AN INFRARED CHARACTERIZATION OF THE ORION NEBULA CLUSTER

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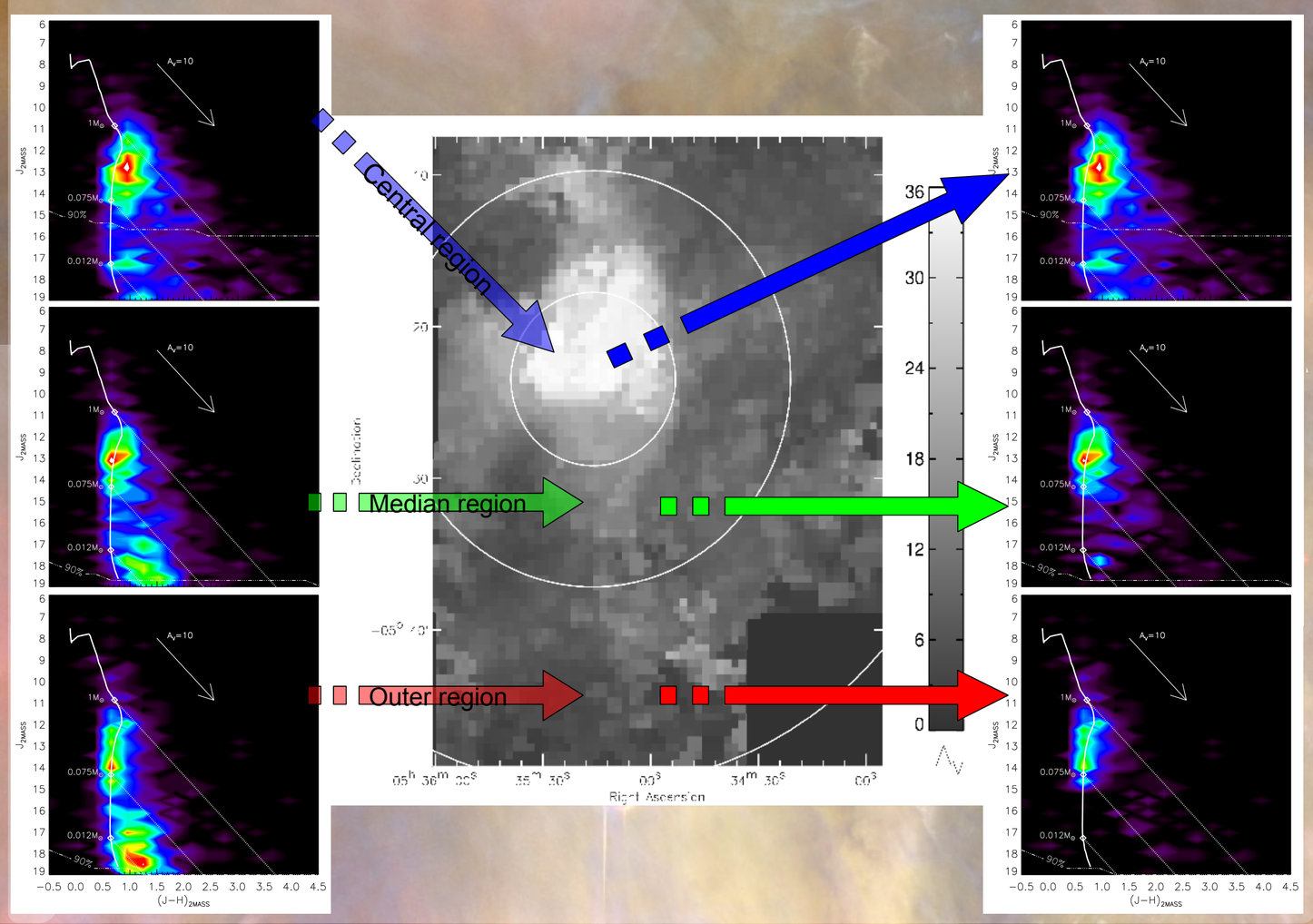
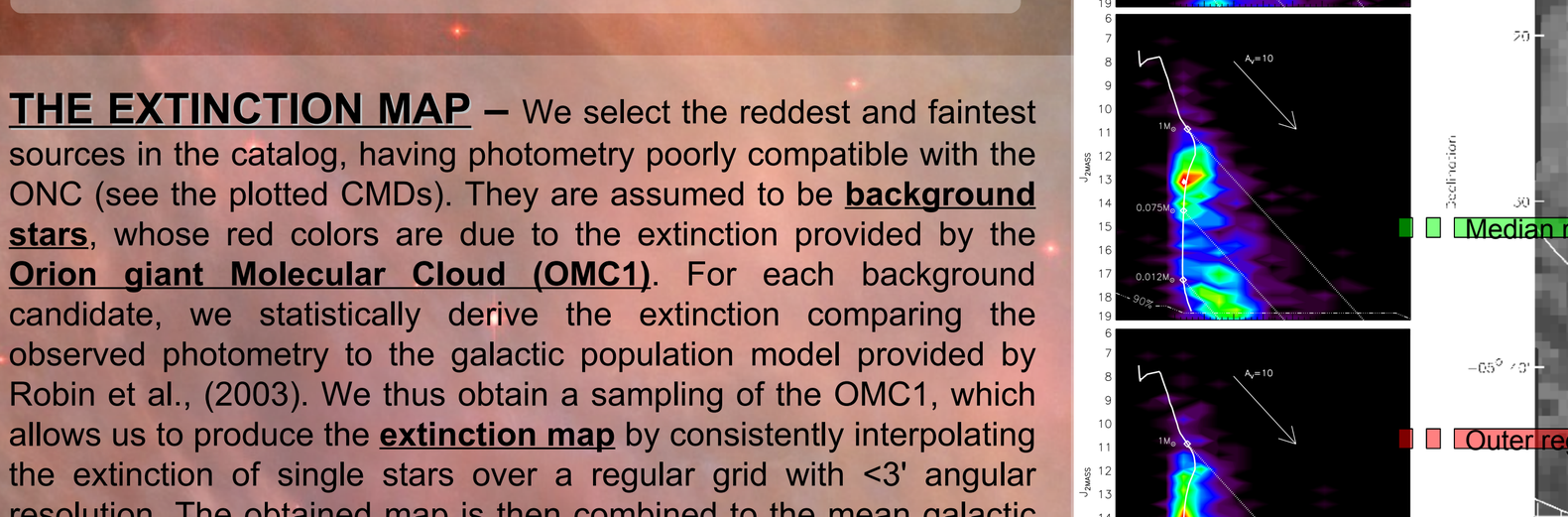
ABSTRACT - We present the latest results from our analysis of the JHK photometry of the ONC, which covers 30'x40' around the Trapezium asterism, reaching magnitudes as low as to K=21. We analyze the color-magnitude diagrams and we compare the observed contaminant population to the synthetic galactic population, deriving the OMC-1 extinction map across the whole surveyed area. For ~500 sources with cross-matched optical photometry and known spectral type we use synthetic IR photometry to analyze the correlation among the IR magnitude excesses. The reddening law and the correlation between magnitude excesses are then combined to consistently derive mass, extinction and IR excess assuming a 1Myr isochrone. Finally we derive the completeness- and contamination-corrected low-mass ($M<0.3M_o$) and substellar Initial Mass Function of the Orion Nebula Cluster. Our results suggest that while the largest fraction of sources with IR excess compatible with circumstellar disks is found in the inner core (projected radius<0.7pc), the IMF does not show significant variations across the cluster: it is peaked between $0.3M_o$ and $0.1M_o$ and continuously decreases in the brown dwarfs domain.

