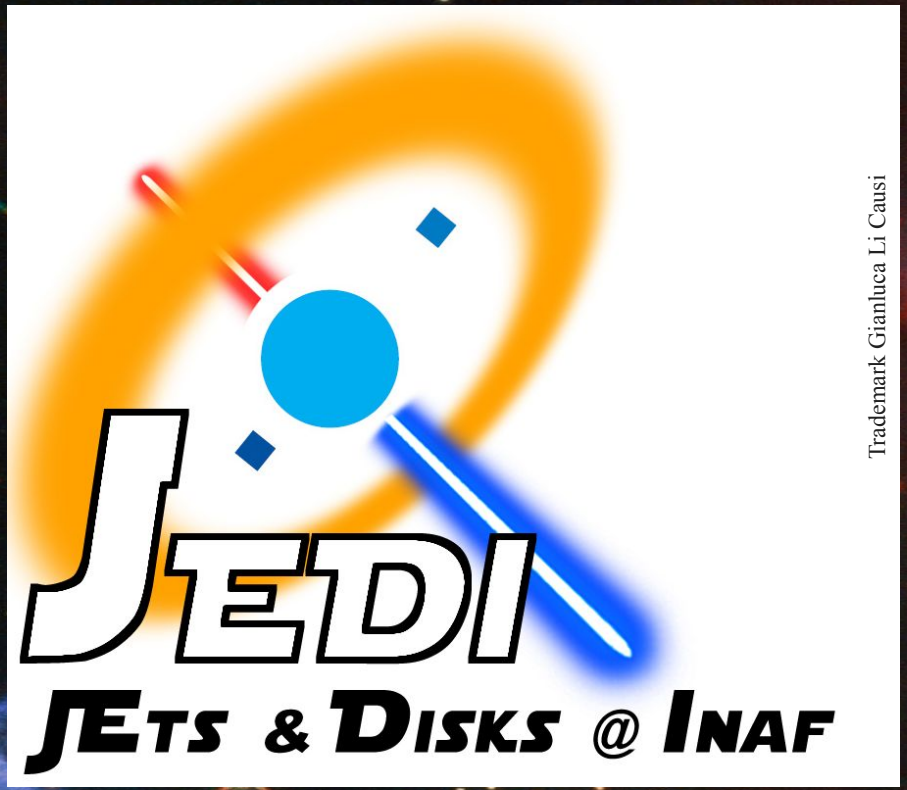


Brunella Nisini

Osservatorio
Astronomico di Roma

on behalf of the
JEDI collaboration

the *JEDI* team

OAA

Bacciotti Francesca
Codella Claudio
Antonio Garufi
Podio Linda
Fabrizio Massi
Marco Padovani

OAR

Antoniucci Simone
Biazzo Katia
Gangi Manuele
Giannini Teresa
Nisini Brunella

OACT

Frasca Antonio
Alonso Santiago Javier

OACN

Alcalà Juan Manuel
Caratti o Garatti Alessio
Covino Elvira

OAPD

Desidera Silvano
Gratton Raffaele
Rigliaco Elisabetta

OAPA

Bonito Rosaria
Mario Guarcello

OATO

Davide Fedele
Claudio Zanni

Associates

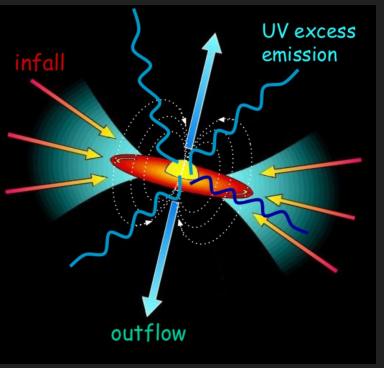
Lodato Giuseppe (UniMi)
Toci Claudia (UniMi)
Garcia Lopez Rebeca (DIAS-Dublin)
Manara Carlo (ESO Garching)
Fiorellino Eleonora (Konkoly Obs.)

https://sites.google.com/inaf.it/jedi/

Image credit: ESO/L. Calçada/M. Kornmesser

JEDI science

B. Nisini Coordinator



MASS ACCRETION
J. Alcala'

JETS and WINDS
F. Bacciotti

JEDI
JETS & DISKS @ INAF

ASTROCHEMISTRY
C. Codella

Young stars properties
A. Frasca

DISKS planet formation
D. Fedele

- angular momentum evolution
- low-mass YSOs
- initial conditions for planet formation

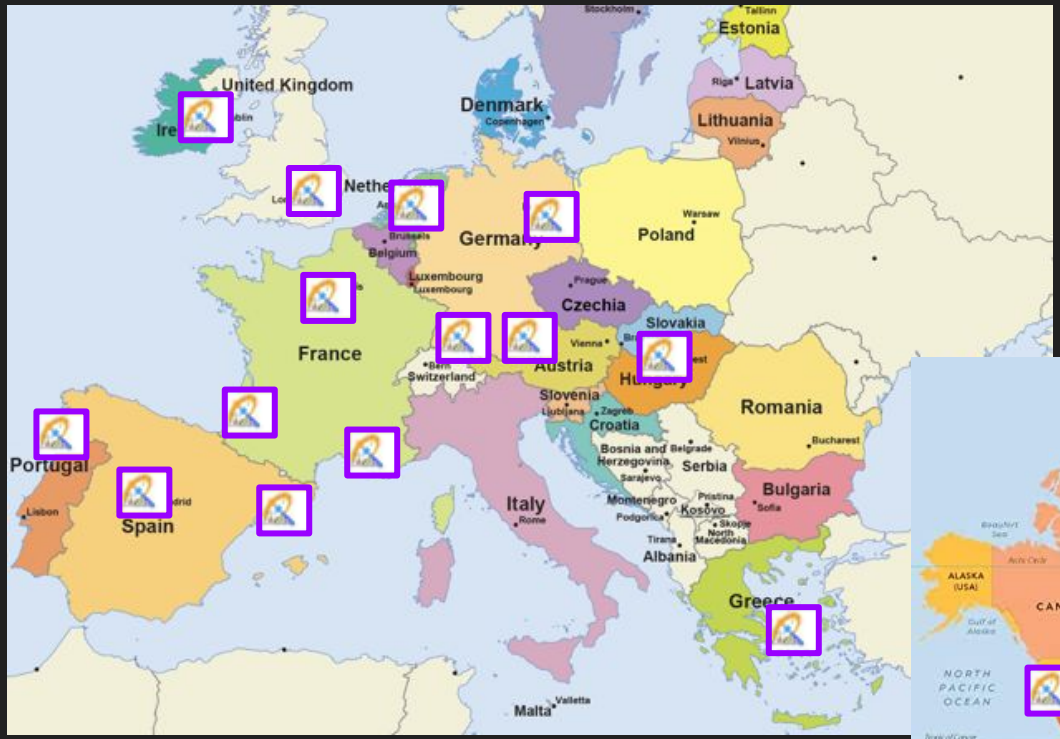
JEDI in Italy

Meetings

2005-2010 Bi-annual *FP7-JETSET* meetings
2013 1st *JEDI* meeting - Monte Porzio
2015 2st *JEDI* meeting - Napoli
2016 3th *JEDI* meeting - Arcetri
2018 *JEDI* national meeting - Monte Porzio

