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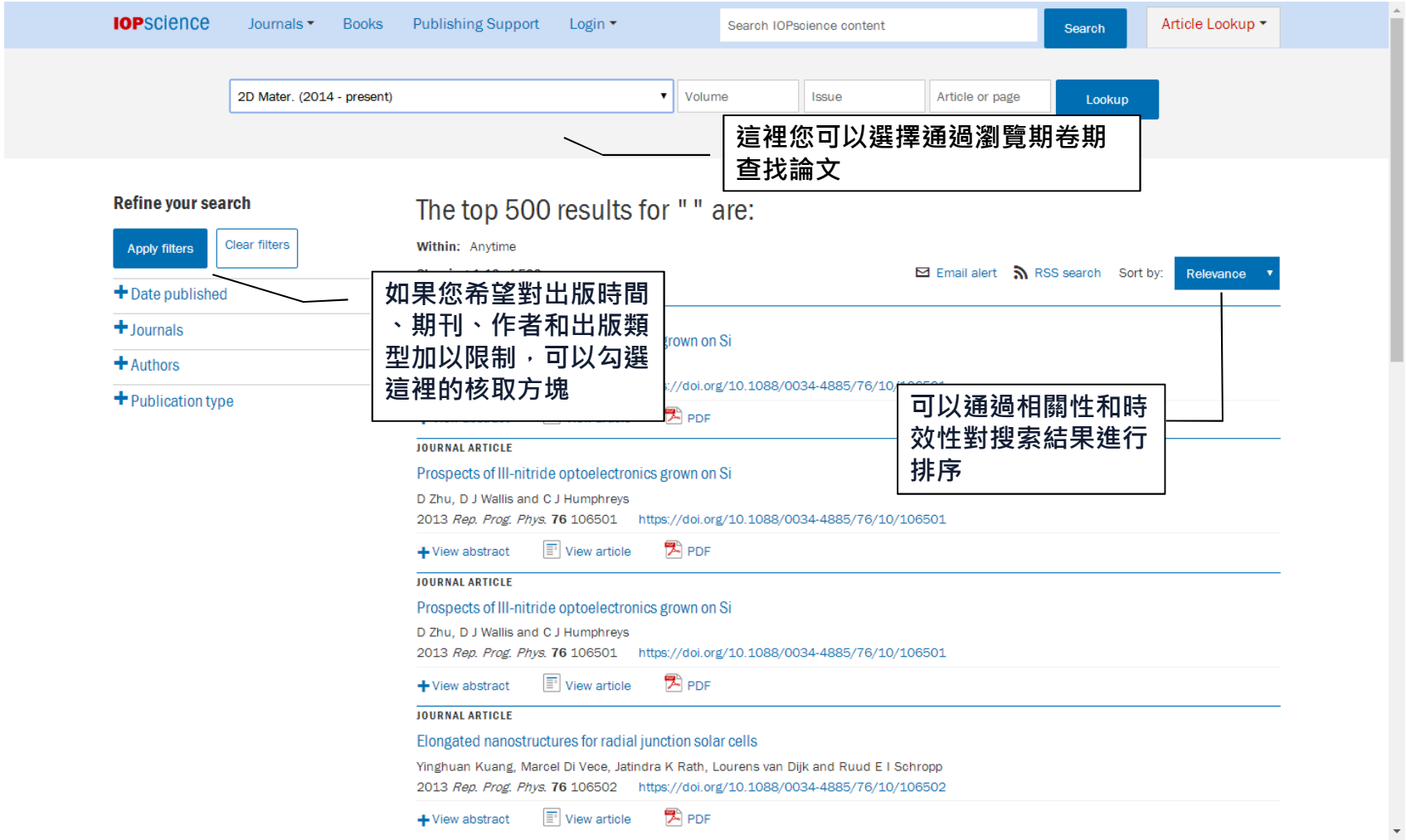

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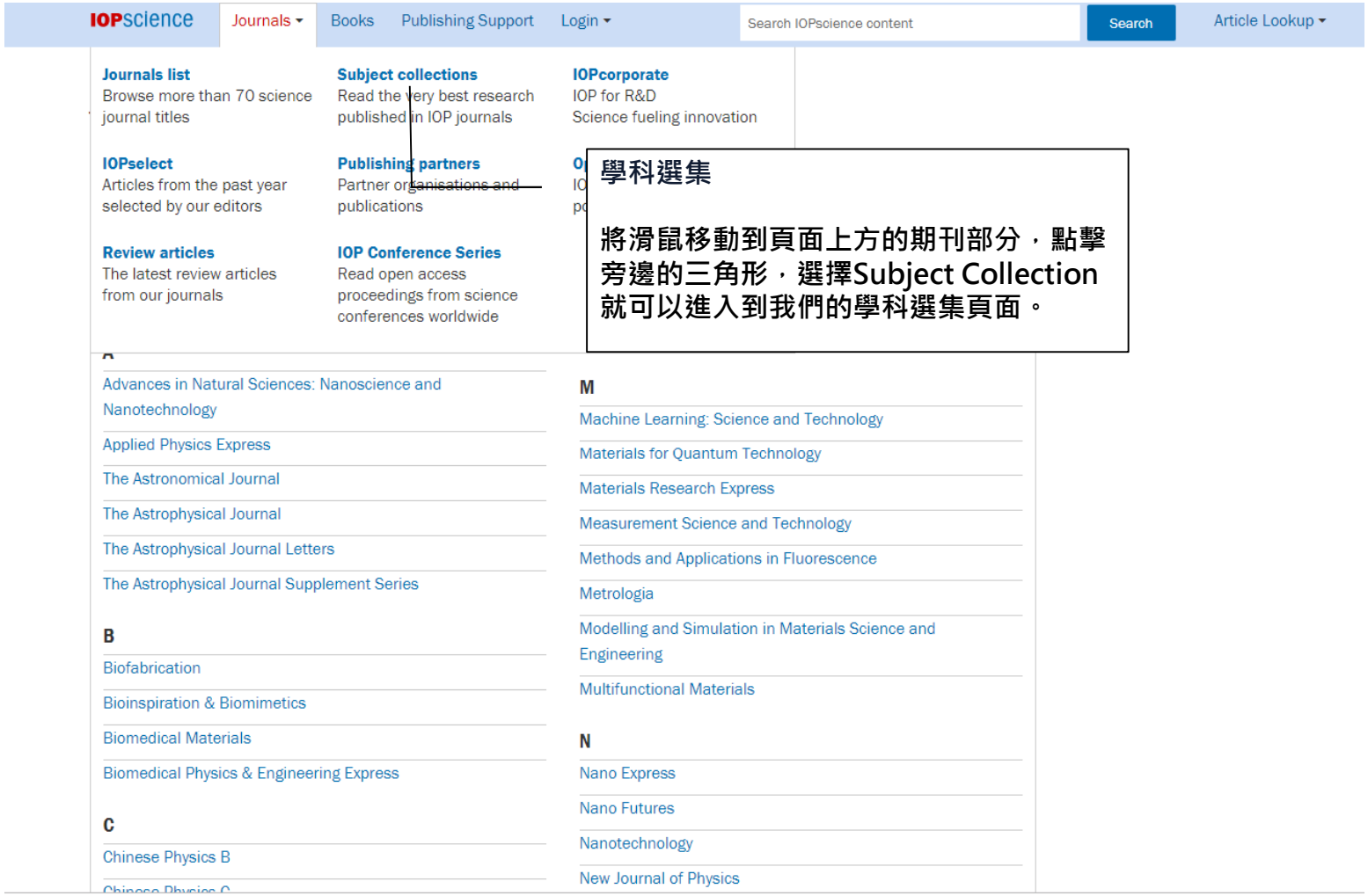

