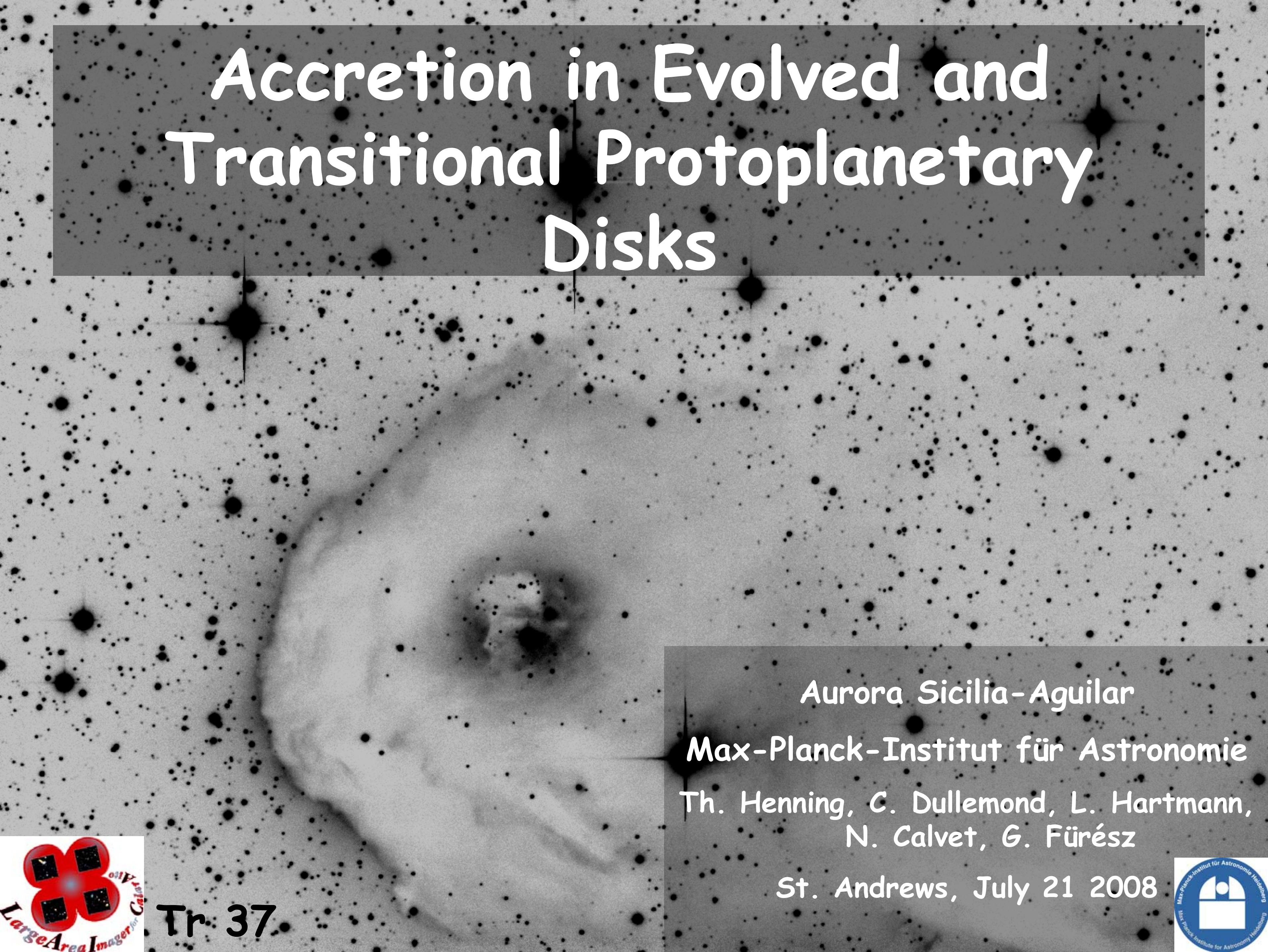
Accretion in Evolved and Transitional Protoplanetary Disks



