

束测仪器与加速器部件

Beam Instruments and Accelerator's Parts

BPM, ACCT, Profile-monitor, Faraday-Cup, Emittance-scanner



V 20260817

ANDESUN

安德信科技

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企业简介 Company Introduction

江苏安德信加速器有限公司（简称：安德信科技）是一家专业从事带电粒子加速器及其部件、束测仪器、真空馈通(FT)、真空观察窗(VOW)、真空隔离器(VI)及相关设备研发与制造的高新技术企业。公司通过了ISO9001质量管理体系认证，是数十家行业头部企业与科研院所合格供应商，上海硬X射线自由电子激光装置项目优秀设备研制供应商，中央电视台《强国智造》栏目展播企业。公司技术团队有外籍院士1人、国家特聘专家2人、教授与研究员9人、副教授与高级工程师5人。

公司成立以来，在离子源、超导腔、常温谐振腔、电子源及40余种不同型号的束流位置探测器（BBPM、BAM、CBPM、SBPM、低温BPM）、荧光靶、法拉第筒、发射度测量仪、ACCT、真空馈通、真空观察窗、真空隔离器等产品的设计、生产制造方面积累了丰富的经验，能够为用户提供全面的服务。经过多年的研发及市场培育和拓展，公司的产品质量和服务得到了客户的广泛认可，具有很高的满意度。产品经美国、法国、德国、英国、俄罗斯、中国等多国近百家科研院、所、大学以及数千家企业使用，完全满足技术要求，性能稳定，达到国际领先水平。



企业简介 Company Introduction

Jiangsu ANDESUN Accelerator Co., Ltd. (Abbreviation: **ANDESUN Technology**) is a high-tech enterprise specializing in the R&D and manufacturing of the **charged-particle accelerators** and their components, **beam-measurement instruments**, **feedthroughs (FT)**, **vacuum observation windows (VOW)**, **vacuum isolators (VI)** and their related equipment. **ANDESUN Technology** has passed the **ISO9001** quality management system certification, and is a qualified supplier to dozens of companies including China National Nuclear Corporation etc.. **ANDESUN Technology** also is an **Excellent Equipment Development Supplier** for the Shanghai High repetition rate XFEL and Extreme light facility (**SHINE**), and **Media Exhibition Enterprise** of CCTV's "**Strong Nation Intelligent Manufacturing**" column. The company's technical team includes 1 foreign academician, 2 nationally appointed experts, 9 professors and researchers, and 5 associate professors and senior engineers.

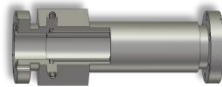
Since the establishment of **ANDESUN Technology**, the company has accumulated rich experience in the design and manufacturing of **ion sources**, **superconducting RF cavities**, **room-temperature RF cavities**, electron accelerators and more than 40 different types of **Beam Position Monitors** (including **BBPM**, **BAM**, **CBPM**, **SBPM**, **low-temperature BPM**), **Profile-monitors**, **Faraday-Cups**, **Emittance-scanners**, **ACCT**, **feedthroughs**, **Vacuum Observation Windows**, **Vacuum Isolators** and other products, and is able to provide users with comprehensive services. After years of R&D and market cultivation and expansion, the **ANDESUN's** product quality and services have been widely recognized by customers, with a satisfaction rate of over 98%. The products have been used by nearly a hundred scientific research **institutes & universities** and thousands of companies in the **United States**, **France**, **Germany**, **the United Kingdom**, **Russia**, **China** and other countries. The products can fully meet the technical requirements, have stable performance, and have reached the international leading level.

产品简介 Product Introduction

束流位置监测器（BPM）是粒子加速器中最为常见的束流诊断设备,对于电子或正电子加速器而言又以条带电极型和钮扣电极型探头为主,其电极输出信号中除包含束团位置信息外,还包含束团电荷量、束团长度等信息,因此如果配以合适的信号处理电子学及信息提取算法,应该可以从单一的BPM探头中同时提取出束团位置、束团电荷量、束团长度等参数,并在此基础上推导出束流损失、束流寿命、束团截面形状因子等参数,实现单一探头进行多参数束流诊断的目的。

Beam position monitor (BPM) is the most common beam diagnostic equipment in particle accelerators. For electron or positron accelerators, strip electrode and button electrode probes are mainly used. In addition to the bunch position information, the electrode output signal also contains information such as the bunch charge and bunch length etc. Therefore, if equipped with appropriate signal processing electronics and information extraction algorithms, it should be possible to simultaneously extract parameters such as bunch position, bunch charge, and bunch length from a single BPM probe. Based on this, parameters such as beam loss, beam life, and beam cross-section shape factor are derived to achieve the purpose of multi-parameter beam diagnosis with a single probe.

Strip-line BPM



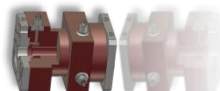
产品结构：束管内部圆周分布四根条形电极，一端引出信号，一端接地。
产品特点：相对较高的灵敏度，适用于短束团。
Product structure: There are four strip electrodes distributed around the circumference of the beam tube, with one end leading out a signal and the other end grounded.
Product features: Relatively high sensitivity, suitable for short beam clusters.

Button BPM



产品结构：束管内部圆周分布四个圆形钮扣电极。
产品特点：耦合阻抗较小，占用纵向空间少，成本低。
Product structure: Four circular button electrodes are distributed around the circumference of the beam tube.
Product features: The coupling impedance is small, occupying less longitudinal space, and the cost is low.

Cavity BPM



产品结构：束管内部构成一Pill-Box谐振腔，沿腔圆周分布四个电极探针。
产品特点：亚微米级束流位置测量精度。
Product structure: The inside of the beam tube forms a PillBox resonant cavity, with four electrode probes distributed along the circumference of the cavity.
Product features: Measurement accuracy of submicron beam position.