THE CATALOG - In the framework of the Hubble Treasury Program on the Orion Nebula Cluster (HST GO10246), we performed JHK_S observations in a 30´x40´ region covering both the M42 and M43 fields (Robberto et al. 2010). Our final catalog contains 2MASS photometry for **6826 point-like sources**, down to J~21.

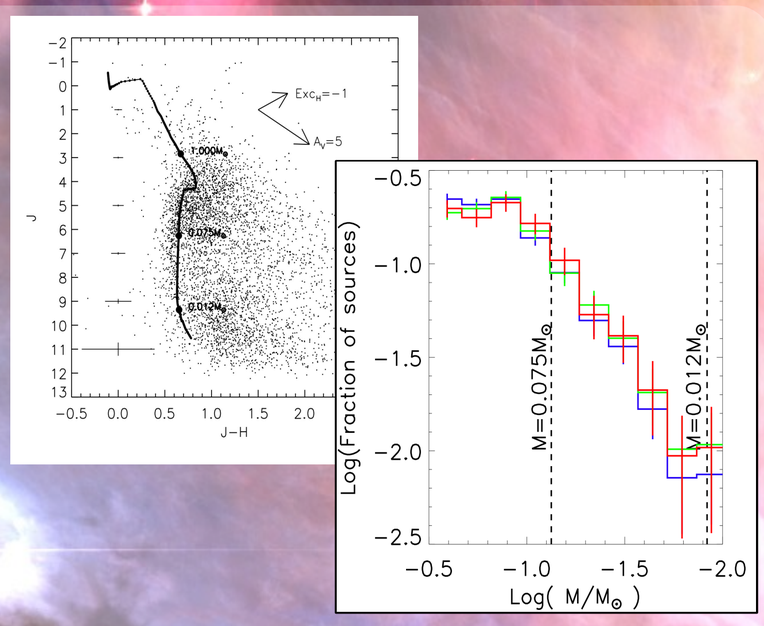
THE EXTINCTION MAP – We select the reddest and faintest sources in the catalog, having photometry poorly compatible with the ONC (see the plotted CMDs). They are assumed to be **background stars**, whose red colors are due to the extinction provided by the **Orion giant Molecular Cloud (OMC1)**. For each background candidate, we statistically derive the extinction comparing the observed photometry to the galactic population model provided by Robin et al., (2003). We thus obtain a sampling of the OMC1, which allows us to produce the **extinction map** by consistently interpolating the extinction of single stars over a regular grid with <3' angular resolution. The obtained map is then combined to the mean galactic population in order to **statistically correct** the observed CMDs of the ONC for contaminants. Figures on the right show our contamination-corrected CMDs.



