

Laura Sommovigo



Title

The dust temperature REBELS

Abstract

ALMA observations have somewhat surprisingly revealed the presence of large amounts of dust in the first generations of galaxies in the Universe. Unfortunately, their dust temperature T_d remains difficult to determine due to the limited available FIR continuum data at redshift $z > 5$. This introduces large uncertainties in several properties of high- z galaxies, namely their dust masses, infrared luminosities, and obscured fraction of Star Formation Rates (SFR). We have developed a new analytical method to constrain T_d using a single continuum data point at 158 microns by combining it with the overlying CII emission. With our method, one can analyse uniquely the large number of [CII] and continuum detections at high- z provided by recent ALMA Large Programs such as REBELS and ALPINE. REBELS sources analysis allows us to extend for the first time the previously reported T_d -redshift relation into the Epoch of Reionization (EoR). We find that T_d increases with redshift, but more mildly than previous suggestions based on stacked SEDs fitting at $z < 4$. We produce a new physical model that explains the increasing $T_d(z)$ trend with the decrease of gas depletion time, $t_{\text{dep}} = M_g / \text{SFR}$, induced by the higher cosmological accretion rates at early times. The model also accounts for the observed T_d scatter at a fixed redshift. A dust temperature increase at high- z has testable and potentially relevant implications: (a) it alleviates the problem of the uncomfortably large dust masses deduced from observations of some EoR galaxies, (b) it results in a larger obscured fraction of the SFR.

CURRICULUM VITAE

PERSONAL DETAILS

Name and Surname: Laura Sommovigo

Place and date of birth: Pisa (Italy), June, 01 1995

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RESEARCH INTERESTS

My primary research interest is the InfraRed emission from the first generations of galaxies in the Universe. I investigate from a theoretical point of view cosmic dust, obscured star formation, and molecular clouds properties in high-redshift ($z > 5$) galaxies.

EDUCATION

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| 2018-present | PhD candidate in Physics
Scuola Normale Superiore (SNS) of Pisa,
Supervisor: Prof. Andrea Ferrara |
| 2016-2018 | Master degree in Astrophysics (mark 110/110 cum laude)
Pisa University, Supervisor: Prof. Andrea Ferrara |
| 2013-2016 | Bachelor degree in Physics (mark 110/110) |

Pisa University, Supervisor: Prof. Giancarlo Cella

PROFESSIONAL EXPERIENCE AND SERVICE

Collaborations and Working Groups:

REBELS ALMA Large Program (P.I. Bouwens)

TALKS AND CONFERENCES

- 06/2019** “Zoom-In and Out: From the Interstellar Medium to the Large Scale Structure of the Universe“, Nordita, Stockholm (Contributed talk)
- 01/2020** “The Interstellar medium of high redshift galaxies”, Sexten (Contributed talk)
- 07/2020** “SAZERAC: the Summer All-Zoom Epoch of Reionization Astronomy Conference”, Online conference (Contributed talk)
- 10/2020** “The rise of metals and dust”, Online conference (Contributed talk)
- 11/2020** “Galaxy crawl”, Online talk series organised by University of Arizona (**Invited talk**)
- 02/2021** “CIDER: The Cold ISM During the Epoch of Reionization”, Online conference (Contributed talk)
- 06/2021** “UniMelb Astro Colloquium”, Online Colloquium (**Invited talk**)
- 06/2021** “EWASS 2021. European Week of Astronomy and Space Science”, Online conference (Contributed talk)
- 10/2021** “SAZERAC SIP: Models and Simulations of High-Redshift Galaxies”, Online conference (Contributed talk)

PUBLICATIONS

First Author Publications

- L. Sommovigo et al., “*Cosmic dust temperature evolution after REBELS*”, 2021, submitted to MNRAS;
- L. Sommovigo et al., “*Dust temperature in ALMA [CII]-detected high- z galaxies*”, 2021, MNRAS, 503, pp. 4878-4891;
- L. Sommovigo et al., “*Warm dust in high- z galaxies: origin and implications*”, 2020, MNRAS, 497, pp. 956–968.

