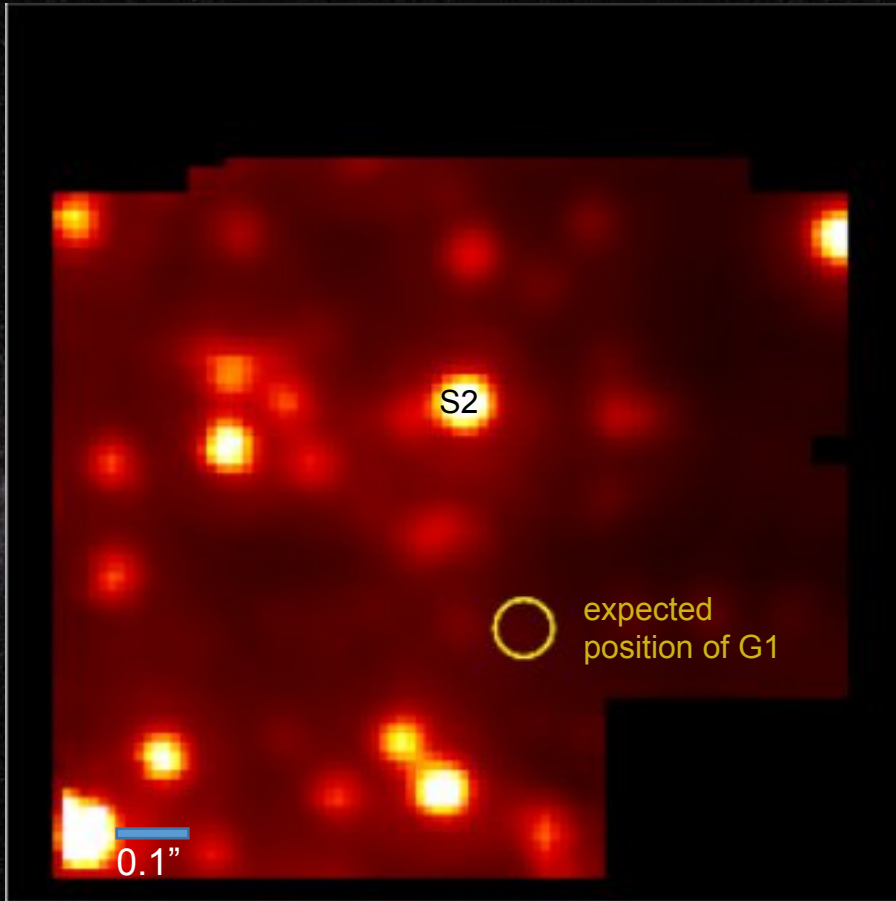
2008.2



2019.4



K-Band Data



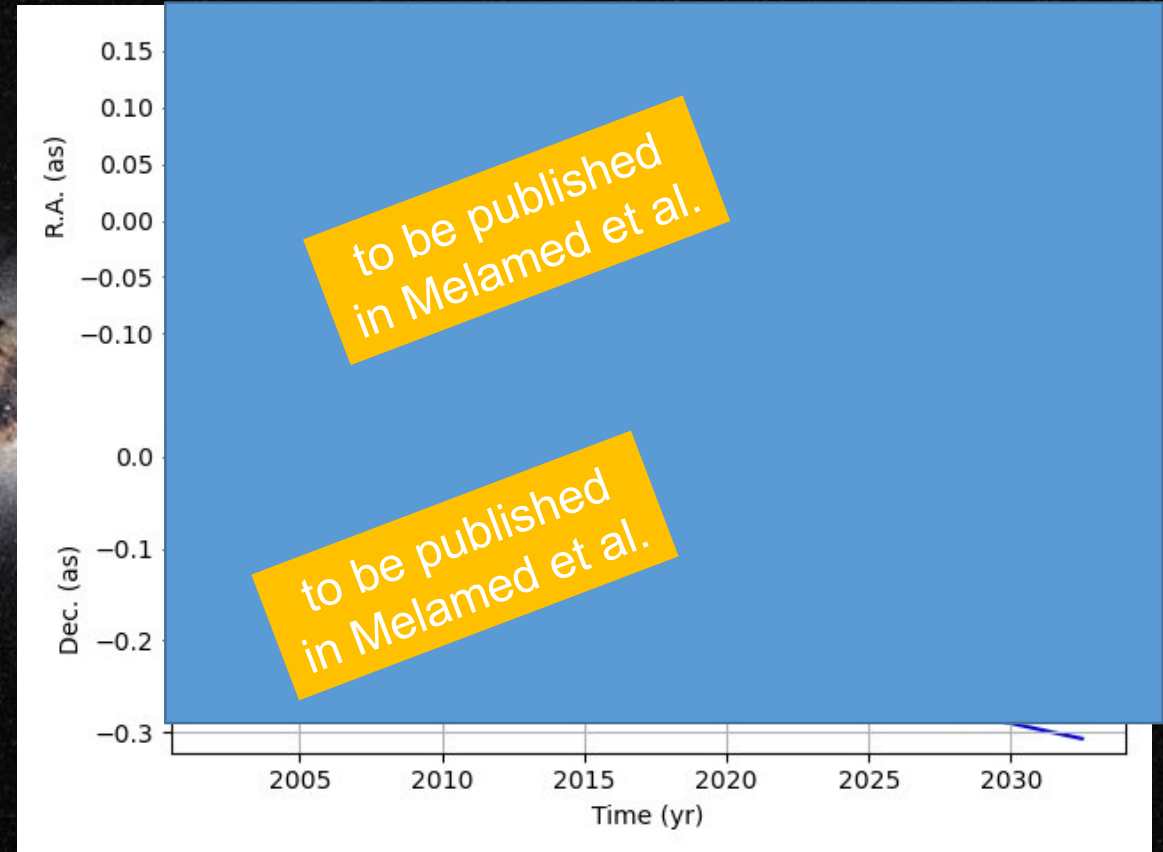
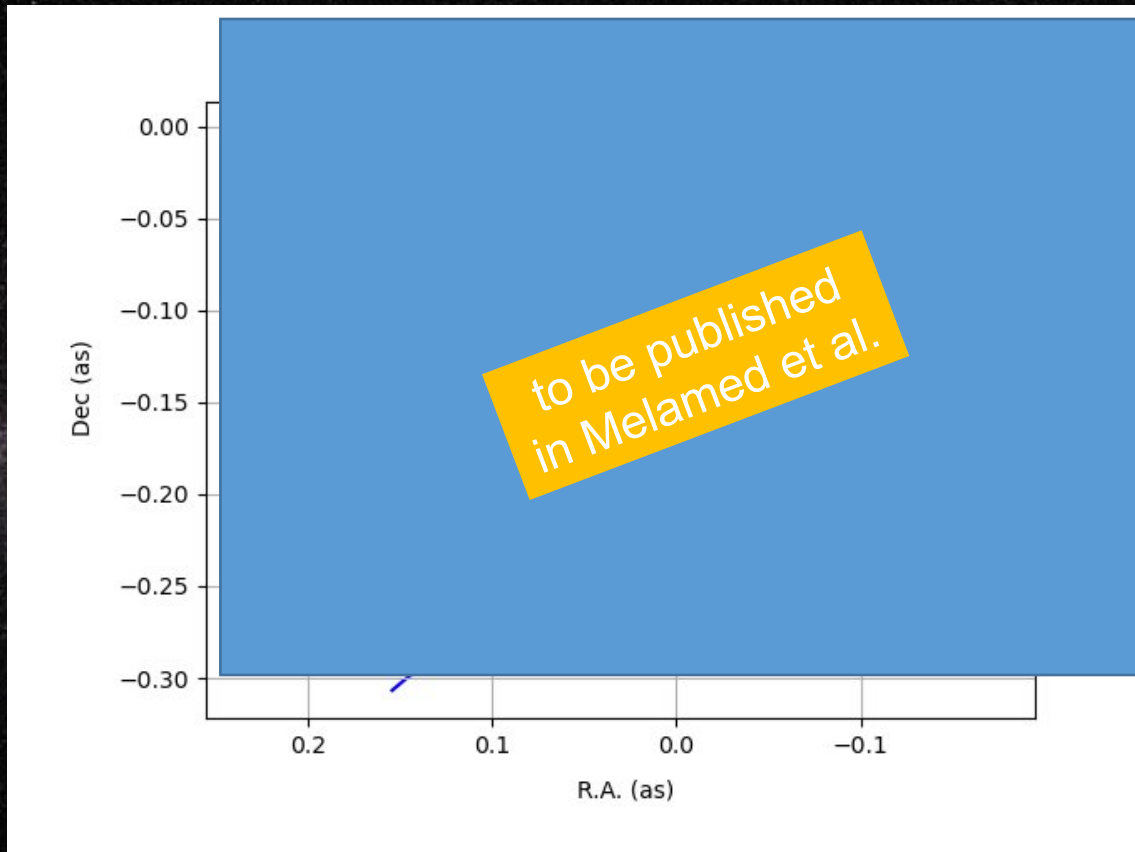
2008.2

- Wavelength range used here:
2.0 μm - 2.2 μm
- Br- γ line: 2.16612 μm (H I line)
- Deconvolution \rightarrow high-pass filters

