The cosmic 21-cm revolution: charting the first billion years of our Universe

Andrei Mesinger

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Preface

This set of files can be used to create your typescript in LaTeX. You can add packages as necessary.

Remember that references need to be at the chapter level and you may find the package chapterbib useful for this.

About the Author

Remember to include a brief biography of the Authors or Editors, including a photo.

Contributors

Gianni Bernardi
INAF - Istituto di Radio Astronomia
via Gobetti 101, 40129, Bologna, Italy &
Department of Physics and Electronics
Rhodes University
PO Box 94, Grahamstown, 6140, South Africa

Lincoln J. Greenhill
Harvard-Smithsonian Center for Astrophysics
60 Garden St, Mail Stop 42
Cambridge, MA 02138 USA

Bradley Greig
School of Physics
The University of Melbourne
Parkville, Melboune VIC, Australia

Vibor Jelić
Ruđer Bošković Institute
Zagreb, Croatia

Peter Jones
Department of Physics
University of New England
Acadia, Maine, USA

Jonathan Pritchard
Blackett Laboratory
Imperial College
London, UK

Simon Smith
Department of Electrical Engineering
University of Oxbridge, Camford, USA

Cathryn M. Trott

International Centre for Radio Astronomy Research
Curtin University, Bentley WA, Australia

Chapter 1

Future prospects

Leon V. E. Koopmans (Kapteyn Astronomical Institute), Gianni Bernardi (INAF-IRA & Rhodes University)

Abstract

This chapter discusses some important things

1.1 Forthcoming interferometric ground based instruments and upgrades

1.1.1 The Hydrogen Epoch of Reionization Array - 1 page

The Hydrogen Epoch of Reionization Array (HERA, [**?**]) is an array currently under construction in the Karoo reserve area in South Africa - following the decommissioning of the PAPER experiment (see Chapters 6 and 8 in this book for an overview of PAPER). HERA is built following the approach used for PAPER: a highly redundant array to maximize the sensitivity on a number of power spectrum modes measured using the avoidance approach. In order to increase the sensitivity with respect to PAPER, it employs 14 m diameter non steerable dishes that, in the final configuration, will be densely packed in a highly redundant hexagonal array configuration of $\sim$ 350 m diameter (see Figure **??**). HERA's main goal is to measure the 21 cm power spectrum in the $6 < z < 12$ range with high significance in the $0.2 < k < 0.4$ Mpc^{-1} range, providing a full characterization of the evolution of the neutral Hydrogen fraction of the intergalactic medium ([**?**], [**?**]).

As the avoidance approach does not take advantage of foreground modeling, particular attention was paid to prevent the instrumental frequency response from corrupting intrinsically smooth foregrounds (Ewall-Wice et al., 2015; Patra et al., 2017). HERA is currently under construction, with more than 200 dishes deployed and science observations routinely carried out (Carilli et al. 2018, Kohn et al. 2019). New feeds that extend the sensitivity to the 50-250 MHz (i.e. enabling observations of the Cosmic Dawn) are currently deployed for testing. In summary, HERA is planned to deliver a complete characterization of cosmic reionization and to attempt the detection of the Cosmic Dawn. Given its redundant con-

