CYCLONE® KIUBE

Max potential, max capacity.
35 years of experience concentrated in one innovation.

— 30 years of innovation and expertise concentrated in the CYCLONE® KIUBE

The first world reference

In 1986, IBA launched the first compact cyclotron for industrial production of radioisotopes. This revolutionary new design increased the production efficiency by a factor 15 and created a world reference.

30 years later, IBA once again makes history with the launch of its new 18 MeV cyclotron. CYCLONE® KIUBE is more compact and the most powerful mid energy PET cyclotron. It has been developed with three keywords in mind: Reliability, High Performance and Flexibility. These keywords were defined in collaboration with our users.

Expertise benefiting to a large installed base

With IBA as partner, you have the assurance to remain at the forefront of innovation and to benefit of every novel feature for tracer production.

More than 300 cyclotrons installed over 5 continents demonstrate this expertise and customer satisfaction.

Support over the lifetime of your system

IBA provides continuous support over the lifetime of your project, expanding your skills and applications, boosting your uptime and maximizing the return on your investment with all the latest innovations, services and training.

In addition, the system is built so that future upgrades can be easily implemented to keep your cyclotron state-of-the-art.

— A story of Cyclotron Innovations

1985
DEEP VALLEY CYCLOTRON 5 X MORE OUTPUT, 3 X LESS ENERGY EP1022190

2000
NIOBIUM NIRTA® FLUOR TARGET FOR BETTER ISOTOPE QUALITY EP1100576

2003
DUAL BEAM REGULATION FOR DOUBLED PRODUCTION EP1586083

2006
TARGET SHELVES FOR EASY DECOMMISSIONING EP2023919

2016
CYCLONE KIUBE CYTHER® CONTROL SYSTEM FOR EASE OF USE EP16169497

2012
ZEPHIROS® CONTROL SYSTEM FOR EASE OF USE EP16169494

2008
TWIN PROTON SOURCES TO MAXIMIZE UPTIME EP1586083

2003
NIRTA® SOLID TARGET TO GIVE ACCESS TO NEW ISOTOPES IP: EP1570493

2002
VECTIO® BEAM TRANSPORT LINE FOR R&D

2005
HIGH CURRENT MACHINE ROOM FOR INCREASED PRODUCTION CAPACITY

2021
EXTRACTION SYSTEM WITH 4 STRIPPERS

2018
CUSTOM ENERGY CYCLONE® KIUBE EP1617003

1990
NIRTA® FLUOR CONICAL TARGET FOR REDUCED ENRICHED WATER USE WO 2012/055970

1985
HIGH CURRENT MACHINE ROOM FOR INCREASED PRODUCTION CAPACITY

2008
TWIN PROTON SOURCES TO MAXIMIZE UPTIME EP1586083

2005
NIRTA® FLUOR CONICAL TARGET FOR REDUCED ENRICHED WATER USE WO 2012/055970

2015
GA-68 PRODUCTION USING A LIQUID TARGET EP1787004

2011
NIRTA® FLUOR CONICAL TARGET FOR REDUCED ENRICHED WATER USE WO 2012/055970

2021
EXTRACTION SYSTEM WITH 4 STRIPPERS

Max potential, max capacity.
**CYCLONE® KIUBE** will evolve with you, for you

**Upgradable like no other**

CYCLONE® KIUBE is upgradable like no other cyclotron, so you can increase your production capacity from 100 µA to 150 µA, 180 µA or even up to 300 µA on target.

With a lower initial investment, you can start with the CYCLONE® KIUBE 100 while maintaining the ability to increase your PET Center’s capacity over time with an on-site upgrade.

**Infinite flexibility**

With eight independent exit ports, CYCLONE® KIUBE is the most flexible system, producing the widest range of PET radioisotopes.

A full range of Nirta® targets are available giving you access to ¹⁸F, ¹³N, ¹⁵O, ¹ⁱC (CO₂, CH₄), ¹⁸F₂, ³⁵S, ... In addition, IBA provides Nirta® Solid target technology for the production of radioisotopes such as ⁶⁴Cu, ⁷⁹Zr, ¹²⁴I, ...

