Near-Infrared Spectral Energy Distribution of Seyfert Galaxies: stellar population, active nucleus and hot dust

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Abstract

We study the stellar population (SP), active galactic nuclei (AGN), featureless continuum (FC) and the hot dust in the inner few hundred parsecs of 9 Sy 1 and 15 Sy 2 galaxies, in the near-infrared (NIR - from 0.8 to 2.4μm). Both the STARLIGHT code and the hot dust as an additional base element were used for the first time in this spectral range. Our synthesis shows significant differences between Sy 1 and Sy 2 galaxies: the hot dust is required to fit the K-band spectra of 80% of the Sy 1, and only of 40% of the Sy 2; about 50% of the Sy 2 require an FC component contribution >20%, while this fraction increases to about 80% in the Sy 1; also, in about 50% of the Sy2, the combined FC and young components contribute >20%, while this occurs in 100% of the Sy1, suggesting recent star formation in the central region. The central few hundred parsecs of our galaxy sample contain a substantial fraction of intermediate-age SPs with a mean metallicity near solar. Our SP synthesis confirms that the 1.1μm CN band can be used as a tracer of intermediate age SPs. The simultaneous fitting of SP, FC and hot dust components increased in 150% the number of AGNs with hot dust detected with mass estimated.

Introduction

To determine if circummstellar stellar populations and nuclear activity are closely related phenomena, or if they are only incidental, it is of utmost importance the correct characterization of the former, since a substantial fraction of the energy emitted by a galaxy is starlight. With the new generations of Evolutionary Populations Synthesis models, which include a proper treatment of the TP-AGB phase (Maraston, 2005), it is now possible to study in more detail the near infrared (NIR) stellar population of galaxies.

The NIR Spectral Energy Distribution

Stars are one of the most important components of the NIR spectral energy distribution. Since we are dealing with active galaxies, the dilution by a featureless continuum should be taken into account. Moreover, in the studied spectral region (0.8-2.4 μm), hot dust plays an important role in the continuum emission. Such component can strongly dilute the absorption features (see Fig. 1).

