Mem. S.A.It. Vol. 92, 63

Memorie della

Nichi at the Medicina radio astronomy station

S. Montebugnoli[1]

Istituto Nazionale di Astrofisica – Istituto di Radio Astronomia, via Gobetti 101, I-40127 Bologna, Italy e-mail: s.montebugnoli@ira.inaf.it

Abstract. I first met Nichi in 1988 at the Medicina radio astronomy station. Here I report about the time that, after that first meeting, Nichi spent at the station. In fact, a great friendship and a fruitful collaboration on the pulsar theme began, oriented towards the construction of a sophisticated data acquisition system. In addition to the scientific aspect of the experiment, Nichi also had an in-depth knowledge of the architecture of the technical system. His exhaustive explanations - continuously provided to the group of the design engineers - allowed them an accurate planning and implementation of the complex data acquisition. Many technical difficulties were faced but finally the result was a highly performing and sophisticated system. His stay in Medicina also allowed him to get to know the group that would assist him in the construction of SRT. To us, technicians and researchers of the Medicina station, his competence and enthusiasm will always remain in our hearts, together with his humanity. This contribution has been translated by Andrea Possenti from the originally provided Italian version.

Key words. Pulsars. Telescopes: Northern Cross

1. The first meeting and the immediate plans

33 years have now passed since that morning in May 1988 when, turning the corner of a corridor of the Medicina radio astronomy station, I bumped into a person who was walking briskly, in the opposite direction to mine, together with Prof. Gavril Grueff. I stopped abruptly apologizing and Gavril told me: "*This is Dr. Nicola D'Amico, he is an astronomer from Palermo, who will work here with us on pulsars for a while*". After a strong handshake, Nichi looked me straight in the eye with a steady gaze and said: "*I have many projects in mind, if you support me in the design and construction of the equipments, we will do very interesting things because ... I saw that there are antennas outside ... and how they are, they are impressive!*".

He referred to the Northern Cross and in particular to the East-West branch (see Fig. 1 and Fig. 2), a cylinder with a parabolic profile of 564x34 m^2, characterized by a radio signal collection area equal to about three football fields and consequently with a very high instantaneous sensitivity. This, combined with the fact of being a transit radio telescope, made available a remarkable survey speed in the UHF band (408 MHz) for the collection of new millisecond pulsars in the northern hemisphere, Nichi's main target.

If I remember correctly, he told me that a short time before he had been in Australia, as part of a millisecond pulsar observation program with the Parkes's 64m dish. His de-

Fig. 1. A portion of the East/West branch of the Northern Cross radio telescope. Two technicians aboard a platform are checking the mirror, made up of about 1200 km of closely spaced metal wires, stretched from one end to the other.

sire was to design and install a very high-performance data acquisition and processing system in Medicina as well, to carry out the same kind of search in the northern sky, rightly convinced that the East/West branch of the Northern Cross was an optimal antenna for this type of research.

2. Nichi's feeling for instrumentation and experimentation

Nichi did not only care about the experiment, but also about the architecture of the system that he would use to carry it out. It was truly educational and instructive to work with him, as he detailed the functions that needed to be performed by the various blocks. This, in addition to providing the technicians with fundamental information for the project, considerably increased both their knowledge and their involvement in the experiment itself.

As Head of the station and the Northern Cross, I obviously had many other duties and tasks to take care of, but whenever I could (especially in the first part of the project), I found a reason for professional growth to work in Nichi's pulsar group. A group that he esteemed and which at that time was made up for the digital part by Andrea Maccaferri and Alessandro Cattani and, for the analog part, by Claudio Bortolotti and Mauro Roma. In particular, I had worked, within the same team, on the 128-channel filter bank (see Fig. 3), used to reduce the effects of dispersion, and on the 1-bit digitizer.

At the end of the 1980s, he asked to widen the band of the East/West branch of the Northern Cross. Then, since three beams were

Fig. 2. A partial view of the East/West branch of the Northern Cross radio telescope, pictured from the North.

already operational on the transit plane, one on the meridian and the other two identical but in advance and delay of 4' respectively, Nichi had the idea of placing two more beams at the intersection points of one beam with the next (Fig. 4). This allowed to strongly decrease the level of voltage jumps in the transit of a pulsar from one beam to the next. The next step was the construction of a programmable *beam former* to continuously track the pulsar in the sky, a precursor of the programmable digital beam former that will be widely used in the future Square Kilometer Array Observatory (SKAO).

Being Nichi a talented programmer, his deep knowledge of the system architecture allowed him to write the software for both testing and managing the individual parts and the system as a whole.