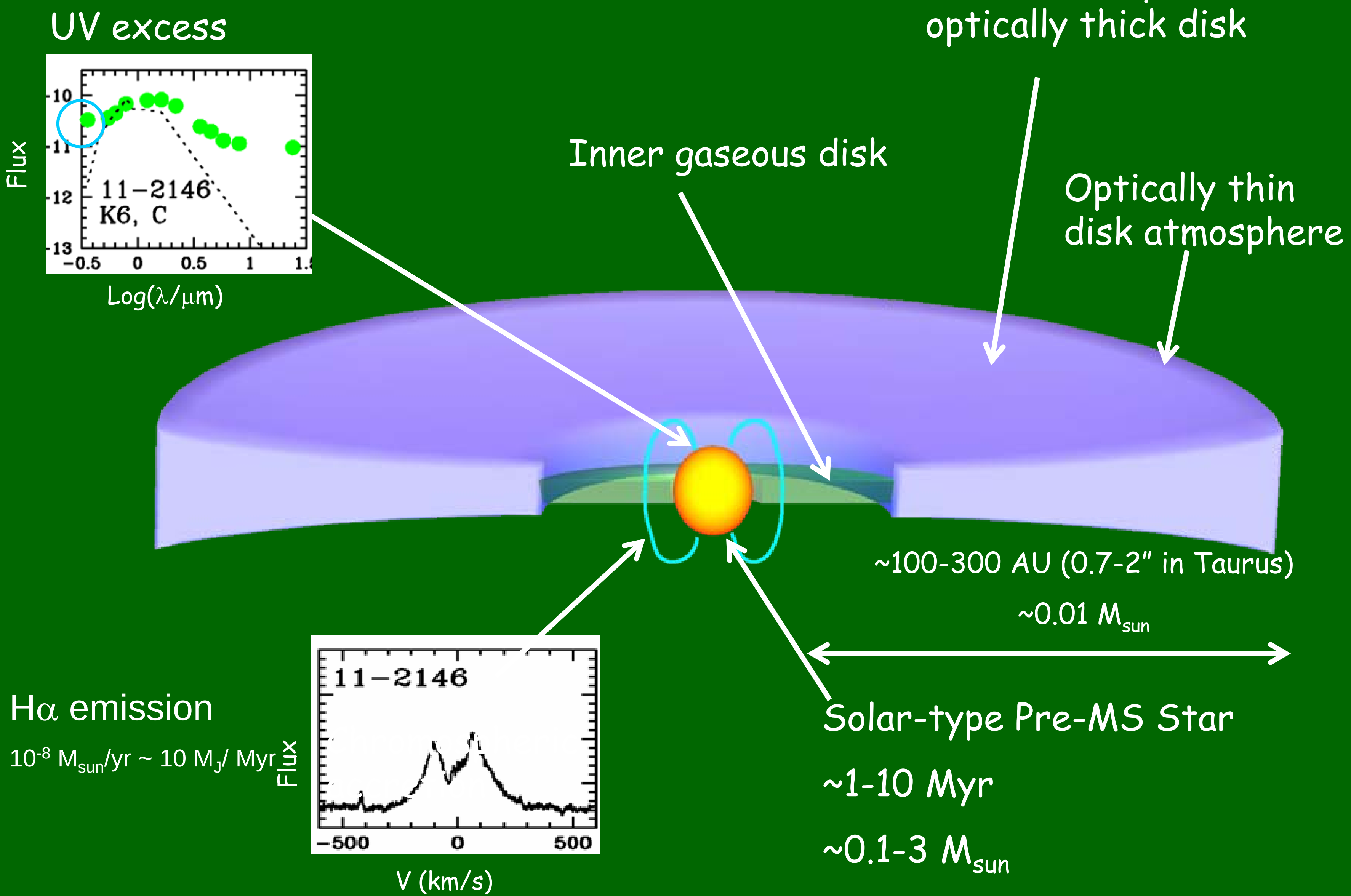
Aurora Sicilia-Aguilar

Max-Planck-Institut für Astronomie

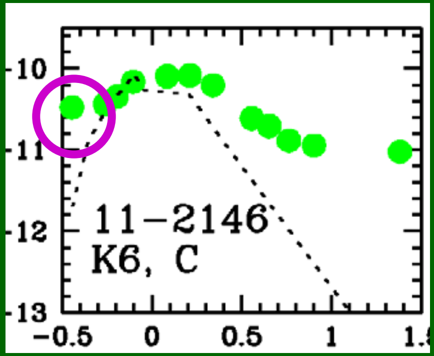
Th. Henning, C. Dullemond, L. Hartmann, N. Calvet, G. Fürész