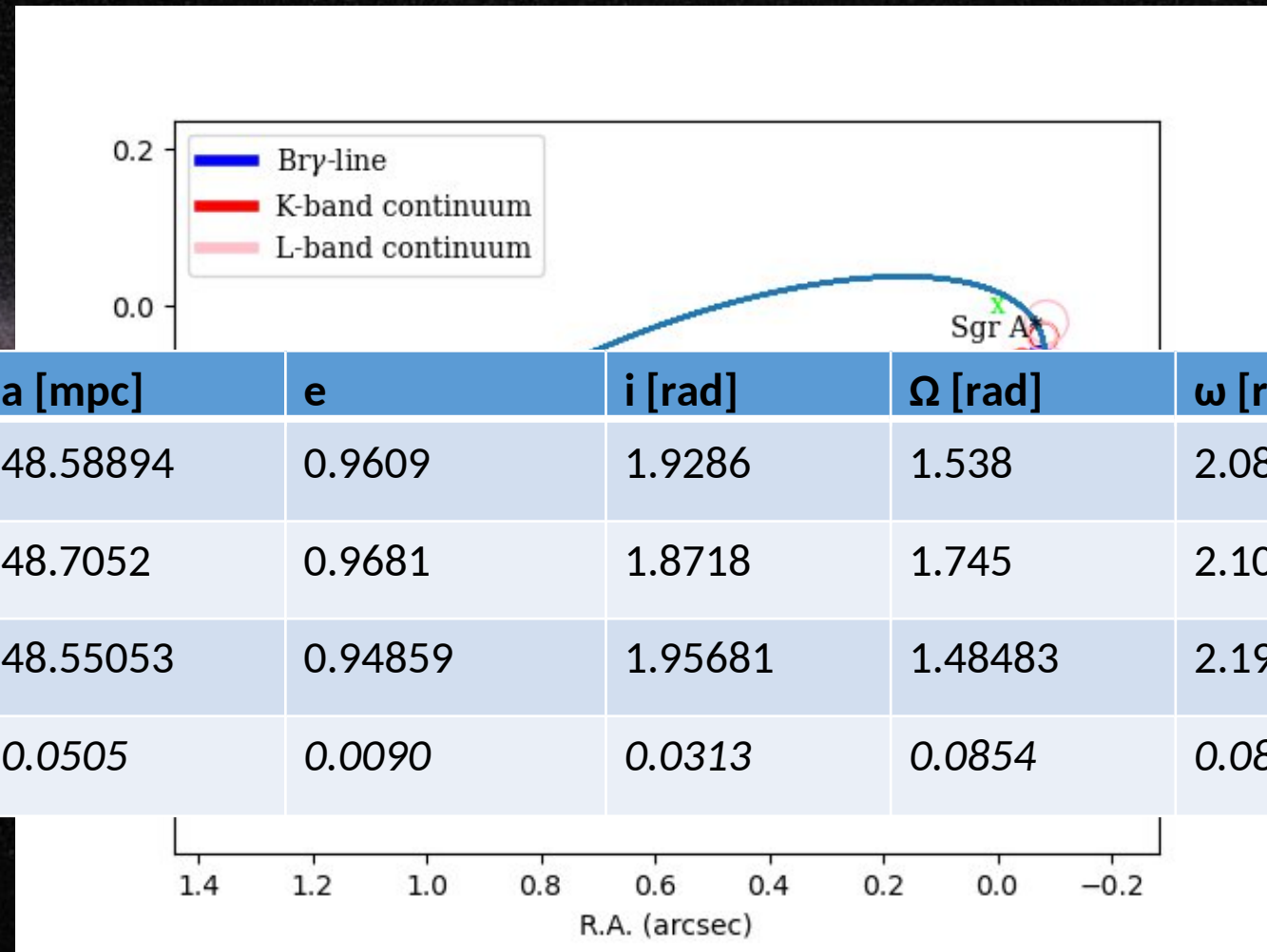
G1 Positions in K-Band



The Orbit of G1 in K-Band



G1 Orbital Elements in Different Wavebands

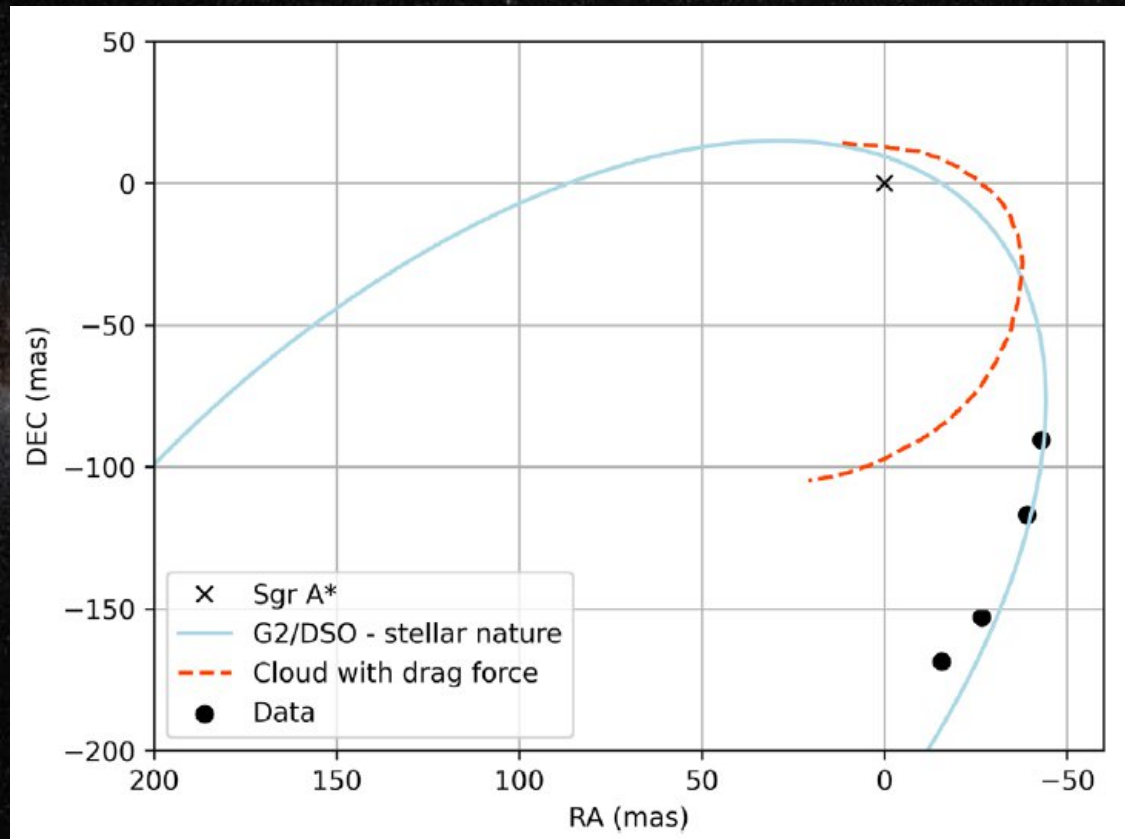


	a [mpc]	e	i [rad]	Ω [rad]	ω [rad]	T_p [yr]
Br- γ	48.58894	0.9609	1.9286	1.538	2.089	2000.99038
K-band	48.7052	0.9681	1.8718	1.745	2.106	2001.08197
L-band	48.55053	0.94859	1.95681	1.48483	2.19981	2000.96494
<i>Standard Deviation</i>	0.0505	0.0090	0.0313	0.0854	0.082	0.0462