JEDI in the world

International collaborations



JEDI funding

2005-2020

- JETSET FP7 RTN 2005-2010 (INAF PI Bacciotti/Nisini)
- ASI contracts to support science with Spitzer/HST/Herschel/Spica (GO and GTO involvement)
- MIUR-SIR (P.I. Davide Fedele, 1TD, 1post-doc, 1PhD)
- ASTROFIT (4 post-doc positions)
- PREMIALE iALMA (PI L. Testi)
- PREMIALE FRONTIERA (PI Pagano, JEDI PI: Bacciotti)
- PRIN 2013 (PI Nisini)
- PRIN Genesis-SKA (PI Codella)
- PRIN-Mainstream (PI Nisini)

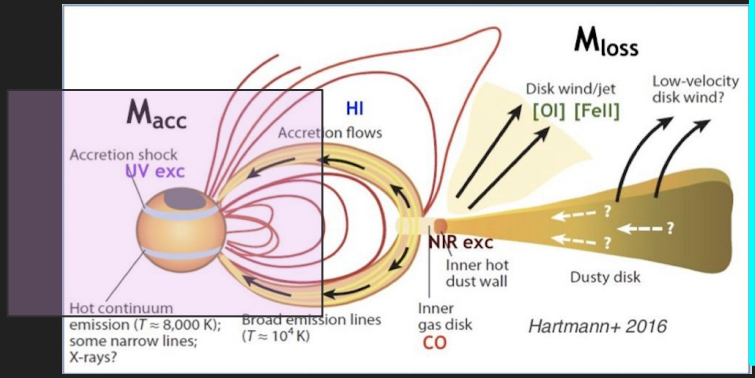
2021-2023

- PRIN-STRADE (PI Alcala)

Partial funding from:

- PRIN- PLATEA (PI Desidera)
- ACO (INAF PI Codella)
- PRIN-MIUR Families (PI Gratton) (submitted)

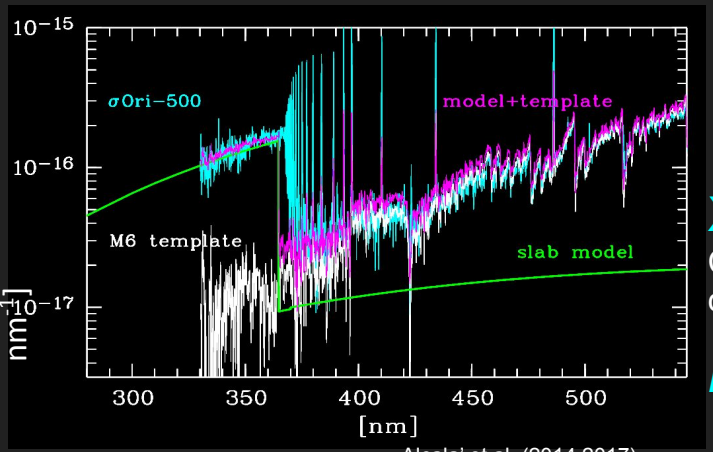
Mass Accretion



M_{acc} main driver of disk dispersal

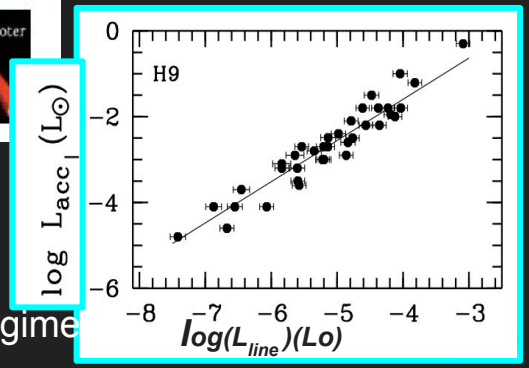
- Evolution of mass accretion rate
- ***JEDI*** leading role
  (X-Shooter GTO/GO, 51 papers, >1500 citations

(e.g. Antoniucci+ 2014, Alcala' +2014,2017, Manara+ 2016,2017,2020
Rigliaco+2012, Venuti+ 2019)



Alcala' et al. (2014,2017)

X-shooter survey:
Complete and homogeneous characterization of YSOs properties



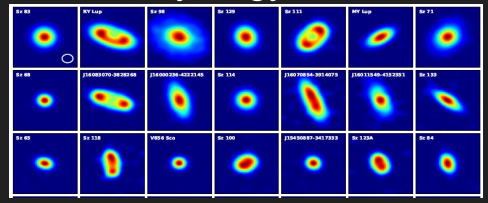
L_{acc} vs L_{line} relations down to BD regime

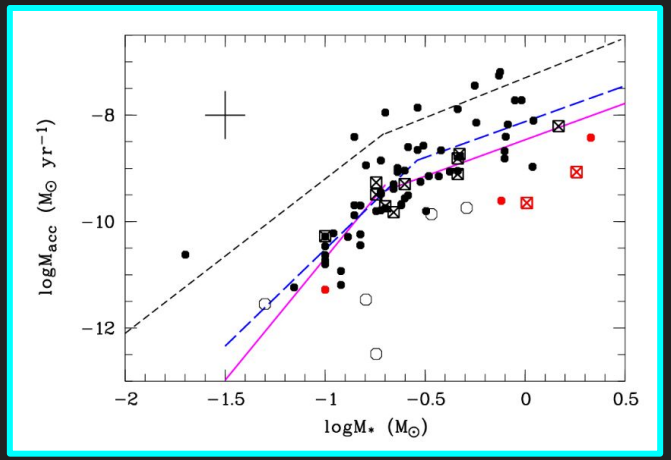
Mass accretion evolution

JEDI provides fundamental observational tests to accretion evolution models probing accretion rates in young and old YSOs populations

Synergy with ALMA

Ansdell + 2016



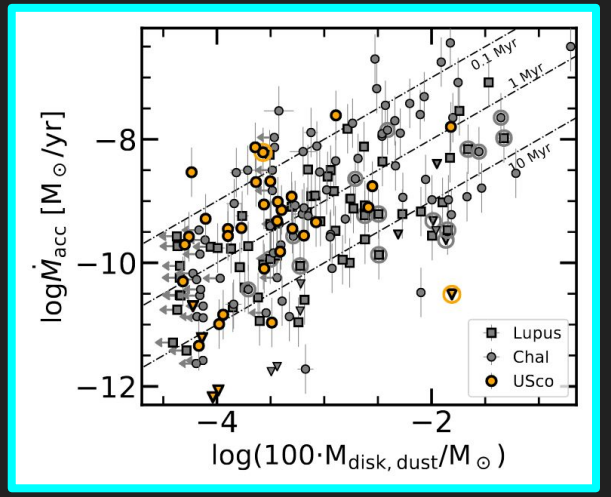


Alcala+ 2014/2017

M_{acc} vs M_*

M_{acc} vs M_{disk}

Large samples of YSOs at different ages :
testing viscous evolution
(Lodato 2017)