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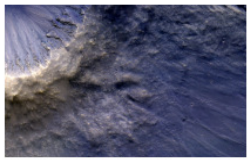
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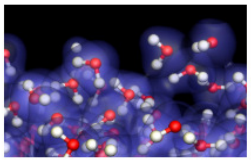
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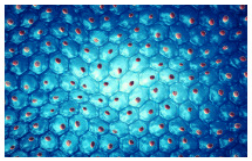
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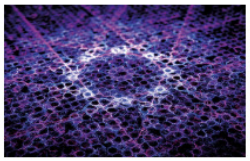
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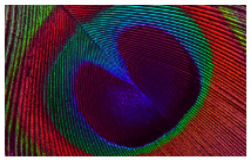
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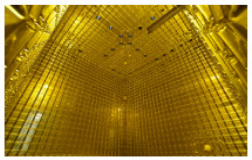
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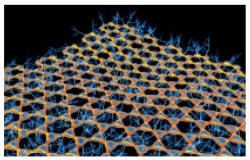
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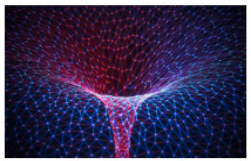
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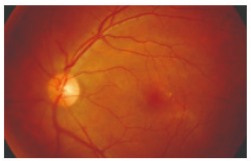
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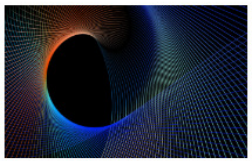
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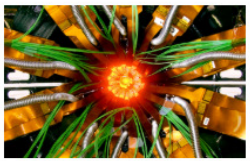
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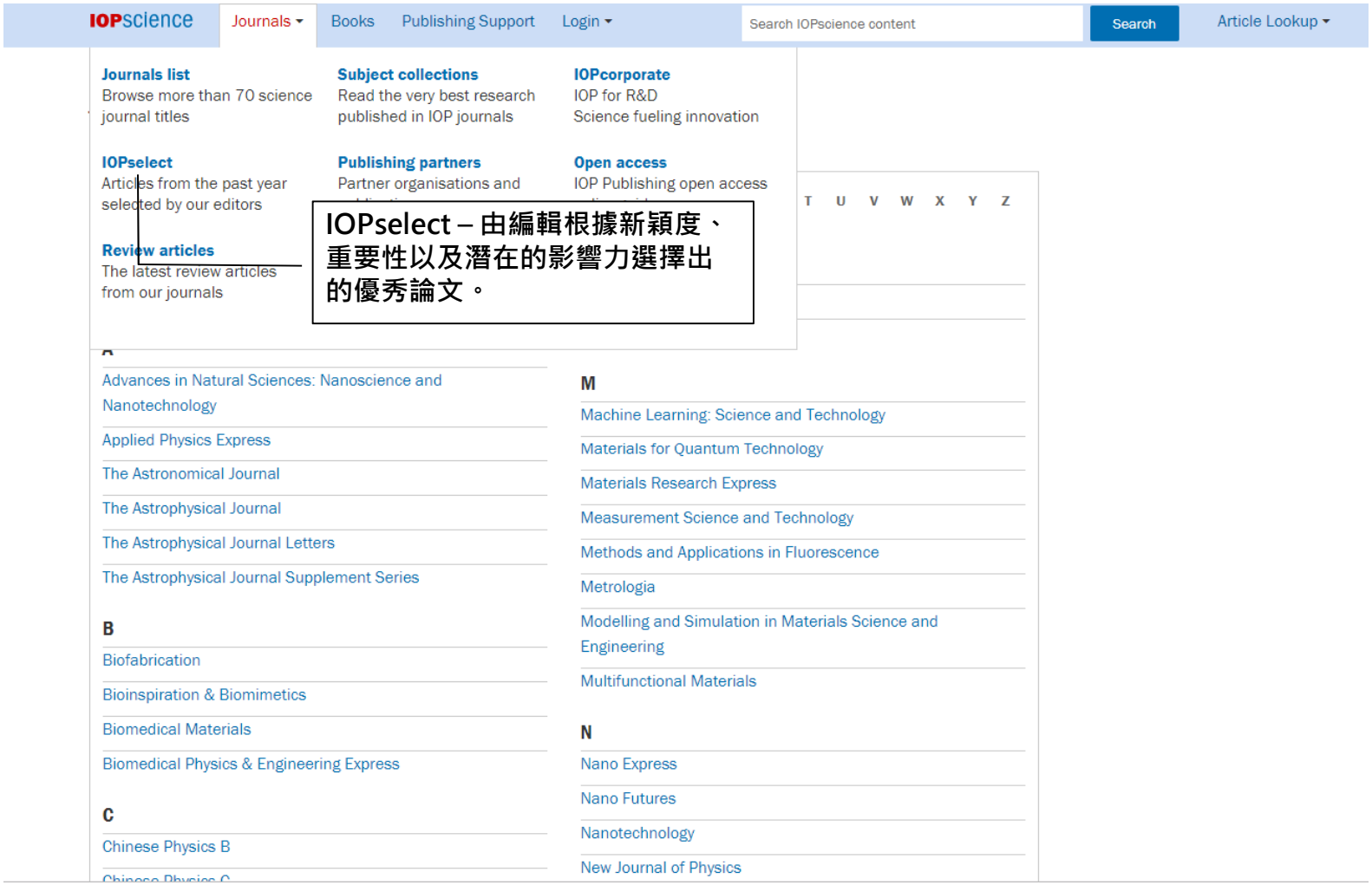

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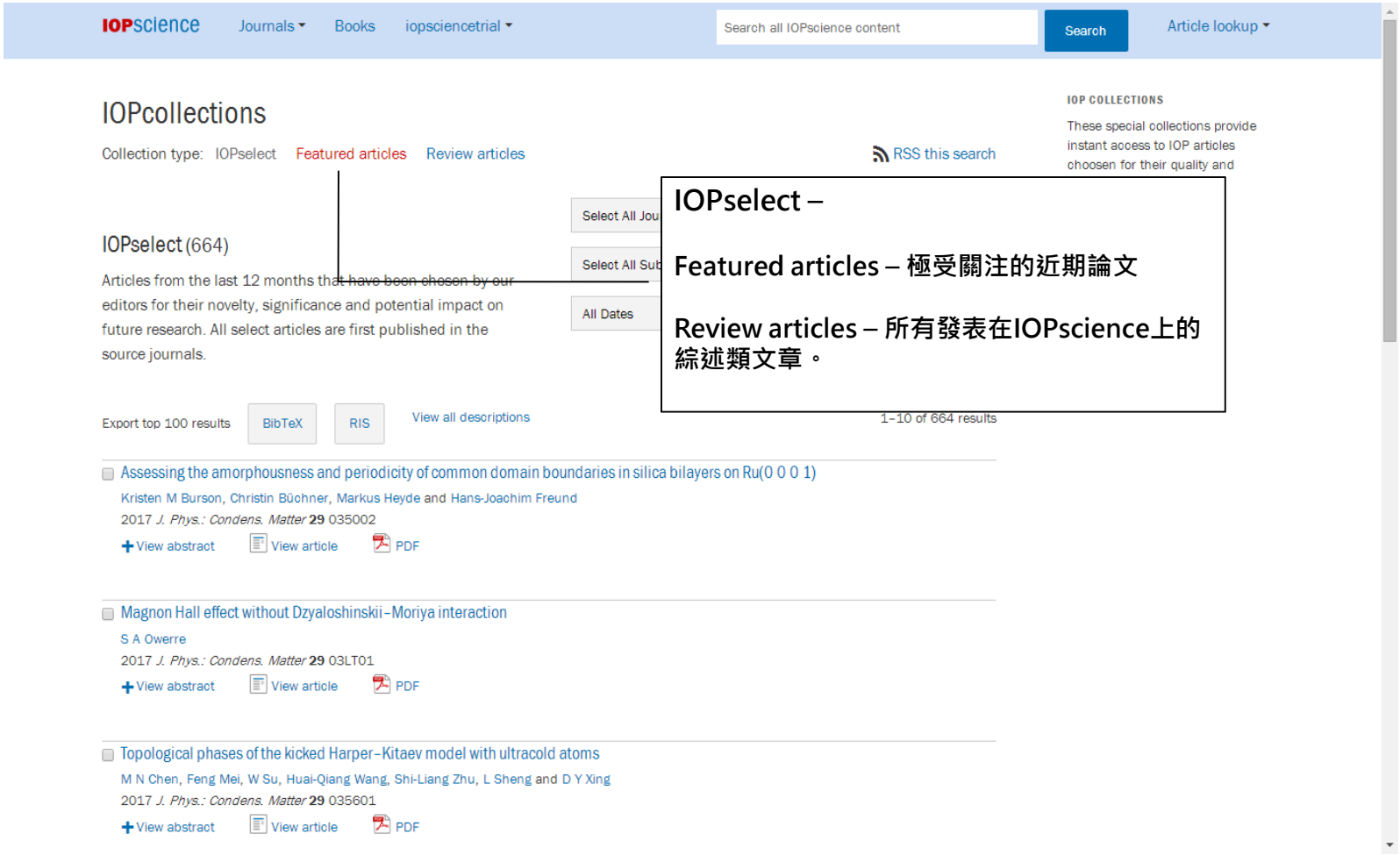