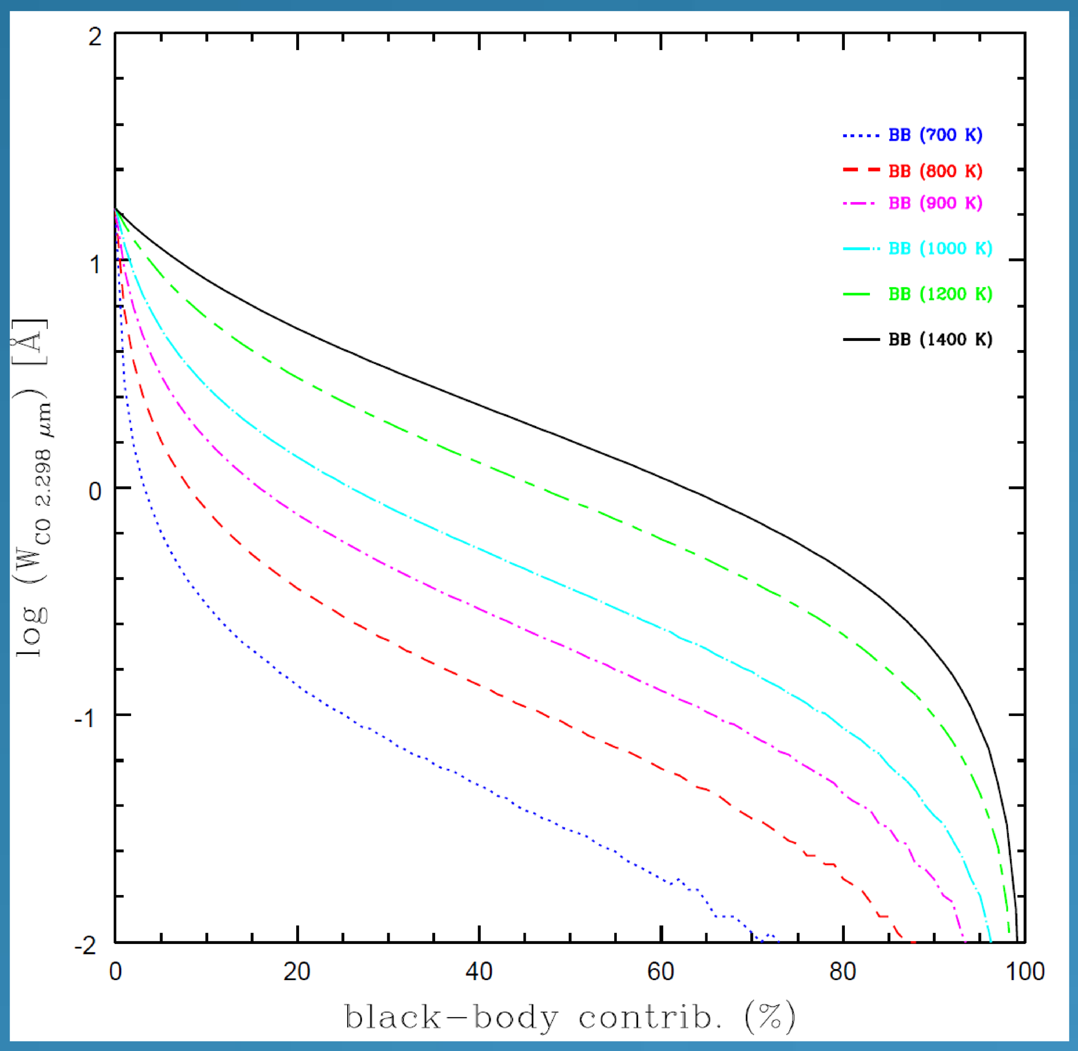

Fig. 1: Dilution of the 2.298 μm CO band by hot dust.

Spectral Synthesis

Code:

STARLIGHT, which models the whole underlying spectrum , excluding emission lines and spurious data(Cid Fernandes et al., 2005);

Base set:

✓Stellar Population: most recent EPS models (Maraston 2005).

✓Featureless continuum: Power Law of the form $F_\nu \sim \nu^{-1.5}$;

✓Planck distribution: 800 ≤ T ≤ 1400 K.

Results

To properly fit the spectral energy distribution of our galaxies we need an additional component, hot dust, in almost all of the Seyfert 1 and some of the Seyfert 2s. We show two examples of the fit for the Seyfert 2 (NGC 7674 and Mrk 1066) sources as well as one to represent the Seyfert 1s (Mrk 334). The fits are shown in Fig. 2 to Fig. 4, where the red line represents the hot dust contribution, the white is the featureless component, the cyan line is the sum of the stellar population components: young (age ≤ 50 Myr); intermediate (100 Myr ≥ age ≤ 2 Gyr) and old (age ≥ 5 Gyr). The individual contribution of each component is given by the histograms.

