(56) Tracking the decay of the accretion outburst in the massive protostar NGC6334I-MM1B

- ➢ The surrounding dust and maser emission declined from early 2020 to late 2022.
- ➢ Progenitor object is point-like in a 120 au beam at 2.2 mm (Band 4).

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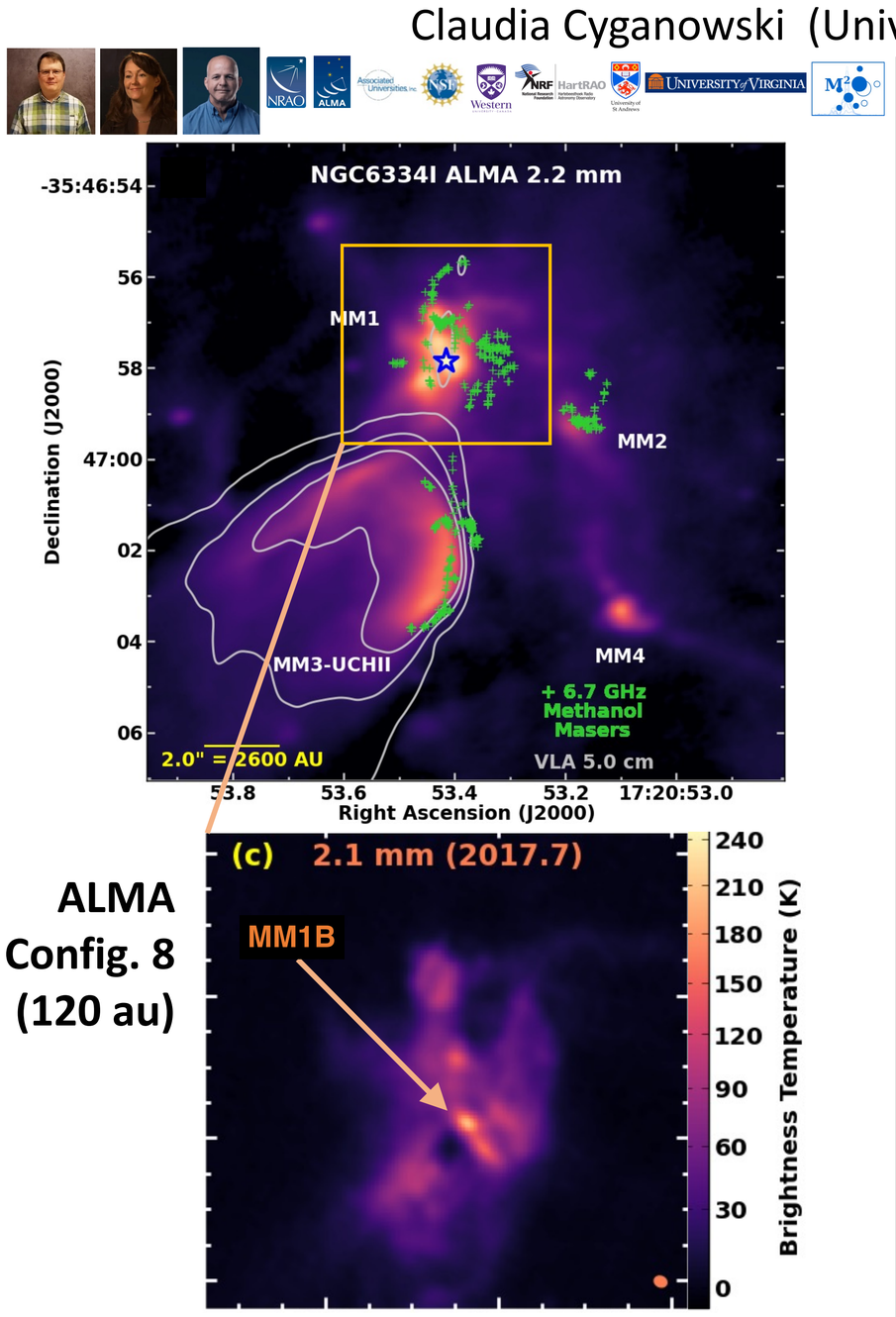
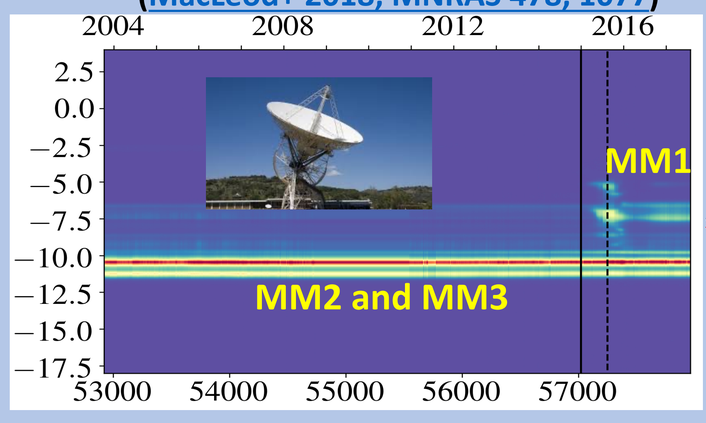