Linear-cut BPM

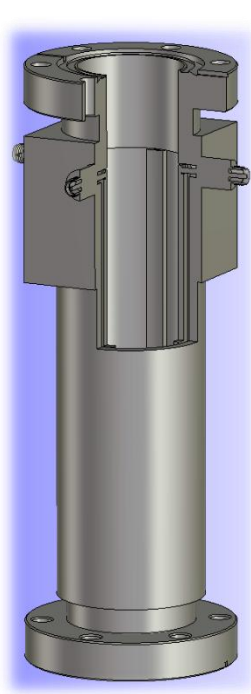


产品结构：束管内部对称分布两对三角形电极板。
产品特点：测量较长束团，信号强，线性区大。
Product structure: Two pairs of triangular electrode plates are symmetrically distributed inside the beam tube.
Product features: Measuring longer beam cluster, strong signals, and large linear regions.

带条型 BPM SBPM

带条型BPM在平行于束流方向放置四个正交的长条电极，利用束流在电极上产生的感应整个频带，这就导致了带条型BPM有着很快的时间响应，可以用于分电荷来推算出横向偏移位置，带条型BPM因为电极面积较大，产生的信号幅度也比纽扣型电极强，带条型BPM产生的电信号带宽较宽，几乎可以覆盖辨短脉冲信号。

Stripline BPM places four orthogonal long electrodes parallel to the beam, and the lateral offset position is calculated using the induced charge generated by the beam on the electrodes. Because the stripline BPM has a larger electrode area, the amplitude of the generated signal is stronger than that of the button electrode. The electrical signal generated by the stripline BPM has a wider bandwidth and can cover almost the entire frequency band. This results in a stripline BPM with a fast time response, which can be used to distinguish short pulse signals.



技术参数 Specification	
类型 Type	带条型 BPM Stripline BPM
束流接口 Beam interface	CF 法兰 CF Flange
信号接口 Signal interface	N型或SMA型真空电极 N or SMA Type Feedthrough
主体材料 Main Material	无磁不锈钢 Non-magnetic stainless steel
漏气率 Leakage Rate	$<1 \times 10^{-12} \text{ Pa} \cdot \text{m}^3/\text{s}$
磁导率 Magnetoeconductivity	$<1.05\mu\text{r}$ (除FT, Except FT)
工作温度 Working Temperature	$-60^{\circ}\text{C} \sim 300^{\circ}\text{C}$
耐气压 Pressure Tolerance	10 Bar

带条型 BPM SBPM

生产样例 Product examples



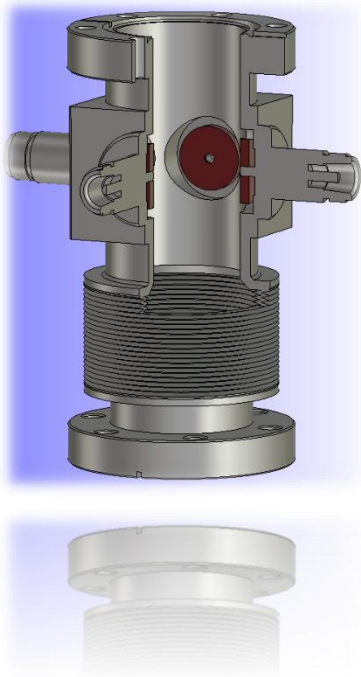
带条型BPM为定制化产品，BPM的物理结构需要匹配束流参数，机械结构需要匹配上下游安装要求，所以最终产品大小形态各异。公司自主生产BPM探头的核心部件Feedthrough，工期进度可控，并具备全线的生产测试能力，包括器件的极限真空和RGA测试，保证产品适用超高真空环境。

Strip-type BPM normally is a customized product, and the physical structure of BPM needs to match the beam parameters, while the mechanical structure needs to match the installation requirements of upstream and downstream. Therefore, the final product size and shape vary. The company independently produces the core component of BPM probes, Feedthrough, with controllable schedule and full production testing capabilities, including extreme vacuum and RGA testing of devices, to ensure that the products are suitable for ultra-high vacuum environments.

纽扣型 BPM BBPM

纽扣型BPM通过数个圆柱形的电极，收集束团在电极上产生的感应电压信号，从而推算出束团的横向位置偏移量。纽扣型电极时间响应快，电极信号较弱，一般用于储能环这种轨道测量。

Button BPM collect the induced voltage signals generated by the bunches on the electrodes through several cylindrical electrodes, so as to calculate the lateral displacement of the bunches. The button electrode has a fast time response and the electrode signal is weak. It is generally used for orbit measurement of energy storage rings.



技术参数 Specification	
类型 Type	纽扣型 BPM Button BPM
束流接口 Beam interface	CF 法兰 CF Flange
信号接口 Signal interface	N型或SMA型真空电极 N or SMA Type Feedthrough
主体材料 Main Material	无磁不锈钢 Non-magnetic stainless steel
漏气率 Leakage Rate	$<1 \times 10^{-12} \text{ Pa} \cdot \text{m}^3/\text{s}$
磁导率 Magnetocoductivity	$<1.05\mu\text{r}$ (除FT, Except FT)
工作温度 Working Temperature	$-60^{\circ}\text{C} \sim 300^{\circ}\text{C}$
耐气压 Pressure Tolerance	10 Bar

