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Nature of the Dusty S-cluster Object (DSO/G2): Pre-main-sequence star with non-spherical dusty envelope

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Abstract. Near-infrared observations reveal several infrared-excess sources near the Galactic Centre with emission lines present in their spectra. One of these objects, DSO/G2, which moves around the supermassive black hole (Sgr A*) on a highly eccentric orbit, passed the pericentre at approximately 160 AU in 2014. It remained compact, which implies that at least in this case it is a star embedded in a dusty envelope. The spectral energy distribution and the detection of polarized continuum emission indicate that it is probably a pre-main-sequence star surrounded by a dense envelope with bipolar cavities. In addition, the star associated with DSO/G2 plausibly develops a bow shock due to its supersonic motion. The model of the star surrounded by the non-spherical dusty envelope can reproduce the main characteristics of the DSO/G2 source: 1. spectral energy distribution in near-infrared bands; 2. linear polarization in K_s band; and 3. the overall compact behaviour.

Keywords. Galaxy: center, radiative transfer, polarization, stars: pre–main-sequence

1. Summary

Based on the observed compactness of the DSO/G2, which is difficult to reconcile with the scenario of the core-less cloud (Witzel *et al.* 2014; Valencia-S. *et al.* 2015; Peissker *et al.* 2016), a dust-enshrouded young star was proposed to explain the observed phenomena (Eckart *et al.* 2013; Zajaček *et al.* 2014; Zajaček *et al.* 2015). Based on the measured near-infrared excess of $K_s - L' > 3$ (Eckart *et al.* 2013) and the total linear polarization degree in K_s band of $\sim 30\%$ for at least three epochs (Shahzamanian *et al.* 2016; , this volume), we propose the model of a young star embedded in a non-spherical dusty envelope to explain the main characteristics of DSO. We performed a set of Monte Carlo radiative transfer simulations using the code Hyperion (Robitaille T. P. 2011) to assess which geometry of circumstellar dusty envelope can explain the significant near-infrared polarized emission – see Fig. 1 for the illustration how the polarization degree varies for different geometries.

The model that fits the observed properties best consists of a star, dusty envelope, bipolar cavities and a bow shock. See Fig. 2 for the simulated SED (left panel) and the RGB image of the source model (right panel). The geometry and densities applied are standard for pre-main-sequence stars of Class 1. The bow shock is expected to form because of the supersonic motion of the star associated with DSO/G2 close to the pericentre (Zajaček *et al.* 2016). The details of the model are described in Shahzamanian *et al.* (2016).

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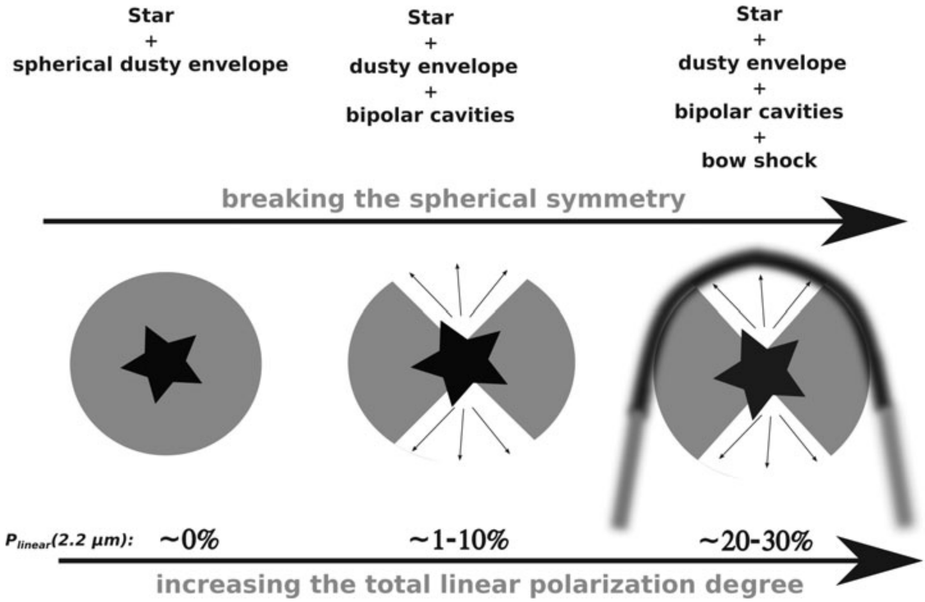

Figure 1. Increasing the total polarization degree by breaking the spherical symmetry.

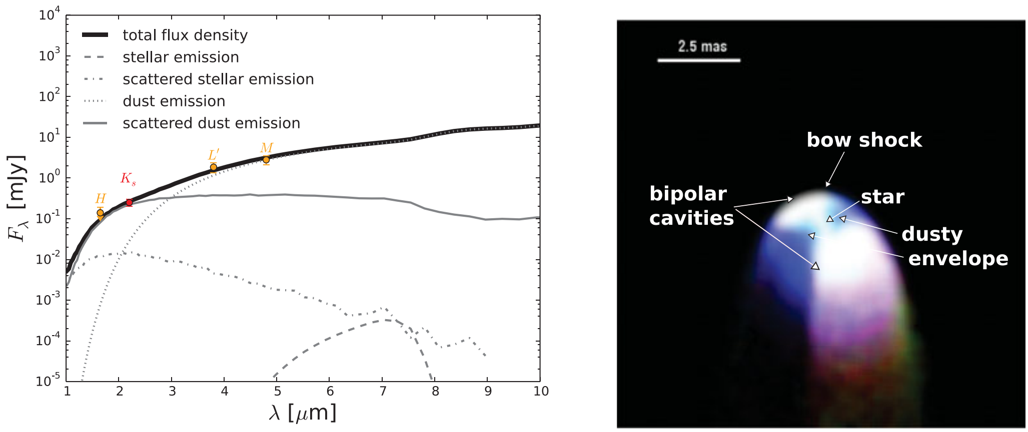

Figure 2. Left: Modelled SED with inferred flux densities in H (upper limit), K_s, L', and M bands. Right: RGB image of the source model of DSO/G2 (K_s, L', and M bands) with the inclined bipolar outflow with respect to the bow-shock symmetry axis by 45°.

References

Eckart A., Mužić K., Yazici S. *et al.*, 2013, *A&A*, 551, A18
Peissker F. *et al.*, 2016, in preparation
Robitaille T. P., 2011, *A&A*, 536, A79
Shahzamanian B., Eckart A., Zajaček M. *et al.*, 2016, *A&A* in print, ArXiv 1607.04568
Shahzamanian B., Zajaček M., Valencia-S. M. *et al.*, Proceedings of IAUS 322, this volume
Valencia-S. M., Eckart A., Zajaček M. *et al.*, 2015, *ApJ*, 800, 125
Witzel G., Ghez A. M., Morris M. R. *et al.* 2014, *ApJL*, 796, L8
Zajaček M., Karas V., Eckart A., 2014, *A&A*, 565, A17
Zajaček M., Eckart A., Peissker F. *et al.*, 2015, Proceedings of 24th WDS, ArXiv 1507.00237
Zajaček M., Eckart A., Karas V. *et al.*, 2016, *MNRAS*, 455, 1257

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