**Custom Energy.**

The IBA-patented custom energy CYCLONE® KIUBE allows users to irradiate the target directly at a fixed energy level of 13, 14 or 15 MeV, without using a degrader.

### This is our typical production schedule thanks to the IBA 8-exit ports cyclotron:

<table>
<thead>
<tr>
<th>Time</th>
<th>Radionuclide</th>
<th>Radio pharmaceutical</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:30-6:00</td>
<td>¹⁸F</td>
<td>FDG</td>
</tr>
<tr>
<td>6:30-8:00</td>
<td>¹⁸F</td>
<td>F-other</td>
</tr>
<tr>
<td>8:15-8:45</td>
<td>¹³C</td>
<td>CHOLINE</td>
</tr>
<tr>
<td>10:00-12:00</td>
<td>¹⁸F</td>
<td>MK9470</td>
</tr>
<tr>
<td>12:30-13:00</td>
<td>¹³C</td>
<td>Raclopride</td>
</tr>
<tr>
<td>13:30-13:40</td>
<td>¹⁵N</td>
<td>NH₃</td>
</tr>
<tr>
<td>14:00-16:00</td>
<td>¹⁰³</td>
<td>¹⁰³NH₃</td>
</tr>
<tr>
<td>16:30-17:00</td>
<td>¹⁵O</td>
<td>PDE10A</td>
</tr>
</tbody>
</table>

*Production in Curies of ¹⁸F - in 2 hours run*
After 10 years of excellent experiences with Cyclone® 18/9,
we now added the new CYCLONE®KIUBE. Outstanding! All well thought engineering details made the operation unprecedentedly easy, reliable and maintenance fast and safer, lowering dose exposure.

Francisco Alves
Chief physicist & head of Cyclotron
ICNAS-UNIV. COIMBRA - PORTUGAL

— CYCLONE®KIUBE delivers outstanding performances

The most cost-effective
It has been demonstrated that 18 MeV is the optimal proton energy for the highest production yield of most of PET radioisotopes. Your production capacity is optimized so as your revenue; your center footprint is kept to a reasonable size so as your investment. This means that 18 MeV is the most cost-effective solution for your PET isotopes production.

The growing demand for radioisotopes means a greater need for efficiency. CYCLONE®KIUBE saves enriched water and has the lowest power consumption per Curie produced, yet is the most powerful of the market.

The most performant cyclotron
CYCLONE®KIUBE offers unmatched production capacity for an internal source PET cyclotron. A 2-hour dual beam run could generate up to 30 Ci of 18F-; hence, an incredible batch of FDG synthesized on your Synthera®+ modules.

Maximum reliability
Its unique twin-proton sources give maximum reliability, as switching to the second source during operation is simple, fast and completely automated, translating into more than 99% source uptime. Moreover, the production is optimized in real time thanks to the automatic tuning of the ion source, stripper and magnetic field.

<table>
<thead>
<tr>
<th>HIGHEST PRODUCTION CAPACITY</th>
<th>¹⁸F- capacity/run</th>
<th>FDG doses/run(*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CYCLONE®KIUBE 100</td>
<td>2 hours : 10 Ci / 370 GBq</td>
<td>60 - 100</td>
</tr>
<tr>
<td>CYCLONE®KIUBE 150</td>
<td>2 hours : 16 Ci / 592 GBq</td>
<td>96 - 160</td>
</tr>
<tr>
<td>CYCLONE®KIUBE 180</td>
<td>2 hours : 20 Ci / 740 GBq</td>
<td>120 - 200</td>
</tr>
<tr>
<td>CYCLONE®KIUBE 300</td>
<td>2 hours : 30 Ci / 1110 GBq</td>
<td>180 - 300</td>
</tr>
</tbody>
</table>

(*) using Synthera® FDG chemistry (12h shelf life - stability).
May vary according to local conditions, transport time and patients schedule.
Described for you.

Its compact design can fit into any existing cyclotron vault. Cyclone®KIUBE is also available with a self-shielding option.

**Compact design**

Its compact design can fit into any existing cyclotron vault.