纽扣型 BPM Button BPM

生产样例 Product examples



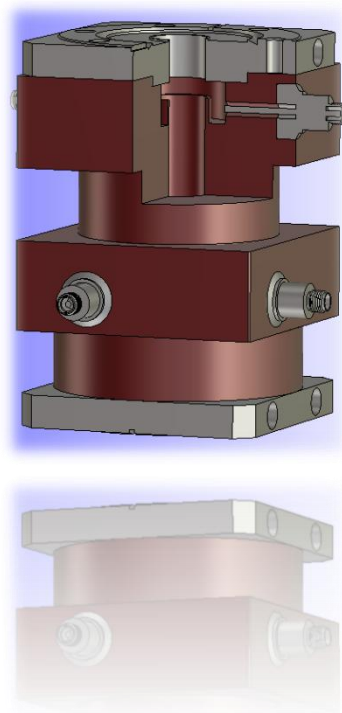
纽扣型BPM为定制化产品，BPM的物理结构需要匹配束流参数，机械结构需要匹配上下游安装要求，所以最终产品大小形态各异。公司自主生产BPM探头的核心部件Feedthrough，工期进度可控，并具备全线的生产测试能力，包括器件的极限真空和RGA测试，保证产品适用超高真空环境。

The button BPM normally is a customized product, and the physical structure of BPM needs to match the beam parameters, while the mechanical structure needs to match the installation requirements of upstream and downstream. Therefore, the final product size and shape vary. The company independently produces the core component of BPM probes, Feedthrough, with controllable schedule and full production testing capabilities, including extreme vacuum and RGA testing of devices, to ensure that the products are suitable for ultra-high vacuum environments.

腔型 BPM CBPM

腔式BPM采用的是高频谐振腔原理，当束团穿过RF谐振腔时，会激荡出高频电磁场，其中的TM010模式与束团的电荷量成正比，TM110模式与中心偏移量成正比，由此可以导出束团的横向位置。腔式BPM带宽较窄，加工成本高，但分辨率一般优于1um，被广泛应用在各类高能加速器上。

Cavity BPM adopts the principle of high-frequency resonant cavity. When the beam passes through the RF resonant cavity, it will excite a high-frequency electromagnetic field. The TM110 mode is proportional to the center offset, from which the lateral position of the bunch can be derived. Cavity BPM has a narrow bandwidth and high processing cost, but the resolution is generally better than 1um, and is widely used in various high-energy accelerators.



技术参数 Specification	
类型 Type	腔式 BPM Cavity BPM
束流接口 Beam interface	CF 法兰 CF Flange
信号接口 Signal interface	N型或SMA型真空电极 N or SMA Type Feedthrough
主体材料 Main Material	无磁不锈钢、无氧铜 Non-magnetic stainless steel、 OFC
漏气率 Leakage Rate	$<1 \times 10^{-12} \text{ Pa} \cdot \text{m}^3/\text{s}$
磁导率 Magnetocoductivity	$<1.05\mu\text{r}$ (除FT, Except FT)
工作温度 Working Temperature	-60℃~300 ℃
耐气压 Pressure Tolerance	10 Bar

腔型 BPM CBPM

生产样例 Product examples



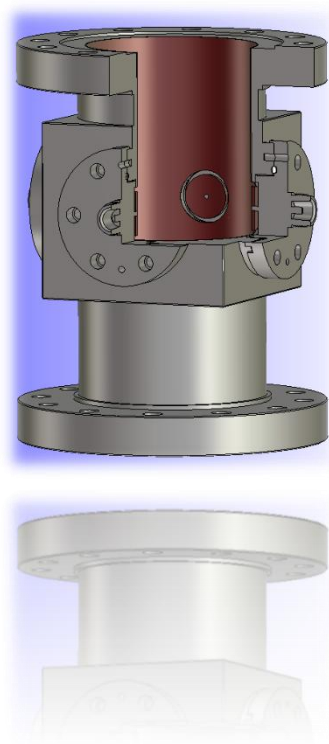
腔式BPM为定制化产品，BPM的物理结构需要匹配束流参数，机械结构需要匹配上下游安装要求，所以最终产品大小形态各异。腔式BPM可由位置腔和参考腔自由组合，位置腔用于测量束流在X和Y方向位置，参考腔用于测量束流的流强并提供相位的参考。公司自主生产BPM探头的核心部件Feedthrough，工期进度可控，并具备全线的生产测试能力，包括器件的极限真空和RGA测试，保证产品适用超高真空环境。

The cavity BPM normally is a customized product, and the physical structure of BPM needs to match the beam parameters, while the mechanical structure needs to match the installation requirements of upstream and downstream. Therefore, the final product size and shape vary. The cavity BPM can be freely combined by a position cavity and a reference cavity. The position cavity is used to measure the position of the beam in the X and Y directions, and the reference cavity is used to measure the beam intensity and provide a reference for the phase. The company independently produces the core component of BPM probes, Feedthrough, with controllable schedule and full production testing capabilities, including extreme vacuum and RGA testing of devices, to ensure that the products are suitable for ultra-high vacuum environments.

低温 BPM Low-temperature BPM

低温BPM常见于超导加速器，用于监测束流在超导加速段的位置，工作在液氦温区，多数为纽扣类型。区别于常温BPM，低温BPM要求能够耐受4K的温度而不发生真空泄露，而且要求器件表面有极低的射频损耗以减小运行成本。