St. Andrews, July 21 2008

Multiwavelength view of a protoplanetary disk



Measuring and detecting accretion

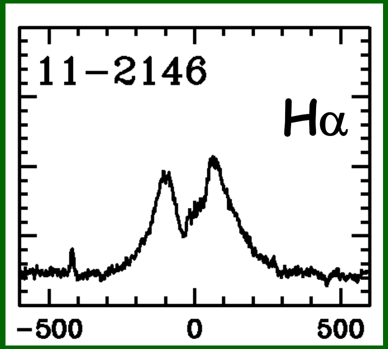


U band excess (Gullbring et al. 1998)

- Easier for K-M stars
- Need to know sp. type and extinction
- Limits: ~10^{-10} M_A/yr (dep. on stellar mass)

Hα emission (Muzerolle et al. 1998, 2001; Natta et al. 2004)

- Detects accretion down to ~10^{-12} M_A/yr
- Check line profile rather than EW
- Large uncertainties



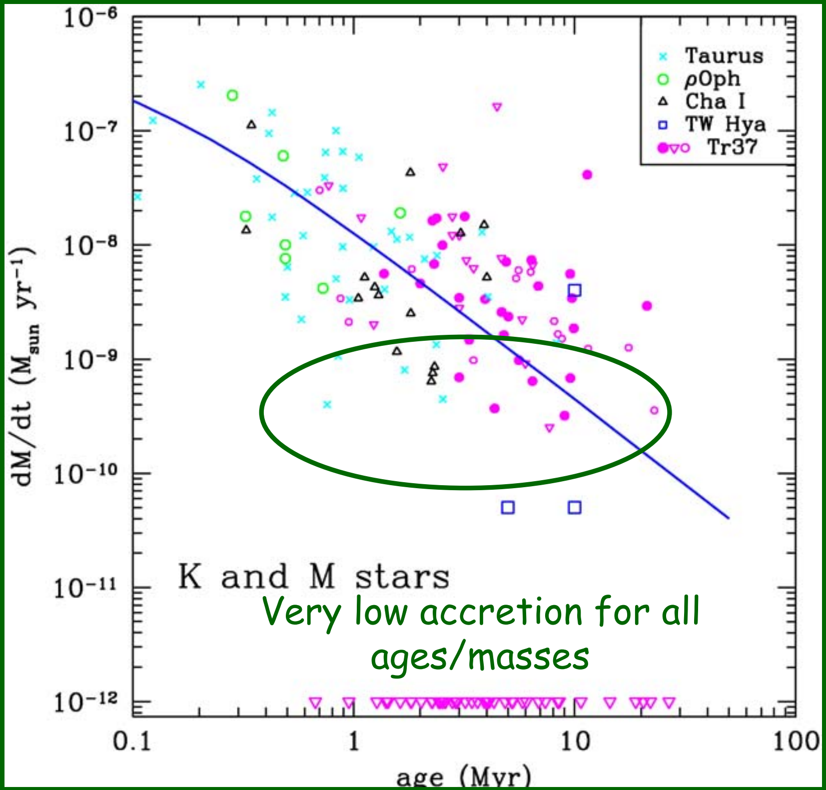
Other methods:

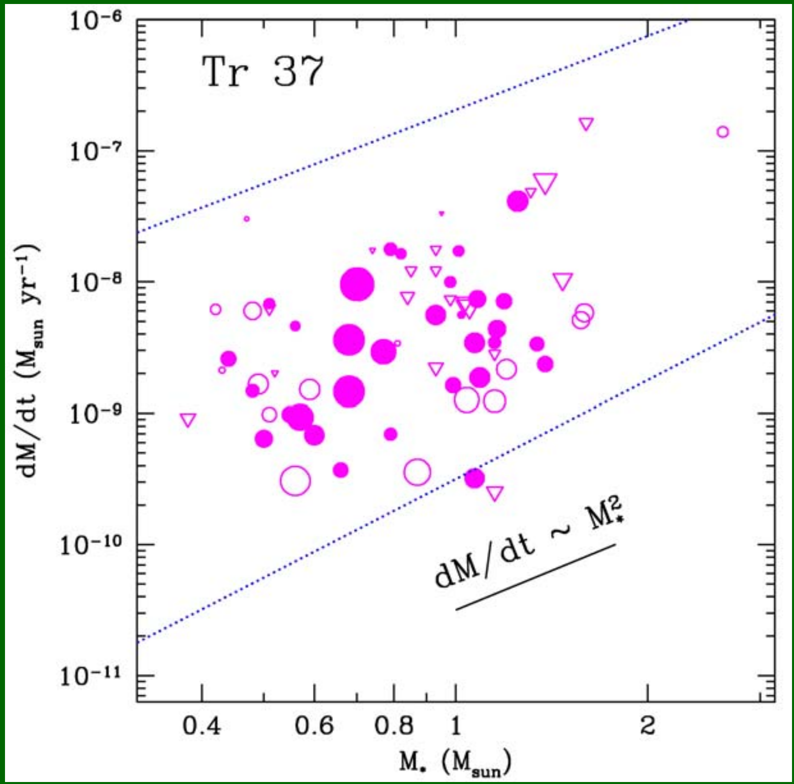
- Veiling (similar to U excess), Ca II, Br g,…

Sicilia-Aguilar et al. 2006, AJ 132, 2135

Accretion in Tr 37 (4 Myr)

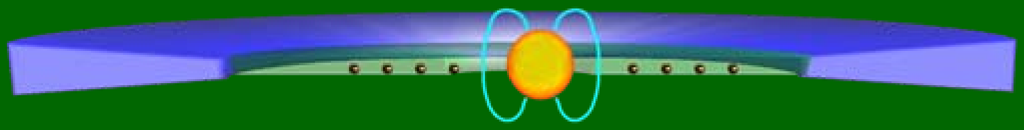
- Measured via U band excess and Hα (to check the presence of accretion in objects with very low rates).
- Parallel dust and accretion evolution: lower IR excesses, lower dM/dt.
- Disk fraction ~48%, most disks are accreting.
- 10% of the disks have inner gaps, only half of them are accreting.

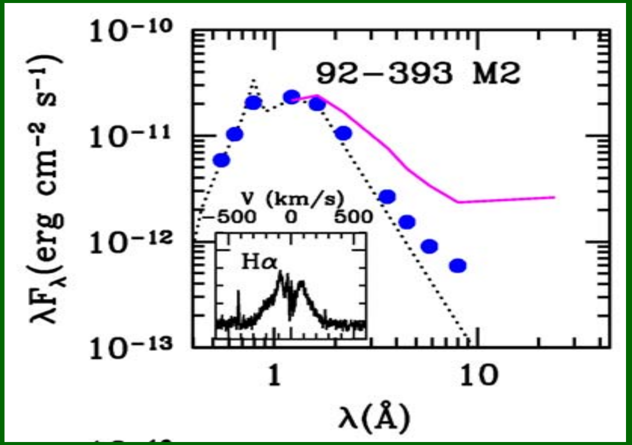




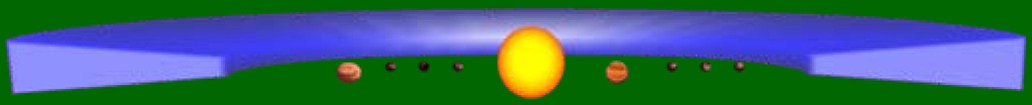
Sicilia-Aguilar et al. 2006, AJ 132, 2135 Sicilia-Aguilar et al. in prep.

