Laboratory modelling of equatorial ‘tongue’ accretion channels in young stellar objects

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The equatorial accretion scenario, caused by the development of the Rayleigh–Taylor (RT) instability at the disk edge, was suggested by accurate three-dimensional magnetohydrodynamic (MHD) modelling [1], but no observational or experimental confirmation of such phenomena has been evidenced yet.

We studied the propagation of a laterally extended laser-generated plasma stream across a magnetic field and investigated if this kind of structure can be scaled to the case of equatorial ‘tongue’ accretion channels in young stellar objects (YSOs) [2]; if so, this would support the possibility of equatorial accretion in young accreting stars.

The laboratory experiment at the PEARL laser facility shows the propagation of a laterally extended laser-generated plasma stream across a magnetic field. We demonstrate that: (i) such a stream is subject to the development of the RT instability, and (ii) the stream, decomposed into tongues, is able to efficiently propagate perpendicular to the magnetic field. Based on numerical simulations, we show that the origin of the development of the instability in the laboratory is similar to that observed in MHD models of equatorial tongue accretion in YSOs.

As we verify that the laboratory plasma scales favourably to accretion inflows of YSOs, our laboratory results support the argument in favour of the possibility of the RT-instability-caused equatorial tongue accretion scenario in the astrophysical case.

References

[1] A.K. Kulkarni and M.M. Romanova, Monthly Notices of the Royal Astronomical Society **386**, 2 (2008)

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