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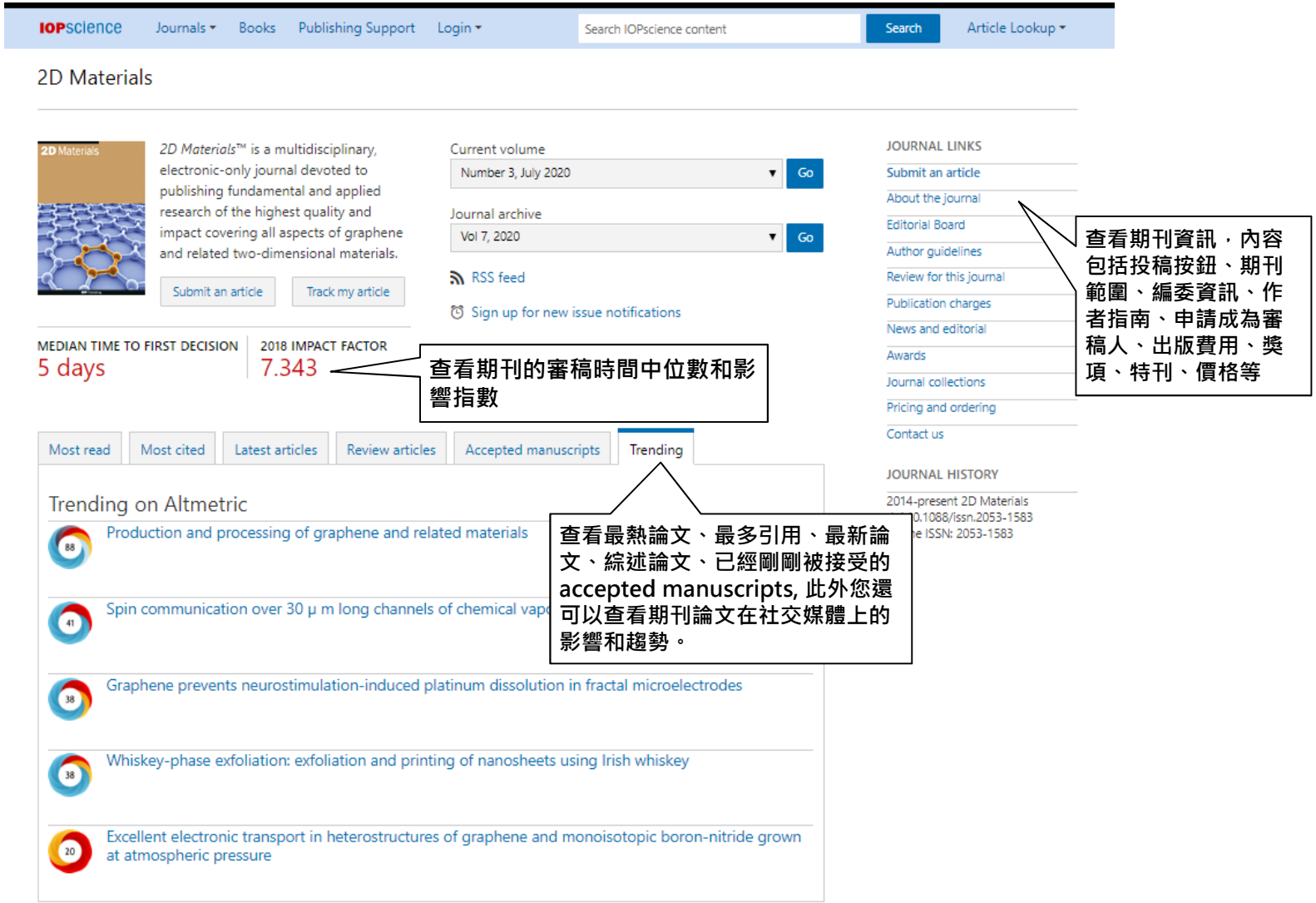

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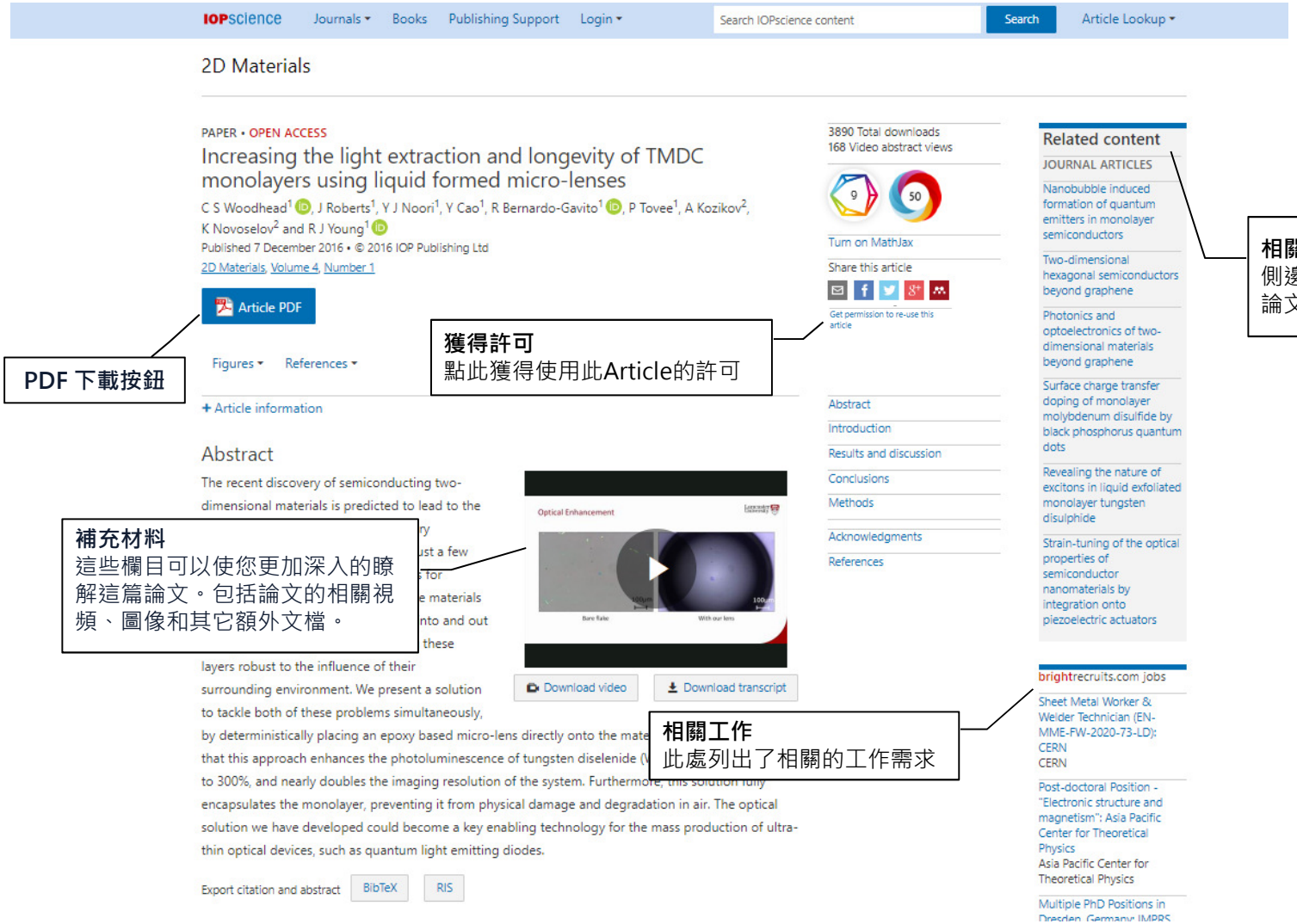

