1. Accretion process (from inner disc onto the star)

2. Large samples of YSOs with $M_{\text{acc}}$ measurements

3. Accretion in phases earlier than Class II

4. Accretion at late stages (Transitional discs)

5. $M_{\text{acc}}$ measurements (methodologies)
1. Accretion process (from inner disk onto star):

- **understand the star — disc interaction**: Magnetospheric model Ok?
- **topology of the stellar magnetic field**: generally bipolar?
- **variable Macc but also star rotation and obscuration (disc distortion)**
- **effects of accretion on the stellar photosphere**?

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Romanova et al. 2004

Max Camenzind 1990

Hartmann et al. 2016
1. Accretion process (from inner disk onto star):

- understand the star — disc interaction: Magnetospheric model Ok?
- topology of the stellar magnetic field: generally bipolar?
- variable Macc but also star rotation and obscuration (disc distortion)
- effects of accretion on the stellar photosphere?
2. Large samples of objects with measured $M_{\text{acc}}$

- $M_{\text{acc}}$ decreases with $M_{\text{star}}$, more steeply at low $M_{\text{star}}$ (?) : mechanisms ?
- $M_{\text{acc}}$ decreases with time (smoothly): after some 5Myr no discs (at [Fe/H]=0)
- for each value of $M_{\text{star}}$/age, large spread of $M_{\text{acc}}$
- different accretion mechanisms may occur at early times
- effects of metallicity (much higher $M_{\text{acc}}$ ?): EELT studies in LMC & SMC

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**Figure:**

- **Manara 2017**
  - Log10 of $M_{\text{acc}}$ (M$_{\odot}$/yr) vs. Log10 of $M_{\text{*}}$ (M$_{\odot}$)

- **Antoniucci et al. 2014**
  - Log(t) (yr) vs. Log10 of $M_{\text{acc}}$ (M$_{\odot}$/yr)

Legend for Antoniucci et al. 2014:
- Cha I
- Cha II
- Li641
- Lup
- Ser
3. How does accretion work at earlier phases?

- early stages (disk still fed by collapsing core, high $M_{\text{acc}}$)
- spasmodic episodes of high $M_{\text{acc}}$

Evans et al. 2009
Dunham et al. 2015
4. Accretion at later stages (transitional discs)?

- accretion rate in TDs with large dust cavities
- accretion in transitional discs (TDs) vs. primodial discs (PDs)
- accretion in TDs with large dust cavities: accreting planets?

Manara et al. 2014

\[ r_{cav} = 90\text{AU} \]

Van der Marel et al. 2018

**Spectral diagnostics of TDs @ FIR (SPICA?)**

- ALMA band-7

\[ r_{cav} = 90\text{AU} \]

\[ r_{cav} = 50\text{AU} \]
5. Macc measurements: $L_{\text{acc}}$ not too bad, but

- **homogeneous and self-consistent methods to measure $M_{\text{acc}}$ and stel. pars.**
- **lines not included in estimates based on continuum excess fitting**

$L_{\text{all-lines}}$: sum of all permitted lines (H, Ca II, He) + $L_{\text{pseudo-continuum}}$

- more than 70% of integrated line luminosity is in Balmer lines
- in most (90%) YSOs $L_{\text{Balmer}} > 60\%$ of $L_{\text{all-lines}}$
- in some YSO (Sz73, Sz83, Sz88A & Sz113) emission in other lines is up to 50%
5. Macc measurements: \( L_{\text{acc}} \) not too bad, but

- **at early SpT (<K3): low-contrast cont. excess — photospheric cont.**
- **alternative methods: FUV, NUV (HST) measurements of \( H_2 \) (Ly-a), CIV, etc**

- **LCIV — Macc relations yield Macc**
- **investigation of disc inner regions**
- **complementary to interferometric methods**
5. Macc measurements:

- Macc and stel. pars. for phases earlier than class II?

Nisini et al. 2005

VLT-ISSAC spectroscopy

**Teff**: from photospheric line ratios

**Lstar**: from dereddened K-mags

**Lacc**: \( L_{bol} - L_{star} \)

Most protostars heavily extinct and veiled:

- no photospheric lines, no Teff & Lstar
- Lacc: from Lacc—Lline relationships

**Discussion on Macc**