G1 Orbital Elements – a Comparison

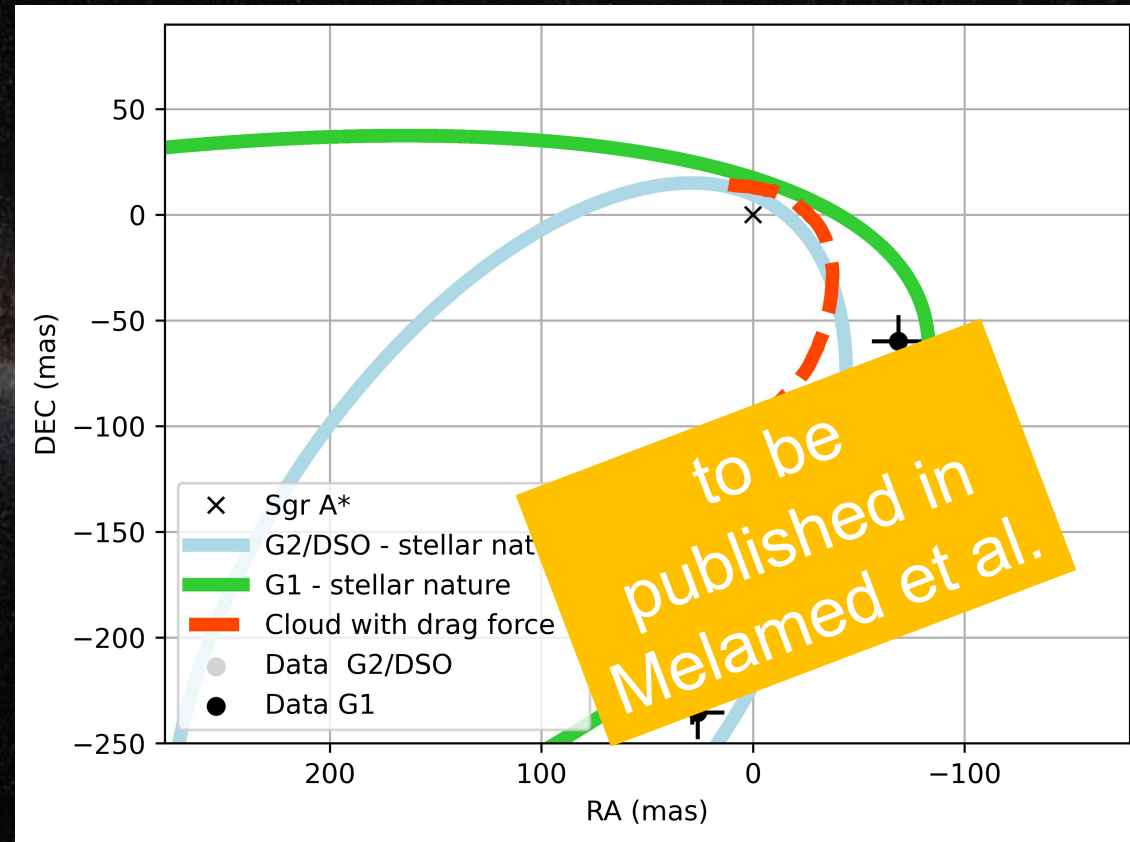
	a [mpc]	e	i [rad]	Ω [rad]	ω [rad]	Tp [yr]
Melamed et al. (in prep.) <i>VLT</i>	48.631 ± 0.031	0.962 ± 0.022	1.922 ± 0.029	1.603 ± 0.032	2.109 ± 0.026	2001.109 ± 0.038
Witzel et al. (2017) <i>Keck</i>	48.596	0.981	1.902	1.553	2.059	2001.0
Pfuhl et al. (2015) <i>early VLT</i>	73 \pm 42	0.86 \pm 0.05	1.89 \pm 0.04	1.19 \pm 0.09	1.9 \pm 0.1	2001.57 \pm 0.40