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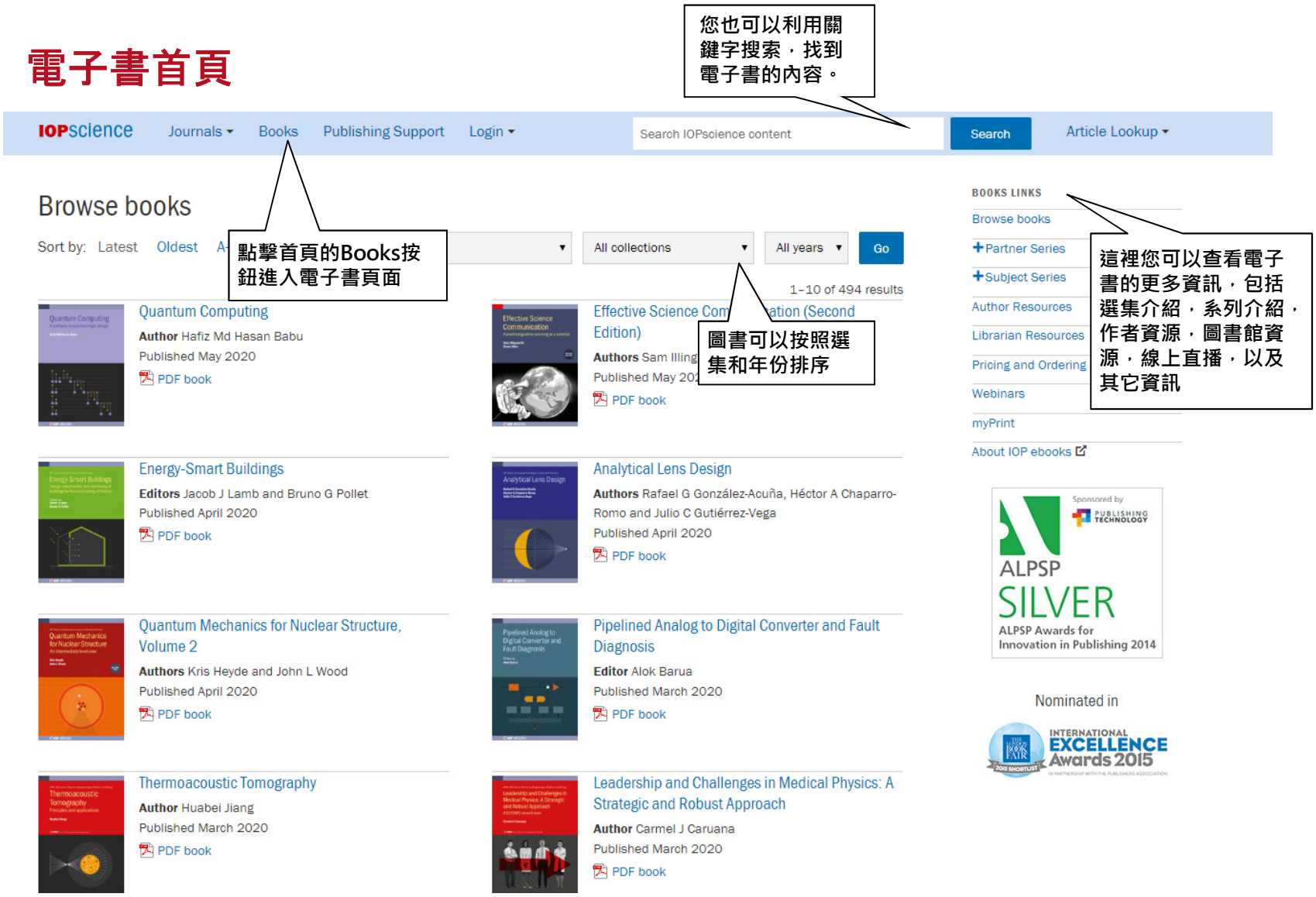

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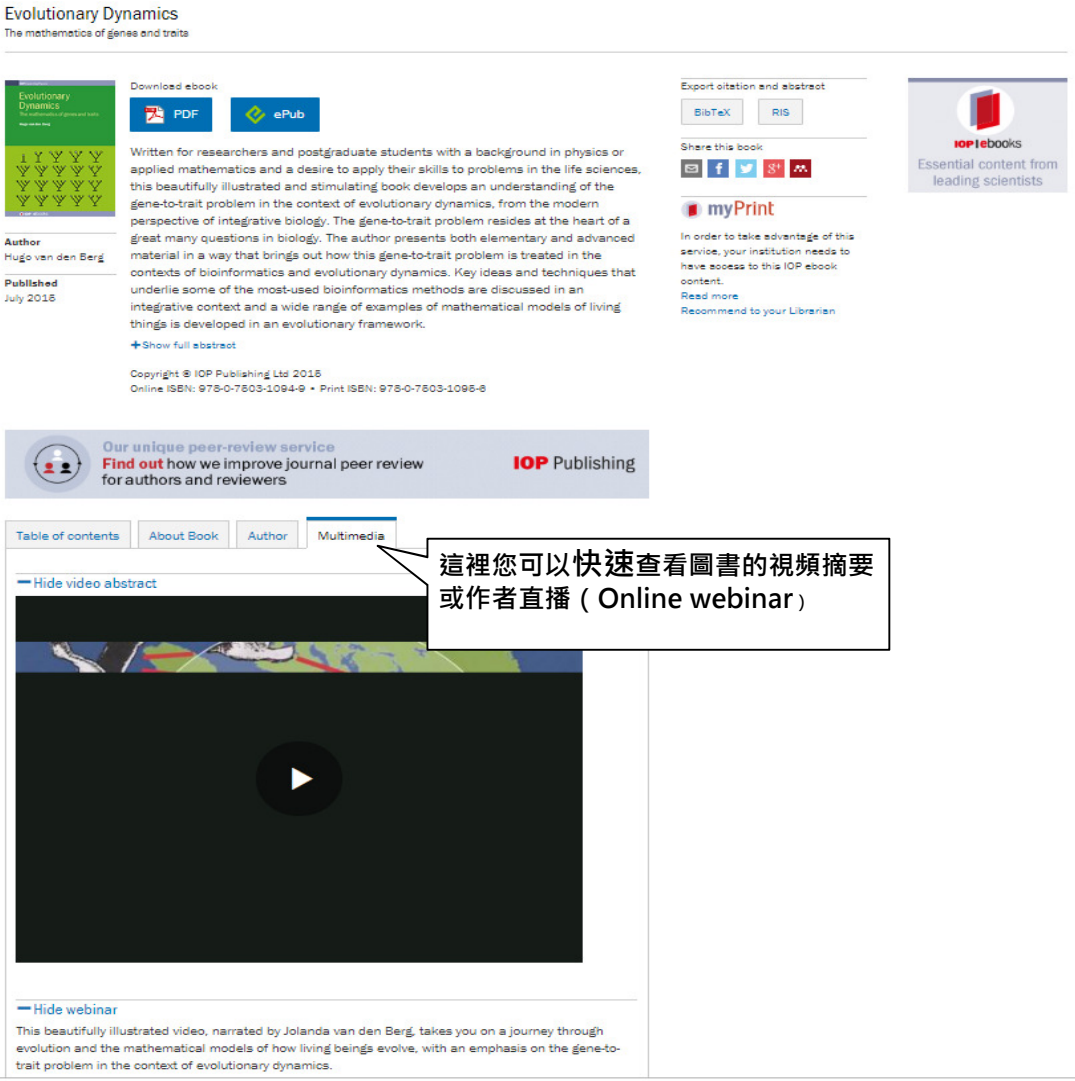

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平臺功能

內置視頻

that has given us this high technology life. This is nicely illustrated by Professor Jesper Nygård in the video of figure 1.1. Several research technologies are discussed in this video, and we will treat many of them in the following chapters of this book.