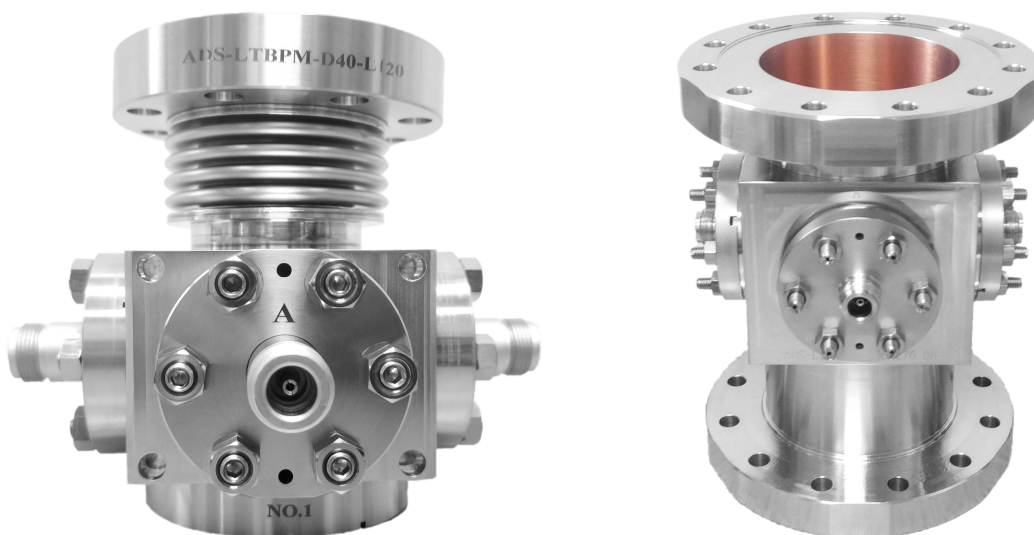
Low-temperature BPM is commonly used in superconducting accelerators to monitor the position of the beam in the superconducting acceleration section, operating in the liquid helium temperature region, mostly button type. Unlike normal temperature BPM, low temperature BPM requires the ability to withstand temperatures of 4K without vacuum leakage, and requires very low RF losses on the device surface to reduce operating costs.



技术参数 Specification	
类型 Type	低温 BPM Low Temperature BPM
束流接口 Beam interface	平面 法兰 Flat Flange
信号接口 Signal interface	N型真空电极 N Type Feedthrough
主体材料 Main Material	无磁不锈钢(镀铜) Non-magnetic stainless steel (Copper plating)
漏气率 Leakage Rate	$<1 \times 10^{-12} \text{ Pa} \cdot \text{m}^3/\text{s}$
磁导率 Magnetconductivity	$<1.05\mu\text{r}$
工作温度 Working Temperature	$-271^{\circ}\text{C} \sim 120^{\circ}\text{C}$
耐气压 Pressure Tolerance	10 Bar

低温 BPM Low-temperature BPM

生产样例 Product examples



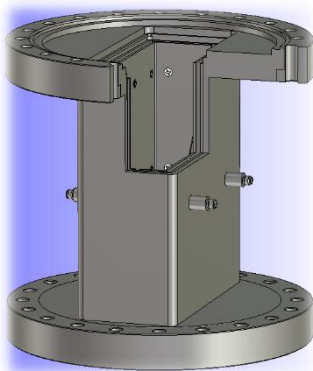
低温BPM为定制化产品，BPM的物理结构需要匹配束流参数，机械结构需要匹配上下游安装要求，所以最终产品大小形态各异。公司自主生产BPM探头的核心部件Feedthrough，工期进度可控，并具备全线的生产测试能力，包括器件的极限真空和RGA测试，保证产品适用超高真空环境。

The low-temperature BPM normally is a customized product, and the physical structure of BPM needs to match the beam parameters, while the mechanical structure needs to match the installation requirements of upstream and downstream. Therefore, the final product size and shape vary. The company independently produces the core component of BPM probes, Feedthrough, with controllable schedule and full production testing capabilities, including extreme vacuum and RGA testing of devices, to ensure that the products are suitable for ultra-high vacuum environments.

三角 BPM Triangular BPM

三角BPM也称静电感应型BPM，由环绕束流管的连续金属板组成，此类BPM的信号强度与束流相对于检测电极的距离无关，而是由电极对束流管的覆盖程度决定。实际的系统中，相邻电极存在容性耦合，因此使用接地保护降低相邻电极信号的串扰。三角BPM全孔径内线性优良，具有高的灵敏度，在质子加速器中广泛应用。

Triangular BPM, also known as electrostatic induction BPM, consists of a continuous metal plate surrounding the beam tube, and the signal strength of such BPM is not related to the distance of the beam from the detection electrode, but is determined by the extent of the electrode's coverage of the beam tube. In the actual system, there is capacitive coupling between adjacent electrodes, so the ground protection is used to reduce the crosstalk of adjacent electrode signals. Triangle BPM has good linearity in full aperture and high sensitivity, and is widely used in proton accelerators.



技术参数 Specification	
类型 Type	三角型 BPM Linear Cut BPM
束流接口 Beam interface	CF 法兰 CF Flange
信号接口 Signal interface	N型或SMA型真空电极 N or SMA Type Feedthrough
主体材料 Main Material	无磁不锈钢 Non-magnetic stainless steel
漏气率 Leakage Rate	$<1 \times 10^{-12} \text{ Pa} \cdot \text{m}^3/\text{s}$
磁导率 Magnetocoductivity	$<1.05\mu\text{r}$ (除FT, Except FT)
工作温度 Working Temperature	$-60^{\circ}\text{C} \sim 300^{\circ}\text{C}$
耐气压 Pressure Tolerance	10 Bar

三角 BPM Triangular BPM

生产样例 Production examples



三角BPM为定制化产品，BPM的物理结构需要匹配束流参数，机械结构需要匹配上下游安装要求，所以最终产品大小形态各异。公司自主生产BPM探头的核心部件Feedthrough，工期进度可控，并具备全线的生产测试能力，包括器件的极限真空和RGA测试，保证产品适用超高真空环境。

The triangular BPM normally is a customized product, and the physical structure of BPM needs to match the beam parameters, while the mechanical structure needs to match the installation requirements of upstream and downstream. Therefore, the final product size and shape vary. The company independently produces the core component of BPM probes, Feedthrough, with controllable schedule and full production testing capabilities, including extreme vacuum and RGA testing of devices, to ensure that the products are suitable for ultra-high vacuum environments.