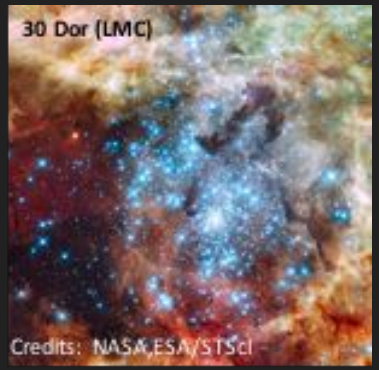


Manara +2020

Mass accretion: further developments

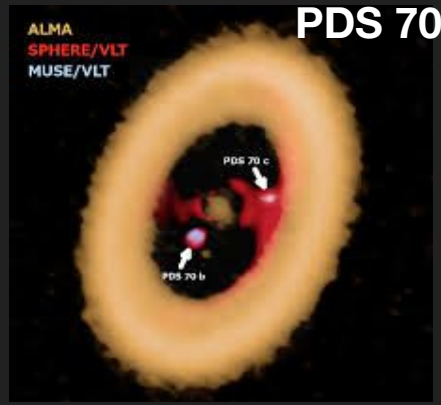
Accretion in different environments:

Young-clusters and low-metallicity SFR (MOONS/JWST/MAVIS)



Biazzo + 2019, Guarcello+2021

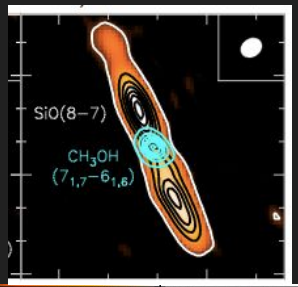
PDS 70



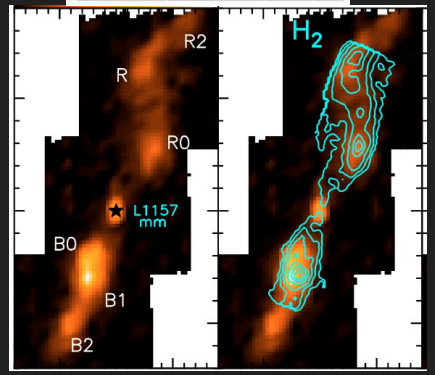
Accretion in forming planets:

High-contrast and high-res imaging/spectroscopy (MUSE/SHARK-VIS/HIRES@ELT)

JETS



Codella+ 2016 ALMA



Nisini + 2010, Herschel+ Spitzer

Erkal+ 2021 HST IR

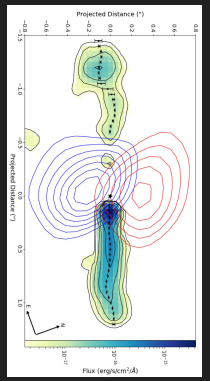
Large and long standing collaboration

Multi-wave studies of jets from proto-stars to T Tauri stars (HST, Spitzer, Herschel, ALMA, VLT)

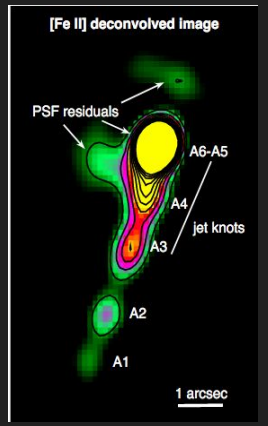
JEDI at the forefront for line diagnostic analysis from UV to mm: constraints on the launching mechanism and accretion/ejection connection

220 papers with more than 7000 citations

Garufi+ 2019 SPHERE



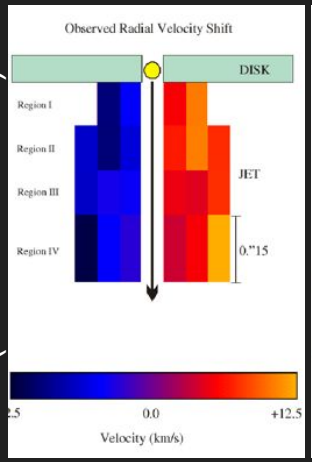
Erkal+ 2021, SINFONI



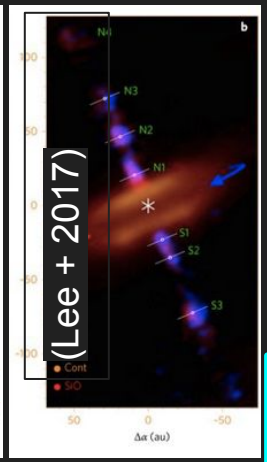
Antoniucci+ 2016, LBT

JETS: the smoking gun for inner disk physics

(Bacciotti + 2000)

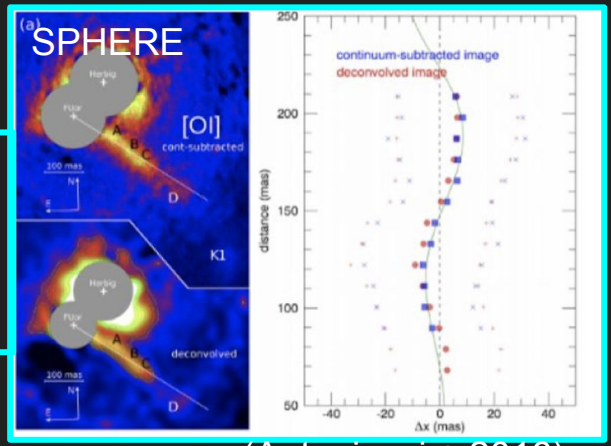


(Lee + 2017)



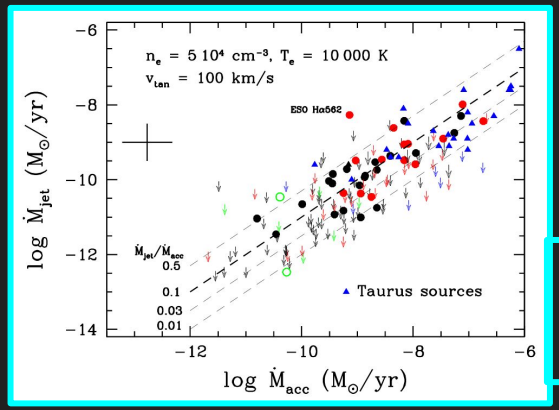
Test angular momentum removal
First observational evidence of JET ROTATION with HST - recently confirmed with ALMA
(Bacciotti +2000, Coffey + 2004,2007)

Indirect probe of past accretion bursts and unresolved massive planets/BD companions
(Antoniucci+2016; Erkel + 2021a/b)



(Antoniucci + 2016)

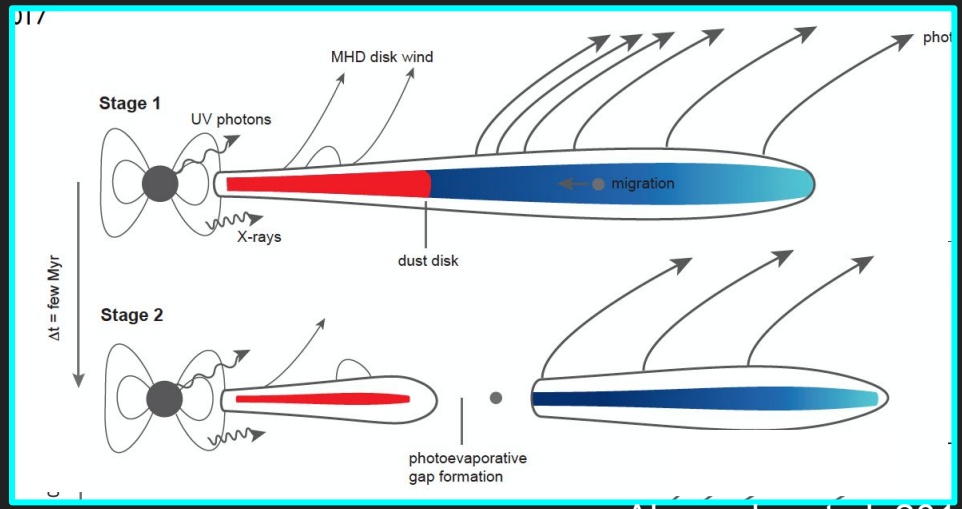
(Nisini + 2018)