Comparison Orbit and Predicted Inspiring

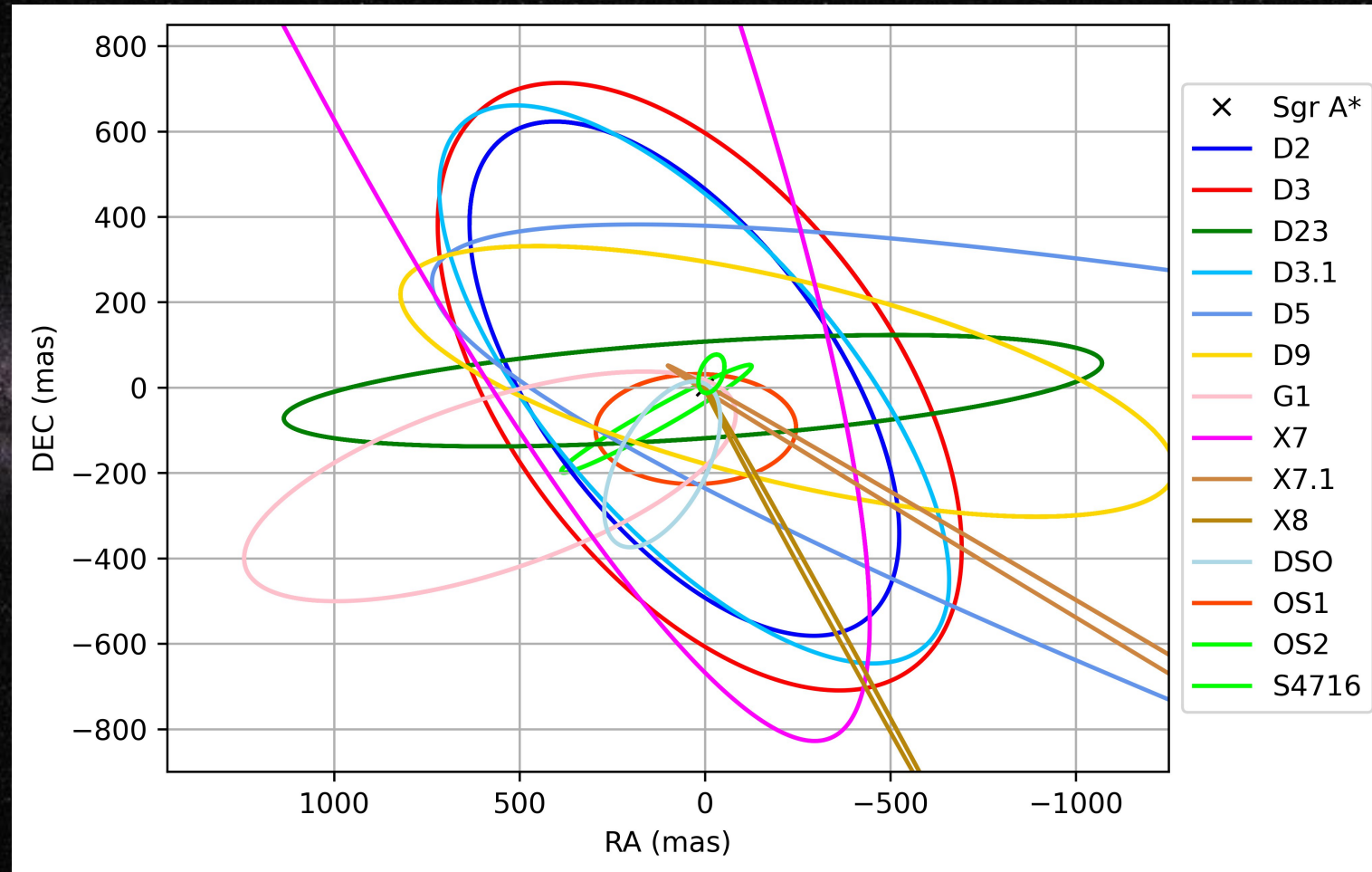


Peißker et al. (2021)

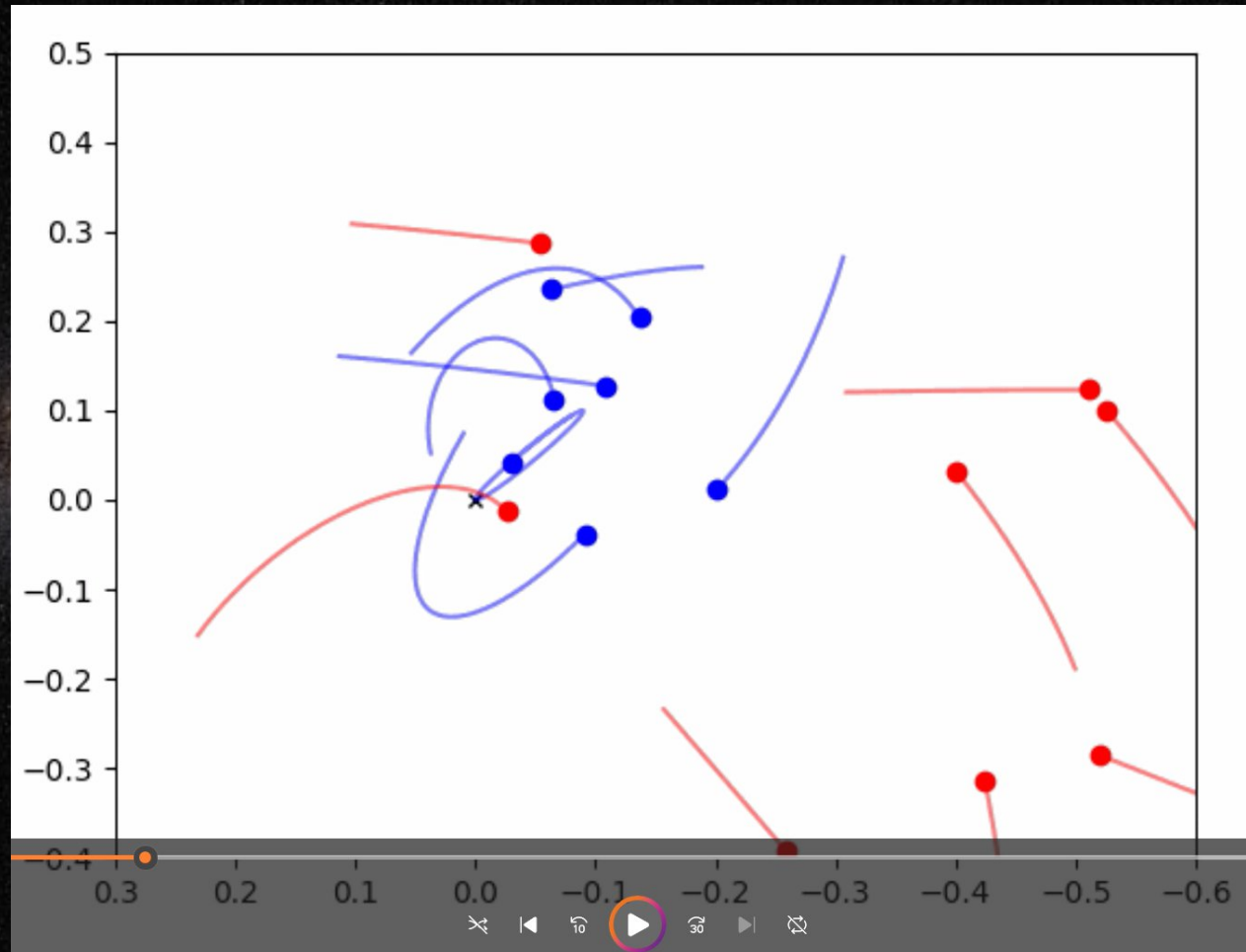
Comparison Orbit and Predicted Inspiring



