# Phase Transitions in Astrophysics, from ISM to Planets

Sunday, May 7, 2017 - Friday, June 2, 2017

Nordita, Stockholm

# Book of Abstracts

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**Author:** Andrea Bracco[None]

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## Smooth Particle MHD, method, expectatives and strategies

**Author:** Federico Stasyszyn[None]

I will introduce Smoothed Particle Hydrodinamics as a numerical method, focussing particularly on the pros and cons when simulating ISM and accretion discs. Additionally I will comment on MHD implementations that currently successfully implemented.

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**Author:** Simon Candelaresi[None]

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**Author:** Marc-Antoine Miville-Deschenes[None]

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## Phase Transition Dynamics of ISM: The Formation of Molecular Clouds and Galactic Star Formation

**Author:** Shu-ichiro Inutsuka[None]

Magnetohydrodynamics of interstellar medium is remarkably different from that of simple barotropic gas owing to the phase transitions between cold phase and warm phase (and hot phase) that trigger variety of instabilities. Identifications of distinct instabilities in various stages provide us important clues for understanding the saturation levels of turbulent energies and rates of formation and destruction of cold clouds, such as HI clouds and molecular clouds. Recent high-

resolution magneto-hydrodynamical simulations of phase transition dynamics with cooling/heating and thermal conduction have shown that the formation of molecular clouds requires multiple episodes of supersonic compression. This finding enables us to create a new scenario of molecular cloud formation as the interacting shells or bubbles in galactic scale, which explains many observational properties such cloud-to-cloud velocity dispersions, accelerating star formation, and very low star formation efficiencies in filamentary molecular clouds. We estimate the ensemble-averaged growth rate of individual molecular clouds, and predict the associated cloud mass function. Cloud-cloud collisions as a mechanism for forming massive stars and star clusters can be naturally accommodated in this scenario. This explains why massive stars formed in cloud-cloud collisions follows the power-law slope of the mass function of molecular cloud cores repeatedly found in low-mass star forming regions.

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**Author:** Tomoyuki Hanawa[None]

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**Author:** Michiel Lambrechts[None]

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**Author:** Steven Vance[None]

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**Author:** Oliver Gressel[1]

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**Author:** Yamila Miguel[None]

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**Author:** Igor Rogachevskii[1]

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**Author:** Alexis Brandeker[None]

AU Microscopii is a nearby red dwarf, belonging to the beta Pictoris moving group. Like beta Pic, AU Mic is famous for its big, edge-on debris disk. Recent high-resolution, multi-epoch imaging of the system has revealed baffling features in the disk in the form of clumps moving at super-Keplerian speed out from the system. Currently, there is no satisfactory explanation for the origin and dynamics of the clumps. In this talk I will review the current facts and hypotheses, and propose a way forward towards solving this mystery.

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## Some aspects of protoplanetary disc formation and evolution

**Author:** Patrick Hennebelle[None]

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**Author:** Oliver Gressel[1]

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## Implementing a Radially Efficient Poisson Equation Solver to Investigate Tidal Downsizing

**Author:** Vincent Carpenter[None]

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## The Dark Milky Way: Probing our Galaxy's Hidden Gas

Many studies have proved the existence of the "dark interstellar medium" (dark ISM) which is not detected by traditional radio emissions from atomic hydrogen (HI) and carbon monoxide (CO) molecules. In recent years, OH has emerged as a powerful indicator of dark-ISM. In this study, we use HI and OH data from the Arecibo Millennium survey (Heiles and Troland 2003) which observed absorption and emission pairs towards 79 extragalatic radio continuum sources. The Λ-doubling transitions of ground-state OH at 1665.402 and 1667.359 MHz were observed along with HI towards 48 of the 79 survey positions. By newly reducing this unpublished data, OH absorption was detected in 23 lines- of-sight, we find that the OH 1665 and 1667 lines satisfy the optically thin assumption with the optical depth $\tau$ less than 0.25 and they are in general not in Local Thermal Equilibrium.
By comparing the thermal dust data from Planck satellite (Release 1.2) and the Sloan Digital Sky Survey (Schlafly et al. 2011) with HI data from Millennium survey, we confirm the tight linear correlations between optical depth $\tau$353, dust radiance R, reddening E(B-V) and the total proton column density N(H). We estimate the molecular hydrogen column densities N(H2)=½[N(H)-N(HI)] from these linear relationships and hence the OH abundance ratio XOH=N(OH)/N(H2), for which few literature measurement exist. The XOH ratios derived from the three N(H) proxies are consistent and appear to be constant around 5.0×10-6. Since these results are obtained in a wide ranges of longitude l and latitude b with some sightlines through the Galactic plane, it suggests that OH main lines are excellent tracers of molecular gas in the interstellar medium including regimes where the usefulness of CO is compromised.

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M dwarfs are optimal targets to search for potentially habitable planets in the solar neighborhood through the photometric transit method and the analysis of radial velocity timeseries. Spanning almost all the low-mass spectral range, "breaking news" terrestrial planets have been found around some nearby M dwarfs, and they will be the primary follow-up targets for further characterization in the near future. After introducing the state-of.-the-art techniques used to detect those planets, I will focus on some of the most promising by highlighting in particular the challenges posed by stellar activity and spectroscopical observational sampling for a proper characterization of their bulk composition.

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