Other Publications

- “*A survey of high- z galaxies: SERRA simulations*”, A. Pallottini, S. Salvadori, A. Ferrara, S. Gallerani, C. Behrens, M. Kohandel, S. Carniani, L. Vallini, V. Gelli, **L. Sommovigo**, V. D’Odorico, F. Di Mascia, E. Pizzati; 2021, submitted to MNRAS;
- “*Epoch of Reionization Giants: Properties of dusty REBELS galaxies*”, A. Ferrara, **L. Sommovigo**, P. Dayal, A. Pallottini, R.J. Bouwens, V. Gonzalez, H. Inami, R. Smit, R. A. A. Bowler, R. Endsley, P. Oesch, S. Schouws, D. Stark, M. Stefanon, M. Aravena, E. Da Cunha, I. De Looze, Y. Fudamoto, L. Graziani, J. Hodge, D. Riechers, R. Schneider, H.S.B. Algera, L. Barrufet, A.P.S. Hygate, I. Labbè, C. Li, T. Nanayakkara, M. Topping, P. van der Werf; 2021, submitted to MNRAS;
- “*The dust content of $z \sim 7$ REBELS Lyman Break Galaxies*”, P. Dayal, A. Ferrara, **L. Sommovigo**, R. Bouwens, P. Oesch, R. Smit, V. Gonzalez, S. Schouws, M. Stefanon, C. Kobayashi, J. Bremer, M. Aravena, R. A. A. Bowler, E. da Cunha, Y. Fudamoto, L. Graziani, J. Hodge, H. Inami, I. de Looze, A. Pallottini, D. Riechers, R. Schneider, D. Stark; 2021, submitted to MNRAS;

- “*Reionization Era Bright Emission Line Survey: Selection and Characterization of Luminous Interstellar Medium Reservoirs in the $z > 6.5$ Universe*”, R.J. Bouwens, R. Smit, S. Schouws, M. Stefanon, R. Bowler, R. Endsley, V. Gonzalez, H. Inami, D. Stark, P. Oesch, J. Hodge, M. Aravena, E. da Cunha, P. Dayal, I. de Looze, A. Ferrara, Y. Fudamoto, L. Graziani, C. Li, T. Nanayakkara, A. Pallottini, R. Schneider, **L. Sommovigo**, M. Topping, P. van der Werf, L. Barrufet, A. Hygate, I. Labbé, D. Riechers, J. Witstok; 2021, eprint arXiv:2106.13719;
- “*Accurate dust temperature determination in a $z = 7.13$ galaxy*”, T. J. L. C. Bakx, **L. Sommovigo**, S. Carniani, A. Ferrara, H. B. Akins, S. Fujimoto, M. Hagimoto, K. K. Knudsen, A. Pallottini, Y. Tamura and D. Watson; 2021, MNRAS, 508, pp. L58-L63.

ACCEPTED TELESCOPE PROPOSALS

2021 ALMA (A)	P.I. J. HODGE, CoI: L. SOMMOVIGO
2021 ALMA (B)	P.I. T. BAKX, CoI. L. SOMMOVIGO
2021 ALMA (B)	P.I. H. INAMI, CoI: L. SOMMOVIGO

PROFESSIONAL SKILLS

Operating systems:

Linux, Windows

Programming languages:

Python, C

Softwares:

LaTeX, Microsoft Office, Open Office

LANGUAGES

Native Italian speaker, Council of Europe level C2 in English

OUTREACH

- 2019 Participation to the project “*Spazio allo spazio*”, giving introductory lessons on cosmology to middle schoolers, 2019;
- 2021 Designer of the outreach project (funded by the Scuola Normale Superiore in Pisa, Italy) “*ISPIRA: Inclusività nelle Scienze, una Possibilità di Identificazione e RAppresentazione*”, aimed at reducing the gender gap in STEM through divulgation performed by female researchers to middle schoolers