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Strong gravitational lensing in the radio domain

Berciano Alba, Alicia

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Acknowledgments

It definitely feels good when your hard work is being recognized. But you know what? It feels *much better* when it is *our work* and you can go and celebrate together. These acknowledgments show what has made this long journey worth it, so yes, this is going to be long, and I'm proud of it!

If I would have to choose a starting point (without going all the way back to the Big Bang), the first thing that comes to my mind is: 24 August 2004, Anton Pannekoek Institute, Amsterdam. I went there to give a talk about my master thesis (well, the Spanish equivalent), as part of an interview for a PhD position with Rob Fender. It was the first time I was going alone to another country. The first time that I had to, not only speak English, but give a scientific talk in English. I actually prepared the talk in Spanish, and then an English teacher friend of my mother translated the entire talk for me. It was so difficult to memorize that, for the first and last time in my life, I had a stack of cards during the talk with every single sentence that I was going to say (just in case). The talk was what I later identified as the living nightmare of any astronomer: all equations, one after another. When I was done they probably wanted to run away (and wash the experience away with some coffee), but there was this one guy that had to ask the courtesy question. What he didn't know, is that my talk was only *half* of the story, so his question gave me the chance to actually start explaining all the cool stuff about the Density Wave Theory. I was so excited!! So I removed the projector screen that was in front of the blackboard, I took a piece of chalk, and I started to explain the rest. Seriously, I have no clue how the hell I managed to do all that in English. But the point is that Rob and the other people that were at the interview were really nice and they appreciated my enthusiasm. I still had to go back to finish a couple of exams (quantum mechanics and digital electronics, a true pain) but the very positive feedback that I got from Rob about the interview was the encouragement I needed to finish my exams. It has rained a lot since that day, but finally I got my chance: thanks a lot, Rob, for inviting me to come to Amsterdam to give this talk :).

Apart for this position in Amsterdam, I was also applying to one of the PhD positions offered by the Marie Curie lensing research network ANGLES. And because life is made of coincidences that make the difference, it turned out that Michael Garrett

was involved in both positions, so he was present during my interview in Amsterdam. That's how I got the invitation to come to Groningen, to meet Léon Koopmans (the other person involved in the ANGLES PhD project) and get the interview that ended up with me being here. By offering me this PhD position, Mike and Leon changed my life completely, and I will never be able to thank them enough for it.

Mike, it was really nice to have you there. Despite all your responsibilities as director (first of JIVE and then of ASTRON), you always managed to make the time for me. And when there was time, it was always easy to talk to you. But above everything, I really appreciate your unconditional support and your confidence in me. **León**, it has been a long way for the both of us. But as we say in Spain: *Bien está lo que bien acaba* (all's well that ends well). And the truth is that, although we disagree on many things, I've learned a lot from you. Now that I look back I see how much I've grown up as researcher, and a large part of that is thanks to you. **Ger**, I want to thank you for taking the lead as promotor during the period that I was trying to ask for a date for my defense. But especially, I want to thank you for the very stimulating discussions that we had on MS0451, and for teaching me some important things about radio data reduction.

I also would like to thank **the ANGLES family**, for being just great. **Ian**, I still cannot believe how lucky I was for being one of the ANGLES PhD students. I'm sure that all the paperwork, meetings and responsibilities involved in putting and keeping together this network must have been exhausting. So I really want to thank you for all your efforts as head of the ANGLES network, and for being part of my reading committee. To **the ANGLES staff**: seriously people, how can you all be so nice? Having an ANGLES meeting always felt like going for holidays with friends... and now it turns out that I was having drinks with *la crème de la crème* in the field of gravitational lensing!. To **the ANGLES students and postdocs**: the "meetings" that we had in Lapland and Turkey will pass into history as some of the best moments of this PhD. I truly enjoyed being part of such a nice group. **Olaf**, it was really great to have you as "my postdoc" (:). Thanks for everything: for giving such great talks, for all that you have taught me about AIPS, lensing and interferometry, for being always there, for the incredible moral support, and for being such a nice guy. Just keep being so awesome and do not let too many responsibilities stress you over, alright?. **John**, why the hell you didn't come here before! It is soooo nice to talk about science with you... It makes me recover sanity points. I wish all astronomers would have the same healthy attitude towards science as you do (and the same social skills, for that matter ;)). Thanks a lot for cheering me up in this tough finishing period.