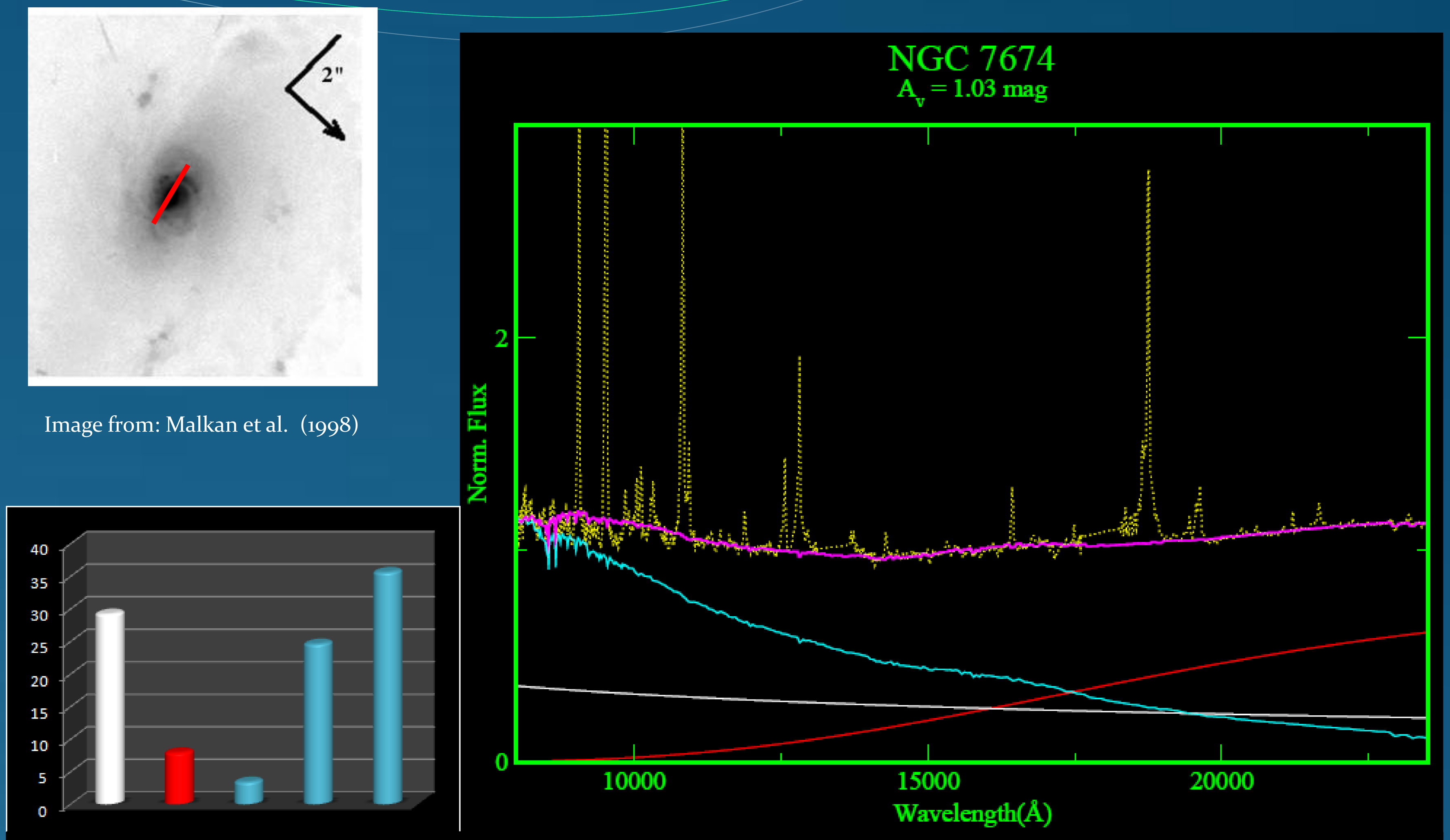

Fig. 2: Results for NGC 7674. Hot dust, featureless and stellar population (young + Inter. + old) components.

