Weighing a High Mass Protostellar Candidate: Physics and Kinematics of the M17 Disk and its associated H$_2$ Jet

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Lifting the Curtains at the High Mass End of Star Formation Research

Chini et al. 2004, Nature, 429, 155

NGC 3603
M 17

Nünnberger 2008, JoPh CS, 131, 012025

Workshop “From Circumstellar Disks to Planetary Systems”
Garching, 03.-06.11.2009
A Huge, Flared Accretion Disk around a High Mass Protostar in M17

D ~ 2.2 kpc
A_V ~ 3 mag
plus $\gtrsim$ 50 mag

Chini et al. 2004

NACO, K_s

FOV ~ 30'' x 30''

JHK_s
ISAAC
VLT Antu

FOV ~ 7' x 7'

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Huge, Flared Accretion Disk and Hourglass-Shaped Outflow Cavity around a High Mass Protostar in M 17

Bipolar Reflection Nebula

Hourglass-shaped Outflow Cavity

Flared Silhouette Disk

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**Optical Spectroscopy of the Bipolar Reflection Nebula**

- **Hα (inverse P Cygni), Ca II triplet and He I**
- **Ongoing Accretion**
- **[Fe II], [Ca II] and [S II] lines**
- **Ongoing Outflow Activity**

**Position – Velocity Diagram of the Molecular Gas inside the Disk**

- Cut along the Major Axis of the Disk, running at an Angle of 45° across our PdBI $^{13}$CO (1–0) Data Cube
- **Velocity Shift of 1.7 km s$^{-1}$ over 30 800 AU**

Comparison to Theoretical Position – Velocity Diagram for an Edge-On Disk around a 15 $\mathcal{M}_\odot$ Star; Outer Part in **Keplerian Rotation**, Inner Part as Rigid Rotator
In order to subtract the continuum from the spectral line data, we obtained images in an adjacent narrow-band K-band centered on λ = 1.63 μm. The mission size is 0.288 arc sec.

3D Radiative Transfer Modeling of the Silhouette Disk


![Image of disk models with increasing inclination angles of 0, 35, and 70 degrees.](image)
Detection of an H$_2$ Jet associated with the M17 Silhouette Disk

NACO Imaging

SINFONI IF Spectroscopy

Detection of an $\text{H}_2$ Jet associated with the M17 Silhouette Disk

NACO Imaging

SINFONI IF Spectroscopy

New SINFONI Data Set:

- 10 OBs á 1 hour, $3 \times 3$ arcsec FoV, AO (NGS)
- J-, H- and K-band (1.10-2.45 $\mu$m) vs. K-band (1.95-2.45 $\mu$m)
- DIT = 900 sec vs. DIT = 300 sec
- fully flux calibrated

Detection of [Fe II] Emission from the Jet associated with the M17 Disk


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