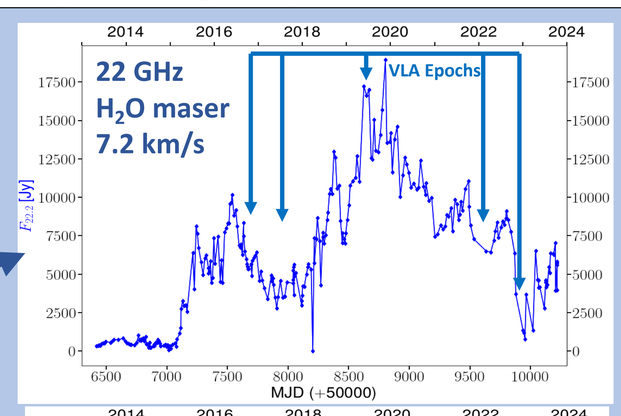
ALMA Config. 8 (120 au)

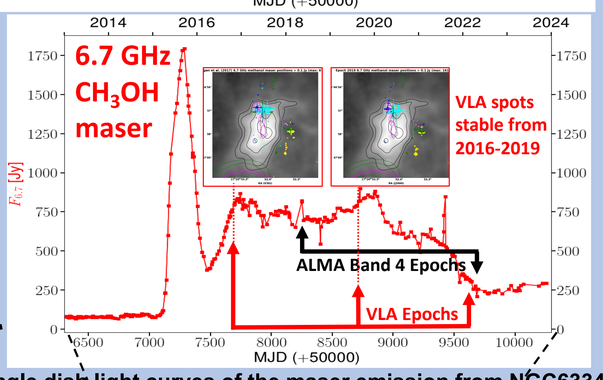
Discovery of maser outburst at HartRAO 26m

([MacLeod+ 2018, MNRAS 478, 1077](#))



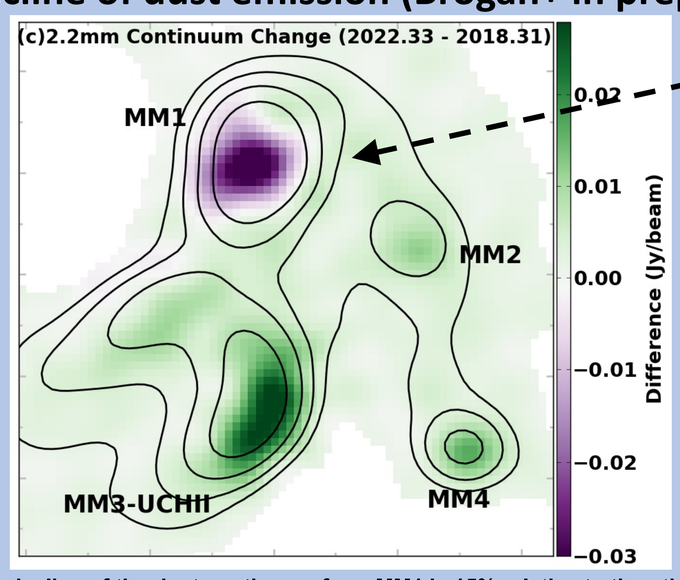
The dynamic spectrum of the 6.7 GHz CH_3OH maser, pumped by IR photons, shows stable emission from the UCHII region for 11 years. The new velocity features in the January 2015 outburst are from MM1. Ten different maser transitions flared contemporaneously. Since 2020, the masers have been declining (MacLeod+ in prep.) along with the mm continuum.