First unbiased and auto-consistent relationship between M_{acc} and M_{jet} from X-shooter observations

DISK WINDS: drivers of disk dispersal

Disk dispersal due to MHD and photoevaporative winds

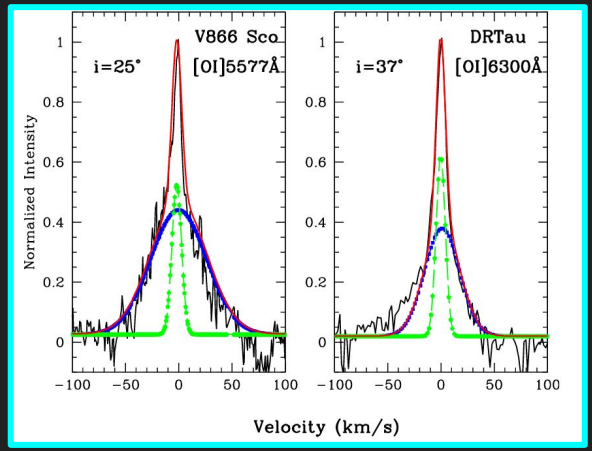


Alexander et al. 2014

(e.g. Rigliaco + 2014; Natta + 2014; Nisini + 2016; Giannini + 2018; Gangi + 2020)

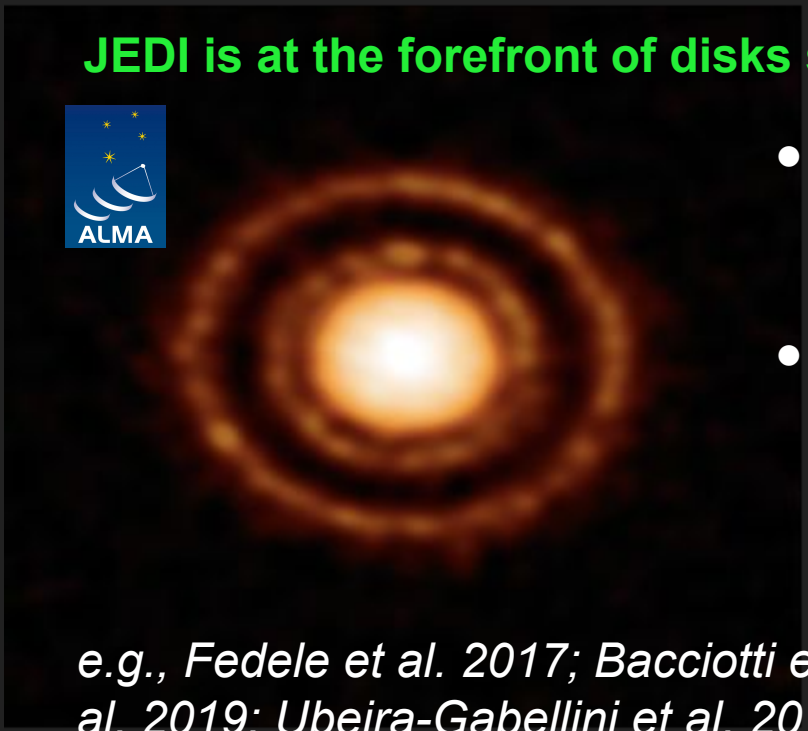
Surveys of optical/IR forbidden and molecular lines tracing extended disk winds with X-shooter/UVES/ESPRESSO/GIARPS

Unique synergy with studies of stellar and accretion parameters and disks



Rigliaco + 2014

Protoplanetary disks & the origin of planetary systems



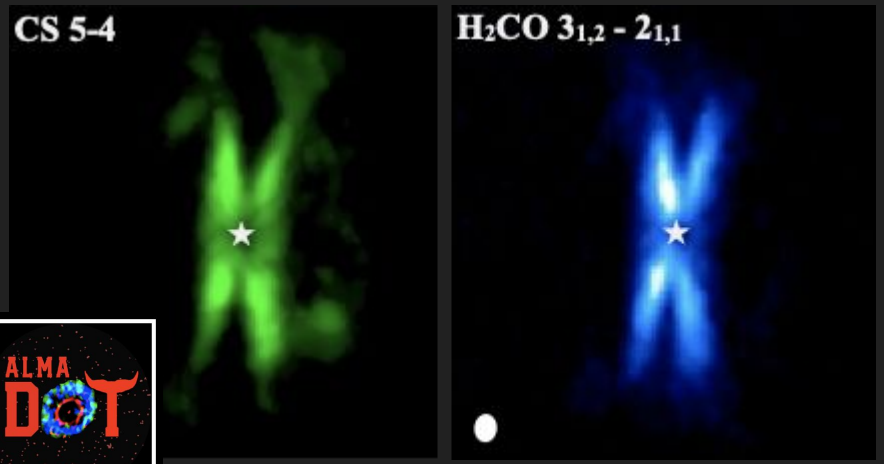
JEDI is at the forefront of disks studies with ALMA

- Observations of dust and gas to unveil the disk structure during the early stages of planet formation
- Thermo-chemical models and hydrodynamics simulations to determine the physical properties and dynamical evolution

e.g., Fedele et al. 2017; Bacciotti et al. 2018; Fedele et al. 2018; Favre, Fedele et al. 2019; Ubeira-Gabellini et al. 2019; Toci et al. 2020; Fedele et al. 2021

Protoplanetary disks & the origin of planetary systems

JEDI is at the forefront of disks studies with ALMA



- Observations of multiple gas tracers to unveil the primordial molecular composition
- Link to the composition of Solar System bodies and atmospheres of exoplanets

e.g., Kama et al. 2016; Favre, Fedele et al. 2018; Podio et al. 2018; Podio et al. 2019, Podio et al. 2020ab, Codella et al. 2020, Fedele & Favre 2020; Kama et al. 2020; Turrini et al. 2021