电子学系统 Electronics

BPM电极引出信号需要通过电子学模块进行处理，才能获得最终的位置数据。常用的电子学处理方法包括三种：对数比、幅相转换和差和比方法。

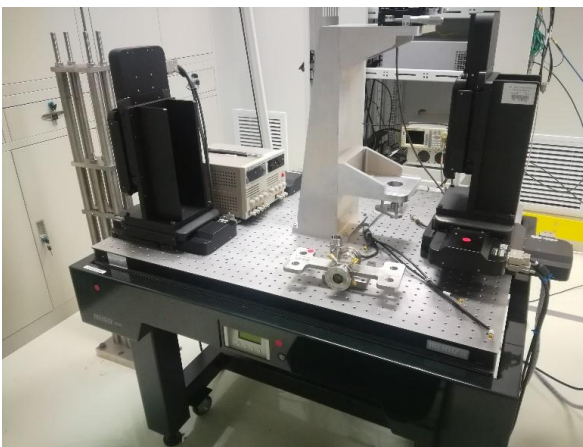
The signal from the BPM electrode needs to be processed by the electronics module to obtain the final position data. Commonly used electronics processing methods include three types: log ratio, amplitude-to-phase conversion, and difference and ratio methods.

电子学从最初的全模拟信号处理逐步向数字信号处理过渡。随着模数转换电路与数字信号处理方法的快速发展，近年来电子学出现了全数字化处理的新趋势。

Electronics is gradually transitioning from initial full analog signal processing to digital signal processing. With the rapid development of analog-to-digital conversion circuits and digital signal processing methods, in recent years, there has been a new trend of fully digital processing in electronics.

安德信科技可以配套BPM的电子学系统，同时可以基于标定平台，完成对BPM的标定。

Anderson Technology can support the BPM electronics system, and at the same time, it can complete the calibration of BPM based on the calibration platform.



两种标定平台 Two kinds of calibration platforms

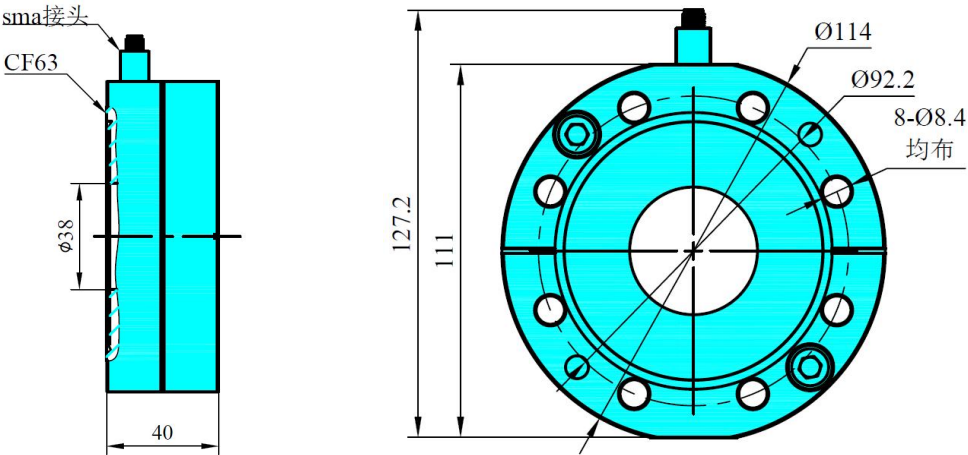
交流电流互感器 ACCT



ACCT是Hereward于1960年首次提出的有源变压器的演进，具有噪声低、输出信号直流偏移低、长期稳定性好等优点。当带电粒子束穿过环形线圈时，它充当ACCT的初级绕组。ACCT的次级绕组直接均匀地绕在圆形铁芯上。ACCT传感器连接到运算放大器，以在测量脉冲宽度超过几微秒的带电粒子束时获得较长的下垂时间常数。传感器和电子设备使用电缆连接，用于长距离信号传输。

ACCT is an evolution of the active transformer first proposed by Hereward in 1960, with the advantages of low noise, low DC offset of the output signal, and excellent long-term stability. When a charged particle beam passes through the toroid, it acts as the primary winding of the ACCT. The secondary winding of the ACCT is wound directly and evenly around a circular iron core. The ACCT sensor is connected to an operational amplifier to obtain a long droop time constant when measuring a charged particle beam with a pulse width longer than several microseconds. The sensor and electronics are connected using a cable for long-distance signal transmission.