Once the first blocks mentioned above were finished, he immediately wrote appropriate software for their testing. I will never forget the satisfaction he brought on his face when one morning, entering the radio astronomy station, I found him close to the coffee machine. He looked at me with a hint of a smile and said satisfied: "*Done! The first stages work, ... now we can go on!*". He was there at the station from 6am! He couldn't wait to test those first blocks with the control software he had finished very late the night before! Several operational blocks were later designed and added, always after his clear explanations about the functions that they had to perform in the general context of the acquisition, each time demonstrating his profound knowledge of the experiment and the instrumentation needed to conduct it. Many were the technological difficulties encountered. One of the most demanding was represented by the digital dedisperser (see Fig. 5), considered essential by Nichi and designed by Andrea Maccaferri, with components at the state of the art of that time and which reached 500 MFlops as equivalent computing power. Every time he tested a new system block and everything worked properly, there was no need to ask him anything, because he had already printed the answer in a faint, very eloquent smile. This was Nichi!

The enthusiasm he transmitted to all of us was truly contagious and also ended up in several publications about our technical developments and the first results of the experiments which stemmed from them, e.g. (Bortolotti et al. 1990, 1991; Montebugnoli et al. 1996,

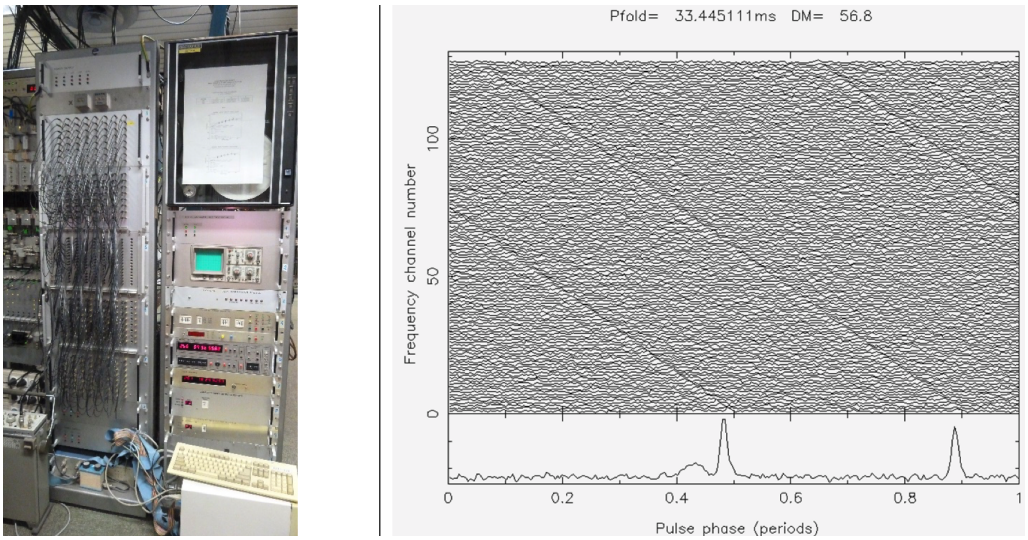

Fig. 3. The method used in the Medicina pulsar survey to reduce the effects of the dispersion of the signal in the interstellar medium (see right panel) was to divide the passband into 128 channels of 32 KHz each, with a bank of filters, here represented (left panel) in their rack (Montebugnoli, Cattani, Bortolotti, Roma).

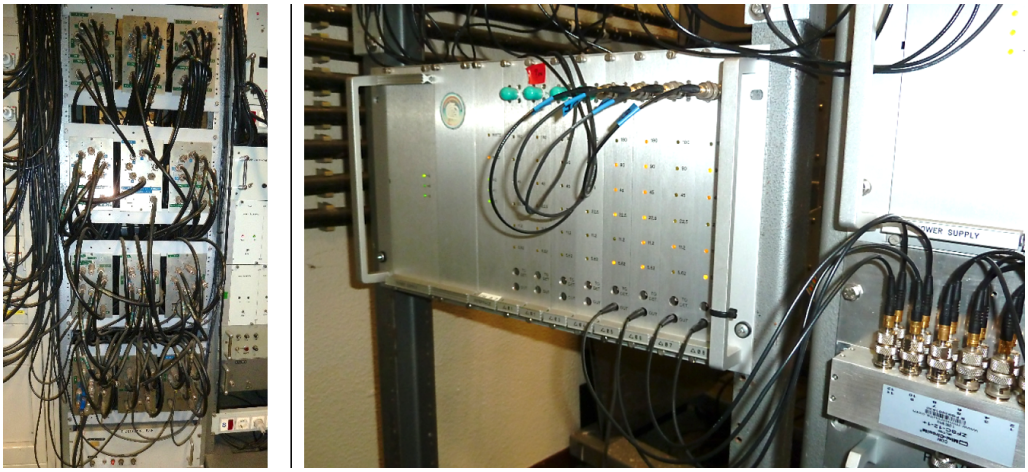

Fig. 4. On the left, the 3 + 2 bundles of the East/West branch obtained by adding coaxial cables of suitable length. On the right, the precursor of the programmable beam former necessary for the construction of the future SKA (Mauro Roma, Claudio Bortolotti).