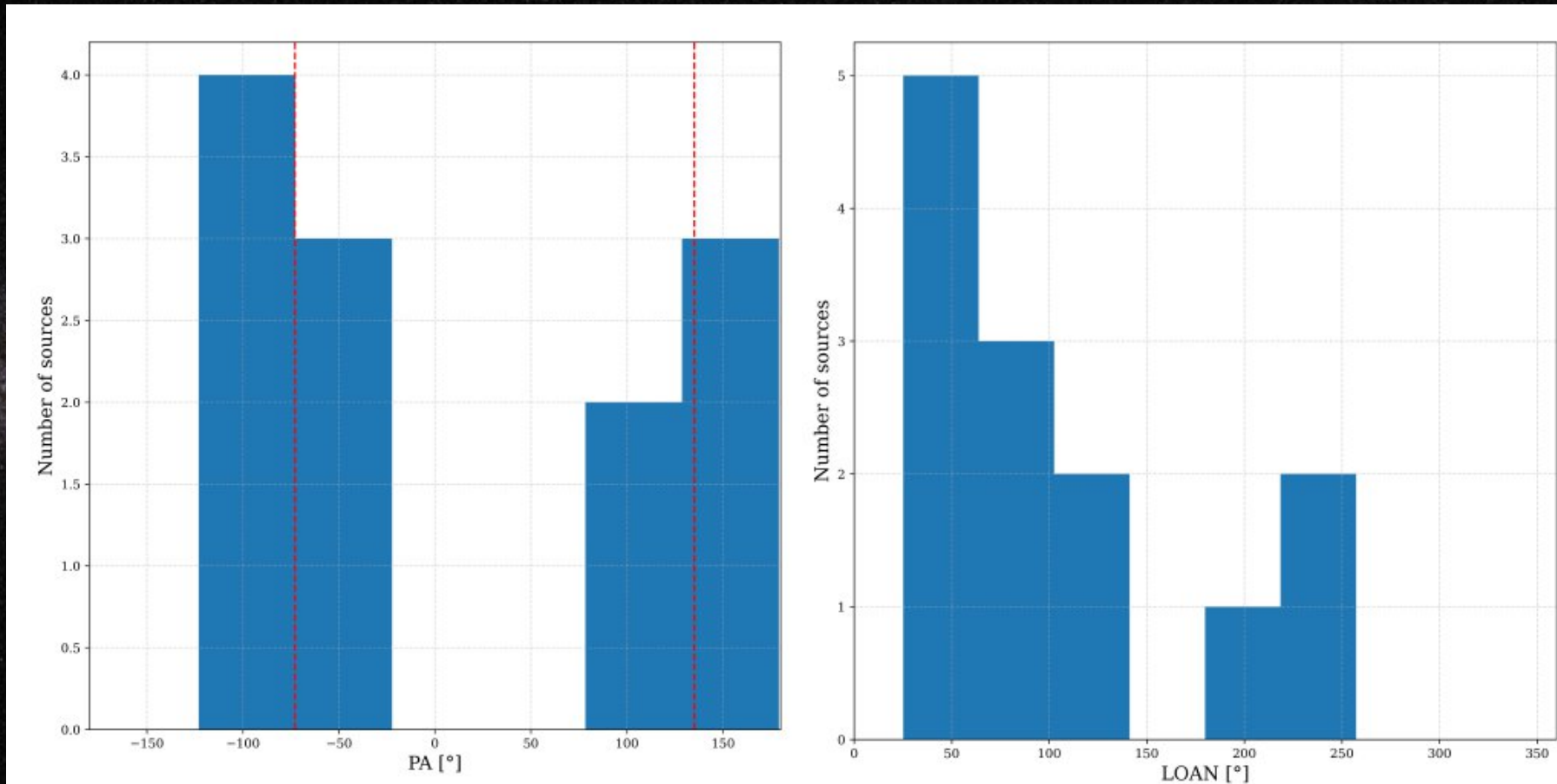
The Orbits of the Dusty Objects



The Orbits of the Dusty Objects



The Orbits of the Dusty Objects



Position Angle

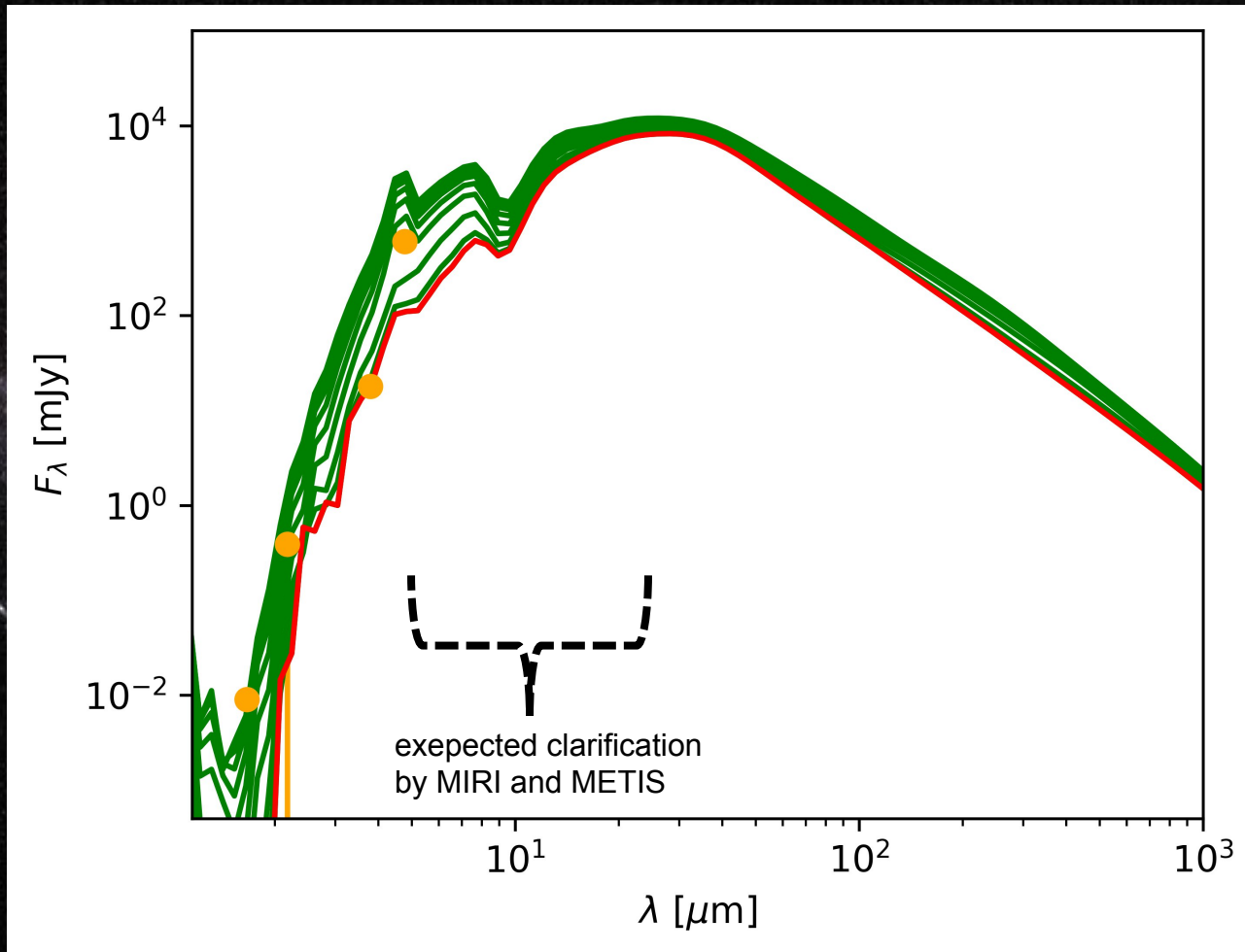
Longitude of the ascending node

Magnitude and Flux Density

Waveband	Flux Density [mJy]
H	
K	
L	
M	

to be published
in Melamed et al.