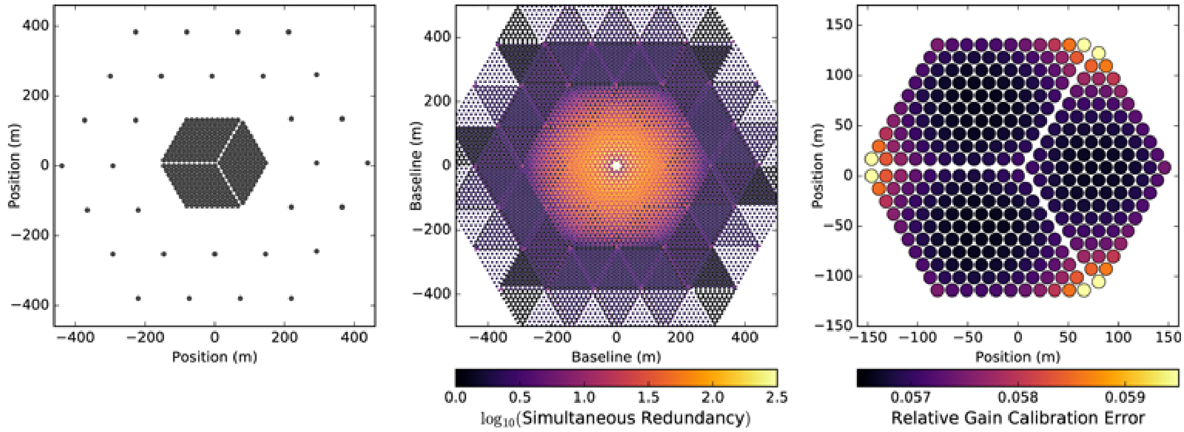

Figure 1.1: HERA antenna layout

figuration, imaging capabilities remain limited and will be the target of a next generation experiment.

1.1.2 The Large aperture Experiment to detect the Dark Ages - 1 page

The Large aperture Experiment to detect the Dark Ages (LEDA) is located in Owens Valley, California. It operates in the 30-88 MHz frequency range corresponding to $15 < z < 46$, therefore seeking to detect the 21 cm signal from the Cosmic Dawn. It is equipped to attempt the measurement of both the global signal via individual dipoles equipped with custom-built calibration sources and 21 cm fluctuations via an array of 256 dipoles. Dipoles are pseudo randomly distributed to achieve an essentially filled array within a 200 m diameter core, providing excellent imaging capabilities to Galactic diffuse emission - the brightest foreground component. The LEDA approach to measure the 21 cm signal can be versatile, allowing to image and subtract foregrounds but also to isolate them in the power spectrum domain without any specific modeling. Current simulations shows that if IGM heating occurs efficiently at z 16, LEDA would be able to detect the 21 cm power spectrum at $k \sim 0.1$ Mpc-1 with a 10 signal to noise ratio in 3000 hours. First observations have set a 108 (mK)2 upper limits on the 21 cm power spectrum at k = 0.1 Mpc-1 at z = 18.4 (Eastwood et al. 2019)