1998; Soglasnov et al. 2001; Montebugnoli et al. 2006).

3. Nichi in the Medicina group

I cannot say the serious discussions we had on the technical problems of the moment or joking about more pleasant things in the receiver

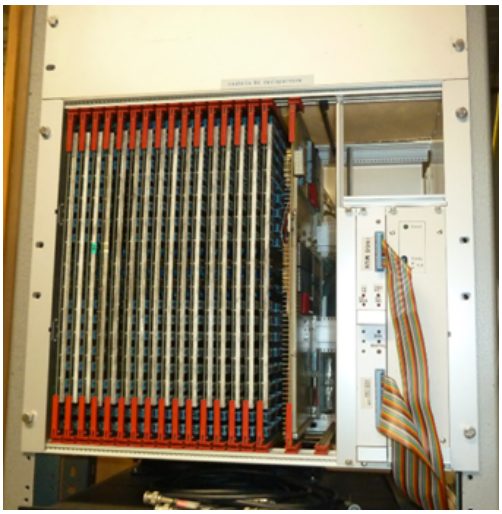

Fig. 5. The complex apparatus which formed the 500 MFlops digital dedisperser (Andrea Maccaferri).

Fig. 6. A dinner with Nichi D'Amico (at the center) during the January 1996. The other people in the picture are: Stelio Montebugnoli (on the right of Nichi), Romano Andalò (on the left of Nichi, and unfortunately passed away at the end of the 90s), and Alessandro Cattani (on the leftmost part of the picture).

room, where at that time we worked side by side: him on the pulsar system and I on the data acquisition of the Cross. A time I will never forget!

Nichi, for the Pulsar group of Medicina, represented a point of reference and an inexhaustible source of scientific culture enriched by a profound humanity. Personally, I'm sorry for those who haven't had the opportunity to work with him!

I want to remind him that he is smiling serenely at a dinner (January 1996, Fig. 6)) where we were celebrating an important career advancement for both of us, with our colleagues of Medicina. On that occasion he gave me the collection of the year 1957 of the magazine *Sistema Pratico* - a monthly known to many of my generation who loved electronics and experimentation in general - with a dedication that I still jealously guard with great affection and gratitude (see Fig. 7). It had in turn been given to him when he was still a kid at the beginning of the 60s. That testifies the passion that Nichi already had as a child for science, technology and experimentation.

Naturally during the years spent in Medicina, Nichi was also able to know and appreciate the rest of the technical staff who dealt with the VLBI parable. Scientific and technical personnel with whom he would have collaborated profitably during the years of construction and testing of the Sardinia Radio Telescope (SRT) and that is still collaborating on SRT project upgrades.

I would like to end this brief overview of the memories of Nichi's period at the Medicina radio astronomy station with a phrase from Ugo Foscolo: *Un uomo non muore mai se c'è qualcuno che lo ricorda!* ("A man never dies if there is someone who remembers him").

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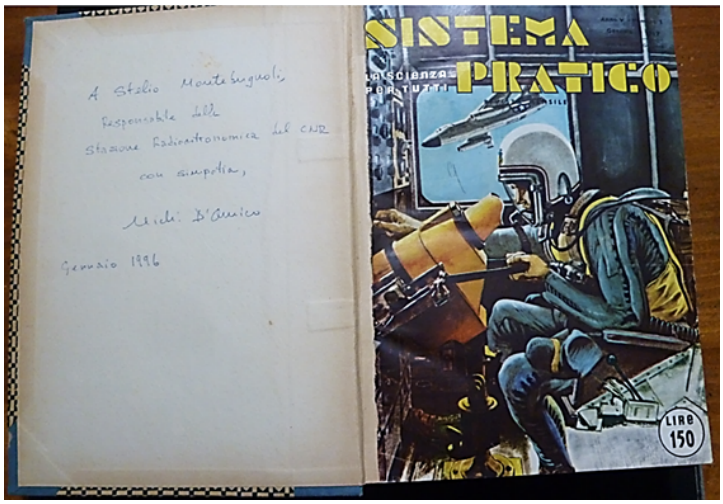

Fig. 7. Nichi's dedication in the second cover of the 1957 collection of the *Sistema Pratico*, a magazine that Nichi donated to the author of this contribution during the 1996.

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