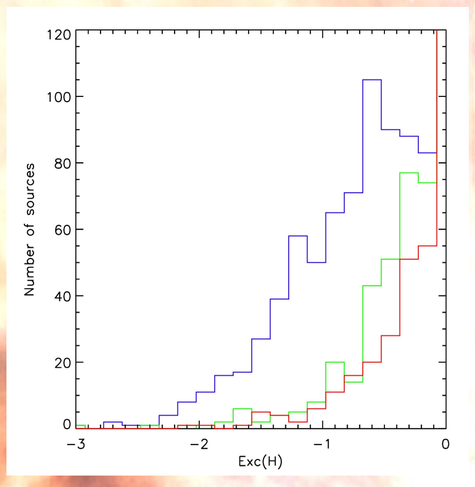


NEAR IR EXCESSES – We extract a sample of 300 stars with known **spectral type** (Hillenbrand, 1997), measured **extinction**, **masse** and **bolometric luminosity** (Da Rio et al. 2010) and accurate JHK_S photometry. The combination of all these quantities allows computing both synthetic stellar photometry and dereddened JHK_S observed colors. Comparing the two of them we derive the **infrared excess** in each band. The **strong linear correlation** between excesses in the three bands allows updating the slope of the **CTTSs locus** in (J-H,H-K_S) provided by Meyer et al., (1997).

IMF - For each star, we compute the combination of extinction (A_V) and IR excess (E_H) which provides the best agreement between photospheric and synthetic photometry, the latter given by the theoretical model of Baraffe et al. (2002). In this way we **estimate the mass** of each source in the sub-solar regime. We also statistically correct our sample for contamination, iteratively drawing a sample of cluster members and deriving the corresponding ONC IMF. The mean IMF we derive is peaked at **M≈0.14M$_\odot$** (SpT: M6) and then continuously decreases below the hydrogen burning limit mass, without any significant variation across the cluster.



IR EXCESS - We find the **highest fraction** of sources with infrared excess in the inner region. This may be due to **CTTSs accretion activity** or to the presence of disk photoionization (**proplyds**) originated by the UV radiation from the Trapezium cluster, or a combination of the two.



DISCUSSIONS - Our JHK_S photometric survey allows us to sample the subsolar regime and the whole brown dwarfs domain across the full extent of Orion Nebula Cluster. Our analysis shows that:

- it is possible to draw a sample of stars in the catalog which are bona-fide background stars, reddened by the OMC1. These stars are used to build the extinction map of the OMC1 with <3' angular resolution;
- cross-correlating our JHK_S observed photometry to previous optical spectro-photometric studies, we eventually detect the presence of circumstellar disks through flux excesses in the NIR wavelength range. We find that the flux excesses in the JHK_S bands are strongly correlated, and we also update the CTTSs locus provided by Meyer et al. (1997).

These two results are consistently used to rule out the effects of contamination and infrared excesses in our NIR photometric catalog, and to draw a statistical sample of ONC members with derived photospheric magnitudes. By means of the appropriate theoretical model, we derive the best estimate of masses and, by consequence, the ONC IMF. We find that it is peaked at M≈0.14M_O and it continuously decreases crossing the hydrogen burning limit. We also find the highest incidence of NIR excess in the neighborhood of the Trapezium asterism: this may be evidence of either on-going accretion phenomena or photoionization of circumstellar disks.

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Scandariato, G., *in preparation*

Tenerife, Canary Islands, Spain, 18th -22th October 2010 – The Origin of Stellar Masses

A meeting of the CONSTELLATION Research Training Netork, organized by the IAC