Cyclone®KIUBE is also available with a self-shielding option.

**IntegraLab® ONE**

IBA experts designed the world’s most optimized (c)GMP PET center with a footprint of less than 100m² (1,070 square feet) including a 18 MeV self-shielded cyclotron, while allowing a very high production capacity of 9F for FDG and 68Ga.

IntegraLab® ONE is a real ready-to-run integrated Radiopharmacy, designed to ensure a fast, smooth and risk-free set-up of your (c) GMP radiopharmacy.

**IntegraLab® PLUS**

IntegraLab® PLUS is a fully integrated solution, combining the equipment and services required to establish a Radiopharmaceutical (c)GMP Production Center tailored to your precise needs.

Our approach is truly comprehensive, taking your project from building design to production, with full regulatory compliance, and with the selection, integration, installation and qualification of the equipment needed to meet your radioisotope production goals.

---

**A self-monitoring cyclotron that maximizes your uptime**

**Unmatched reliability**

CYCLONE®KIUBE has an unmatched reliability. Its compact design includes redundancy for the main systems (ion sources, strippers, targets, vacuum pumps,...).

The software self-tests prior to production and automatically self-audits after maintenance, leading to maximized uptime.

The choice of low activation material combined with the optimization of the maintenance tasks ensure the lowest radiation exposure for your staff.

**User-friendly Software**

The software is very user-friendly, meaning it is easier to train and rotate the staff that operates the system. It provides an easy and guided control of the system with a simple production mode for an automatic set up to maximise your 9F production and the manual mode gives you full flexibility.

The 24/7 helpdesk provides you with peace of mind, with IBA experts analyzing cyclotron data in order to diagnose and solve 99% of problems remotely.

**IntegraLab® ONE**

IBA experts designed the world’s most optimized (c)GMP PET center with a footprint of less than 100m² (1,070 square feet) including a 18 MeV self-shielded cyclotron, while allowing a very high production capacity of 9F for FDG and 68Ga.

IntegraLab® ONE is a real ready-to-run integrated Radiopharmacy, designed to ensure a fast, smooth and risk-free set-up of your (c) GMP radiopharmacy.

**IntegraLab® PLUS**

IntegraLab® PLUS is a fully integrated solution, combining the equipment and services required to establish a Radiopharmaceutical (c)GMP Production Center tailored to your precise needs.

Our approach is truly comprehensive, taking your project from building design to production, with full regulatory compliance, and with the selection, integration, installation and qualification of the equipment needed to meet your radioisotope production goals.

---

Max potential, max capacity.
Nirta® target technology

Complete target range for your extended needs

— 18F- conical liquid target

High power with low enriched water consumption
- Different design to deliver between 40 – 100 Ci/hour run
- Caused enriched water consumption on the target.
- Low enriched water consumption on the target.
- Very fast disassembling, assembling and manipulation.

— Liquid targets

Unique solution for 68Ga production
- New issue and accessory (Nirta® Solid and Nirta® Plus solid) solution for the production of 68Ga (40 Ci/ml in 2 hour-run) for hospital use and many advantages:
- No liquid waste calculation of the whole process with the method of liquid waste
- High power with low enriched water consumption
- Production every hour depending on patient schedule
- Simple and cost effective 68Ga production process for a house user or for distribution production similar to the 18F process

— Solid targets

Solid target technology for the production of novel radioisotopes
- Best producing and economic target
- Full packages available including dissolution and purification modules
- Possibility to have a target design
- Full packages available including dissolution and purification modules
- Routine production and research programs

Thanks to the combination of the CYCLONE® KIUBE and the Nirta® 18F- targets, we have a cost-effective solution for large production of 18F high activity in a short run with low enriched water consumption. We are happy with the reliability and performance and we are proud to produce 60 Ci 18F a day to deliver to hospitals for patient diagnosis.