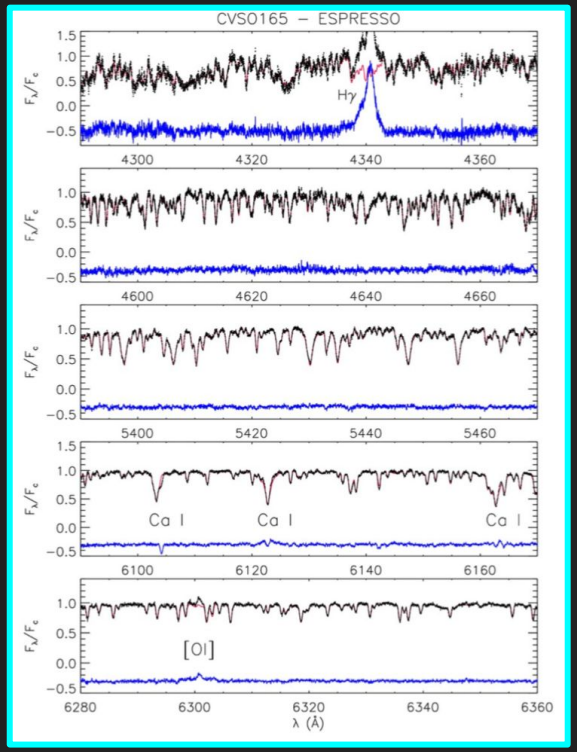
Protoplanetary disks & the origin of planetary systems

JEDI is at the forefront of disks studies with high contrast imaging

- VLT/SPHERE observations to trace the distribution of the small dust particles
- Probing the disk vertical structure
- Detection of newly-formed protoplanets

e.g., Avenhaus et al. 2018, Garufi et al. 2019, Ubeira-Gabellini et al. 2020; Garufi et al. 2020; Toci et al. 2020; Zurlo, Garufi et al. 2021

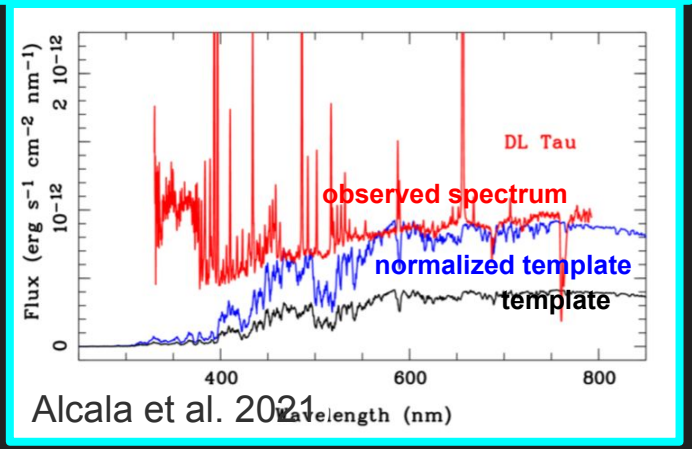
YSOs stellar parameters



Application of ROTFIT tool to ESPRESSO spectra of YSO (Manara et al. 2021)

- Homogeneous Determination of basic parameters:
(Teff, log(g), L*, M*, Av, RV, veil)
- Specific tools developed within the JEDI collaboration
- Routinely used in several spectroscopic surveys
of young stars (e.g. GES, X-shooter, Weave, and 4MOST)

(e.g. Frasca +2017,2018; Biazzo+2017; Alcala' + 2021; Manara et al. 2021)



Alcala et al. 2021

- Extending the tools in the IR for use with MOONS and JWST surveys (embedded or cold young sources, Biazzo et al. in prep.)

Projects: STRADE

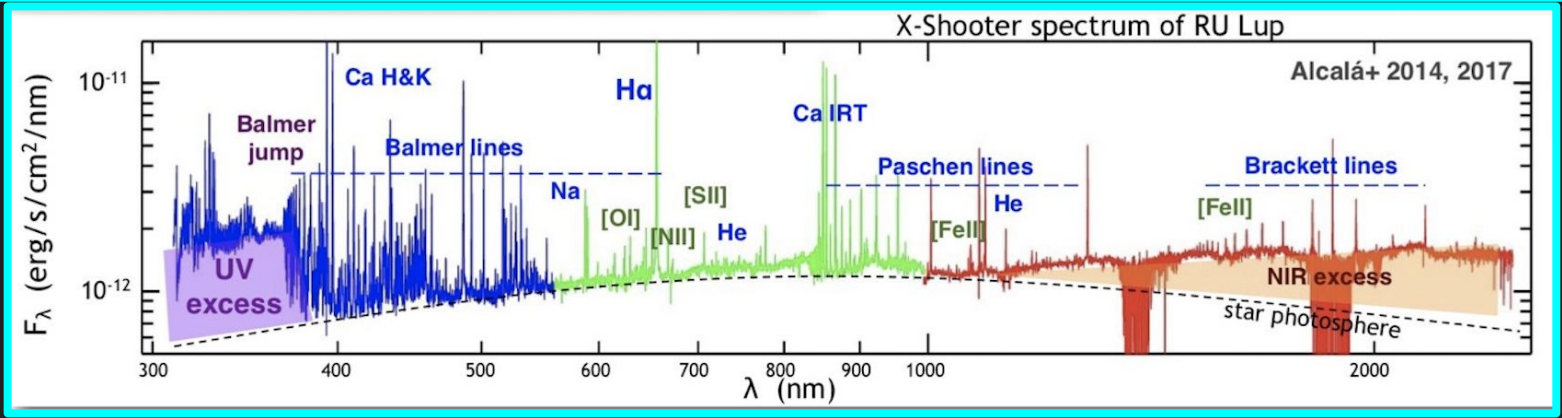
Spectroscopically TRAcing the Disk dispersal Evolution

PRIN2020: P.I. Juan Alcala'

Institutes involved: OANa, OACt, OAR, OAA, OAPa

Funds: 134 kEuro, 3 post-doc

- Spectroscopic surveys of YSOs in different ages and mass range
- Physics of the star-disk interaction, jets and winds simultaneously addressed
- Homogeneous analysis tools
- Different facilities: X-shooter, UVES/ESPRESSO, KMOS, GIARPS, LBT-LUCI/MODS
- Synergy with high-angular resolution observations with HST/VLTI-Gravity



Project: ULLYSES/PENELLOPE

Coordinator A. Frasca (OACt)

ULLYSES: Hubble UV Legacy Library of Young Stars as Essential Standard

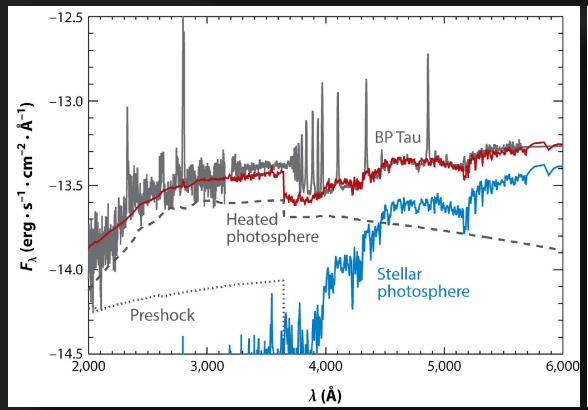
- DDT HST: ~500 orbits dedicated to solar-type YSOs

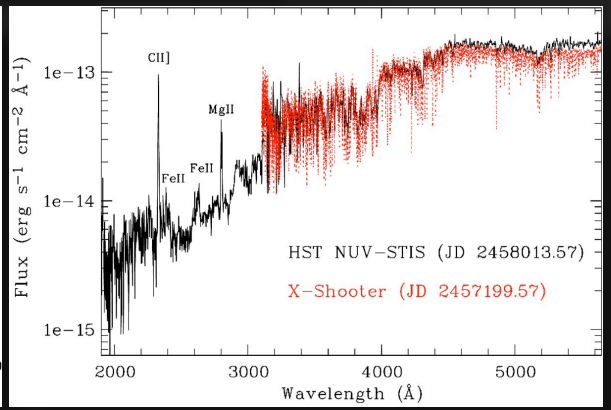
COS—FUV + STIS—NUV/Optical spectra

The ESO data legacy program to complete the Hubble UV Legacy Library of Young Stars (ULLYSES)

PI: Carlo Manara, INAF co-I from OACt, OANa, OAR, OAA, OAPa

Papers: Manara et al. 2021, in press; Frasca et al. 2021 in prep.