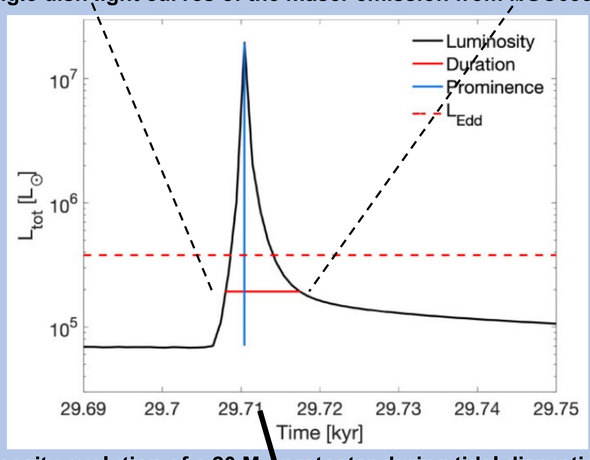


Single dish light curves of the maser emission from NGC6334I.

Decline of dust emission (Brogan+ in prep.)



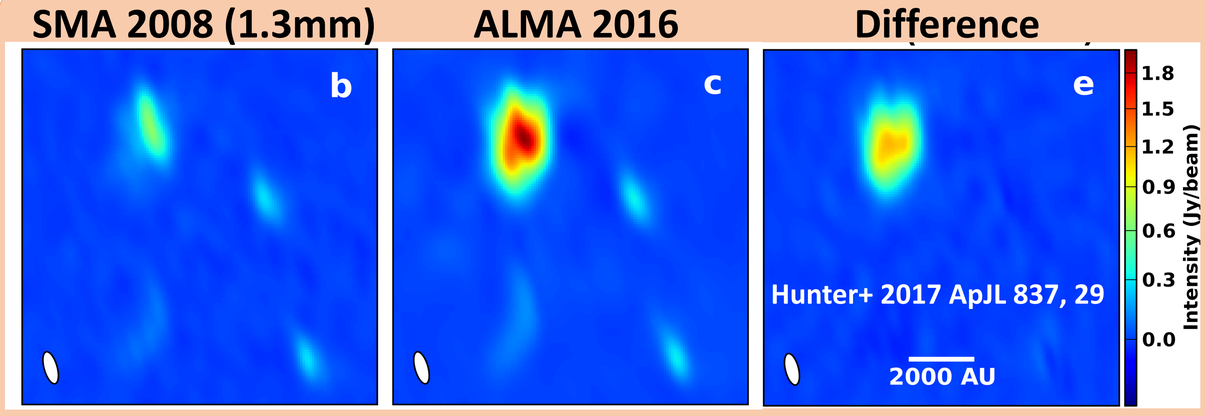
The decline of the dust continuum from MM1 is 15% relative to the other sources in the field, which likely were stable over this 2-year interval.