交流电流互感器 ACCT



技术参数 Specification

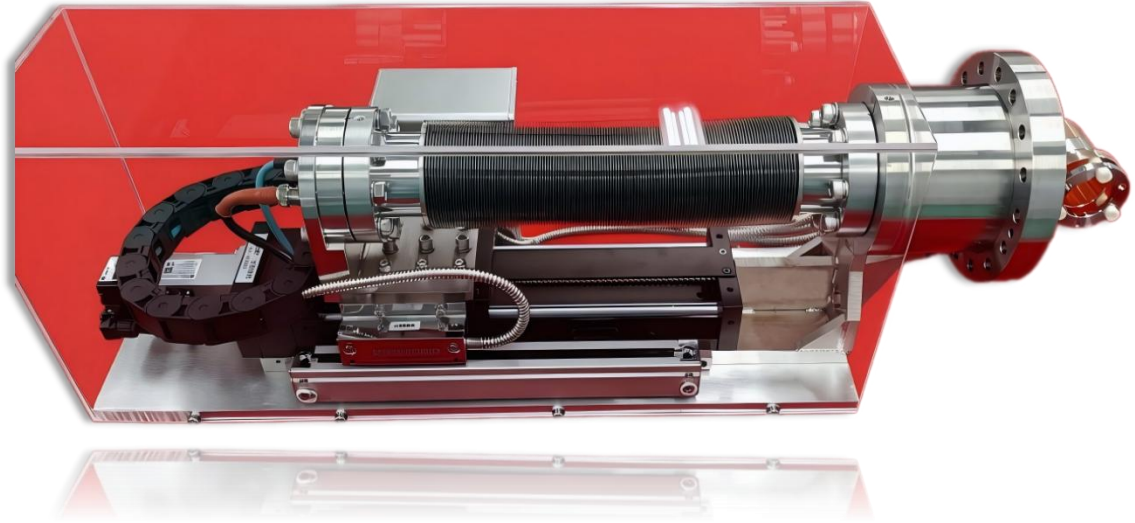
测量方式	Measurement Method	通过式 Pass-through
束流量程	Beam Flow Range	1mA-2A
顶降	Droop	≤2%/ms
上升时间	Rise Time	≤800ns
束流接口	Beam interface	CF 法兰 CF Flange
信号接口	Signal interface	SMA型真空电极 SMA Type Feedthrough
主体材料	Main Material	无磁不锈钢 Non-magnetic stainless steel
漏气率	Leakage Rate	<1×10 ⁻¹² Pa•m ³ /s
工作温度	Working Temperature	-60℃~150 °C
耐气压	Pressure Tolerance	10 Bar

本产品主要包括探头和电子学，电子学由“Input”端口接收来自探头的模拟信号，经处理后从“Output”端口输出模拟信号。另外，探头的规格，电子学的输出接口均可定制。

This product mainly includes the sensor and electronics. The electronics receives the analog signal from the sensor by the "Input" port, and outputs the analog signal from the "Output" port after processing. In addition, the specifications of the probe and the output interface of electronics can be customized.

法拉第筒

Faraday Cup



法拉第筒是直接测量束流的最简单和最常用的拦截式探测器。设计的法拉第筒由连接电流前置放大器的隔离铜套和用于控制法拉第筒位置的步进电机组成，隔离铜套可以增加二次电子抑制级。

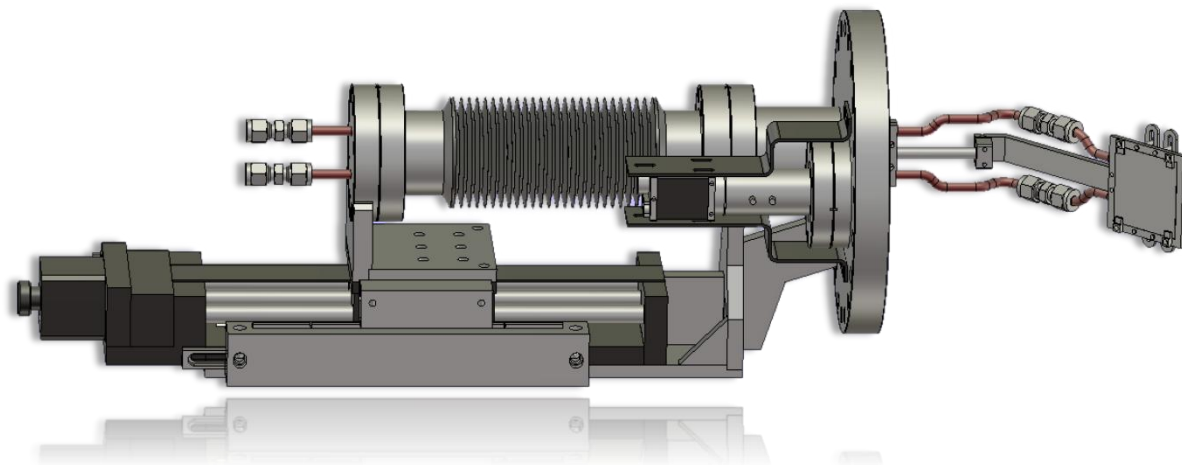
产品真空漏率 $<1 \times 10^{-11} \text{Pa} \cdot \text{m}^3/\text{s}$ 。具体参数可根据客户需求定制设计。

The Faraday cup is the simplest and most commonly used destructive detector to measure the beam current directly. The developed Faraday cup consists of an isolated copper cup connected to a current sensitive preamplifier and a stepper motor to control the position of the Faraday cup. The isolation copper sleeve can enhance the secondary electron suppression level.

The product vacuum leak rate is less than $1 \times 10^{-11} \text{Pa} \cdot \text{m}^3/\text{s}$. Specific parameters can be customized according to customer needs.

束流轮廓测量仪

Beam Profile Monitor



束流轮廓测量仪用于测量束流的光束直径。测量束流轮廓最直接的方法是通过由束流照射并由 CCD 摄像机监控的闪烁屏发出的光。步进电机控制闪烁屏在测量期间伸出。闪烁屏上的光斑由 CCD 摄像机通过法兰上的观察窗（硼硅玻璃）捕捉，数据通过网线传输到 PC。