Will observe all the ULLYSSES targets with ESPRESSO/UVES and X-Shooter
+ ground-based photometry: REM and SLN

Scientific goals:

- Emission line kinematics and variability for accretion and winds
- Accurate estimate photospheric parameters
- Metallicity estimates
- Balmer continuum and IR emission lines tracing accretion and winds

Project: GHOsT

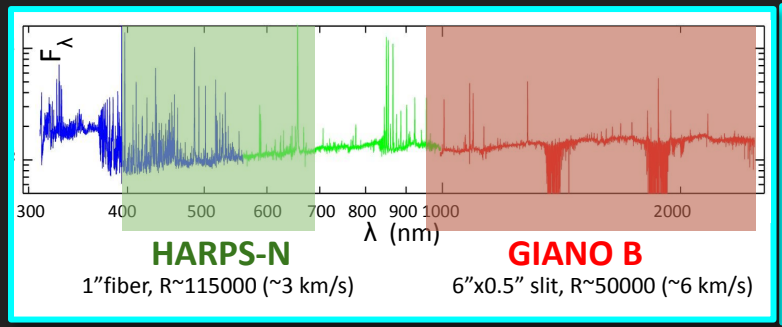
GIARPS High-resolution Observations of T Tauri stars

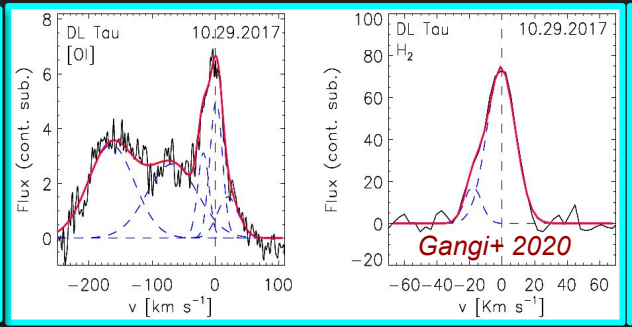
core team: S. Antoniucci (PI, OAR); K. Biazzo, M.E. Gangi, T. Giannini, B. Nisini, F. Vitali (OAR); J.M.Alcalà (OANa); A. Frasca (OACt); U.Munari, E.Rigliaco (OAPd); A. Harutyunyan (TNG); C. Manara (ESO)

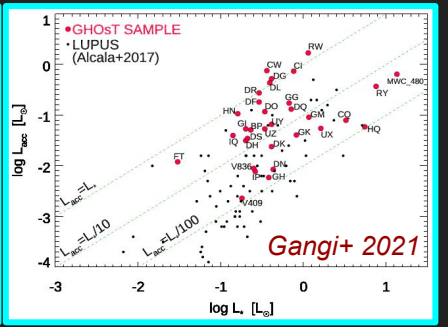
aims: → stellar and accretion/ejection parameters simultaneously and homogeneously for T Tauri stars in Taurus-Auriga
→ unique and solid observational reference for disk evolutionary models and

facilities: TNG/GIARPS but also Asiago, REM, SLN, TNG/NICS
sample/obs: flux-limited sample, ~60h of TNG time in the last 4 winter semesters, observed 52 objects

papers: Antoniucci+ 2017, Giannini+ 2019, Gangi+ 2020, Alcalà+ 2021, Gangi + in prep.

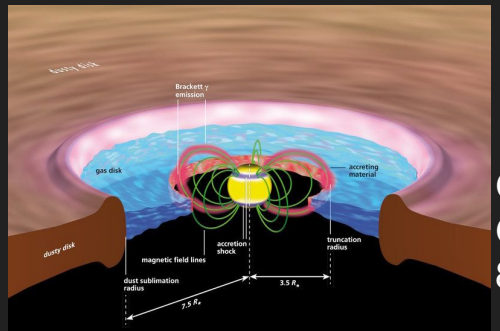






GGSy: GIARPS-GRAVITY Synergy

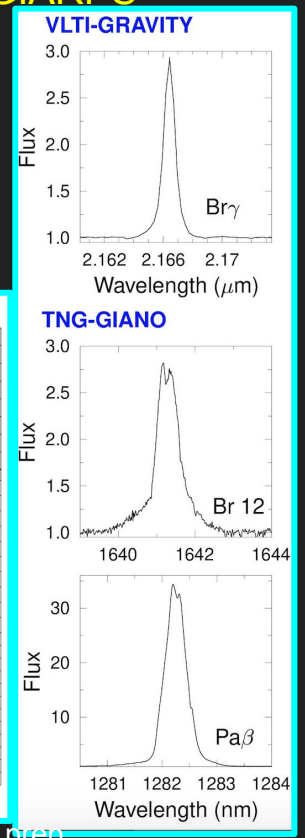
Coordinator F. Massi (OAA)



Garzia-Lopez +Gravity collaboration, Nature 2020

- Combining VLT-GRAVITY high spatial resolution with GIARPS high spectral resolution in young pms stars
- Get insights on the inner 0.1 au of PPD

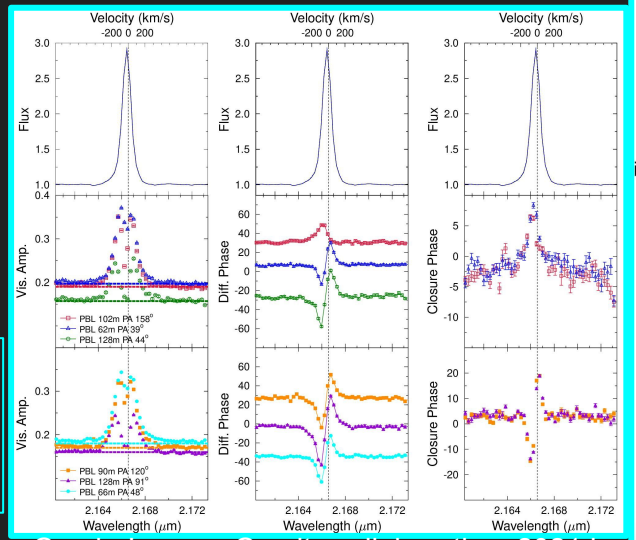
GIARPS obs: F.Massi (OAA), A. Caratti o Garatti (OANa)
GRAVITY GTO: R. Garcia Lopez (INAF ass.), A. Caratti o Garatti
8 INAF researchers involved



66 T Tauri/HAeBe stars observed in 6 TNG observing runs

One year AdR founded within the STRADE project

- Evidence for emission in a keplerian disk suggested by GRAVITY observations are confirmed by the HI double peak observed by GIANO