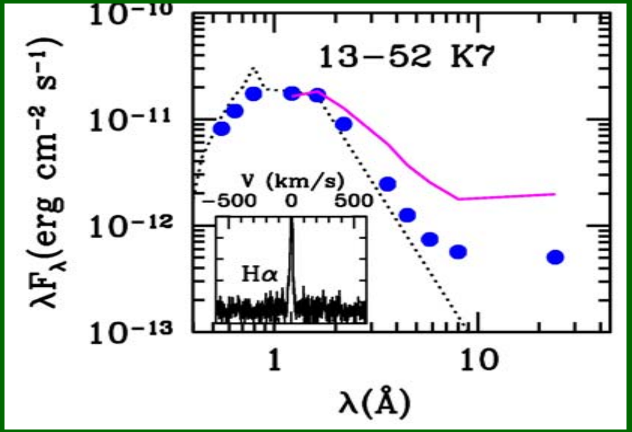
Accretion in transition objects





Accreting TO: grain coagulation/planet formation





Non-accreting TO: grain coagulation/planet formation… or photoevaporation?

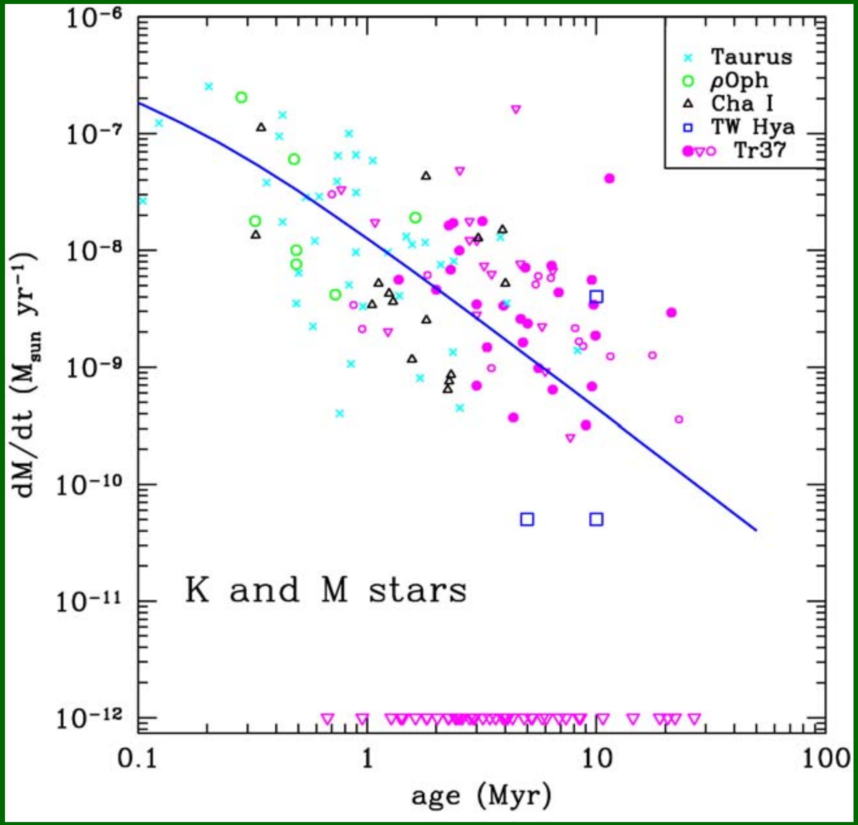
TW Hya: accreting TO with a planet (Setiawan et al. 2008 Nature 451, 38)