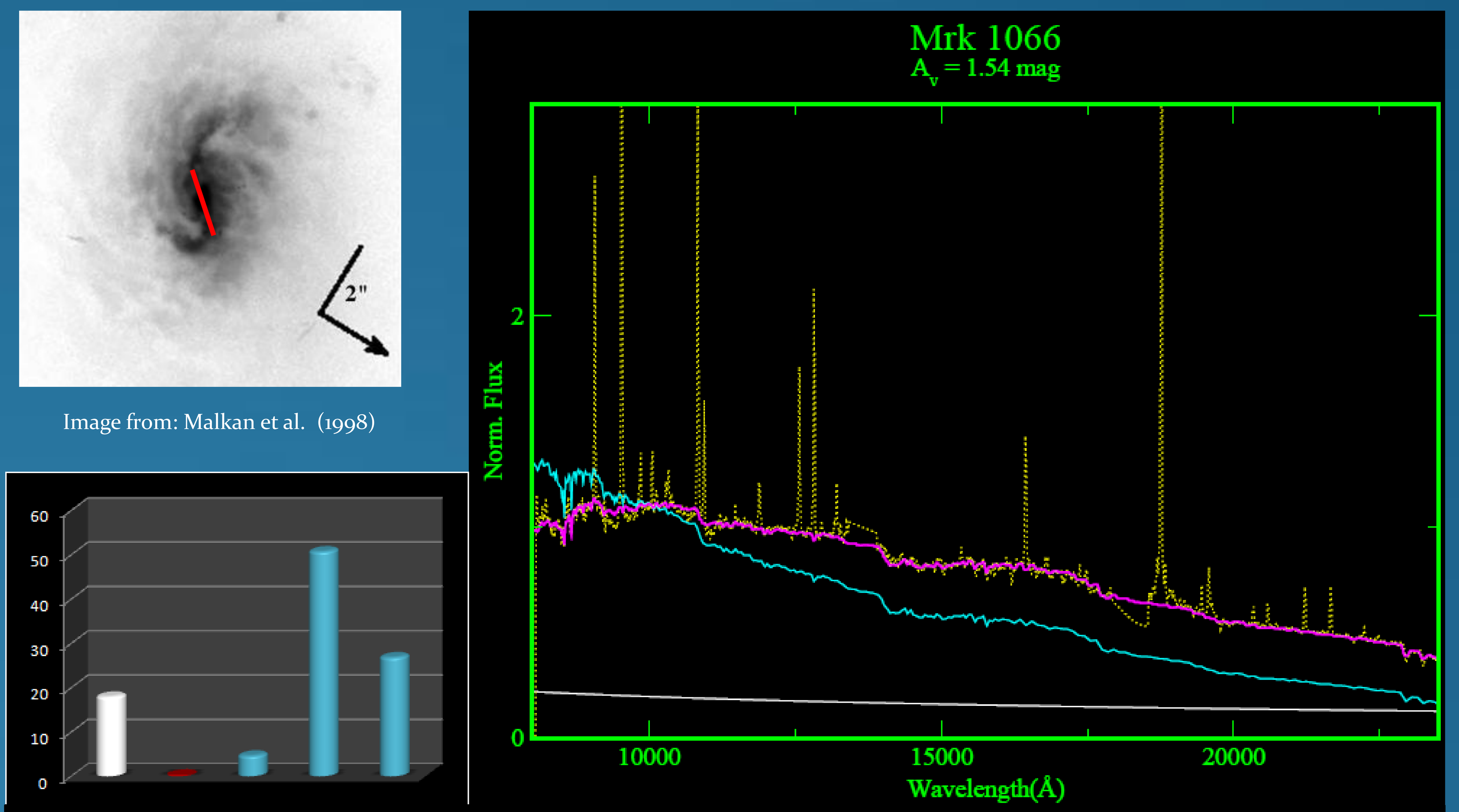

Fig. 3: Results for Mrk 1066. No Hot dust, featureless and stellar population (young + Inter. + old) components.