Spectral Energy Distribution



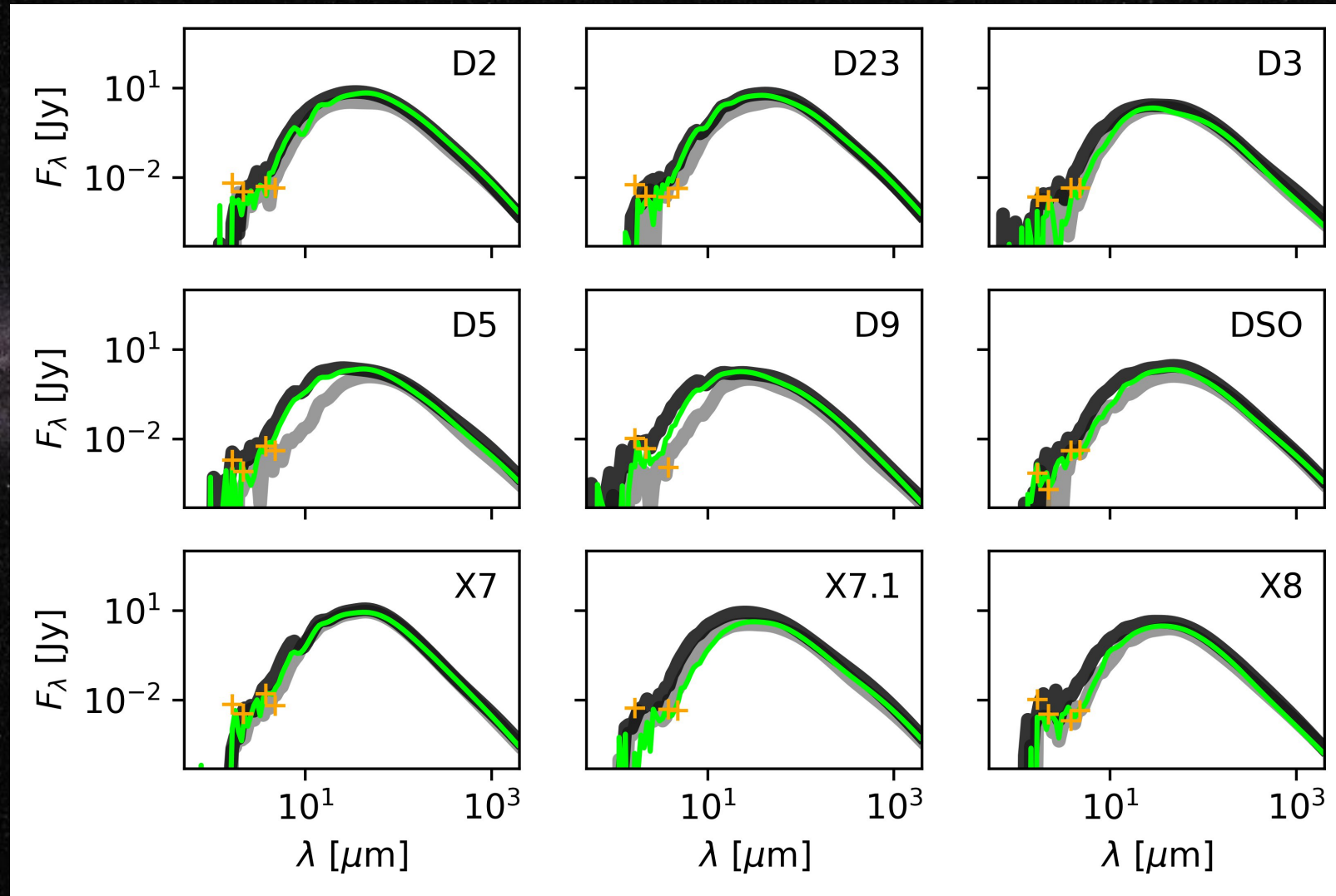
Class I YSO

Parameter	Value
Stellar Radius	1 R_⊙
Stellar Mass	1 M_⊙
Total Luminosity	
Disk Accretion Rate	
Disk Mass	
Disk Radius	
Ulrich Envelope Radius	

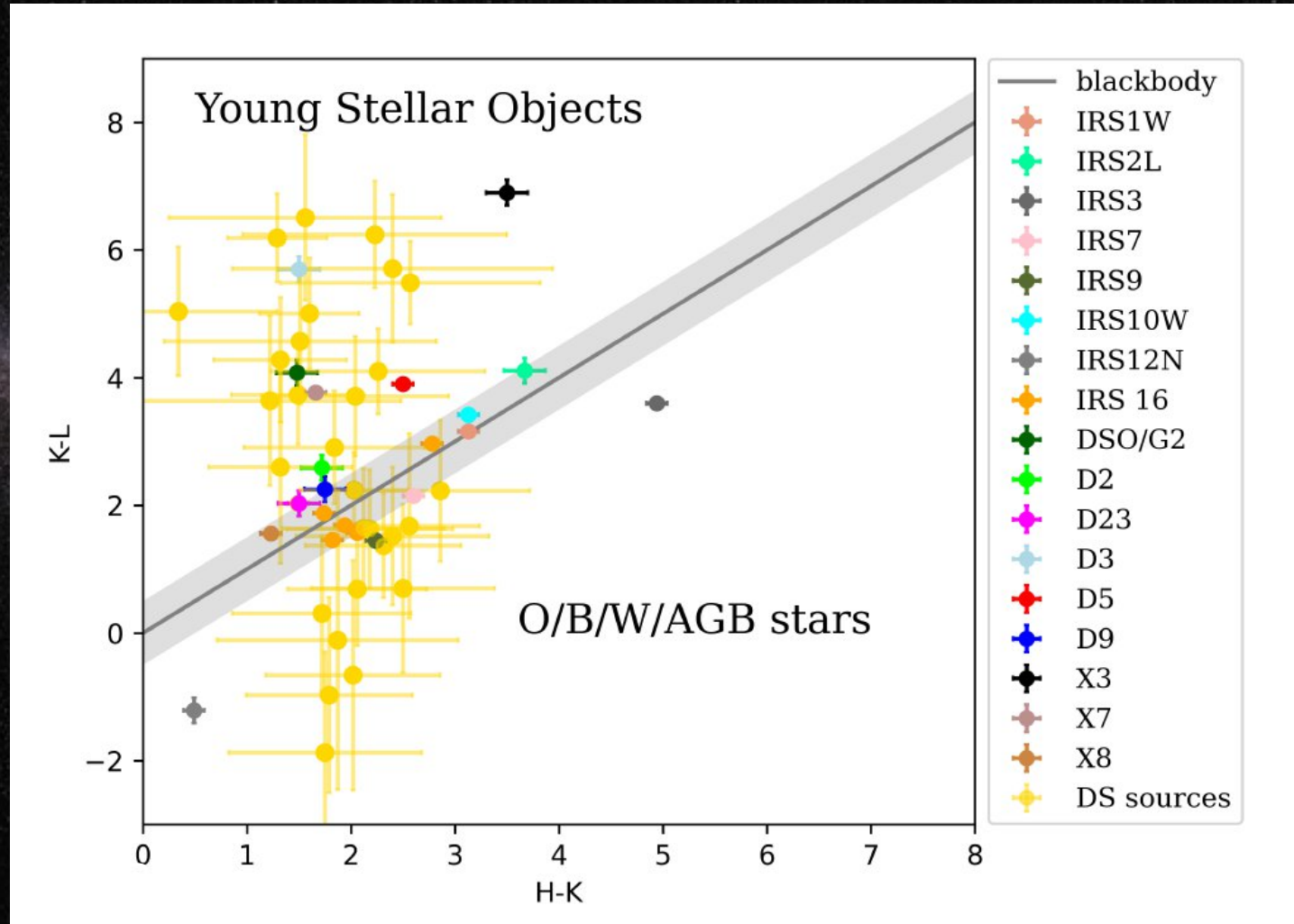
to be published
in Melamed et al.

- Comparable to G2 (Zajaček et al. 2017)
- G1 and G2 probably low-mass objects (suggested by Ciurlo et al. 2020)

Spectral Energy Distributions



Color-Color Diagram



→ IRS13

Summary

The dusty Sources

- Can be found in multiple wavebands and Br- γ emission
- Move on Keplerian orbits around Sgr A*
- Are located on (“red”) disk in the S cluster
- Show dusty and stellar properties \rightarrow candidate YSO's

Outlook

- Continue observing the sources
- Add observations in other wavebands
 - VISIR and ERIS data
 - MIRI/ JWST data
 - METIS/ ELT
 - GRAVITY+
- Comparison to other sources in GC
- Star formation channels in GC?