18F

<table>
<thead>
<tr>
<th></th>
<th>Chemical form</th>
<th>Target yield (mCi/µA sat)</th>
<th>Insert volume (ml)</th>
<th>Target reaction</th>
<th>Energy degrader</th>
<th>Target material</th>
<th>Insert material</th>
<th>Window material</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>[18F-]</td>
<td>(2)</td>
<td>4 – 5/min (cont. flow)</td>
<td>15O(p, n)15O</td>
<td>Graphite</td>
<td>Medium</td>
<td>Aluminum</td>
<td>Aluminum</td>
</tr>
<tr>
<td>B</td>
<td>[18F-]</td>
<td>(2)</td>
<td>5 – 6/min (cont. flow)</td>
<td>14N(p, a)11C</td>
<td>Graphite</td>
<td>Medium</td>
<td>Aluminum</td>
<td>Aluminum</td>
</tr>
<tr>
<td>C</td>
<td>[18F-]</td>
<td>(2)</td>
<td>1 – 2/min (cont. flow)</td>
<td>14N(p, a)11C</td>
<td>Graphite</td>
<td>Medium</td>
<td>Aluminum</td>
<td>Aluminum</td>
</tr>
</tbody>
</table>

Chemical form: 
- [18F-] = 18F / 18O
- [15O] = 15O / 14N
- [11C] = 11C / 14N

Target material:
- Medium = Medium
- Medium = Medium
- Medium = Medium

Insert material:
- Aluminum = Aluminum
- Aluminum = Aluminum
- Aluminum = Aluminum

Window material:
- Aluminum = Aluminum
- Aluminum = Aluminum
- Aluminum = Aluminum

Synthera® KIUBE

“Simple & cost effective GMP production process for in-house production every hour depending on patient schedule. No risk of long-lived 68Ge (271 days) in the final product. Seamless automation of the whole process with the use or for distribution production similar to the 18F process.”

The Vecto® beam line extension can be installed for high power solid target work and for research with proton beam.
## Technical features

### HIGH CAPACITY PROTON BEAM

<table>
<thead>
<tr>
<th></th>
<th>Cyclone® KIUBE 100</th>
<th>Cyclone® KIUBE 150</th>
<th>Cyclone® KIUBE 180</th>
<th>Cyclone® KIUBE 300</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>18 MeV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beam current on target</td>
<td>100 µA</td>
<td>150 µA</td>
<td>180 µA</td>
<td>300 µA</td>
</tr>
</tbody>
</table>

### TARGET FLEXIBILITY

| Number of target ports | 8                  |
| Simultaneous extracted beams | 2                  |
| Vectio® Beam Transport Line | short, medium, long |

### LOW POWER CONSUMPTION

| Stand-by mode        | < 3 kW             |
| Beam-on mode         | < 45 kW            | < 55 kW            | < 60 kW            | < 65 kW            |

### COMPACT DESIGN

| Cyclotron weight                     | 18 Tons             |
| Cyclotron overall dimensions [m]     | 1.9 x 1.9 x 1.8 [l x w x h] |
| Internal room dimensions [m]         | 3.8 x 3.8 x 2.5 - Recommended : 4 x 4 x 2.5 [l x w x h] |
| Internal room dimensions with self-shielding [m] | 6 x 7 x 3 [l x w x h] | - | - |
| Self-shielding overall dimensions/piece [m] | 4.645 x 2.770 x 2.575 [l x w x h] | - | - |
ABOUT IBA (Ion Beam Applications S.A)
IBA is a cancer diagnostics and treatment company and the worldwide technology leader in the field of proton therapy. The company’s expertise lies in the development of next-generation proton therapy technologies and radiopharmaceuticals that provide oncology care providers with premium quality services and equipment, including IBA’s leading fully-integrated IntegraLab® system.

ABOUT IBA RADIOPHARMA SOLUTIONS
Based on long-standing expertise, IBA RadioPharma Solutions supports hospitals and radiopharmaceutical distribution centers with their in-house radioisotope production by providing them with global solutions, from project design to the operation of the facility. In addition to high-quality technology production equipment, IBA has developed in-depth experience in setting up GMP radiopharmaceuticals production centers.

CONTACT US:
Chemin du Cyclotron, 3 | 1348 Louvain-la-Neuve, Belgium
Tel.: +32 10 201 275 | Fax: +32 10 47 59 58 |
RadioPharmaSolutions@iba-group.com