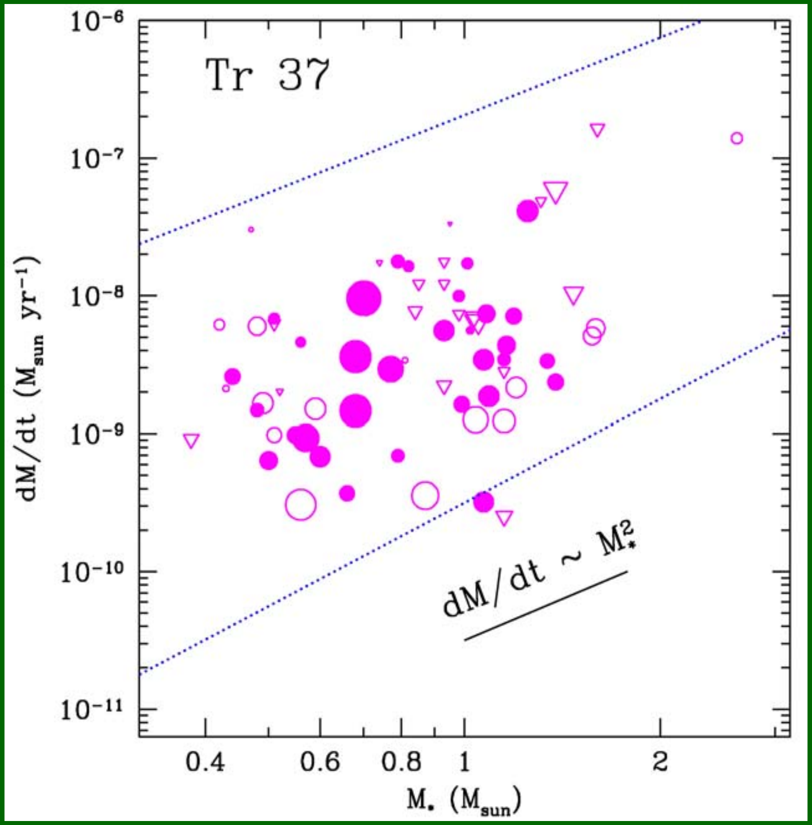
In addition: TO seem more common among M-type stars than among solar-type stars (Sicilia-Aguilar et al. 2008 ApJ in press).

Other ways of producing inner holes: **Binaries** (e.g. CoKu Tau/4; Ireland & Kraus 2008)

Accretion in the TO in Tr 37 (4 Myr)

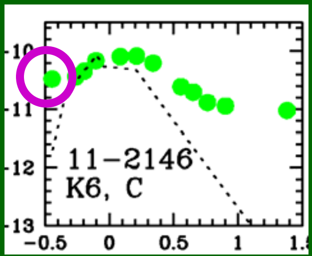
- 10% of the disks have inner gaps, only half of them are accreting.
- Accretion rates of the TO are typically low (<10^{-8}-10^{-9} M_A/yr)
- But many "normal" disks have similarly low accretion rates!

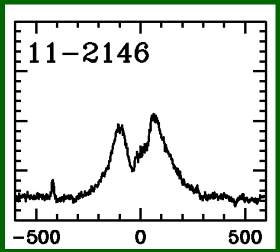


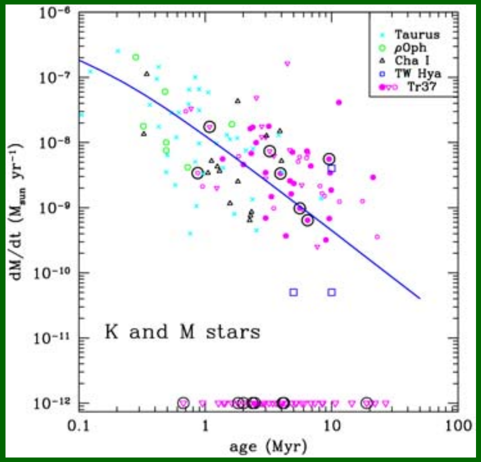


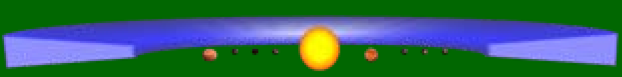
Sicilia-Aguilar et al. in prep.

Conclusions









- Accretion can be measured/detected via **UV excess** and Hα.
- ***Accretion rates decrease with age***, but there is a large spread at any given age.
- Low-mass stars have lower accretion rates, with **large individual variations**.
- **50% of the TO are accreting**, and their rates are low but not significantly different from the accretion rates in disks without inner holes.