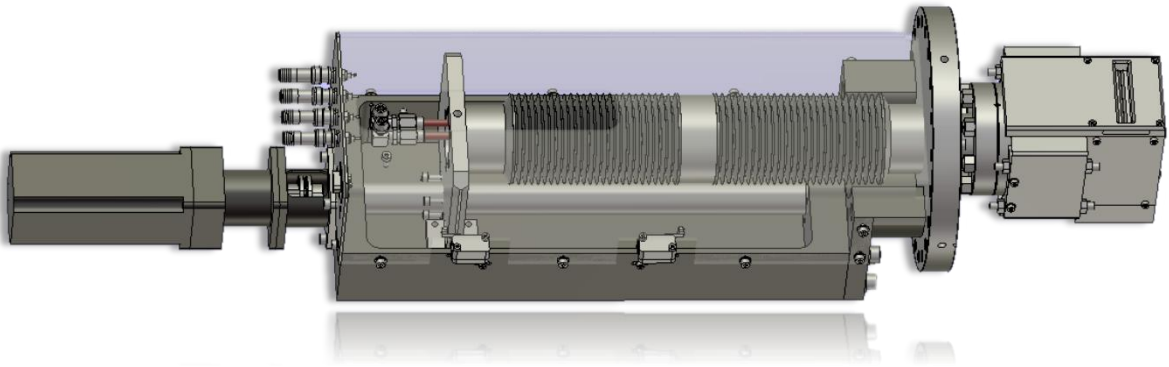
产品真空漏率小于 $1 \times 10^{-11} \text{Pa} \cdot \text{m}^3/\text{s}$ 。具体参数可根据客户需求定制化设计。

The beam profile monitor is used to measure the beam diameter of beam. The most direct way to measure the beam profile is via the light emitted from a scintillation screen irradiated by beam and monitored by a CCD camera. The scintillation screen is controlled by a stepper motor to protrude during the measurement. The beam spot on the scintillation screen is captured by a CCD camera through the viewing window (borosilicate glass) on the flange, and the data are transferred to a PC via a network cable.

The product vacuum leak rate is less than $1 \times 10^{-11} \text{Pa} \cdot \text{m}^3/\text{s}$. Specific parameters can be customized according to customer needs.

发射度测量仪

Allison-type Emittance-scanner



Allison型发射度测量仪用于测量束流的发射度。研制的艾里逊式扫描仪由探头、伺服电机、控制系统和电源组成。Allison型发射扫描仪的探头由一个前狭缝、两个偏转板、一个后狭缝、一个抑制电极和一个收集器组成。在测量过程中，使用带有编码器的伺服电机控制探头以计算其位置。此外，扫描仪上安装了两个限位开关，以限制探头的运动。

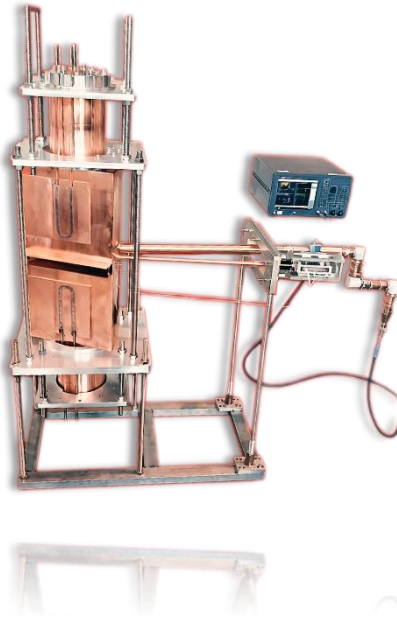
产品真空漏率小于 $1 \times 10^{-11} \text{Pa} \cdot \text{m}^3/\text{s}$ 。具体参数可根据客户需求定制化设计。

An Allison-type emittance scanner is used to measure the emittance of the beam. The developed Allison-type scanner consists of a probe, a servo motor, a control system and a power supply. The probe of the Allison-type emittance scanner consists of a front slit, two deflecting plates, a rear slit, a suppression electrode and a collector. During the measurement, the probe is controlled using the servo motor with an encoder to calculate its location. Besides, two limit switches are installed on the scanner to limit the motion of the probe.

The product vacuum leak rate is less than $1 \times 10^{-11} \text{Pa} \cdot \text{m}^3/\text{s}$. Specific parameters can be customized according to customer needs.

回旋加速器高频腔

Cyclotron RF Cavity



高频腔作为BNCT系统的关键部件，对频率和Q值要求较高，相应的对机加工精度和表面处理要求较高。公司拥有完善的加工、焊接、表面处理、测试流程，保障产品的性能。

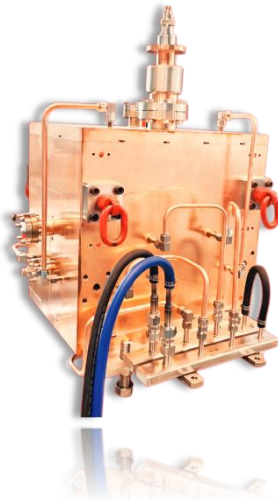
产品真空漏率小于 $1 \times 10^{-11} \text{Pa} \cdot \text{m}^3/\text{s}$ 。具体参数可根据客户需求定制化设计。

As a key component of the BNCT system, the RF cavity has stringent requirements for frequency and Q value, which in turn necessitates high machining precision and surface treatment. Our company possesses comprehensive processes for machining, welding, surface treatment, and testing, ensuring the performance of our products.

The product vacuum leak rate is less than $1 \times 10^{-11} \text{Pa} \cdot \text{m}^3/\text{s}$. Specific parameters can be customized according to customer needs.

