EVIDENCE FOR DISK PHOTOEVAPORATION DRIVEN BY THE CENTRAL STAR – IMPACT ON PLANETARY ARCHITECTURES. I. Pascucci[1], M. Sterzik[2], R. D. Alexander[3], G. Sacco[4]. [1]Lunar and Planetary Laboratory, The University of Arizona. Email: pascucci@lpl.arizona.edu. [2]European Southern Observatory. [3]Department of Physics & Astronomy, University of Leicester. [4]INAF, Osservatorio Astrofisico di Arcetri

Introduction: Gas-rich dust disks around young stars (hereafter, protoplanetary disks) provide the raw material to build up planets. Thus, the timescale over which they disperse and the physical mechanisms contributing to their dispersal are key in understanding what type of planets can form. Significant progress has been made in the past few years in measuring the dispersal timescale of protoplanetary disks, e.g. [1]. Still much debate exists on the disk dispersal mechanisms and on their efficiency.

Models of protoplanetary disk evolution suggest that *viscous evolution* (accretion of gas onto the central star) and *photoevaporation driven by the central star* (heating of disk gas to thermal escape velocities) are the main disk dispersal mechanisms [2]. While there is abundant observational evidence that young stars are accreting disk gas (e.g. [3]), unambiguous diagnostics of centrally driven disk photoevaporation were lacking so far.

Here we present the first observational evidence for disk photoevaporation driven by the central star and discuss the implications of photoevaporation on the architecture of planetary systems.

Observations: [NeII] emission at 12.81 micron was recently recognized as a powerful diagnostic of stellar high-energy photons impinging on the disk surface [4,5]. We carried out high-resolution (R~30,000) spectroscopy of [NeII] lines toward a large sample of protoplanetary disks spanning a range of evolutionary stages based on their spectral energy distribution.

Results: We show that in 'evolved' disks the [NeII] lines are slightly blueshifted (from a few to ~10 km/s, see Fig. 1) and have full widths at half maximum increasing with the disk inclination [6,7]. For the source where we have multiple observations and the highest signal-to-noise spectra we also show that the [NeII] line profiles are slightly asymmetric, with more emission on the blue than on the red side [8]. These line properties are a tell-tale sign of unbound gas leaving the star-disk system in a slow thermal photoevaporative wind [9,10]. They represent the first unambiguous diagnostics for central star-driven photoevaporation.

Implications on planetary architectures: While the surface density of a disk that is *only* viscously evolving will smoothly decrease with time at all disk radii, photoevaporating disks should open gaps that widen with time as the photoevaporation rate becomes larger than the stellar accretion rate, e.g. [10]. We demonstrate that this disk clearing mechanism has a strong effect on the distribution of giant planet semi-major axes [11]. In particular it may be responsible for the observed pile-up of Jupiter-mass planets at ~1AU seen in exoplanet surveys [12]. We also discuss how upcoming exoplanet observations can be used to test models of both planet migration and disk clearing.

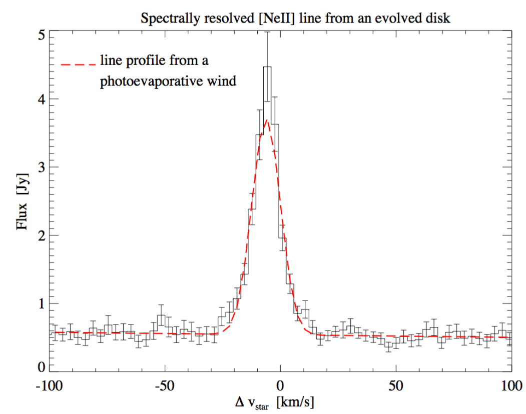

Figure 1: Spectrally resolved [NeII] line from the 'evolved' disk around the nearby star TW Hya [6]. The blueshift and line profile are well reproduced by a photoevaporative wind model [9].

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