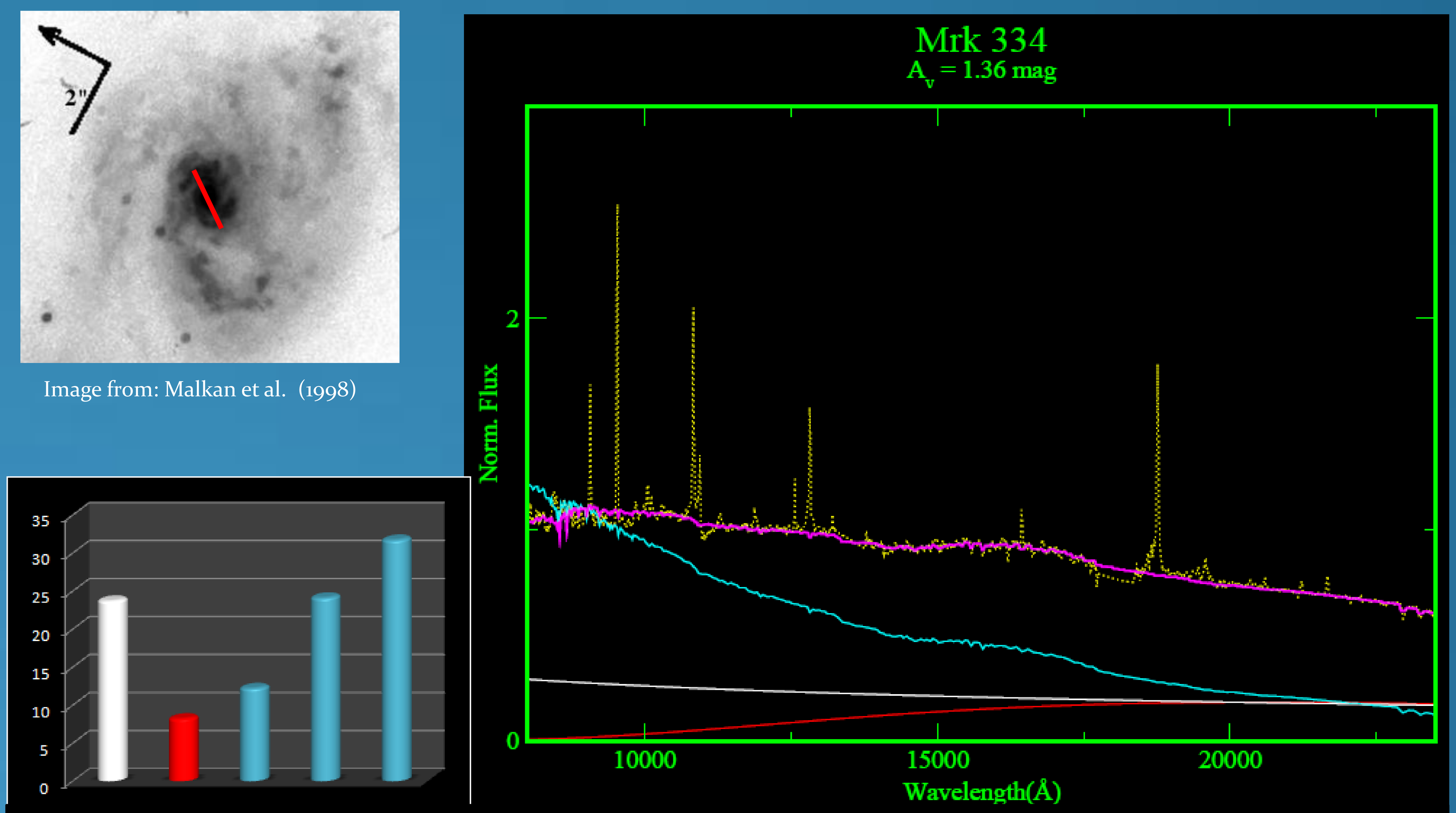

Fig. 4: Results for Mrk 334. Hot dust, featureless and stellar population (young + Inter. + old) components.

Conclusions

✓The simultaneous fitting of SP, FC and hot dust components allows a proper analysis of each one of them;

✓ A substantial fraction of Intermediate age stellar populations is detected (~40%);

✓There are significant differences between the NIR stellar populations of Sy 1 and Sy 2 galaxies in the hot dust and featureless components.

✓ We estimate the hot dust mass for 13 objects. This represents an increase of 150 % in AGNs with hot dust mass estimated (see Tab 1).

Tab. 1. Mean mass and temperature of hot dust.

	Seyfert 1	Seyfert 2
Hot dust mass	20 x 10^{-5} $M_\odot$	200 x 10^{-5} $M_\odot$
Mean Temp.	1080 K	1370 K

Full Paper: http://arxiv.org/abs/0907.4144

References

Cid Fernandes +, 2005, MNRAS, 358, 363.

Malkan +, 1998, ApJS, 117, 25.

Maraston, 2005, MNRAS, 362, 799.