Hey **DEMONS**... I haven't forgotten you! What we did in the Alpbach school was really unbelievable (not to mention our workshop and the SPIE conference afterward). Being your team leader was one of the most remarkable experiences of my PhD. **Peter**, this would have never been possible without you. Thank you so much for sharing our enthusiasm, for being such a friendly Professor, and for having such style in smoking pipe!

Although I've spent most of the time at Kapteyn, I also had my share of visits to JIVE and ASTRON. **Andy**, you were a postdoc there when I just started. You cannot imagine how many times I've regretted that we overlapped for such a short period of time. You were my first AIPS master, and you were real good at it. Thanks a lot, also for helping me by email afterward when I got questions about my data reduction. **Cormac**, you (together with Olaf) were Andy's successor. Thank you SO MUCH for helping me with all the AIPS crap. And there is (of course) **Mike Sipior**, my personal Parseltongue "assistant". Thanks a lot for all your help too. One of the things that makes me proud of this thesis is that I finally managed to really understand the formation of multiple images. And for that, I have to thank **Ton Schoenmaker**, an optical designer working at ASTRON. He made the nice ray tracing figures presented in the introduction of the thesis.

Well, I suppose that it is about time to start talking about the **Kapteyn Institute**, right? The first person that I met here was **Isa**. It has been so good to have you here... I could always go to you when I was upset and I needed to express myself in Spanish. But also, all the very nice conversations and support that I got from you are priceless. Hey **Ángel**... I'm still proud to know somebody that works in something really useful :) I feel lucky for having the chance of meeting such an extraordinary couple. And talking about extraordinary people... **Teffie!!!** You were the second person I met, because I could stay at your place for a week before I got the keys to my room in Groningen. Our dinners with a glass of wine were truly *gezellig*. And thanks to you I got to see this band of Japanese drummers... that was so awesome!! Well, and let's not forget that you were the one that started the tradition of inviting the people at Kapteyn to go out for dinner in my birthday :). **Dieter, Wilfred**, I will never forget when we met in my first birthday in Groningen... you came to hug me singing happy birthday, and you told me about the 3 kisses in The Netherlands. I think that you were completely drunk, weren't you? ;) Still, the best welcome I could get. Thanks a lot for being so friendly and for introducing me to snooker!. Then, there is the dutch old core: **Paul, Attila, Erwin, Chris, Christiaan, Niels and Polko**. Remember Jelte's and Bjorn's defense parties? The zoo? The super heroes kastanje feest? The NOVA school? Attila's wedding? Thank you so much for sharing all those memorable moments and the daily life at the institute. Hey Niels... did I already mentioned that you rock making thesis covers?

Matteo!!!! I've really missed you in this last bit of inferno before sending the thesis to the printer. I definitely could have used a bit of your refreshing sarcasm, which you have elevated so skillfully to the degree of art. Thanks a lot for all the laughs and all the bitching... and for being a role player! And by the way, thanks for having such awesome friends, it was a great thesis party. **Simo**... what could I say to match the message of a big hug?. Like Matteo, you have also been there in many crucial moments. And you have brought a bit of (red) color to this institute :) It still gives me the creeps to hear the word *Bayesian*, but at least now I understand it thanks to you. Well, and how could I forgot our friendly giant! **Oliver**, my "optical expert". It was a relieve to have somebody in the group that could speak observational language for a change ;)

Hey, **gran Italian vacca!!** It seems that there is a light at the end of the tunnel after all... so try to hold on a bit longer! We have faced so much crap together during the PhD! But we also had a lot of good times with ciabattas, pizzas, movies, BBQs, sassolino (ummm... lekker!), the turkish restaurant... and of course our *very intellectual* conversations ;) Btw, thanks for giving us Alias to watch! It really helped to get the last part of the thesis done.