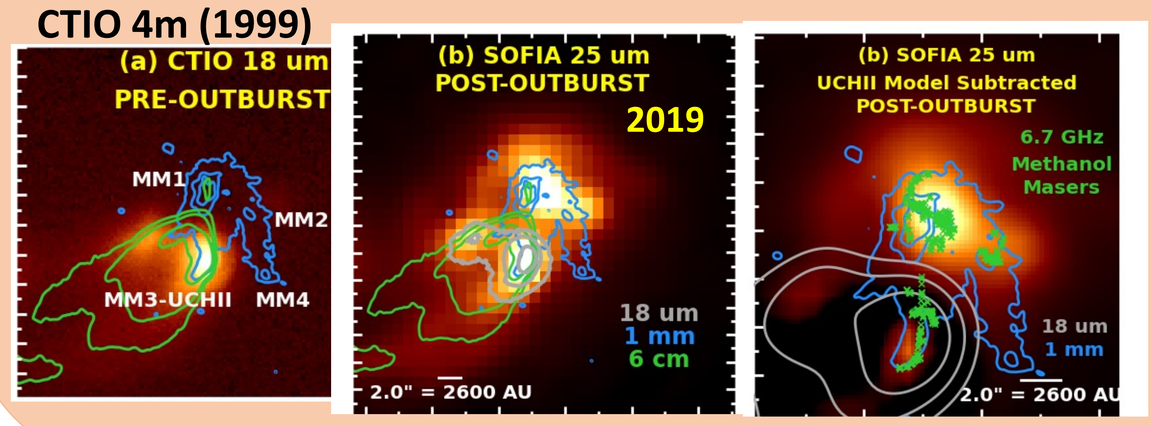
Luminosity evolution of a 20 $M_\odot$ protostar during tidal disruption of a 500-Jupiter mass object in the inner accretion disk ([Elbakyan+ 2023](#)).

Discovery of outburst in dust continuum (SMA, ALMA, SOFIA)

SMA 2008 (1.3mm) ALMA 2016 Difference



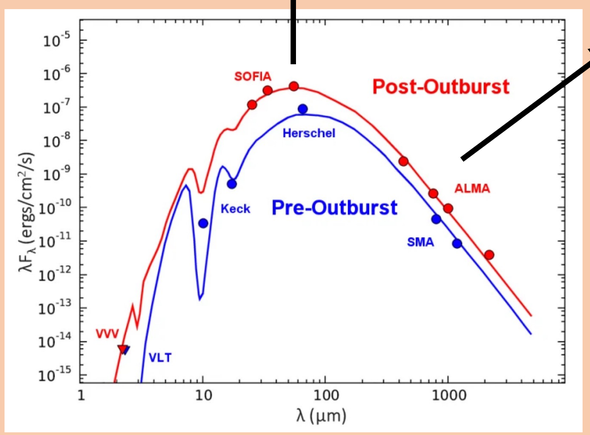
CTIO 4m (1999)



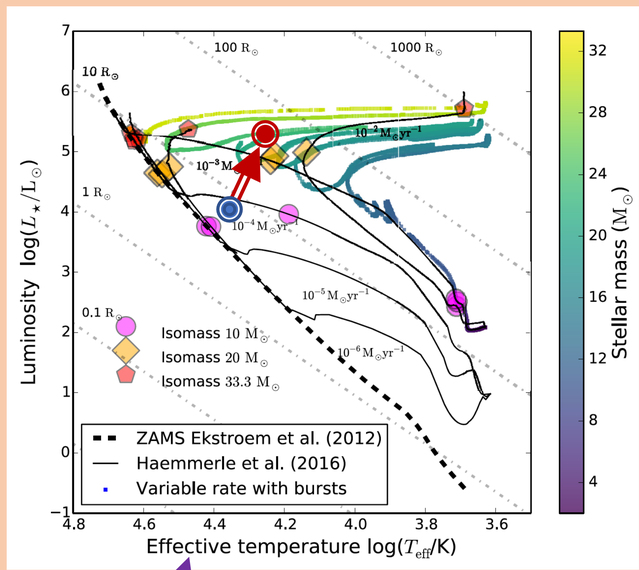
SED fit results for luminosity

([Hunter+ 2021 ApJL 912, 17](#))

- Preburst = 2900+-600 $L_\odot$
- Outburst = 47600+-7800 $L_\odot$
- ratio = 16.3+-4.4
- Meyer+2021 magnitude = 3
- accretion rate = 2 x 10^{-3} $M_\odot$/yr



The millimeter and radio data together are consistent with a temporary change of location on the HR diagram, which directly depends on the change in accretion rate ([Meyer, Haemmerle, & Voroboyov 2019](#)).