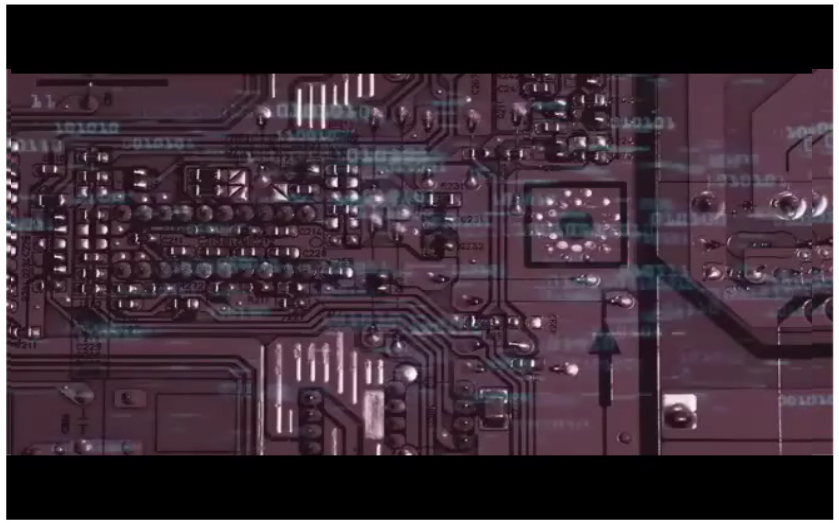

Figure 1.1. Jesper Nygård on nanotechnology, artificial atoms, and the future of computing. (Video hosted by Professor Jesper Nygård, Neils Bohr Institute, and produced by the Compound for Neils Bohr Institute, included here with their permission.)

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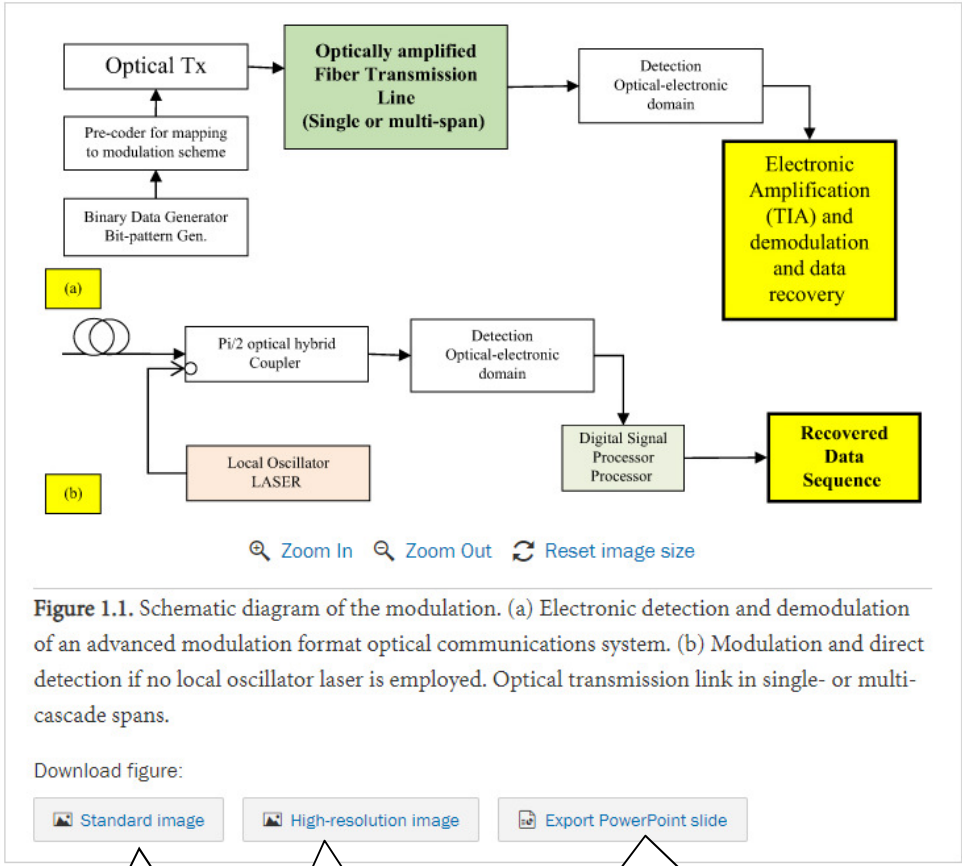

Figure 1.1. Schematic diagram of the modulation. (a) Electronic detection and demodulation of an advanced modulation format optical communications system. (b) Modulation and direct detection if no local oscillator laser is employed. Optical transmission link in single- or multi-cascade spans.

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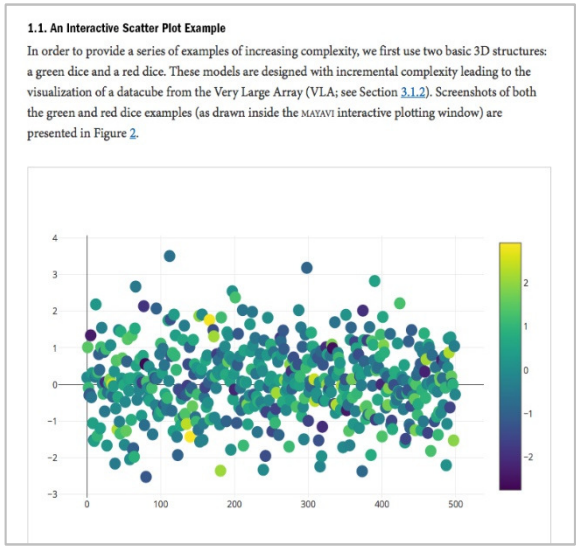