Seungyoup, my office-mate... although you probably stayed more time in Edo and Rob's office than in ours :P. Together with Rob, you have been one of the constants in my life here. Remember when we putted the carpet at Rob's place? What a team! :) Thanks a lot for introducing me to Korean noodles and Korean BBQ... they truly are the best!. Take care (or I will go there to kick your Korean ass!).

I also would like to thank this other Italian guy... which was his name again.... ah! yes, **GIANNI!!!**. I want to thank you for the laughs and the many discussions that we had, in particular when going to Dwingeloo with Rob. But I especially want to thank you for your very healthy appetite... it was always a pleasure to cook for you.

I could go on an on naming all the nice people that I've met at the institute, you know? One of the best experiences at Kapteyn has been to have the possibility of meeting so many people from some many different countries. One gets used very quickly to it, but the truth is that most of the people do not have this kind of privilege. So I want to thank **all the kapteyners**, for enriching my life so much. And also, I want to thank you again for contributing to make this big pile of cards for Seungyoup :)

Bueno, y qué sería de mi sin esa pedazo de familia que tengo! A parte de mis padres (que me lo han dado todo y más), tengo una abuela indomable; mis tíos Andrés, Luis y Telvi, con los que puedo contar para lo que sea; mis primas Tere y Genia, que siempre han hecho las veces de hermanas; mi primo Guzmán, que sabe apreciar mis "vicios"; y mi "familia del sur", que le dan sentido a Las Navidades. Gracias a todos por estar ahí .

Del mismo modo, esta tesis no puede terminar sin mencionar a mis amigos de toda la vida: **Victor, Jorge, Érica, David, Fran, Carlos y Bea** (que en realidad no es de toda la vida, pero como si lo fuera). Gran parte de lo que soy ahora os lo debo a vosotros y a todas las innumerables conversaciones que tuvimos durante la época del instituto y la universidad. Gracias, por haber tenido siempre esa profunda inquietud intelectual. Que sepáis que esta tesis va por vosotros!.

Luego está la peña de la promoción de astrofísicos 2003: **Lu, Rebe, Oma, Jairo, Teo, Mon, Rubi, Charli, Nayra, Migue, María, Javi y Antonio**. No ha llovido ni nada desde los penosos días de Mecánica Cuántica y Dinámica de Flúidos!! Y aún así aquí andamos, desperdigados por medio mundo, juntándonos cuando se tercia. Bueno, pues esta vez me ha todado a mí montar la trankatesis con trankadoba incluída!! Gracias por seguir estando ahí, y por todas las juergas alucinantes que hemos pasado juntos.

Jul, tú tampoco puedes faltar. Aún me maravillo de cómo fuistes capáz de mantenernos informados con esos pezado de e-mails diarios durante la tesis. Pero lo que quisiera pasar a la posteridad en esta tesis son esas pezado de vacaciones que nos pegamos en Praga después de mi escuela de verano en Alphach. En *dos* palabras: ERES EL MEJOR :)

Finally, the place of honor of this acknowledgments it is reserved for three very special people:

Cosimo, Chapter 5 is the best thing that happened to this thesis. Its been a true pleasure working with you... it made me feel like a *real* researcher :) Thanks for bringing back my passion for science.

Marco, I wish that one day I could become such a great professor as you are. It is not very common to find people with the integrity and the courage that you have, and unfortunately it is getting more and more difficult every day. Thank you for making the difference.

And **Edo**, the jewel of the crown. Shearing all the little things of the daily life with you is something that I won't trade for anything else. This is the most important conclusion of my PhD. But also... thanks for all the help, the support, and the countless discussions that made this little book possible :)

Alicia Berciano Alba, 8 de Octubre 2009