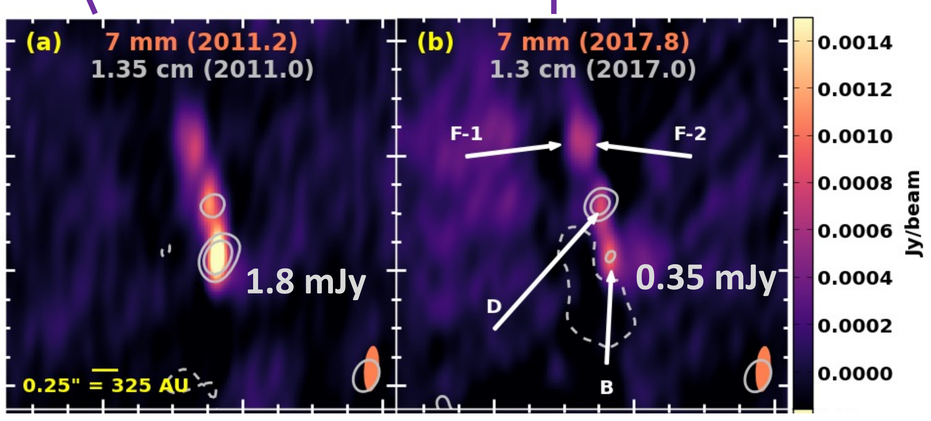
MM1B's 1.3 cm flux density in 2011 required an ionizing photon rate: log(N_L)=44.3.

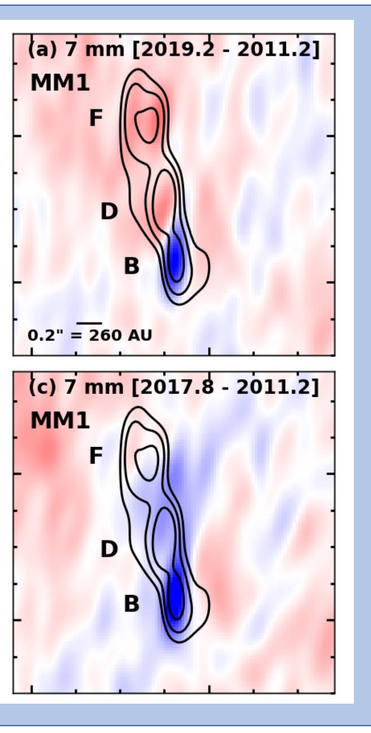
<u>Conclusion:</u> Progenitor consistent with a deeply-embedded ZAMS B2 star (T_{eff} = 22000 K, R = 2.6 $R_\odot$)

Factor of 4 dimming at 1.3 cm requires a lower stellar temperature and a larger radius by factor of ~8 (to 20 $R_\odot$) ⇒ B4 (T_{eff} = 16000K)

Such bloating is predicted by accretion models of [Hosokawa & Omukai 2009](#) and [Inayoshi+ 2013](#) for $\dot{M}$ = 2x10^{-3} $M_\odot$ per year

VLA 7mm & 1.3cm





VLA B-config difference images

<u>Left panels:</u>

The dimming of free-free emission from MM1B persisted from 2017 to at least 2019. <u>The latest epoch (2023) is not yet processed.</u> (Free-free dominates over dust contribution at 7mm.)

<u>Right panels:</u>

In contrast, a control source in the field (MM4) shows no significant variation at 7mm in either epoch.