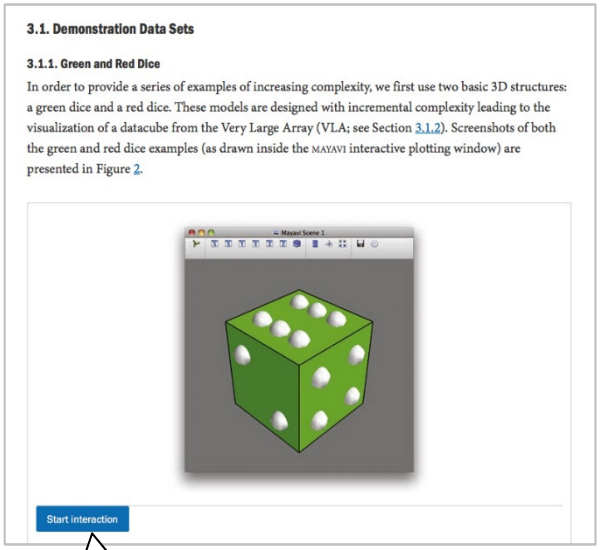

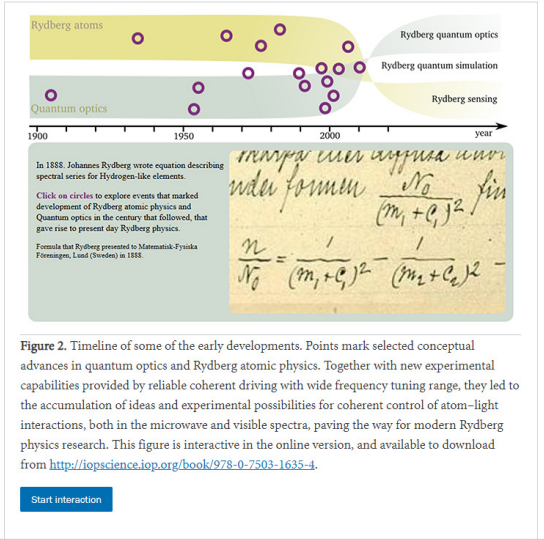

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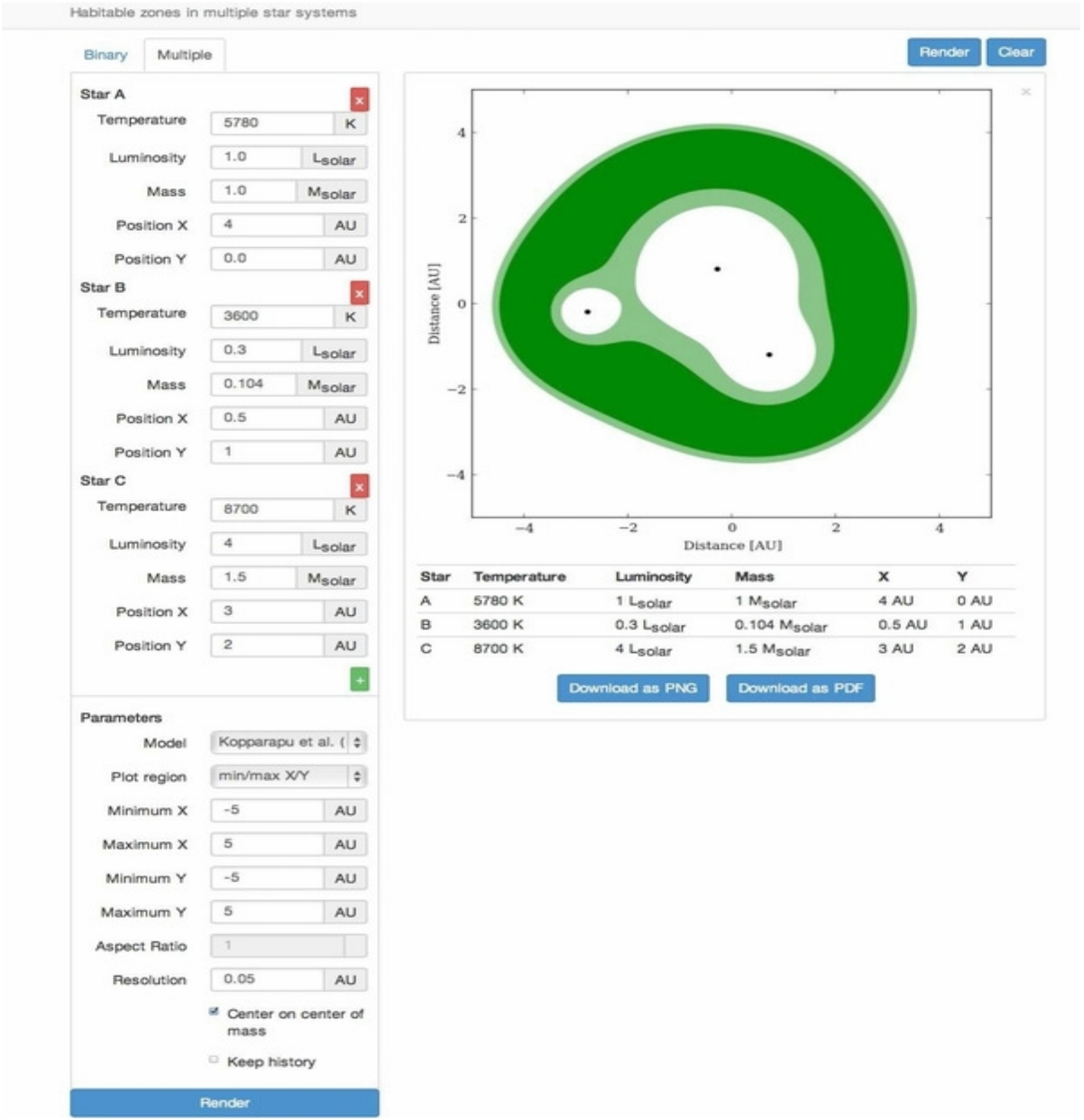
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Star C
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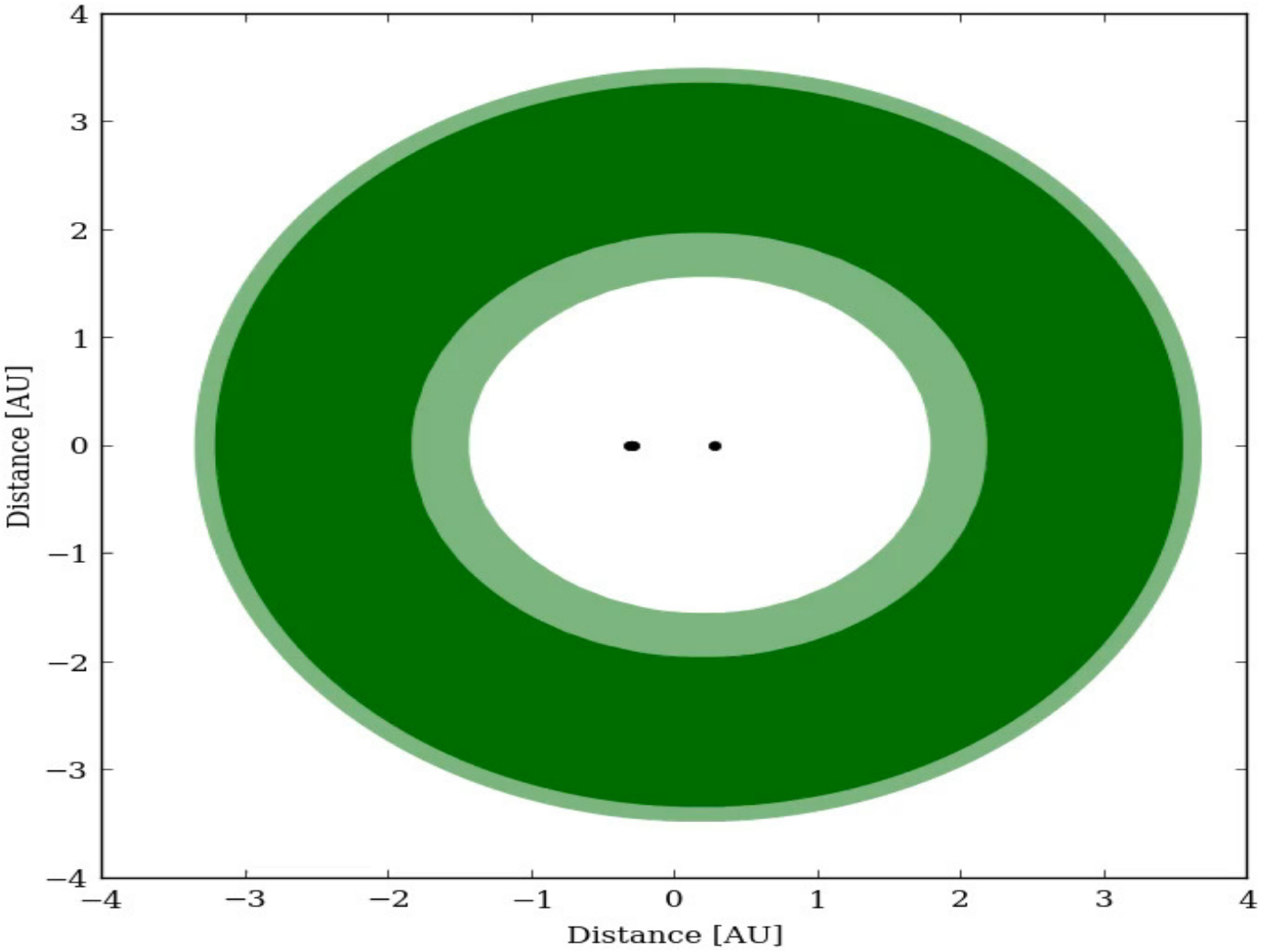
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平臺功能

交互問答 – 習題

1.9. Exercises

Exercise 1:

1. The metric on the sphere is given by

$$d\Omega^2 = d\theta^2 + \sin^2\theta d\phi^2. \tag{1.174}$$

Compute the non-zero components of the Christoffel symbol.