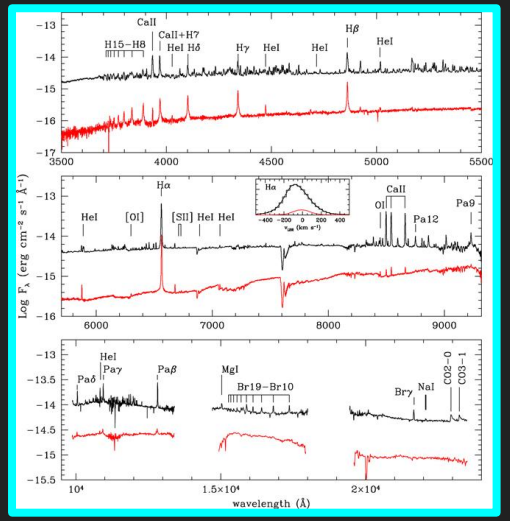
Garzia-Lopez +Gravity collaboration, 2021 in prep

Project:EXORCISM (EXOR optiCal Infrared Systematic Monitoring)

Coordinator T. Giannini (OAR)

Eruptive accretion in low-mass stars:

- role of the episodic accretion in the general context of star formation
- evolution of episodic accretion



Optical/Near-infrared spectrum of V1118Ori in quiescence and in burst (Giannini et al. 2016)

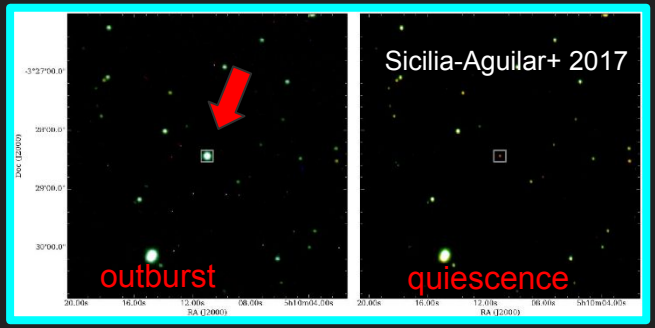
Institutions:

- INAF-OAR, INAF-OANa, INAF-OAPa
- Konkoly Observatory (Hungary)
- DIAS (Ireland)

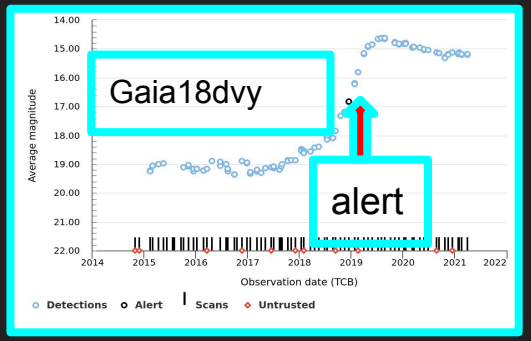
Facilities:

- LBT, VLT, TNG, NTT, REM
- e-ROSITA
- GTO program with SoXS
- Participation to the TVS collaboration of VRO

ASAS-SN3db



(22 papers in the last 10 yr, e.g. Giannini-2021,2017; Antoniucci+2015)



→ See also project Rubin-LSST-YSO of Sara Bonito

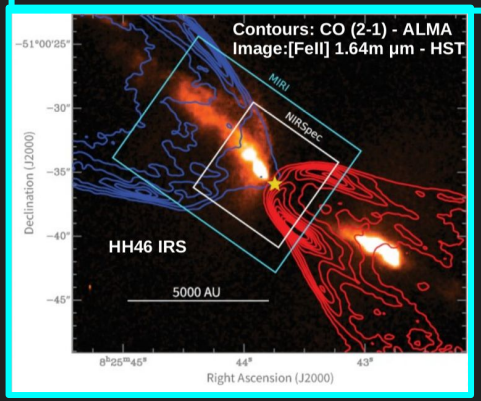
Project: Star Formation with JWST

Coordinator A. Caratti o Garatti (OANa)

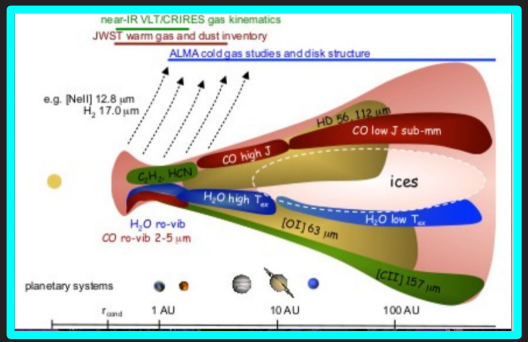
Three Cycle 1 GO project:

- A. Caratti o Garatti, NAOMY-J: NIR-dark Accretion Outbursts from Massive YSOs with JWST
- B. Nisini, PROJECT-J: PROtostellar JEt's Cradle Tested with JWST
- M. Guarcello: Testing Protoplanetary Disk Evolution and Brown Dwarf Formation in Starburst: NIRCam and MIRI Observations of the Young Cluster Westerlund 1

Participation to GTO and ERS projects on star formation: K. Biazzo (OAR), A. Caratti o Garatti (OANa), M.E. Palumbo (OACt)



OUTFLOWS



PROTOSTELLAR DISKS

YOUNG CLUSTERS

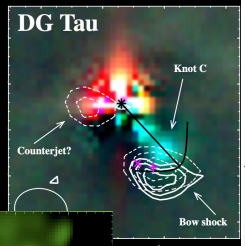
localCRs

coord. M. Padovani

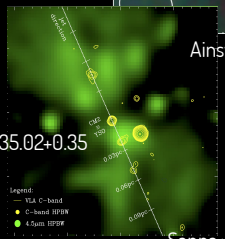
JETS, DISCS, and HII regions as cosmic-ray factories

- Ionization of cloud and disks
- drive of chemical complexity
- Planetesimal formation , planetary atmospheres

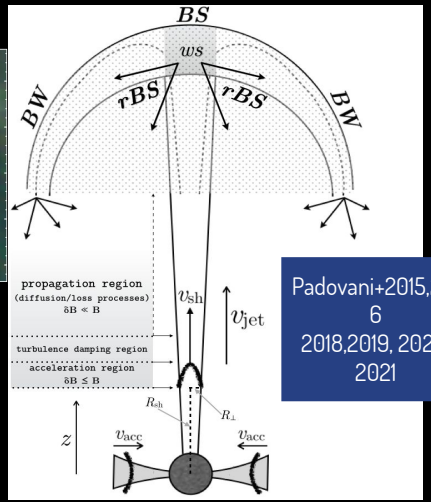
Local CR acceleration revealed by
molecular line emission (ALMA NOEMA, IRAM)
Synchrotron emission, γ-rays (SKA, LOFAR, CTA)