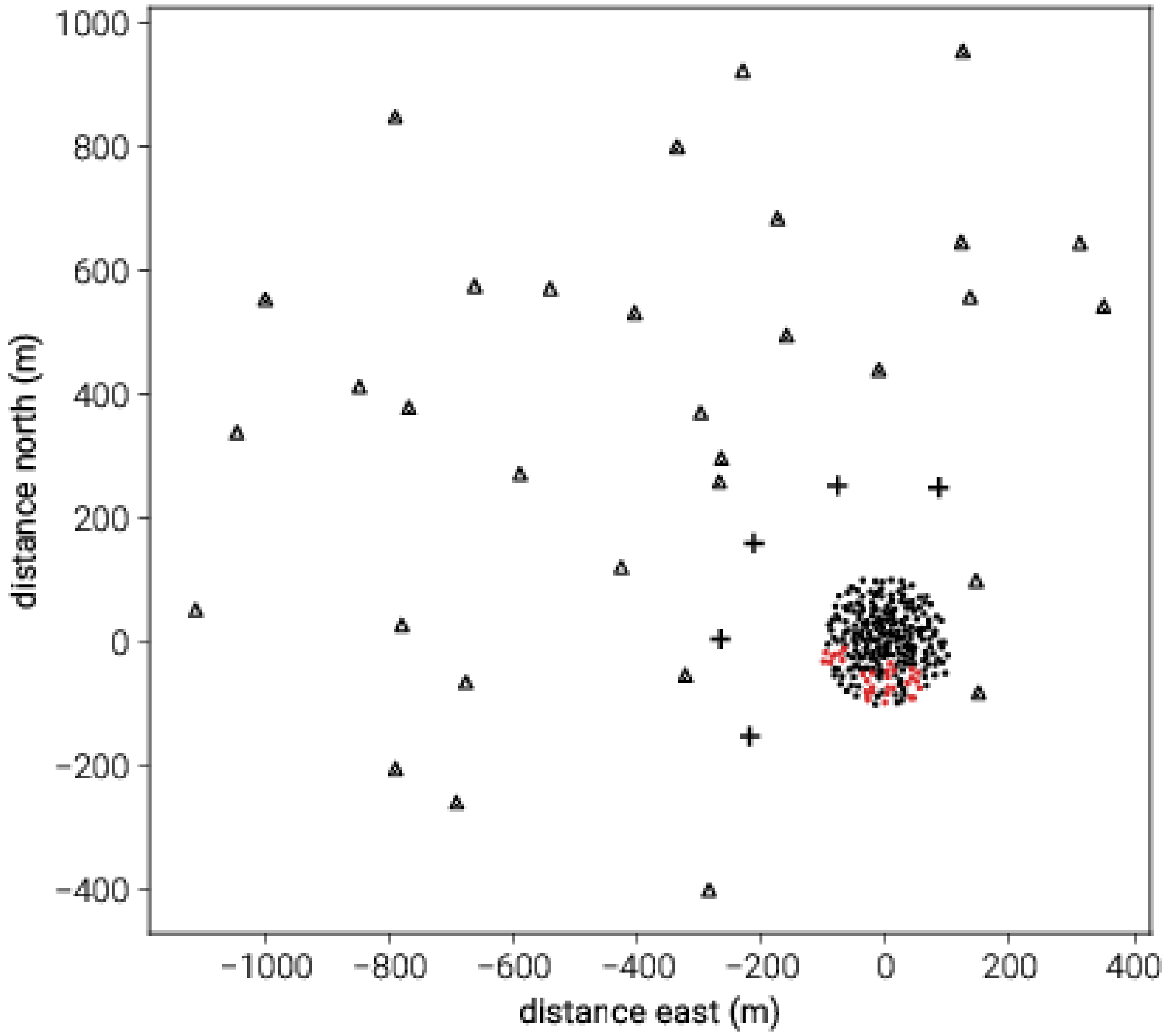

Figure 1.2: LEDA antenna layout

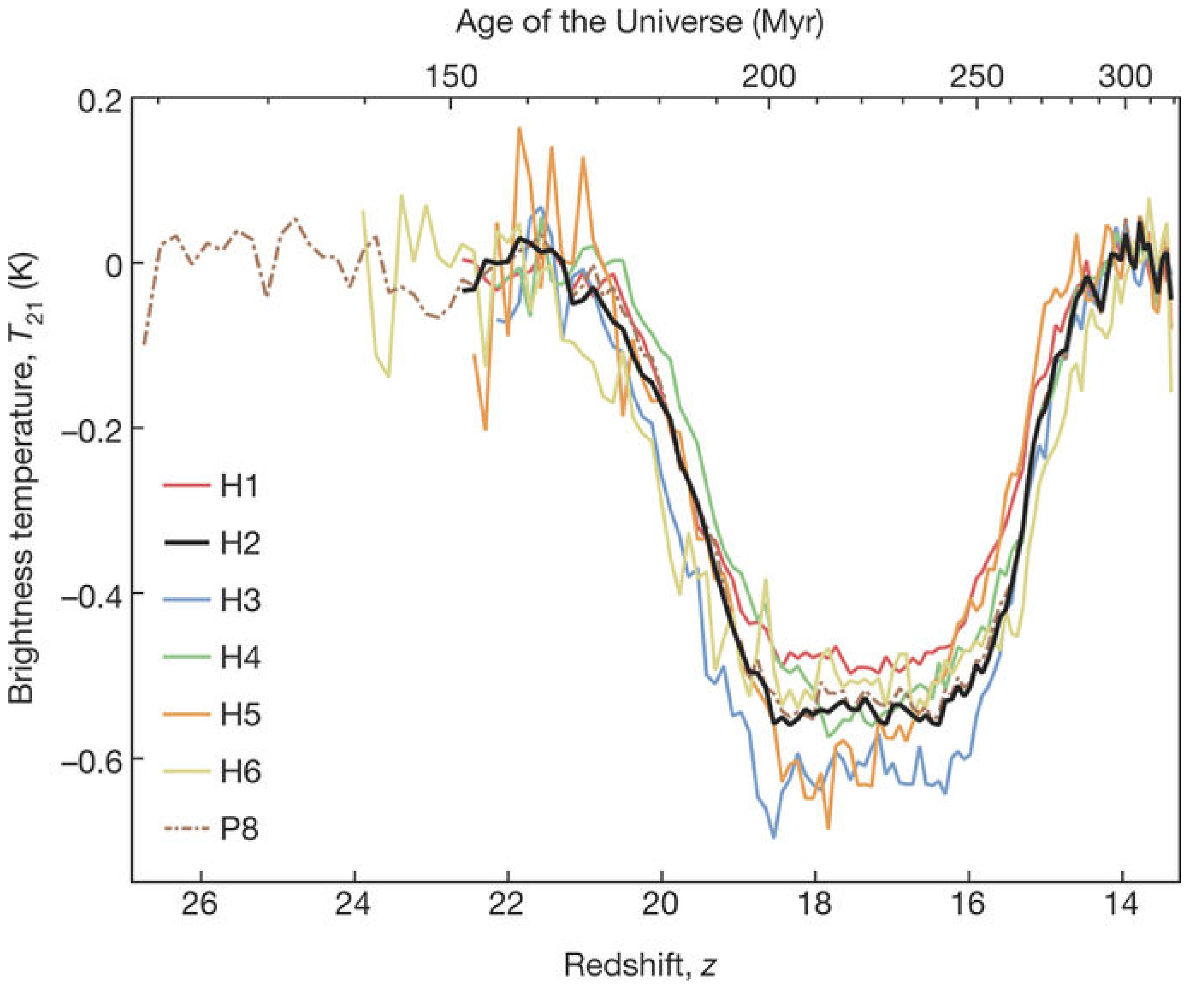

Figure 1.3: EDGES

Figure 1.4: LEDA dipole

1.1.3 MWA phase II - Bernardi - 1 page

1.2 Forthcoming Global Signal Experiments

1.2.1 EDGES - Bernardi - 0.5 page

1.2.2 LEDA - Bernardi - 0.5 page

1.3 A Section

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$$\begin{aligned}
C(12) &= \left[\vec{\pi}\cdot\vec{\phi}(x+r)\right] \\
&\approx 1-\mathrm{const}\frac{r^2}{L^2}\int_r^L \frac{x\mathrm{d}x}{x^2}+\cdots \\
&\approx 1-\mathrm{const}\frac{r^2}{L^2}\ln\frac{x\mathrm{d}x}{x^2}+\cdots. \qquad (1.1)
\end{aligned}$$

Figure 1.5: This is figure 1 in chapter 1.

Table 1.1: Greek Letters.

α	β	γ	δ	ϵ	ε	ζ	η
θ	ϑ	γ	κ	λ	μ	ν	ξ
o	π	ϖ	ρ	ϱ	σ	ς	
τ	υ	ϕ	φ	χ	ψ	ω	
Γ	Δ	Θ	Λ	Ξ	Π	Σ	Υ
Φ	Ψ	Ω					

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Cras adipiscing sagittis nunc vel luctus. Suspendisse volutpat augue quis erat semper consequat dignissim tellus euismod. Morbi hendrerit, tellus id aliquam iaculis, nibh leo tincidunt eros, vitae varius ligula felis in mi.

Bibliography

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[2] D. Tulone and S. Madden. PAQ: Time Series Forecasting for Approximate Query Answering in Sensor Networks. In *Proceedings of the 3rd European Workshop on Wireless Sensor Networks*, pages 21–37. Springer, 2006.