

IN RICORDO DI

Donato Palumbo (1921-2011)



Donato Palumbo died on February 8, 2011, at the age of almost 90 years. As a young theoretical physicist he became well-known by his studies of isodynamic equilibria (a term coined by him). But most importantly, his name is uniquely linked to the European Fusion Programme.

Following the setting up of the European Coal and Steel Community in 1951/52 the European Economic Community was established in 1957 together with the European Atomic Energy Community (Euratom). Among the missions of this third supranational European organization an important objective is the coordination of the Member States' research efforts for the peaceful use of nuclear energy. From their inception, the Euratom Research and Training Programmes encompassed also the development of nuclear fusion which in the nineteen fifties had been carried out under classified actions mainly in the US, the Soviet Union and England. However, it had become apparent that developing fusion power stations was a difficult and tedious endeavour. This led, at the 1958 Geneva Conference of the United Nations, to a declassification of the results obtained so far and triggered, at European level, an initiative for merging the fusion research efforts of Euratom Member States in a single research programme. Initially it was intended to create this programme in the frame of CERN (founded in 1953); however, this could not be realized.

In this situation Donato Palumbo was appointed by the Commission in Brussels to design a European Programme which would integrate and further develop the Member States' existing efforts in fusion research. Palumbo initiated an extensive exchange with the directors of the large fusion laboratories. He recognized that the established procedures and instruments of research funding would be

inadequate for the long term nature of fusion development which – this was evident from the beginning – would eventually require very large fusion devices, projects difficult to realize within Euratom's own remit. Therefore he developed and proposed a system of cooperation of the fusion laboratories in the (then six) Member States under so-called Contracts of Association. This was a novel concept under which Euratom, represented by the Commission, was participating at 25% in the general expenditure of the national laboratories related to their fusion work. In addition Euratom provided fusion experts to the laboratories. In exchange for this financial (and personnel) support the Commission became an equal partner in the Associations' steering committees and thereby was able to promote common programmatic orientations among the Associations and pursue a harmonization of the individual laboratories' research programmes.

A first Contract of Association, prototype for all subsequent ones, was concluded in 1959 with CEA (France) to which initially the Frascati Laboratory (Italy) joined as a subcontractor. A *groupe de liaison* (later complemented by a *comité de directeurs*) and subsequently *Consultative Committees* such as the *CCFP* and later the *CCE-FU* supported at European level the development of strategic orientations, supervision and interfacing to the political level. Initially, this unusual system encountered considerable opposition both in Brussels and partly also from the hoped-for partners. However, Palumbo managed to overcome these obstacles with enormous patience and insistence. Eventually, Association Contracts were concluded with institutions or laboratories in all the then existing six Member States. In 1986, when Palumbo retired, thirteen Associations contributed to fusion research in the larger European Communities.

Palumbo had to guide the Fusion Programme through very difficult times. In the nineteen sixties the worldwide fusion research discovered new physical features which made the perspective towards a fusion reactor much more difficult than anticipated. Furthermore, in 1968 Euratom encountered a crisis which made it impossible to find any commensurate financing for the fusion programme.

Fortunately, during the same year spectacular results from the Russian Tokamak gave new hope. This and other promising developments provided a firm basis for the realization of hot fusion plasmas as they are needed for a reactor. Immediately Palumbo seized the occasion and requested for the following five years Euratom programme (1971-1976) a vigorous strengthening of the

European Fusion Programme. Simultaneously he proposed a new strategy of concentrating on toroidal plasma confinement which forced many laboratories to a radical reorientation. With a preferential support scheme (+20%) for the investment in those fusion facilities which were awarded priority status with regard to the objectives of the programme he introduced a novel financial instrument which became pivotal not only for the integration and aim orientation of the programme but in particular for the realization of larger experiments which were needed to access hotter plasmas. A crucial condition for preferential support was that these facilities at national laboratories had to be made available to all partners in the Fusion Programme. For furthering the common know-how he proposed a special mobility scheme which led to a massive exchange of scientists and engineers among the Associations, in particular for work on the new large fusion devices which were realized starting with the nineteen seventies. These instruments still exist and have led to a strong joining of forces among all laboratories including, in particular, also the smaller ones.

Already in 1969 Palumbo pushed for the setting-up of a planning group for a new very large fusion experiment, able to approach the thermonuclear regime, from which later the design team for the Joint European Torus (JET) emanated. JET, indeed a joint European project, was built in Culham (UK). It was commissioned in 1983 and enabled Europe immediately to catch up with the US and the Soviet Union's fusion efforts. Over the following ten years JET was developed into the most powerful and best-performing Tokamak in the world, a position which it still maintains. With JET and the synergy which it created for the accompanying research efforts in the Associations the European Fusion Programme has taken up and maintained an internationally leading position in fusion research.

In view of the engineering and technological developments necessary for a fusion reactor Palumbo started in the nineteen eighties to integrate fusion technology activities in the programme. He also proposed a team for preparing the transition from JET towards a "Next European Torus" for assessing the perspectives for fusion reactors. This NET team became the nucleus for the European participation in the international ITER team for the design of a Tokamak with the capability of 500 MW of fusion power. After difficult times of agreeing internationally on the realization of this project, the construction of this large device has now started, in a wide international collaboration (EU, China, India, Japan, Russia, S. Korea, and USA), in Cadarache (France). Also

the reactor-oriented activities beyond ITER, now carried out under the European Fusion Development Agreement (EFDA, created in the year 2000) originate initially from the NET team.

The important cornerstones of the European Fusion Programme which continue to exist until today are based on conceptions by Donato Palumbo. He was appreciated for his desire to minimize "bureaucracy" as much as possible. He selected his collaborators in Brussels according to their scientific qualification and engaged himself actively in all important scientific issues of the programme. After his retirement, as long as age and health allowed it, he continued to follow closely the work of his successors in Brussels.

Legendary was the persistence, against all directives and opposition, of this small and

fragile-looking man in getting accepted the views and actions which he had recognized as important. When the British Queen, at the inauguration of JET, asked Palumbo how he had been able to realize this enormous project he is said to have answered "By disobedience, your Majesty". His eminent intellectual capacity, the depth of his physics insight, his farsighted visions, his straightforward character, his loyalty and trustworthiness as partner of the fusion researchers and his outstanding talent for moving in the political arena made him highly respected by all who dealt with him in the Fusion Programme and beyond.

Palumbo's early theoretical work on isodynamic magnetohydrostatic equilibria (he gave the first proof of their existence in axial symmetry) have found fruitful applications. It has been generalized to the concept of

quasi-isodynamic equilibria, one of the three confinement principles for modern Stellarators. It will be applied in Wendelstein 7-X, the large superconducting Advanced Stellarator which is nearing completion of construction in Greifswald (Germany).

Donato Palumbo conceived the European Fusion Programme and led it, during the 28 years of his directorship, towards an internationally leading position. At the occasion of his retirement in 1986 he was awarded the very exceptional title of an Honorary Director General of the European Commission. Donato Palumbo will remain unforgotten in the fusion laboratories.

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