Ainsworth+2014



Sanna+2019



Padovani+2015,2016
2018,2019, 2020, 2021

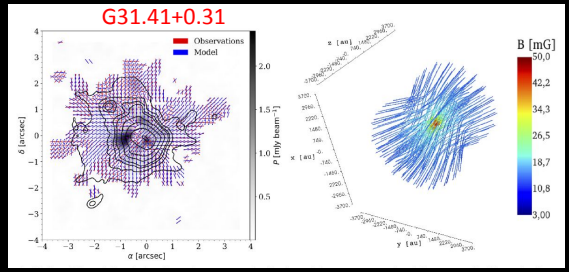
MAGNETIC

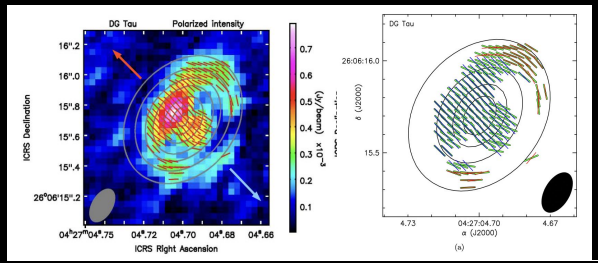
coord. M.T. Beltràn

POLARIZATION observations + MHD theory :

- Role of magnetic fields in star-formation at all scales
- Diagnostics of dust properties in disks from scattering
- Program operating since 2009
- 13 Team members OAA, OAC, OAB, IAPS - 9 FTE total
- Infrastructures: ALMA, NOEMA, JCMT, SMA, VLBI, EVN

B-Field in High-mass star-forming region (Beltrán+ 2019)

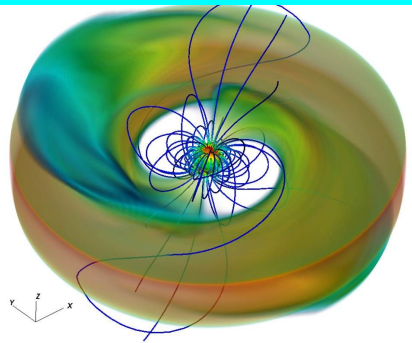




Dust scattering in disks around low-mass stars (Bacciotti+ 2018)

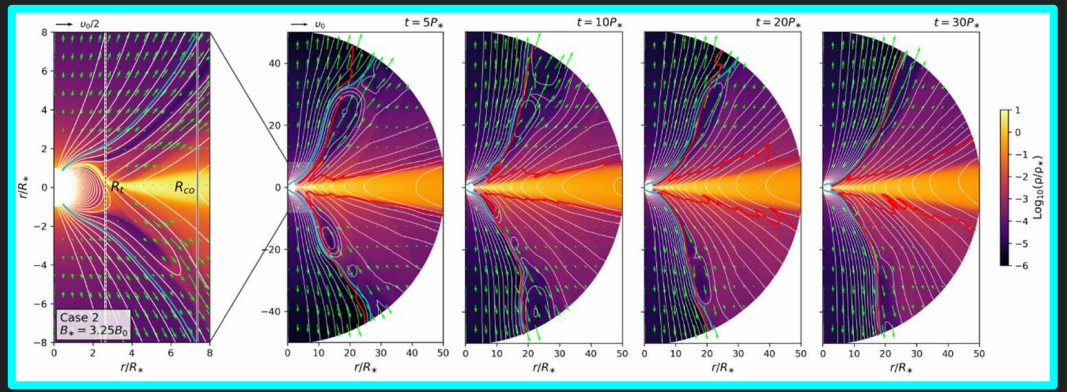
Project: Star Disk Interaction (SDI)

Coordinator C. Zanni (OATo)



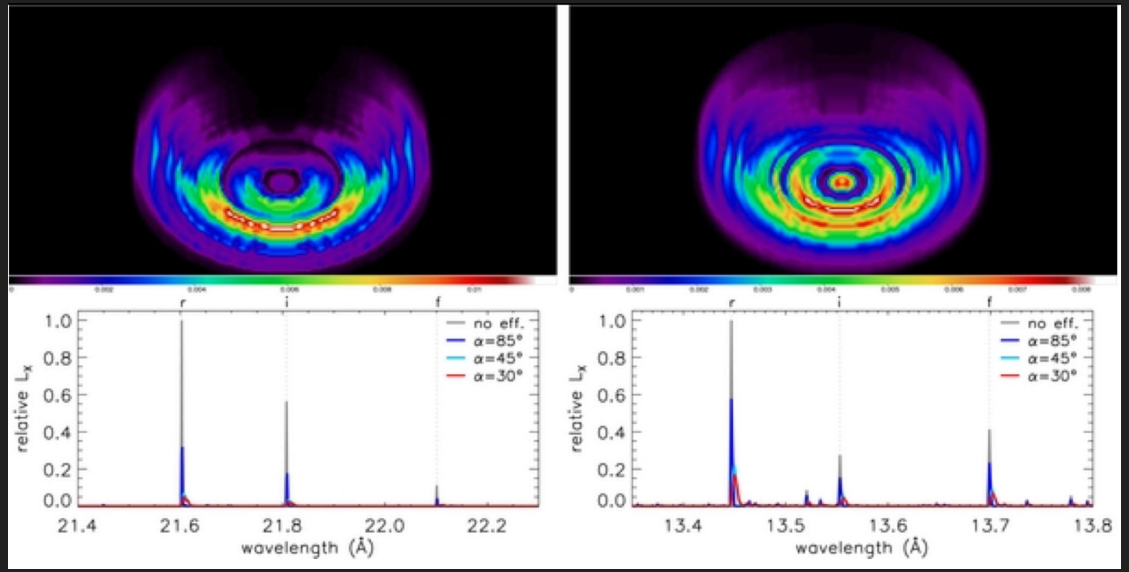
- MHD Dynamical and radiative numerical models for the interaction of the stellar magnetic field with the accretion disk
- Prediction of stellar angular momentum evolution
- Simulations carried out with the MHD code PLUTO, developed @ OATo and UniTo

- Collaboration with IPAG Grenoble
- Funded by Marie Curie Grant MAESTRO and ERC SPIDI (PI Bouvier, Grenoble)



Pantolmos, Zanni & Bouvier 2020

Project: YSO-ALESA: R. Bonito



(Bonito+2011,2014; Albertazzi+2014;Revet+2021)

- MHD numerical models of accretion shocks predicting synthetic X-ray spectra
- Interpretation of laboratory laser experiments using intense magnetic fields reproducing astrophysical outflows

JEDI involvement in future projects

Participation in the science groups and GTO

Criticità

Campo estremamente fertile ed in rapida crescita grazie anche alla riconosciuta importanza dello studio dei dischi per la formazione degli esopianeti.

Alcune necessita':

- Rafforzamento del network JEDI per aumentare la coesione e il coordinamento dei vari gruppi. JEDI-talks e meetings aperti ai nostri collaboratori internazionali
- Rafforzamento ed acquisizione di nuove competenze in campi critici per l'utilizzo delle nuove facilities:
  - Analisi di post-processing di immagini in extreme-AO
  - Competenze per analisi in tempi rapidi dei dati JWST
  - Tools per analisi di big-data sets, sia fotometrici (VRO) che spettroscopici (MOONS,SOXS)
  - Tecniche di analisi spettrale di stelle giovani nell'IR, per surveys su sorgenti estinte piu' giovani o BD
  - Aumentare la sinergia tra osservazioni e modelli teorici

Per mantenere il livello di eccellenza raggiunto e' FONDAMENTALE mantenere una continuità e rafforzamento dei fondi, per creare nuove professionalità in questo settore e non disperdere quelle acquisite.