横模腔

Transverse-mode Cavity



横模腔是一个高Q值谐振腔，在束流偏转系统中通过内置一对极板为束流提供偏转电压。工作时，通过调谐杆和水冷控温，精确控制谐振频率。公司有丰富的谐振腔调试经验，可以提供高频率精度，高品质因数的定制化谐振腔。

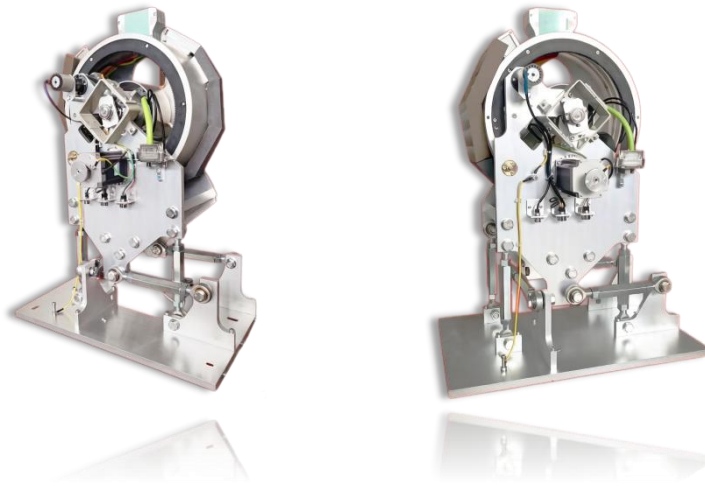
产品真空漏率小于 $1 \times 10^{-11} \text{Pa} \cdot \text{m}^3/\text{s}$ 。具体参数可根据客户需求定制化设计。

The transverse-mode cavity is a high-Q resonant cavity that provides deflection voltage for the beam through a pair of built-in electrodes in the beam deflection system. During operation, the resonant frequency is precisely controlled through tuning rods and water cooling temperature control. The company has extensive experience in tuning resonant cavities and can provide customized resonant cavities with high frequency accuracy and high quality factor.

The product vacuum leak rate is less than $1 \times 10^{-11} \text{Pa} \cdot \text{m}^3/\text{s}$. Specific parameters can be customized according to customer needs.

降能器

Energy Reducer



降能器型在质子治疗系统中属于束流传输系统的一部分，主要功能是快速调节质子束的能量水平，可实现束流系统输出的质子能量在240MeV~70MeV内的连续可调。

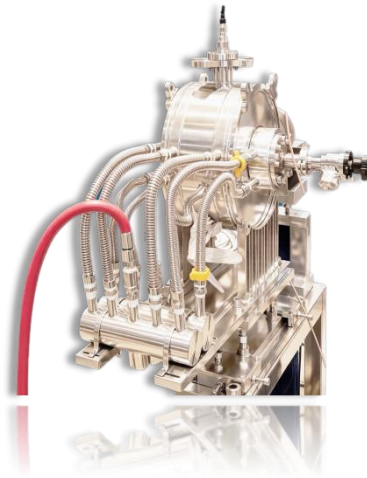
降能器安装在传输系统的支座(非供货范围)上，主要由降能器主体和罩壳组成，其中主体部分包括支撑框架、降能模组与转盘组件、驱动电机、变压器、电位器、零位开关、束流检测装置和电气控制系统等。

The energy reducer is part of the beam transport system in the proton therapy system. Its main function is to quickly adjust the energy level of the proton beam, enabling continuous adjustment of the proton energy output by the beam system within the range of 240MeV to 70MeV.

The energy reducer is installed on the support of the transmission system (not within the scope of supply), and mainly consists of the energy reducer body and the housing. The body part includes the support frame, energy reduction module and turntable assembly, drive motor, transformer, potentiometer, zero position switch, beam detection device, and electrical control system.

次谐波聚束腔

Sub-harmonic Bunching Cavity



次谐波聚束腔用于对电子束进行速度调制，是直线加速器获得高品质电子束流的重要途径，也是高亮度对撞机的强流注入器以及自由电子激光装置中的关键部件。

次谐波聚束腔主要参数包括频率调谐范围、Q值、加速电压、分路阻抗、表面电场的最大值等，结构主要由谐振腔体、功率耦合器、调谐器、场探针、水冷机构、调节支架组成。

The sub-harmonic bunching cavity, which is used for velocity modulation of electron beams, is an important way to obtain high-quality electron beams in linear accelerators. It is also a key component in high-brightness colliders, intense-current injectors, and free-electron laser devices.

The main parameters of the sub-harmonic bunching cavity include frequency tuning range, Q value, accelerating voltage, shunt impedance, maximum value of surface electric field, etc. The structure mainly consists of a resonant cavity, power coupler, tuner, field probe, water cooling mechanism, and adjustment bracket.

生产流程 PRODUCTION PROCESS

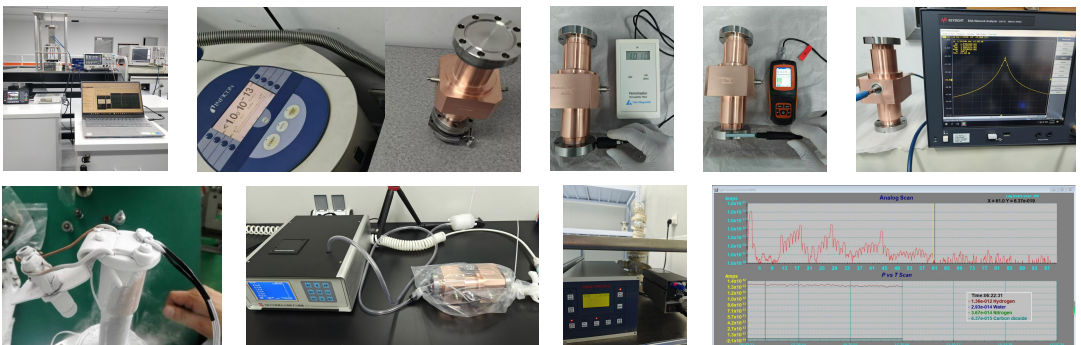
部件加工 Components Manufacturing

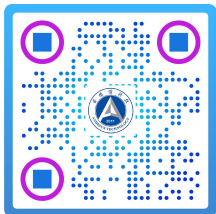


装配焊接 Assembly Welding



性能测试 Performance Testing





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