2. Compute the non-zero components of the Riemann tensor and the Ricci tensor. Compute the Ricci scalar.
3. Recall that the metric in polar coordinates on R^3 is given by

$$ds^2 = dr^2 + r^2 d\Omega^2. \tag{1.175}$$

The components of this metric are independent of φ. Determine the Killing vector associated with rotation around the z axis with angle φ.

4. Determine the Killing vectors associated with rotations on the sphere. Hint: use ∂_x, ∂_y, and ∂_z as basis elements.

Solution 1:

1.

$$\Gamma^{\theta}_{\phi\phi} = -\sin\theta\cos\theta,\ \Gamma^{\phi}_{\theta\phi} = \cot\theta.$$

2.

$$R^{\theta}_{\phi\theta\phi} = \sin^2\theta,\ R_{\theta\phi\theta\phi} = \sin^2\theta.$$
$$R_{\theta\theta} = 1,\ R_{\phi\phi} = \sin^2\theta,\ R_{\theta\phi} = 0.$$
$$R = 2.$$

3.

$$R = \partial_\phi = -y\partial_x + x\partial_y = (-y, x, 0).$$

4.

$$T = (\vec{r} \times \vec{\partial})_x = (0, -z, y).$$
$$S = (\vec{r} \times \vec{\partial})_y = (z, 0, -x).$$

點擊圖片中的“Solution”按鈕查看答案

Exercise 2:

The metric on the hyperboloid H^2 (Poincaré half-plane) is given by

$$ds^2 = \frac{r^2}{y^2}(dx^2 + dy^2). \tag{1.176}$$

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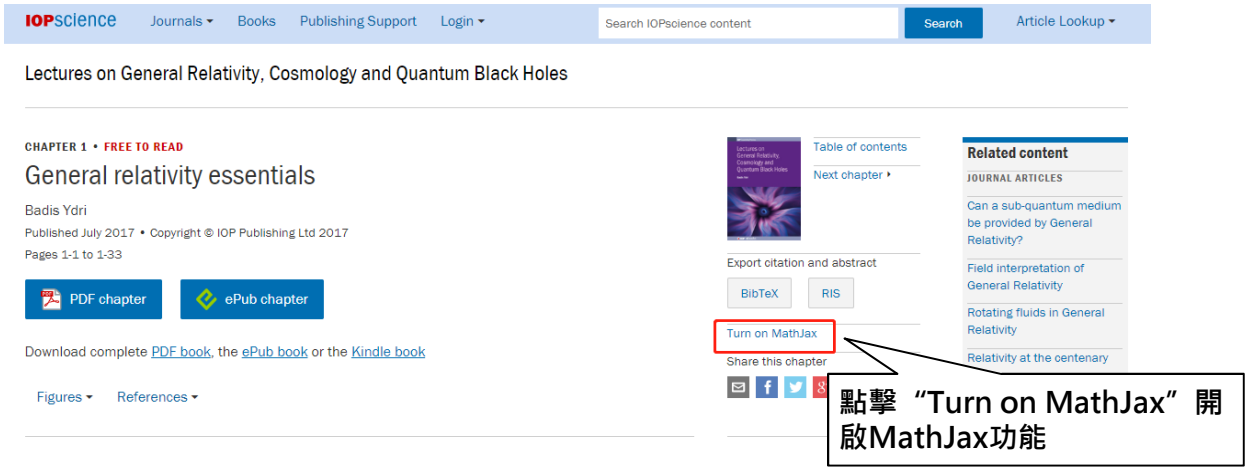

1.6.1. Tidal gravitational forces

Let us first start by describing tidal gravitational forces in Newtonian physics. The force of gravity exerted by an object of mass M on a particle of mass m a distance r away is $\vec{F} = -\hat{r}GMm/r^2$, where $\hat{r}$ is the unit vector pointing from M to m and r is the distance between the center of M and m. The corresponding acceleration is $\vec{a} = -\hat{r}GM/r^2 = -\vec{\nabla}\phi, \phi = -GM/r$. We assume now that the mass m is spherical of radius Δr. The distance [illegible] M and [illegible] center of m is r. The force of gravity exerted by the mass M on a par[illegible] stan[illegible] the centers of M and m is given by $\vec{F} = -$[illegible]^2. T[illegible]

$$\vec{a} = -\hat{r}GM\frac{1}{(r+\Delta r)^2} = -\hat{r}GM\frac{1}{r^2} + \dots \qquad (1.99)$$

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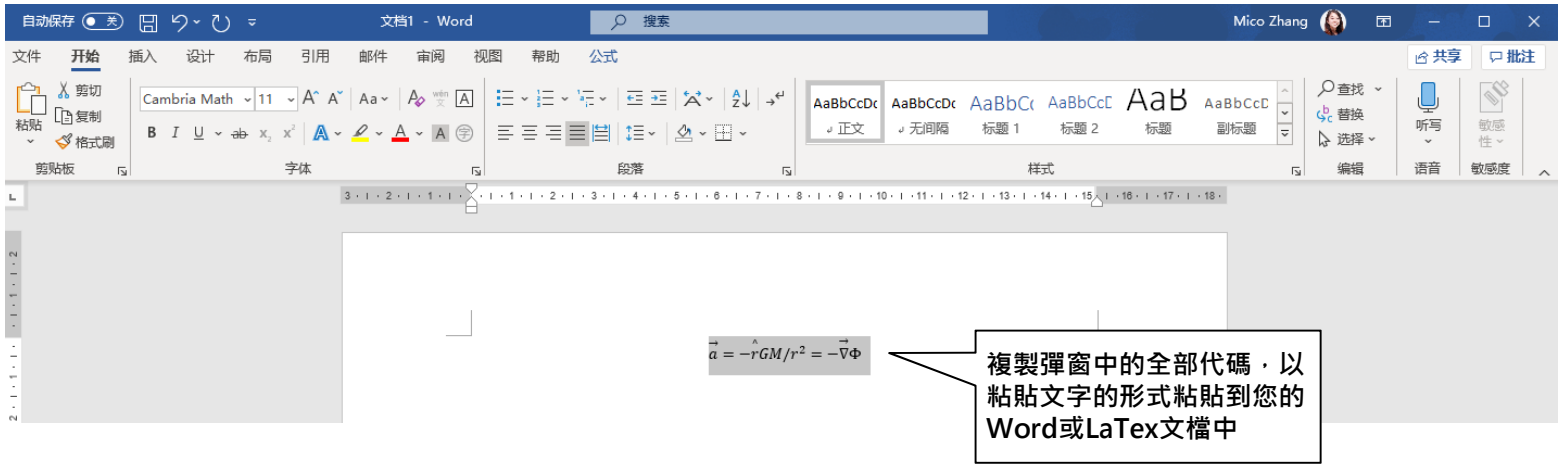

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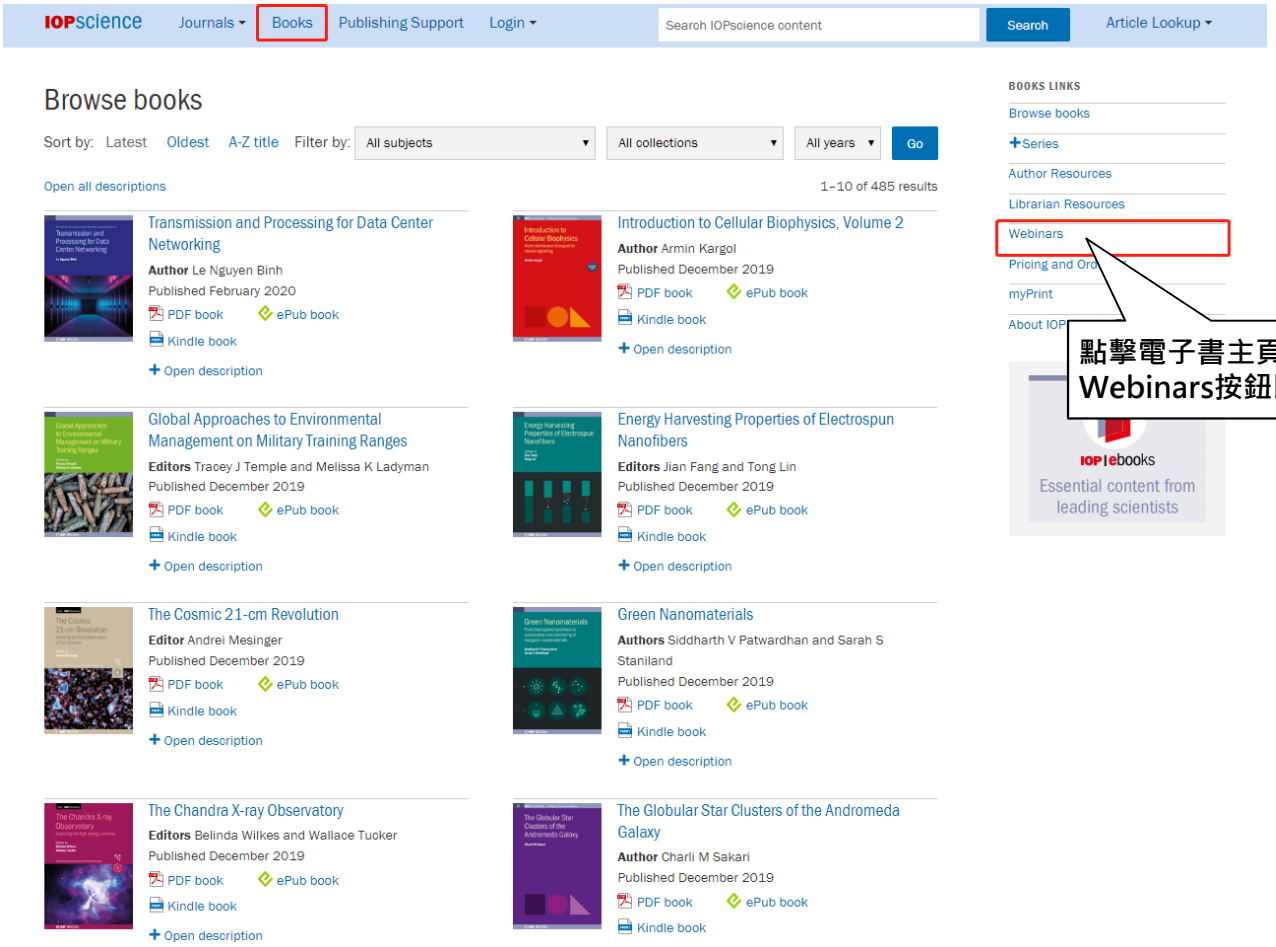

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Quantum entanglement (QE) is one of the most mysterious and promising subjects in physics. With applications in cryptographic space-to-space, space-to-earth and fibre communications, in addition to teleportation and quantum computing, QE goes beyond fascination and into the pragmatic spheres of commerce and the military. In this webinar author Dr Duarte will guide you through the research behind his book, Fundamentals of Quantum Entanglement. It is the first text to provide a side-by-side description of the philosophical path and the physical path to QE in a clear and cohesive manner.

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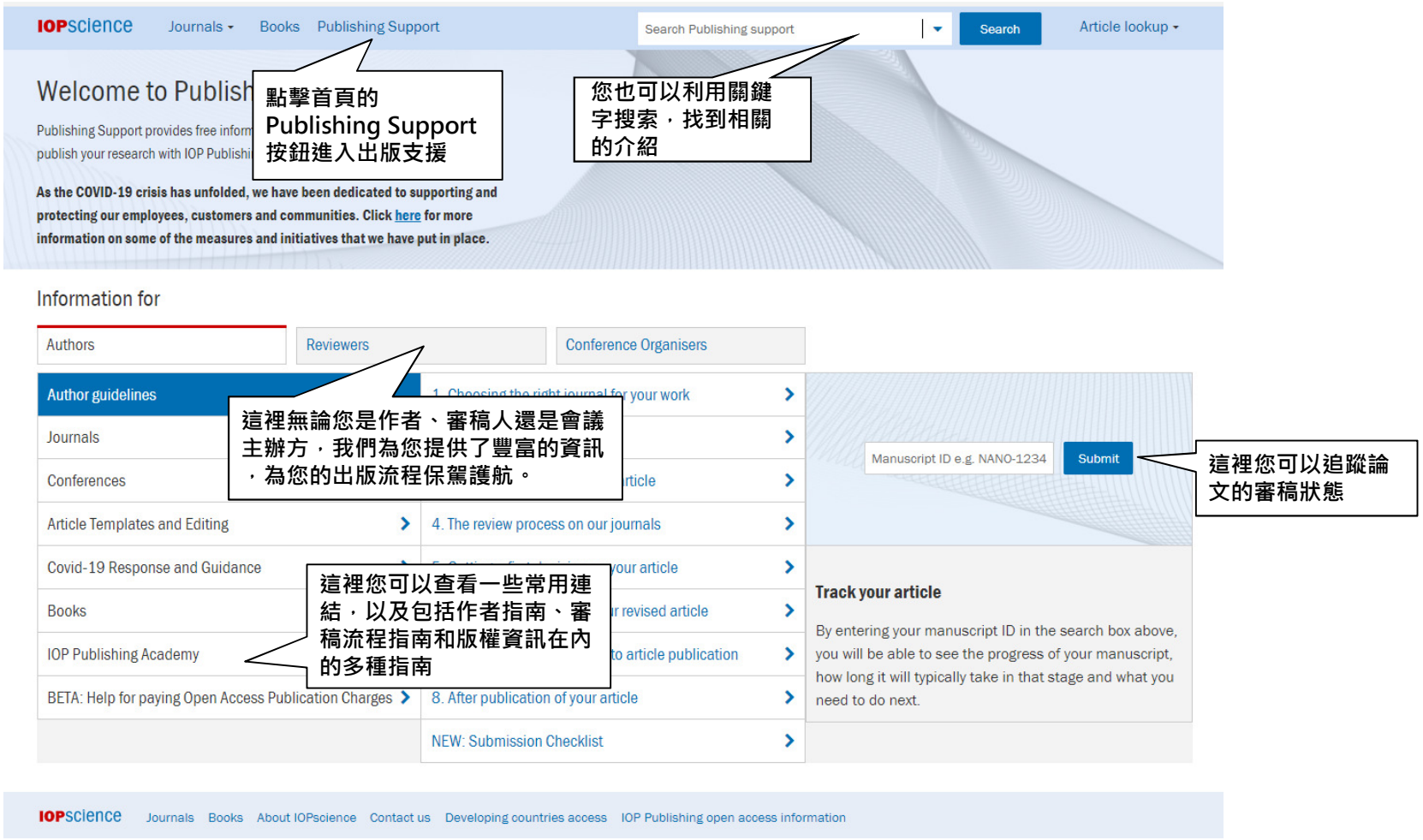

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